United States
Environmental Protection
Agency

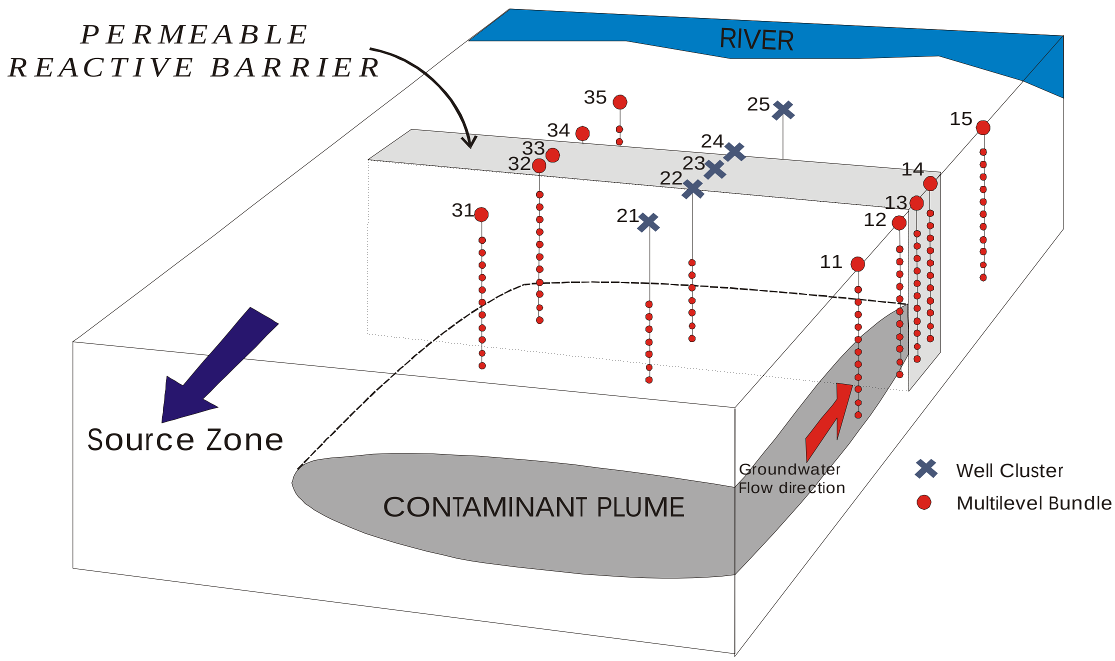
Office of Research and
Development
Washington DC 20460

EPA/600/R-99/095b
September 1999

EPA

An *In Situ* Permeable Reactive Barrier for the Treatment of Hexavalent Chromium and Trichloroethylene in Ground Water:

Volume 2
Performance Monitoring



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Cooperative Agreement No. CR-823017

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Notice

The U. S. Environmental Protection Agency through its Office of Research and Development partially funded and collaborated in the research described here under Cooperative Agreement No. CR-823017 to the University of Waterloo. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

All research projects making conclusions or recommendations based on environmentally related measurements and funded by the Environmental Protection Agency are required to participate in the Agency Quality Assurance Program. This project was conducted under an approved Quality Assurance Project Plan. The procedures specified in this plan were used without exception. Information on the plan and documentation of the quality assurance activities and results are available from the Principal Investigator.

Foreword

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet these mandates, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites and ground water; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

Environmental scientists are generally familiar with the concept of barriers for restricting the movement of contaminant plumes in ground water. Such barriers are typically constructed of highly impermeable emplacements of materials such as grouts, slurries, or sheet pilings to form a subsurface "wall." The goal of such installations is to eliminate the possibility that a contaminant plume can move toward and endanger sensitive receptors such as drinking water wells or discharge into surface waters. Permeable reactive barrier walls reverse this concept of subsurface barriers. Rather than serving to constrain plume migration, permeable reactive barriers (PRBs) are designed as preferential conduits for the contaminated ground water flow. A permeable reactive subsurface barrier is an emplacement of reactive materials where a contaminant plume must move through it as it flows, typically under natural gradient, and treated water exits on the other side. The purpose of this document is to provide detailed design, installation and performance monitoring data on a full-scale PRB application which successfully remediated a mixed waste (chromate and chlorinated organic compounds) ground-water plume. It was also the first full-scale installation of this technology to use a trencher to install a continuous reactive wall to intercept a contaminant plume. The information will be of use to stakeholders such as implementors, state and federal regulators, Native American tribes, consultants, contractors, and all other interested parties. There currently is no other site which has used this innovative technology and reported on its performance to the extent detailed in this report. It is hoped that this will prove to be a very valuable technical resource for all parties with interest in the implementation of this innovative, passive, remedial technology.

Clinton W. Hall, Director
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Abstract

A 46 meter long, 7.3 meter deep and 0.6 meter wide reactive barrier was installed at the U.S. Coast Guard Support Center (USCG) in Elizabeth City, North Carolina, in June 1996. The reactive barrier was designed to remediate a hexavalent chromium [Cr(VI)] groundwater plume, in addition to treating portions of a larger and not yet fully characterized trichloroethylene (TCE) groundwater plume at the site. The barrier is composed of Peerless Metal and Abrasives of Detroit, Michigan (Peerless™) granular iron and removes Cr(VI) and TCE from the groundwater via processes of reduction and precipitation, and reductive-dechlorination, respectively.

In addition to nine large-screen compliance wells, a monitoring network of approximately 150 small-screen sampling points was installed in November 1996 to provide detailed information on changes in porewater geochemistry through the barrier. This network was sampled seven times between November 1996 and December 1998 at 3 to 6 month intervals: November 1996, February 1997, June 1997, September 1997, March 1998, June 1998 and December 1998.

Eh values decline from background values between 100 and 500 mV (vs. Standard Hydrogen Electrode, SHE) to values as low as -580 mV SHE within the barrier. Groundwater pH values rise from background values between 6 and 8 to values as high as 11.74 within the barrier. These extreme Eh and pH conditions within the barrier have a significant impact on the groundwater geochemistry. Concentrations of redox sensitive species such as sulphate (SO_4) and nitrate (NO_3) decline from background values of up to 140 mg/L and 5 mg/L to less than 20 mg/L and 0.05 mg/L, respectively. The decline of concentrations of Ca, Mg, Mn and alkalinity within the barrier may be the result of Ca, Mg, Mn carbonate mineral precipitation. Geochemical calculations indicate that the water within the barrier becomes supersaturated with respect to calcite [$CaCO_3$], dolomite [$CaMg(CO_3)_2$] and rhodochrosite ($MnCO_3$).

Low Eh and high pH values indicate that conditions are suitable for the reduction of Cr(VI), the precipitation of Cr(III) oxyhydroxides and the reductive-dechlorination of TCE within the barrier. Sampling results indicate that upgradient concentrations of up to 5.1 mg/L Cr are consistently reduced to less than the maximum contaminant level (MCL) of <0.05 mg/L within the zero valent iron barrier. In addition, the upgradient concentration of TCE (up to 5,652 µg/L) is being reduced to close to or less than the maximum contaminant level (5 µg/L TCE) within the permeable barrier. Cr(VI) concentrations of less than the MCL value were consistently maintained downgradient of the barrier. TCE and cis-1,2DCE (cDCE) concentrations of less than MCL values were maintained downgradient of the barrier for most of the sampling sessions.

High TCE concentrations (> MCL) were regularly measured in the deepest (7 m) downgradient monitoring points and in two downgradient compliance wells, one located at the western extent of the barrier and one located beneath the barrier. Due to the limited size of the barrier, this part of the TCE plume was not intercepted by the barrier. In the February and June 1997 sessions, TCE breakthrough at 17 and 6.8 µg/L (respectively) was observed downgradient of the barrier at one location, suggesting the presence of a zone of lower granular iron density or thickness. Although there is localized breakthrough of TCE contaminated water, the results suggest that TCE and Cr(VI) contaminated water that flows through the barrier is successfully treated to MCL values.

Vinyl chloride (VC) is also treated as the groundwater flows through the barrier. Occasionally VC concentrations downgradient of the barrier concentrations exceed the MCL (2µg/L). This breakthrough of VC may result from inadequate residence time within the barrier, possibly due to higher than anticipated groundwater velocities within the barrier, or less iron thickness in the barrier than the design criteria.

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List of Acronyms Used:

BLQ	below limit of quantitation
cDCE	cis-1,2dichloroethylene
DO	dissolved oxygen
FID	flame ionization detector
GC	gas chromatograph
ICP	inductively coupled plasma
I.D.	inner diameter
MCL	maximum contaminant level
ND	non-detect
O.D.	outer diameter
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
SEM	scanning electron microscopy
SI	saturation index
TCE	trichloroethylene
TOC	total organic carbon
U.S. EPA	United States Environmental Protection Agency
UW	University of Waterloo
VC	vinyl chloride
VOA	volatile organic analysis
VOC	volatile organic compound
WDS	wavelength dispersive spectroscopy
XPS	X-ray photoelectron microscopy

Introduction

A permeable *in situ* subsurface reactive barrier was installed in June 1996, at the U.S. Coast Guard support center located near Elizabeth City, NC (Figure 1), to treat ground water contaminated by Cr(VI) and TCE (Bennett, 1997; Blowes *et al.*, 2000). The primary goal of the barrier was to remediate a 35 m wide and 6.5 m deep Cr(VI) plume which extends northward from an old chrome plating shop towards the Pasquotank River (Figure 2). In addition to remediating the Cr(VI) plume, the barrier is intended to treat portions of a larger overlapping TCE plume. Cr concentrations in excess of 10 mg/L and TCE concentrations in excess of 19,200 µg/L have been detected in the shallow aquifer since 1991 (Puls *et al.*, 1994; Parsons Engineering Science, 1993, 1994, 1995, 1997). These concentrations are orders of magnitude greater than the MCL for these contaminants (0.05 mg/L Cr and 5 µg/L TCE).

The heterogeneous surficial aquifer at the site is composed of layers of fine sand mixed with varying amounts of silty clay, which range between less than 0.3 m and greater than 3 m thick (Puls *et al.*, 1994; Bennett, 1997). The aquifer is underlain at approximately 20 m depth by dense clay of the Yorktown confining unit. The ground-water flow direction varies between approximately N30°E and N10°W, with an average horizontal hydraulic gradient of between 0.0011 and 0.0033. Previous studies provide a more detailed description of site geology and history (Parsons Engineering Science, 1993, 1995, 1997; Puls *et al.*, 1995; Bennett, 1997).

The barrier is a permeable subsurface wall composed of granular iron, installed in a 46 m long, 7.3 m deep and 0.6 m wide trench oriented perpendicular to the direction of ground-water flow (Blowes *et al.*, 2000). The mass of Peerless™ granular iron deposited into the trench (280 tons) was less than the design estimate of 450 tons. Assuming the iron fills the trench completely, the calculated average emplaced density is 1.69 g/cm^3. This emplacement density is lower than the value determined for laboratory column tests, which were the basis of the barrier design (Blowes *et al.*, 2000). The higher laboratory-measured bulk density of 2.72 g/cm^3, suggests that the in situ porosity of the emplaced iron (porosity= η = 0.62) is greater than observed in the laboratory (η = 0.43). Alternatively, the lower mass of iron deposited in the trench suggests that the granular iron may not occupy the entire volume of the trench. The physical properties of the granular iron, calculated from previous laboratory column experiments (Bennett, 1997; Blowes *et al.*, 2000), are shown in Table 1.

The granular iron reduces Cr(VI) and reductively-dechlorinates TCE in the ground water that flows through the barrier. At an emplaced density of 2.72 g/cm^3, the 60 cm wide barrier was calculated to provide sufficient residence time to remove Cr(VI) from the ground water and degrade TCE and chlorinated degradation products that are intercepted by the barrier to less than MCL values (Bennett, 1997; Blowes *et al.*, 2000). Patents held by the University of Waterloo cover the removal of dissolved metals from ground water through the *in situ* precipitation of harmless, insoluble reduced metal phases in a permeable reactive mixture placed in the path of the contaminated ground water (U.S. Patents 5,362,394 and 5,514,279). A patent held by the University of Waterloo covers the *in situ* removal of dissolved halogenated organic contaminants from water using zero valent iron installed in the pathway of the contaminated ground water (U.S. Patent 5,266,213).

The goal of this study was to determine changes in ground-water chemistry as the ground water flows through the reactive barrier and to assess the effectiveness of the reactive barrier in reducing Cr(VI), TCE and degradation product concentrations to less than their MCL values. Nine 10 ft (3.05 m) screened compliance wells were installed in the vicinity of the barrier for long term monitoring of ground-water quality and for regulatory compliance. Five of these wells were installed downgradient of the barrier to determine whether ground water directly downgradient, on either side of and beneath the barrier meets the MCL values. A detailed monitoring network composed of three rows or transects of multilevel samplers was also installed across the reactive barrier in November 1996 (Figure 3). This network was installed for research purposes to provide a detailed description of ground-water geochemistry between the watertable and the bottom of the barrier. The piezometer network was sampled seven times between November 1996 and December 1998, at 3 to 6 month intervals after barrier installation: November 1996, February 1997, June 1997, September 1997, March 1998, June 1998 and December 1998. Single well response tests were performed to assess the hydraulic conductivity within the vicinity of the barrier. These results were used in conjunction with two-dimensional (2D) reactive-transport modeling to assess the distribution and trends of ground-water contaminants and constituents. Ground-water samples were collected and analyzed to determine the concentrations of the target contaminants Cr(VI), TCE, cDCE and VC. Ground-water samples were also collected to define the overall ground-water geochemistry. Water chemistry data were interpreted with the assistance of the geochemical speciation computer program, MINTEQA2 (Allison *et al.*, 1990).

Objectives

The goals of the present study are to evaluate the in-situ hydraulic properties of the barrier and to determine if design parameters were met. The collected data will provide evidence of the portion of the contaminant plume intercepted by the barrier. Ground-water sampling several times a year, for several years will be used to determine the degree of removal of the target contaminants TCE, cDCE, VC and Cr(VI) from the water, and for evaluating the long-term performance of the barrier at removing the target contaminants.

Background

Reactive Barriers

Permeable *in situ* subsurface reactive barriers are a promising new technology that can be applied to treat ground water contaminated by chromium (Blowes and Ptacek, 1992; Blowes *et al.*, 1995a, 1995c, 1997; Puls *et al.*, 1995), halogenated organics (Gillham and O'Hannesin, 1992, 1994; O'Hannesin, 1993), gasoline derivatives (Bianchi-Mosquera *et al.*, 1994), dissolved nutrients (Robertson and Cherry, 1995; Baker *et al.*, 1996) and acid mine drainage (Blowes *et al.*, 1995b; Benner *et al.*, 1997; Waybrant *et al.*, 1998; Benner *et al.,* 1999). These barriers are composed of a permeable reactive material that reacts with the contaminant in the ground water, reducing its concentration by physical or chemical processes. Processes that can reduce the aqueous concentration of a ground-water constituent include adsorption, oxidation, reduction, precipitation, chemical transformation or a combination of these processes. These subsurface reactive barriers are installed into the flowpath of the contaminated ground-water plumes. The contaminated ground water is passively remediated as it flows through the reactive barrier.

Cr(VI) Reduction

One of the principal contaminants at the U.S. Coast Guard Support Center (USCG), Elizabeth City, is Cr(VI). Cr(VI) undergoes little adsorption or retardation in the saturated sediments at the Elizabeth City site and is found at concentrations up to 10 mg/L (Puls *et al.*, 1994). These Cr(VI) concentrations are significantly greater than the MCL value of 0.05 mg/L.

The approach to removing the Cr(VI) from the ground water at the site is to reduce Cr(VI) to Cr(III) using zero-valent iron, Fe^0, as the reductant (*eqn. 1*).

$$8H^+ + CrO_4^{2-} + Fe^0 \rightarrow Fe^{3+} + Cr^{3+} + 4H_2O \tag{1}$$

The reduction of Cr(VI) by Fe^0 exhibit half-order kinetics with respect to Cr(VI) and H^+ and is dependent on the surface-area of Fe^0 (Gould, 1982) as shown in *eqn. 2*

$$\frac{d\left[Cr^{VI}\right]}{dT} = -k\left[Cr^{VI}\right]^{0.5}\left[H^+\right]^{0.5}A \tag{2}$$

where A is the surface area of zero-valent iron (cm^2/L) and the surface-area normalized rate constant k has a value of 5.45 x 10^{-5} L cm^{-2} min^{-1}, or 3,270 L m^{-2} h^{-1}.

Laboratory experiments indicate that the reduction of Cr(VI) to Cr(III) by granular iron is very rapid (Blowes and Ptacek, 1992; Powell *et al.*, 1995; Blowes *et al.*, 1997; Blowes *et al.*, 2000). In treatability studies conducted using groundwater from the Elizabeth City site, 12 mg/L Cr(VI) was reduced to less than the detection limit of 0.01 mg/L within tens of minutes in batch experiments with Peerlessä granular iron (O'Hannesin *et al.*, 1995; Blowes *et al.*, 2000).

Once reduced by Fe^0, Cr as Cr(III) forms sparingly soluble hydroxides in water (*eqn. 3*) which have a minimum solubility between pH 7 and 10. Under these conditions, sparingly soluble Cr(III) hydroxide or mixed Fe(III)-Cr(III) hydroxides may precipitate (Eary and Rai, 1988; Schwertmann, 1989; Puls *et al.*, 1994; Powell *et al.*, 1995; Blowes *et al.*, 1997; Blowes *et al.*, 2000) limiting dissolved Cr(III) concentrations to less than the MCL value (Rai *et al.*, 1987; Sass and Rai, 1987; Blowes *et al.*, 1997).

$$(x)\ Cr^{3+} + (1\text{-}x)\ Fe^{3+} + 3H_2O \Leftrightarrow (Cr_xFe_{1-x})(OH)_3 + 3H^+ \tag{3}$$

The reduction of Cr(VI) by granular iron has also been demonstrated in small-scale field experiments (Puls *et al.*, 1995) to rapidly remove Cr from contaminated ground water.

TCE Reductive-Dechlorination

The other principal contaminant at the USCG site is TCE. The reductive-dechlorination of chlorinated aliphatics, such as TCE, by Fe^0 is thermodynamically favored (Vogel *et al.*, 1987). The reductive-dechlorination of TCE by Fe^0 to non-toxic hydrocarbon end products occurs by both reductive β-elimination and sequential hydrogenolysis (Roberts *et al.*, 1996; Arnold and Roberts, 1997). The sequential hydrogenolysis pathway results in the production of toxic chlorinated intermediates, such as cis-dichloroethylene (cDCE) and vinyl chloride (VC) (Figure 4). However, less than 10-20% of the TCE mass degrades via this pathway producing cDCE and VC byproducts (Orth and Gillham, 1996), and these byproducts are themselves reductively-dechlorinated by Fe^0. The major end products of reductive-chlorination of TCE are ethene and ethane. Ethene, ethane and lower concentrations of methane, propene, propane, 1-butene and butane end products have been observed in previous laboratory experiments with granular iron (Orth and Gillham, 1996).

The reductive-dechlorination of TCE, cDCE and VC fits a pseudo first-order reaction mechanism. Johnson *et al.* (1996) describe a pseudo first-order kinetic model for the dehalogenation of various chlorinated hydrocarbons by Fe^0:

$$\frac{-d[P]}{dt} = k_{sa} a_s \rho_m [P] \tag{4}$$

where k_{sa} is the specific reaction rate constant normalized to the surface area of Fe^0 ($L\ h^{-1}\ m^{-2}$), a_s is the surface area of Fe^0 ($m^2\ g^{-1}$) and ρ_m is the mass concentration of Fe^0 ($g\ L^{-1}$ of solution). In this case, [*P*] represents the concentration of TCE, cDCE or VC. Reaction rates for TCE, cDCE and VC with Peerless™ granular iron were calculated from previous column experiments (Bennett, 1997; Blowes *et al.*, 2000) and are shown in Table 2.

Iron Corrosion

In addition to Cr(VI), TCE, cDCE and VC, other oxidized species are present in the ground water at the Elizabeth City site. These include dissolved O_2, NO_3 and SO_4. These oxidized species are reduced at the surface of the granular iron through corrosion reactions similar to those observed for Cr(VI) and TCE. The redox potentials for these oxidized constituents decline in the order: $O_2 > NO_3 > SO_4$. Reduction of all of these constituents by granular iron is thermodynamically favorable, with the energy yield decreasing in the same order: $O_2 > NO_3 > SO_4$. Generally, redox processes proceed sequentially from the highest energy yield downwards (Appelo and Postma, 1994), suggesting that O_2 will be removed or reduced first (*eqn. 5*).

$$2\ Fe^0 + O_2 + 2\ H_2O \Leftrightarrow 2\ Fe^{2+} + 4\ OH^- \tag{5}$$

Nitrate is expected to be reduced next (*eqn. 6*). Laboratory experiments indicate that the reduction of NO_3^- by zero-valent iron is rapid (Rahman and Agrawal, 1997; Cheng *et al.*, 1997). This reaction forms a nitrite, NO_2^-, intermediate and ammonia, NH_3, as the end product.

$$4\ Fe^0 + NO_3^- + 10\ H^+ \Leftrightarrow 4\ Fe^{2+} + NH_4^+ + 3\ H_2O \tag{6}$$

Sulfate should be reduced next (*eqn. 7*). This reaction has been found to be quite slow, unless bacterially or microbially catalyzed.

$$4\ Fe^0 + SO_4^{2-} + 10\ H^+ \Leftrightarrow 4\ Fe^{2+} + H_2S + 4\ H_2O \tag{7}$$

In the absence of oxygen, the corrosion of iron by water itself can occur (Reardon, 1995) (*eqn. 8*).

$$Fe^0 + 2\ H_2O \Leftrightarrow Fe^{2+} + 2\ OH^- + H_{2(g)} \tag{8}$$

These reactions result in a decrease in these oxidized constituents and net increase in pH and ferrous iron concentration. Laboratory experiments indicate that the iron corrosion rate and equilibrium pH are a function of solution composition (Reardon, 1995). Geochemical calculations suggest that the pH of ground-water solutions in the presence of iron can be controlled by ferrous iron mineral phases, which include amakinite [$Fe(OH)_2$] and siderite [$FeCO_3$].

Methodology

Monitoring Network Installation

Nine compliance wells and a detailed monitoring network of multilevel samplers were installed in the vicinity of the reactive barrier (Figure 5, Appendix A). The compliance wells are constructed of 5.05 cm (2 in) schedule 40 PVC pipe, with 1.5 or 3 m screened sections. Immediately downgradient of the barrier, two compliance wells (MW47 and MW49) are screened between 4.3 and 7.3 m below ground surface and one deep well (MW50) is screened between 7.3 and 9.1 m below ground surface. Further downgradient of the barrier, one well (MW46) is located at the western extent of the barrier and screened between 4.3 and 7.3 m below ground surface and the other (MW35D) is centrally located and screened between 16.1 and 19.1 m below ground surface. The other four compliance wells are screened between 4.3 and 7.3 m below ground surface and are located upgradient of the barrier. These compliance wells were installed using a hollow stem auger, as described by Parsons Engineering Science (1995).

The detailed monitoring network consists of two rows of multilevel sampling bundles (Transects 1 and 3) and one row of well clusters (transect 2). The multilevel sampling bundles and well clusters were installed in transects, each aligned perpendicular to the reactive barrier and parallel to ground-water flow direction (Figure 3). The three transects were installed across the width of the barrier (Figure 3, 5). Each transect contains five multilevel sampler bundles. Within each transect, one multilevel sampler was placed approximately 2 m upgradient of the reactive barrier and one was placed approximately 1.5 m downgradient. The remaining three sampling bundles were placed in the barrier, inside of a 1.25 m long by 0.64 m wide and 0.5 to 0.7 m deep metal-sided roadbox.

Multilevel sampling bundles of two configurations were installed into transects 1 and 3. Three of the multilevel sampling bundles in transects 1 and 3 (ML11, ML14 and ML15; ML31, ML34 and ML35) are composed of ten 0.32 cm I.D. (0.125 in) Teflon™ sampling tubes attached with nylon ties to a 1.26 cm (0.5 in) schedule 80 PVC centerstock (Figure 6). Bundles ML12, ML13, ML32 and ML33 used 0.95 cm I.D. by 1.27 cm O.D. (0.375 in by 0.5 in) polyethylene centerstock. The ends of the Teflon™ sampling tubes are arranged at 50 cm intervals, from depths of 2 to 6.5 m along the centerstock. Each sampling tube terminates with a 15 cm (6 in) slotted section which is screened with 0.02 cm (0.0083 in) opening NYTEX™ nylon mesh attached with stainless steel wire. The PVC centerstock also terminates with a 15 cm (6 in) long 0.025 cm (0.01 in) slotted section placed at a depth of 7 meters below ground surface (Appendix A).

The well clusters in transect 2 are comprised of seven 1.26 cm I.D. (½ in) Schedule 80 PVC wells. These wells were assembled from commercial flush-joint casing slotted over the bottom section 15 cm (6 in) with 0.025 cm (0.01 in) slots. The wells in each cluster were placed with their slotted sections terminating at 50 cm intervals from approximately 7 meters depth to 4 meters depth below ground surface.

Bundles or well clusters located outside of the permeable iron barrier were installed using a 6.9 cm (2¾ in) I.D. hollow stem auger. Bundles located within the granular iron barrier, inside the roadboxes, were installed using 5 cm (2 in) E/W flush joint drive casing. The use of smaller diameter drive casing caused less disturbance within the vicinity of the granular iron barrier.

Field Analysis

Samples from the multilevel bundle piezometers were collected according to a modified version of the Standard Operating Procedure RSKSOP-152 (Appendix I). Appendix H lists the standard operating procedures used for analytical measurements. Measurements of Cr(VI), ferrous iron [Fe(II)], dissolved sulfide (S^{2-}), dissolved O_2 (DO), electrical conductivity, temperature, pH, Eh, alkalinity and ground-water turbidity were made in the field. Cr(VI), Fe(II) and S^{2-} were analyzed in the field colorimetrically with a UV/VIS spectrophotometer (Hach® DR/2010). Cr(VI) was analyzed directly on the spectrophotometer using 1,5-diphenylcarbazide as the complexing agent (Standard Methods, 1992). Fe(II) was analyzed directly by a colorimetric method using 1,10-phenanthroline as the complexing agent (Standard Methods, 1992). Dissolved sulfide was determined colorimetrically using the methylene blue method (Standard Methods, 1992). Dissolved O_2 measurements were made using a CHEMets® colorimetric test kit for DO, which utilizes a rhodazine-D colorimetric technique (White *et al.*, 1990). Ground water electrical conductivity and temperature measurements were conducted on freshly pumped water using an ORION® Model 128 conductivity probe and meter. The Eh and pH of freshly pumped ground water were measured in a sealed flow-through cell using platinum redox and glass-bulb pH electrodes (ORION® 9678BN combination redox electrode; ORION® Ross 815600 combination pH electrode). A constant-temperature water bath was used to maintain the flow cell at ground-water temperatures during pH and Eh measurements. The pH electrode and meter (Fisher Model 955 pH/mV meter) were calibrated at ground-water temperatures using pH 4 and 7 or 7 and 10 buffer solutions at the start of the day and between samples. The stability of the Eh meter and electrode were checked with Zobell solution (Zobell, 1946; Nordstrom, 1977) and Light solution (Light, 1972) between samples. Alkalinity measurements were made by titrating freshly filtered ground-water samples with standardized H_2SO_4 acid using a Hach® Digital Titrator and bromocresol green-methyl red indicator. The turbidity of unfiltered ground water was determined with a Hach® turbidimeter (Model 2100P). Where appropriate, field measurements were later corrected for temperature.

Sampling, Storage and Analysis

Ground-water sampling was conducted by University of Waterloo personnel at bundles located in transects 1 and 3. Personnel from the R.S. Kerr Environmental Research Laboratory, U.S. EPA and from ManTech Environmental Research Services Corp., Ada, Oklahoma, sampled bundles located in transect 2 in addition to the compliance wells at the site. Detailed sampling included the collection of organic and inorganic samples, pH and Eh data, alkalinity, Cr(VI), Fe(II) and dissolved oxygen concentrations, ground-water electrical conductivity and turbidity. Detailed sampling was conducted at even-numbered points in transects 1 and 3 and at all points in transect 2. At the odd-numbered points in transects 1 and 3, all parameters except pH and Eh were collected. The following procedure and equipment description is for the analysis and collection of samples in transects 1 and 3. The procedures used by the EPA and ManTech for transect 2 were mostly similar, except that a dissolved oxygen probe was used to determine DO concentrations.

Stainless steel sampling manifolds (Figure 7) were used to fill two 40 mL volatile organic analysis (VOA) glass vials and a 60 mL glass serum vial, for analysis of dissolved gases and volatile organic compounds (VOC). These manifolds, designed and constructed at the University of Waterloo, prevent exposure of volatile organic ground-water samples to the air and pump tubing, minimizing volatilization and adsorption. The manifold was placed upstream of a peristaltic pump (Masterflex® Model 7533-20). Between 1.5 and 2 purge volumes of ground water (225-300 mL) were passed through the manifold prior to collection of the samples. After the turbidity had been recorded, ground-water samples for analysis of volatile organic parameters were collected. The samples were collected within the next 2 manifold purge volumes (~300 mL) at flowrates of 100 to 200 mL/min, using the peristaltic pump, regardless of the turbidity of the ground water. In most cases, purging, combined with the slow pumping rate resulted in low water turbidity (< 20 ntu; Nephelometric Turbidity Units). Upon collection, the VOA and gas/VOC samples were preserved with one drop of concentrated H_2SO_4 and were placed into coolers with ice until analysis. Between samples, the manifolds and pump lines were flushed with Alconox™ solution (~150 ml), followed by about 0.5 L of deionized water. All organic and inorganic contaminant samples were submitted for analysis at ManTech Environmental Research Services Corp by the ManTech personnel. A discussion of the quality assurance/quality control (QA/QC) results for field blanks, duplicates and trip blanks collected during the sampling sessions is in included in Appendix J.

For each sampling session, at one point in each bundle, the sampling manifold was monitored for cross-contamination effects. These field-blank samples consisted of deionized water pumped through the manifold immediately after being flushed (using the normal field sampling routine) with Alconox™ solution and deionized water. At least one complete set of duplicate samples (VOA and gases) was collected for each bundle, preserved according to the description above. Two sets of trip blanks, originating from the EPA and the University of Waterloo research groups, were prepared for each sampling session. Additional samples were collected from transects 1 and 3 for VOC analysis at the University of Waterloo for comparison. Samples for analysis at the University of Waterloo were collected at even numbered points in transect 3, where the VOC concentrations were higher, and one organic sample was collected from each bundle piezometer along transect 1.

VOA vials were sampled automatically for analysis using a PTA-30 carousel type autosampler connected to a Tekmar LSC 2000 sample concentrator. Desorbed analytes were then transferred to a Hewlet-Packard Model 5890 gas chromatograph (GC), where separated analytes were detected by a Flame Ionization Detector (FID). Dissolved gases including ethene, ethane and methane were analyzed by GC and FID (Kampbell *et al.*, 1991). Refer to Appendix H for the list of operating procedures used for the analysis of dissolved VOCs in the water.

After the ground water was sampled for organic parameters, samples were collected for the analysis of inorganic parameters. Measurements of pH, Eh and carbonate alkalinity were made immediately before collecting water for cation and anion analysis. The electrical conductivity of the unfiltered sample water was measured periodically as pH and Eh were being measured. Temperature measurements were generally made after a bundle was completely sampled or during purging. Cation and anion samples were collected downstream from the peristaltic pump (Masterflex® Model 7533-20), at flowrates of 50 to 100 mL/min, after the turbidity had been recorded. Both filtered and unfiltered samples were collected for cation analysis and were acidified to pH 1 with concentrated nitric (HNO_3) acid. Filtered samples were passed through disposable 0.45 µm Gelman™ Aquaprep filters after allowing a 100 mL purge volume to pass. Additional sets of unfiltered samples were collected at each sampling point for comparative cation analysis by personnel from the R.S. Kerr Environmental Research Laboratory, U.S. EPA. Total metal content was determined by ICP on an Atomcomp 975 system. Refer to Appendix H for the list of operating procedures used for the analysis of dissolved cations in the water. Samples that appeared turbid (generally greater than 75 ntu) were filtered prior to analysis for Cr(VI) and Fe(II) on the Hach® spectrophotometer.

Samples collected for anion analysis were unfiltered and not acidified. NO_2 and NO_3 concentrations were determined colorimetrically following hydrazine reduction (Kamphake *et al.*, 1967). Cl and SO_4 concentrations were determined using the Waters capillary electrophoresis method. Unfiltered samples were also collected for total organic carbon (TOC) analysis. These samples were preserved with one drop of concentrated H_2SO_4. Appendix H summarizes the operating procedures used for the analysis of dissolved anions in the water.

Even numbered sample points were analyzed for Cr(VI), Fe(II) and DO after the collection of samples for inorganic parameters. For the odd numbered points, these measurements were made after the collection of the VOC samples. DO values were determined on freshly pumped well water, while Fe(II) and Cr(VI) were analyzed within 10 minutes of being collected, unfiltered.

Between samples, the pump lines were flushed with Alconox™ solution (~150 mL), followed by about 0.5 L of deionized water. At least one complete set (cations, anions, total organic carbon) of duplicate samples and post-decontamination samples was collected for each bundle. These samples were filtered and preserved according to the description above. The post-decontamination samples were collected after flushing the pump lines with Alconox™ and deionized water. Two sets of trip blanks, originating from the EPA and the University of Waterloo research groups, were prepared for each sampling session.

In the February 1997 and December 1998 sampling sessions, unfiltered, unpreserved water was collected in transects 1 and 3 for the analysis of ^{34}S enrichment of dissolved SO_4. These analyses were conducted at the University of Waterloo Environmental Isotope Laboratory.

Ground Water Flow

The piezometer elevations were surveyed and water level measurements were made to determine hydraulic head (Appendix A). These measurements were made in the 1.26 cm I.D. wells in transect 2 and in the center stocks of the bundles in transect 1 and 3, but not in the 0.32 cm I.D. Teflon™ multilevel bundles due to equipment limitations. Field measurements of hydraulic conductivity were calculated from single-well response tests for wells in transect 2 and for the center stock points of bundles upgradient and downgradient of the barrier in transects 1 and 3. Water levels were lowered to steady drawdown values below static level at constant pumping rates and were monitored as the water level recovered (Appendix F). Hydraulic conductivity was then calculated using the constant-head or variable-head method of Hvorslev (1951).

Methods of Interpretation

Reactive-Transport Modeling

Two-dimensional ground-water flow and reactive transport simulations were performed with the computer model FRAC3D. FRAC3D is a three-dimensional (3D) finite-element reactive-transport model that has been previously used to simulate the flow hydraulics of Funnel-and-Gate systems (Shikaze and Austrins, 1995; Shikaze *et al*., 1995) and reactive barriers (Bennett, 1997; Blowes *et al*., 2000). Using calculated hydraulic conductivities in transect 2, ground-water flow simulations were used to estimate possible ground-water velocity distributions and ground-water flow pathlines within the vicinity of the barrier. In addition, reactive transport simulations of the decay of TCE, cDCE and VC were performed to determine the granular iron zone thickness necessary to explain the observed breakthrough of VC in transect 2.

Geochemical Modeling

The geochemical speciation computer model MINTEQA2 was used to assist in the interpretation of trends observed in the data. The database of the model was modified to be consistent with the database of WATEQ4F (Ball and Nordstrom, 1991). The solid phase amakinite, $Fe(OH)_2$, was added to the database. The reaction, expressed using MINTEQA2 components, is shown in eqn. 9.

$$Fe^{2+} + 2\,H_2O - 2\,H^+ \Leftrightarrow Fe(OH)_{2(s)} \qquad \text{Log K} = -13.31 \qquad (9)$$

Results and Discussion

Hydrogeology

Hydraulic conductivity values were calculated for all sampling points in transect 2 (Figure 8a). Duplicate bail tests were also conducted and generally indicated 30% agreement between values for a given sampling point. Because of the small diameter of the sampling tubes in transects 1 and 3, hydraulic conductivity testing in these transects could be conducted on only the larger center stock points, which are the deepest points in the bundles.

Calculated hydraulic conductivity values within the aquifer vary from 1 m/day to 16 m/day (Appendix F1). These values, calculated in 15 cm long, 1.26 cm diameter screened wells, differ from those measured in previous tracer and pump tests, which were conducted within 1.5 m long, 5.05 cm (2 in) diameter screened wells. In the earlier well-response tests, calculated hydraulic conductivity values were between 0.1 and 4.8 m/day (Sabatini *et al.*, 1997). The hydraulic conductivity estimated from a previous tracer test was 26 m/day (Sabatini *et al.*, 1997). The aquifer in the vicinity of the permeable reactive barrier is heterogeneous, and is comprised of a series of layers. The thickness of these layers varies from 0.3 to 3 m. The hydraulic conductivity values calculated from the small well screens, installed in the vicinity of the permeable barrier, are probably reasonable estimates for these layers. Slug tests, conducted in the 1.5 m long screened wells, may yield hydraulic conductivity values which represent an average of many layers within the screened interval. The operational hydraulic conductivity varies with the scale of the problem and with the scale of the measurement (Bradbury and Muldoon, 1989), suggesting that the field measurements should be conducted on the same scale as the field problem. Bradbury and Muldoon (1989) indicate that slug tests may only provide representative hydraulic conductivity values for the volume of material tested; *i.e.,* on the order of m^3 for slug tests. The hydraulic conductivity values calculated within this study therefore may be representative for the small, approximately 4 m by 3 m, cross-sectional area occupied by the sampling points of the well clusters in transect 2.

The positions of the upgradient and downgradient edges of the barrier are inferred from construction information (Blowes *et al.*, 2000), and from measurements made in the field after the barrier was installed. Hydraulic conductivities measured within the inferred zone of granular iron vary from 0.01 to 196 m/day. The highest hydraulic conductivity values measured exceed the laboratory measured hydraulic conductivity of 85 m/day. The high hydraulic conductivity values measured within the granular iron zone may result from the lower mass of granular iron deposited into the trench and the corresponding lower emplaced density. The barrier design called for the installation of 450 tons of granular iron into the trench; 280 tons of iron were actually installed. Assuming that the granular iron filled the entire volume of the 46 m x 7.3 m x 0.6 m trench, the minimum average emplacement density is 1.69 g/cm^3. This value is 62% of the value determined in the laboratory column experiments (2.72 g/cm^3).

The wide range of hydraulic conductivity values measured in the barrier may be a result of the installation technique. Due to the installation method, the exact location of the front and rear of the barrier, the nature of the aquifer-barrier contact is not known. The distribution of hydraulic conductivity values in the vicinity of the barrier suggests the locally, the zone of granular iron may be thinner than the design value of 60 cm. Low hydraulic conductivity values (< 0.2 m/day) are measured between approximately 4 - 5 m and 6.5 - 7 m depth below ground surface, near the upgradient side of the barrier. These low hydraulic conductivity zones may result from mixing and disturbance of granular iron and aquifer material or slumping of aquifer material into the granular iron zone.

Two-dimensional simulations of ground-water flow were performed using hydraulic conductivity values similar to those observed within transect 2. The model domain was 4 m by 3.7 m (Figure 8b) with a grid spacing varying between 0.02 and 0.1 m. The top and bottom boundaries were designated as no-flow boundaries. The upgradient and downgradient boundaries were assigned constant head values, resulting in an average horizontal hydraulic gradient of 0.0033 across the domain. The flow simulation results (Figure 8c) indicate a zone of preferential flow and higher ground-water velocities between 4.5 to 6 m depth, upgradient of the barrier. This zone moves downward to 5.5 to 6.5 m depth immediately upgradient of the barrier because of the presence of low hydraulic conductivity zones at a depth of 4 to 5 m. Ground-water velocities within the barrier also increase, perhaps as a result of a funnelling effect produced by the low hydraulic conductivity layers on the upgradient side of the barrier. Modeled ground-water velocities are calculated to approach 0.20 m/day within the barrier.

During several of the sampling sessions, the roadboxes in transects 1 and 2 were observed to fill with water from the parking lot during rain events. The hydrogeological implications of this flooding have not been determined. Although the hydrogeological response in the aquifer to these flooding events was not monitored, the spatial distribution of geochemical parameters within the aquifer remained relatively uniform between sampling episodes. The Roadbox in transect 3 did not fill with water during the rain events.

Conservative Ground Water Constituents

Sodium and chloride are anticipated to be relatively conservative under the geochemical conditions present at the site. Between November 1996 and December 1998, only small variations in the Na and Cl concentration profiles are observed

(Figure 9, Appendices D and E). The highest concentrations of Na and Cl coincide with the zones of highest concentrations of Cr(VI) and dissolved organic contaminants.

Comparison of Na and Cl concentrations indicates a 1:1 molar stoichiometry. The Na:Cl ratio is similar upgradient, within and downgradient of the reactive barrier. The concentrations of these species do not change significantly in the vicinity of the barrier or downgradient. These observations suggest that the granular iron of the barrier does not affect the transport of Na and Cl. Na and Cl, therefore, can be used as conservative tracers, their vertical distribution indicating preferential flowpaths and possible higher conductivity zones within each transect. There is some agreement between measured hydraulic conductivity, the flow modeling results and the distribution of Na and Cl within transect 2. These results suggest that there is a preferential flowpath between 4 and 6 m depth below surface.

Redox and pH Conditions

The Eh of untreated ground water entering the barrier is generally high, at between 400 to 500 mV at ground-water temperatures (15-20°C) (Figures 10, 11; Appendix B). The Eh decreases sharply, by several hundred mV, within the barrier to between +50 and –600 mV, reflecting the removal of oxidized species including dissolved oxygen, nitrate, ferric iron, and sulfate from water in the barrier. Both high and low Eh values are observed in the sampling bundles located just upgradient of the front of the barrier in transect 1. This distribution suggests that the piezometer bundles ML12, ML22 and ML32 are located at the leading edge of the barrier, where the distribution of granular iron is irregular. Within the barrier, Eh values in transect 1 are generally several hundred mV lower than in the other two transects. Between November 1996 and December 1998, Eh values downgradient of the barrier decreased slightly. Within the barrier, no consistent change in Eh values was evident between sampling episodes.

The measured pH of untreated ground water entering the barrier is slightly acidic, with pH values between 5.5 and 6.7 at ground-water temperatures (Figures 12, 13, Appendix B). The pH of water entering the barrier increases sharply to between 7.6 and 11. The increase in pH in the barrier is likely most attributable to the corrosion of iron (*eqns. 5, 8*). The pH within the barrier in transect 3 is generally lower than in the other two transects, possibly reflecting different positions of the sampling points relative to the upstream edge of the barrier. At the most downgradient bundle in each transect, pH values decrease to between 6.5 and 9.4, suggesting that water with higher pH values generated in the barrier is being transported and neutralized in the aquifer downgradient of the barrier. In general, ground-water Eh and pH values approach background levels downgradient of the barrier.

Major Ions

Upgradient of the barrier, the dissolved iron concentration is highest between 2 and 4 m (up to 7.5 mg/L total Fe) below surface. Dissolved iron is not detectable at greater depth (Figure 14, 15; Appendix D). Total dissolved iron concentrations (Fe) are occasionally higher than ferrous iron [Fe(II)] concentrations. Under the neutral to alkaline pH conditions that prevail in the aquifer, dissolved Fe(III) concentrations are expected to be negligible because of the low solubility of Fe(III) oxyhydroxide minerals. The higher concentrations of total dissolved iron may reflect differences between the methods used to measure the total and ferrous iron concentrations. The colorimetric method used to measure Fe(II) does not detect iron bound to colloidal material. In contrast, the ground-water samples analyzed by ICP were preserved by acidification. Acidifying the samples may have dissolved colloidally bound Fe(II) and Fe(III), resulting in higher measured total iron concentrations.

The exposure of the ground water to the atmosphere during sampling may have resulted in oxidation of Fe(II) to Fe(III), and subsequently lower Fe(II) concentrations. Hem (1982) suggests that the precipitation of ferric oxyhydroxide by oxygenation of ferrous solutions is rapid at near neutral pH and increases by a factor of 100 for each unit increase in pH. In an effort to minimize the possibility of this complication, samples at the field site were typically analyzed for Fe(II) within 10 minutes of being collected.

At shallow depths upgradient of the barrier, iron concentrations increase between the November 1996 and December 1998 sampling sessions. MINTEQA2 calculations suggest that, where Fe is measurable upgradient of the barrier, the ground water is supersaturated with respect to ferrihydrite [$Fe(OH)_3$] and goethite [FeOOH] (Figures 16-18, Appendix G). Precipitation of these phases may limit Fe concentrations at shallow depths, upgradient of the barrier. Between 4 and 7 m depth upgradient of the barrier, Fe concentrations are consistently near detection.

Iron Corrosion

Total iron concentrations increase from upgradient values of < 0.5 mg/L, to as much as 18 mg/L at the upgradient edge of the barrier (Figures 14, 15). The presence of high Fe concentrations in the bundles just upgradient of the barrier (bundle ML12) suggests that granular iron may exist in front of the assumed position of the front of the barrier. This increase in concentrations in the barrier is probably a result of the corrosion of the granular iron (*eqn. 5, 8*) and the removal of Cr(VI) (*eqn. 1*). In transects 1 and 2 total iron concentrations decrease to less than 1 mg/L further downgradient in the barrier. In transect 3, ground water with a total iron concentration of 0.1 to 4 mg/L persists across the width of the barrier. Total iron reaches peak concentrations of 14 to 16 mg/L locally within transect 3.

MDL for Fe is lower for the performance report. Total iron concentrations at the most downgradient bundle in each transect (5^{th} bundle position, ML *x*5, where *x*=1, 2, 3; Figures 3, 5) range from the detection limit (0.002 mg/L) to 5 mg/L. The higher concentrations (> 2 mg/L) in the most downgradient bundles are observed at depths less than 4 m. At these points, higher Fe concentrations may result from the oxidation of mixtures of granular iron, entrained in the aquifer material, by infiltrating surface water. The absence of higher Fe concentrations in the deeper points of the 5^{th} bundle position suggest that Fe released during the reduction of Cr(VI) is removed from the water before leaving the barrier, or in the aquifer sediments between the barrier and the 5^{th} bundle.

MINTEQA2 calculations suggest that the water within and downgradient of the barrier approaches equilibrium with respect to ferrihydrite and is supersaturated with respect to goethite (Figure 16). These calculations assume a Fe concentration of Fe=0.001 mg/L (*i.e.,* 20% of the MDL) for samples containing Fe concentrations that are below analytical detection. It is likely that precipitation of ferrihydrite, goethite or a mixed Cr-Fe oxyhydroxide limits Fe(III) concentrations within the barrier. In all cases, the Fe(III) concentration is calculated from the total iron concentration based on the measured Eh of the water.

Samples from transect 3 (Figure 18) have the highest concentrations of Fe. The water in the barrier at transect 3 ranges from slightly undersaturated to slightly supersaturated with respect to ferrihydrite (-1.4 < SI < 1.6, SI=Saturation Index) and is supersaturated with respect to goethite. An analysis of the barrier materials using samples collected six months after installation, confirmed the presence of goethite (Palmer, 1999). These results are consistent with laboratory experiments in which Cr(VI) removal from the water with Fe^0 was attributed to the co-precipitation of Cr with goethite (Blowes *et al.,* 1997; Blowes *et al.,* 2000), or a mixed Fe(III)-Cr(III) hydroxide solid (Puls *et al.*, 1994; Powell *et al.*, 1995 and Blowes *et al.*, 1997).

Where dissolved iron concentrations within the barrier exceed the MDL (transects 2 and 3), MINTEQA2 calculations suggest that the water approaches or attains equilibrium with respect to siderite and amakinite (Figures 19, 20). Precipitation of these minerals may affect the pH and may limit Fe concentrations in the water as it passes through the barrier. In areas where the Fe concentration is below the MDL, the Fe concentration was assumed to be 0.001 mg/L (i.e., 20% of the minimum detection limit (MDL)). The saturation index values reported from these locations, therefore, are not strictly representative of the aquifer/barrier conditions. Palmer (1999) confirmed the presence of amakinite, but did not unequivocally identify siderite in material collected from the barrier six months after installation.

The observed increase in ferrous and total iron concentrations near the upstream edge of the barrier indicates that the corrosion (*eqn. 8*) or oxidation of zero-valent iron (*eqn. 7*) is occurring. The oxidation of zero valent iron is coupled with the reduction of oxidized species, such as DO, NO_3, or SO_4 (*eqns. 5-7*). The DO concentrations in the barrier and aquifer are variable, but generally are low (< 1 mg/L; Figures 21-26). Upgradient of the barrier, the highest concentrations of NO_3 and SO_4 were measured between 4 and 6 m below the ground surface. Sulfate concentrations in the upgradient water vary by 40-80 mg/L between sampling sessions, with no trend over time. Nitrate and SO_4 concentrations decrease sharply as the ground water enters the barrier. Nitrate concentrations of up to 8 mg/L in the upgradient zone decrease to below detectable values (0.1 mg/L) within a few centimeters distance into each transect. Sulfate concentrations decrease more slowly with distance into the barrier. Influent SO_4 concentrations of up to 140 mg/L generally decline to detection limit values (0.1 mg/L) before reaching the downgradient side of the barrier. The relative depletion of NO_3 and SO_4 in the barrier is consistent with the thermodynamically predicted sequence, where the species with lower redox potential persist (*eqns. 5-7*).

Sulfate concentrations at locations within and downgradient of the barrier are similar in all sampling sessions. Nitrate and SO_4 remain at low concentrations downgradient of the barrier (Figures 21-26), suggesting that these compounds are being mineralized or retained within the barrier. Under the strongly reducing conditions present within the barrier, NO_3 and SO_4 are thermodynamically unstable and may be reduced to ammonia and sulfide species. Determinations of the $^{34}S/^{32}S$ isotopic ratio of dissolved sulfate-sulfur indicate that the dissolved sulfate of water samples collected from several locations within and downgradient of the barrier in transect 3 is enriched in ^{34}S relative to upgradient locations (Table 3). Enriched ^{34}S concentrations is indicative of bacterially mediated sulfate reduction (Thode, 1951). Within transect 1, there is no clear evidence of ^{34}S enrichment. In most parts of the barrier, SO_4 concentrations were too low for sulfur isotopes to be quantified on 1 liter samples.

Geochemical calculations conducted with MINTEQA2 suggest that the reduced forms for nitrogen and sulfur (NH_3 and S^{2-} respectively) are the dominant aqueous forms under the measured pH and Eh conditions. Saturation index values for ferrous monosulfide and mackinawite [FeS] were calculated using the measured pH, Eh, total iron and sulfate values and allowing the field-measure redox potential to control the speciation of iron and sulfur. The results from the November 1996 sampling session suggest that the water is generally undersaturated with respect to ferrous monosulfide and mackinawite within the barrier, although supersaturation is indicated at one location in transect 1 (Figure 27). In areas where Fe and SO_4 are below detection, the Fe and SO_4 concentrations specified for the MINTEQA2 calculations were set at 0.001 mg/L (20% MDL) and 0.01 mg/L (10% MDL) respectively. Mineralogical study of the barrier materials did not confirm the presence of secondary sulfides (Palmer, 1999). The lack of detection of these phases may reflect the difficulty in detecting the small mass that could have formed in the 6 month treatment period before analysis of the material. SI values for the December 1998 data (Figure 27, Appendix G) suggest that the water is near equilibrium or is supersaturated with respect to mackinawite at locations near the middle or downgradient side of the barrier in transects 1 and 2. These results suggest that the precipitation of these sulfide minerals or other less crystalline precursors within the reactive barrier is thermodynamically favored.

The ground-water Eh declines from upgradient values of 100 to 500 mV SHE to less than -100 mV SHE within the barrier, in all transects (Figures 10, 11). In transects 1 and 3, Eh values less than -500 mV SHE approach the lower limit of thermodynamic stability for water. These strongly reducing conditions suggest that the reduction of water by Fe^0 may be occurring. The reduction of water is a net acid consuming reaction, which increases the pH and releases H_2 gas (*eqns. 5, 8*). The pH increases from between 5.5 and 7 upgradient of the barrier, to between 8.5 and 11 within the barrier (Figures 12, 13). Changes in the pH measurements made at individual sampling points between the first and last sampling sessions are minimal.

The rate of iron corrosion in ground water has been estimated from hydrogen evolution rates (Reardon, 1995). Iron corrosion rates of approximately 0.05 - 0.7 mmol Fe^{2+} (kg Fe)$^{-1}$ day^{-1} were reported. Assuming a residence time of 4 days within the barrier and a calculated iron density of 3.9 kg Fe/L H_2O, a maximum ferrous iron concentration of approximately 520 mg/L is expected. The maximum observed concentration of 15 mg/L Fe is significantly lower than the calculated concentration. Reardon (1995) found that the iron-corrosion system reaches an invariant composition upon saturation with respect to iron mineral phases, which included amakinite and siderite. The calculated pH of these invariant systems was in close agreement with observed iron-corrosion experiments.

Cr(VI) Reduction

Upgradient of the barrier, the center of Cr plume mass is located between 4.5 and 5.5 m below the ground surface (Figures 28, 29). The margins of the plume, defined by the MCL value of 0.05 mg/L, are located between 4 and 7 m below the ground surface. The highest Cr(VI) concentrations (2 – 4 mg/L) are observed upgradient of the barrier in transects 1 and 2. Cr(VI) concentrations entering transect 3 are lower than in transects 1 and 2, with maximum values varying with time between 0.1 and 0.5 mg/L. Between November 1996 and December 1998, the concentrations and distribution Cr(VI) upgradient of the barrier vary by 1 - 2 mg/L (Figures 30-32). The Cr plume extends beyond transect 1 to the east, but is fully intercepted on west side of the barrier. The vertical extent of the Cr plume is fully intercepted by the barrier.

Total Cr and Cr(VI) determinations (Appendices B and D) indicate that Cr(VI) is the dominant valence of dissolved Cr in ground water entering the barrier and that Cr(III) concentrations in this water are low. In transects 2 and 3, Cr(VI) concentrations decrease slightly prior to entering the barrier (Figures 31, 32). Where Cr concentrations are above detection upgradient of the barrier, the ground water is slightly supersaturated with respect to amorphous $Cr(OH)_3$ and is undersaturated with respect to crystalline $Cr(OH)_3$ (Figures 16-18). This early depletion of Cr(VI) suggests that some zero valent iron may have been entrained in the sand adjacent to the barrier and that Cr(VI) reduction begins a few centimeters in front of the assumed barrier position.

In each transect the Cr plume dips to a greater depth as it approaches the barrier. The change is most pronounced in transect 2, where it enters the barrier at 6-7 m depth. Within a few centimeters (<10 cm) travel distance into the barrier, Cr(VI) concentrations decline from upgradient values as high as 4 mg/L to less than 0.01 mg/L (Figures 30 - 32). Under the highly reducing conditions within the barrier, Eh values approach -600 mV SHE (Figures 10, 11). Thermodynamic calculations suggest that Cr(III) is the dominant valence state of Cr below an Eh of approximately 200 mV at pH 10.

$$CrO_4^{2-} + 3\,e^- + 5\,H^+ \Rightarrow Cr(OH)_3^0 + H_2O \qquad \text{Log K= 60.27} \qquad (10)$$

$$pe = 20.09 - 1.67\,pH$$

The high pH conditions within the barrier favor the precipitation of sparingly soluble Cr(III) hydroxide and mixed Cr(III)-Fe(III) hydroxide phases. Analytical measurements confirm that the total Cr concentrations and therefore also the Cr(III) concentrations are near the Cr analytical detection limit (0.002 mg/L) within the barrier. Calculations conducted with MINTEQA2 suggest that dissolved Cr(III) concentrations of 0.01 mg/L Cr(III) (*i.e.,* 50% of the Cr(VI) MDL) within the barrier would result in supersaturation of the water with respect to amorphous $Cr(OH)_3$. The co-precipitation of Cr within a mixed Fe(III)-Cr(III) oxyhydroxide (e.g. $Cr_xFe_{1-x}(OH)_3$) would also result in the observed low Cr concentrations. The total dissolved Cr concentration, and therefore dissolved Cr(VI) concentration, remains less than 0.01 mg/L downgradient of the barrier in all transects and all sampling sessions. There is no indication of a decline in effectiveness of the granular iron barrier at removing Cr over the two and one half-year monitoring period (Table 4).

Unfiltered samples were analyzed for Cr(VI) in the field using a UV/VIS Hach DR/2010 spectrophotometer and 1,5-diphenylcarbazide complexing agent. This technique is specific for Cr(VI), whereas total Cr samples were analyzed in the laboratory by ICP. Although the total Cr samples were filtered, the 0.45 µm filter may not exclude colloidal particles which contain adsorbed Cr(VI) or possibly reduced Cr(III) precipitates. Acidification of the ground-water samples as a preservation technique may also release the colloidal Cr. As a result, the measured total Cr concentrations (*i.e.,* including colloidal Cr) may be higher than the actual aqueous total Cr values. A comparison conducted during one sampling session (March 1998) suggests that 0.45 µm filtered total Cr and unfiltered Cr(VI) concentrations are similar.

Reductive-dechlorination of Chlorinated Aliphatics

TCE, cDCE and VC

Upgradient of the barrier, the TCE plume occurs at two discrete depth intervals (Figures 33-38). The upper part of the plume is 4 to 5 m below ground surface and is totally intercepted by the barrier. The deeper plume is present below 6 m depth, and is not totally intercepted by the barrier. The highest TCE concentration (3,790 µg/L, December 1998; Appendix C) is located upgradient of the barrier in transect 2, in the lower plume. Maximum TCE concentrations within the upper plume are found in the upgradient portion of transect 3 (680 to 2,000 µg/L). The lowest influent TCE concentrations are located upgradient of transect 1 (60 to 114 µg/L). Between November 1996 and December 1998, there is no consistent increase or decrease in TCE concentrations upgradient of the barrier (Table 4).

In addition to TCE, the ground-water upgradient of the barrier contains cDCE and VC. The cDCE (Figures 34, 37) and VC (Figures 35, 38) plumes are located between 4 and 5 m below ground surface, with the highest concentrations (170-286 µg/L cDCE, 29-65 µg/L VC) located upgradient of transects 2 and 3. Between November 1996 and December 1998, there is no consistent increase or decrease in cDCE or VC concentration upgradient of the barrier. cDCE and VC were not detected in the lower plume, upgradient of the barrier (Table 4).

TCE, cDCE and VC distribution along transects 1, 2 and 3 are shown in Figures 39 through 44. The upper TCE plume dips slightly as it approaches the barrier. Ground-water flow and contaminant transport simulations (Figure 45) indicate that the TCE plume moves downward due to the presence of the low hydraulic conductivity zones immediately upgradient of the reactive barrier. In each transect the TCE concentration decreases to less than approximately 5 µg/L within a few centimeters travel distance into the barrier. The degree of TCE treatment in the barrier does not change significantly between the first and last sampling sessions (Table 4). TCE concentrations remain less than 5 µg/L downgradient of the barrier in all sampling sessions.

The cDCE concentration decreases from a maximum value of 290 µg/L upgradient of the barrier to less than 24 µg/L within a few centimeters travel distance in the barrier. Except for one measurement of 22 µg/L (February 1997; Table 4), cDCE concentrations downgradient of the barrier are < 11 µg/L. These cDCE concentrations are less than the MCL value of 70 µg/L.

The maximum VC concentration upgradient from transects 2 and 3 varies from 32 to 65 µg/L. These VC concentrations are reduced within the barrier to less than 6 µg/L. Generally, VC concentrations downgradient of the barrier are less than 5 µg/L, slightly greater than the MCL value of 2 µg/L, however, the concentrations vary from less than the MCL up to 9 µg/L. VC concentrations of ~1 µg/L are common downgradient of transect 1 in the November 1996 and December 1998 sampling sessions, although VC was not detected upgradient of the barrier during these periods. This VC is a product of TCE degradation. The degree of removal VC does not vary significantly between sampling sessions.

In each transect, the distribution of TCE, cDCE and VC remains relatively constant between sampling sessions. However, the maximum TCE concentration upgradient of transect 3 increases from approximately 400 µg/L to 2,000 µg/L between November 1996 and February 1997 and then decreases to 670 µg/L in December 1998. Higher TCE, cDCE and VC concentrations within and downgradient of the barrier in the February 1997 sampling session are associated with these high upgradient TCE concentrations. For example, downgradient of the barrier cDCE concentrations increase from 11 µg/L in November 1996, to 23 µg/L in February 1997. This increase in the cDCE concentration downgradient of the barrier is probably due to the increased TCE concentration entering the barrier in February 1997. These cDCE concentrations remain below the MCL of 70 µg/L, however.

A second, deeper TCE plume is located at > 6 m depth in transects 2 and 3 (Figures 36, 39-44). The concentrations of cDCE and VC are not detected in the position of this deeper TCE plume. Maximum TCE concentrations of 5,652 µg/L were measured within this deep plume at the front of the barrier (ML22-1, transect 2) in November 1996. During subsequent sampling sessions, TCE concentrations at this position decreased, eventually to 242 µg/L in December 1998 (Table 4). These concentrations declined to less than 5 µg/L downgradient within the barrier. In the November 1996 and February 1997 sampling sessions, TCE concentrations at the deepest point in the farthest downgradient bundle in transect 2 are at high values, between 50 and 140 µg/L (Figure 40). This observation suggests that part of the TCE plume extends below the base of the barrier and is not treated. In subsequent sampling sessions, however, TCE at this point was below the MCL, suggesting the direction of flow may vary periodically. cDCE concentrations exceeding MCL values were not detected in these deepest monitoring points. In February 1997 and December 1998, VC concentrations (4-15 µg/L) at these deep monitoring points exceeded MCL values in transect 2.

Continued monitoring of the reactive barrier indicates that the barrier is reducing TCE and cDCE concentrations to less than MCL values. The sampling results suggest that the granular iron has remained effective at removing the TCE and cDCE over the two and one-half year monitoring period. VC concentrations of up to 5 µg/L are present downgradient of the barrier and exceed the MCL value of 2 µg/L. The breakthrough of VC at just above MCL values may result from inadequate residence time within the barrier. The short residence time may result from a combination of factors including higher than anticipated ground-water velocities within the barrier, reaction rates that are slower than measured in laboratory experiments, and lower density of iron within the barrier. Lower iron densities may occur where the granular iron pinches out or thins to less than the design value of 60 cm. In places, the iron emplacement density may also be less than the average value. Increased ground-water velocities may result from the funnelling effects of low conductivity layers upgradient of the barrier. Laboratory measurements indicated that the reductive-dechlorination rates are surface-area dependent and thus are proportional to the density of granular iron within the barrier (Gillham and O'Hannesin, 1994). Because the emplaced granular iron density is less than the laboratory-measured value, the reaction rates between the iron and volatile organic contaminants within the barrier will be less than the laboratory-measured rates.

Reactive Transport Simulations

Three reactive transport simulations were performed with FRAC3D to assess the thickness of granular iron that would explain the observed breakthrough of 5 µg/L VC (Bennett, 1997). The transport parameters used are shown in Table 5 and the results from these simulations are shown in Table 6. Simulation 1 assumes that the emplaced iron density (2.72 g/cm^3) and reaction rates are the same as in the laboratory. Simulation 2 assumes that the granular iron occupies the entire volume of the trench and therefore has a lower emplacement density of 1.69 g/cm^3. Corresponding overall reaction rates are only 62% of the laboratory-measured values because the surface area density of granular iron would be only 62% of the laboratory-measured value. Simulation 3 has the same assumptions as simulation 2. However, the lower emplacement density corresponds to a higher porosity, which is calculated to be 0.62. This higher porosity will result in lower ground-water velocities within the barrier.

The reactive transport simulations indicate that the observed breakthrough of 5 µg/L VC would occur if the width of the granular iron zone were between 8 cm and 12 cm, depending on the emplaced density of granular iron. The observed breakthrough of VC suggests that in places the barrier thickness may not meet the design criteria.

Dechlorination Products

The major end products of reductive-chlorination of TCE are ethene and ethane. Ethene, ethane and lower concentrations of methane, propene, propane, 1-butene and butane have been found to account for 70% of the TCE mass in iron column experiments (Orth and Gillham, 1996). Ethene, ethane and methane are not detected upgradient of the barrier (Figures 46, 47). The concentrations of these dissolved gases increase within and downgradient of the barrier. The highest concentrations are generally found in transects 2 and 3. Ethene concentrations increase from below detection (3 µg/L) upgradient of the barrier to as high as 44 µg/L in the barrier (transect 2, November 1996), with downgradient concentrations ranging from 4 to 24 µg/L. Ethane concentrations increase from below detection (2 µg/L) upgradient of the barrier to as high as 59 µg/L within the barrier (transect 2, November 1996). Downgradient from the barrier, ethane concentrations up to 39 µg/L are observed. Methane concentrations increase from less than 1 µg/L upgradient of the barrier to 31 µg/L at the front of the barrier. Between the November 1996 and December 1998 sampling sessions, the maximum concentrations of these gases decreased by 50 to 75% (Figures 46, 47 Appendix C).

Compared in terms of molar concentrations, the maximum concentrations of 1.5 µM ethene, 0.3 µM ethane and 2 mM methane are significantly greater than the maximum TCE concentration of 0.05 mM. A mass balance comparison of TCE, cDCE and VC and methane, ethane and ethene concentrations indicates that these hydrocarbons can account for more than 100% of the chlorinated organics present. Figures 48 and 49 indicate that the TOC content of the water increases slightly within the barrier. The spatial correlation between these gases and the chlorinated organics is poor. As a result, a mass balance for breakdown products cannot be conducted as these observations suggest that other sources are generating organic carbon, increasing the TOC and releasing methane. Hydrocarbons have been produced in water/iron batch and column systems in the absence of chlorinated aliphatic compounds. It has been hypothesized that these hydrocarbons were formed by the reduction of aqueous CO_2 by zero-valent iron (Hardy and Gillham, 1996). Alternatively, the carbide carbon in iron has been suggested as a likely source for the production of background hydrocarbons (Deng *et al.*, 1997). A mass balance comparison of TCE, cDCE, VC and chloride ion is similarly inconclusive as upgradient Cl concentrations are significantly larger, by a factor of 20 or more, than chlorinated organic concentrations.

Mineral Precipitation

Major cations within the ground water include Ca, Mg and Mn. The highest concentrations of these ions are observed between 3 and 5 m below ground surface. The concentrations of these species decline in all transects as ground water moves into the barrier (Figures 50-55; Appendix D and E). Ca concentrations decrease from as high as 40 mg/L upgradient of the barrier to less than 5 mg/L within and downgradient of the barrier. Mg concentrations decrease from up to 17 mg/L to less than 5 mg/L. Mn concentrations decrease from up to 3.3 mg/L to less than 0.1 mg/L. The concentration of Ca, Mg and Mn remained consistent in all transects between samplings sessions.

Upgradient of the barrier alkalinity values range between 40 and 110 mg/L as $CaCO_3$. Alkalinity values decrease substantially within the barrier, to between 10 and 80 mg/L $CaCO_3$ (Figures 56, 57; Appendix B). These lower alkalinity values extend downgradient of the barrier. Geochemical calculations indicate that the SI values of calcite [$CaCO_3$], aragonite [$CaCO_3$], dolomite [$CaMg(CO_3)_2$], siderite, rhodochrosite [$MnCO_3$] and magnesite [$MgCO_3$] (Figures 58-63) approach or exceed 0 within the barrier. The concentrations of dissolved Ca, Mg, Mn and alkalinity, therefore, may be controlled by the precipitation of carbonate minerals, or more hydrated carbonate phases. Between November 1996 and December 1998, alkalinity values throughout each transect varied without consistency.

The precipitation of carbonate, sulfide and hydroxide minerals within the barrier also can impact the performance of the barrier, by altering the porosity and reactivity (available reactive surface) of the granular iron media. A decrease in porosity will result in increased ground-water velocities within the barrier, with an associated reduction in available reactive surface area. Secondary mineral precipitation may eventually lead to clogging of the barrier. Previous column studies using zero valent iron have indicated uniform porosity losses throughout the column, which decline rapidly at first and then level off to between 5-15%. This porosity change was attributed to the precipitation of $Fe(OH)_2$ (amakinite) and the formation of a thin H_2 gas film around the Fe^0 particles, which occurs throughout the column. The precipitation of ferrous and calcium carbonate minerals from anaerobic, high alkalinity ground water was also indicated by Wavelength Dispersive Spectroscopy (WDS) and X-ray photoelectron microscopy (XPS). The precipitation of these minerals was believed to occur near the influent end of the iron columns, where declines in calcium and alkalinity were observed. Schuhmacher *et al.* (1997) similarly detected the presence of $CaCO_3$ and $FeCO_3$ on iron surfaces by using scanning electron microscopy (SEM) and X-ray spectroscopy. Raman spectroscopy indicated that calcium carbonate was present as aragonite in the first 4 cm of the granular iron columns. Mackenzie *et al.* (1997a) calculated that the precipitation of carbonate minerals and $Fe(OH)_2$ throughout the column could only account for 0.3% and 1%, respectively, of the observed porosity loss. However, enough H_2 was produced by the anaerobic corrosion of iron in one day to account for a porosity loss of 10% within their column. They suggested that the formation of a thin film of H_2 gas around iron particles could account for the observed porosity loss and that the precipitation of minerals may affect porosity over longer treatment times (Mackenzie *et al.*, 1997b).

The porosity losses due to $CaCO_3$ and $Fe(OH)_2$ precipitation can be estimated from the observed ground-water concentrations of Ca, alkalinity and iron corrosion rates. At ground-water flow velocities averaging 15 cm/day (Puls *et al.*, 1995), 50% estimated barrier porosity and concentrations of 100 mg/L $CaCO_3$ (alkalinity), and assuming a molar volume of 35 mL/mol for $CaCO_3$, a uniform porosity loss rate of 8.7×10^{-6} $mLmL^{-1}day^{-1}$ or 0.0009 %/day is calculated. At this rate, a porosity decrease of 10% throughout the barrier would take 32 years. If the $CaCO_3$ only precipitates within the first 10 cm of the barrier, a porosity loss rate of 5.2×10^{-5} $mLmL^{-1}day^{-1}$ is calculated for this zone. At this rate, the porosity of the front of the barrier would decrease by 10% over about 5 years. As a worst case, if calcite precipitation concentrates in the front 5 cm or 2.5 cm of the barrier, a 10% reduction in porosity would be observed after 2.6 or 1.3 years, respectively. Siderite may precipitate instead of calcite. If siderite precipitation occurs, the porosity will decrease 20% more slowly (e.g., 6.2 years for a 10 cm zone), because of the lower molar volume of siderite (29.4 ml/mol).

Using an iron corrosion rate of 0.6 mmol Fe^{2+}/kg Fe per day (Reardon, 1995) and a $Fe(OH)_2$ molar volume of 26.4 mL/mol, the porosity loss rate due to $Fe(OH)_2$ precipitation would be 0.006% per day. At this rate, a uniform porosity loss of 10% throughout the barrier would take 4.5 years.

Sulfate entering the barrier is consumed before discharging from the barrier. The sulfate may be reduced to sulfide, which may then precipitate as an insoluble metal sulfide, such as iron sulfide (FeS, molar volume 24.4 ml/mol). Assuming an average input concentration of 50 mg/L SO_4, and that Fe^{2+} is available in excess, a 10% porosity loss in the front 10 cm of the barrier would occur over 15 years, or 75 years over the full thickness of the barrier.

These calculations suggest that the precipitation of $CaCO_3$ or $FeCO_3$ at the front of the barrier and $Fe(OH)_2$ or iron sulfide throughout the barrier may be important in adversely influencing the porosity and hydraulic conductivity of the barrier over long time periods. However, these calculations assume that all the minerals precipitate within the barrier and adhere to the granular iron. In addition, the precipitation of $Fe(OH)_2$ does not account for the original volume of Fe^0 that dissolves to form Fe^{2+}. The long-term impact of precipitate formation on barrier porosity is considered further in Volume 3.

Mineralogical study of barrier materials collected immediately after installation of the barrier (June 1996) and 6 months later, in November 1996 confirmed that secondary $Fe(OH)_2$ and ferric hydroxides (goethite) formed on iron within the barrier after installation (Palmer, 1999). Secondary carbonates (siderite) were not unequivocally identified. Secondary sulfides were not detected on the granular iron, though this may be a result of the small mass that would have formed in the six month treatment period before the analysis (Palmer, 1999).

In terms of precipitate impact on reactivity, column studies with zero-valent iron conducted for more than three hundred pore volumes indicate minimal loss in reactivity towards TCE (Cippollone *et al.*, 1997). At ground-water velocities of 10 cm/day, this corresponds to a barrier lifetime of at least 5 years with a minimal decline in TCE reaction rate. Similarly, laboratory column experiments (O'Hannesin *et al.*, 1995; Blowes *et al.,* 2000) indicated Cr(VI) front migration which suggested breakthrough of Cr(VI) after 1,400-2,000 pore volumes. This would correspond to a barrier lifetime of between 19-28 years. These estimates suggest that the precipitation of minerals may have an impact on granular iron reactivity towards Cr(VI) and TCE over a long time period.

Other Impacts

Apart from Na and Cl, the concentrations of all other major ground-water constituents (Ca, Cr, Mg, Mn, SO_4, NO_3 and CO_3) decline within the barrier. The decreases in aqueous constituent concentrations, resulting from reduction and precipitation, affect the electrical conductivity of the ground water. The electrical conductivity of a solution is proportional to the concentrations of dissolved ions (Hem, 1982). Thus, as dissolved species are removed from solution by precipitation, the electrical conductivity decreases. In transect 1, electrical conductivity values decrease from 230-880 µS/cm upgradient of the barrier, to 40-600 µS/cm within and downgradient of the barrier (Figures 64, 65). In transect 3, the electrical conductivity decreases from 150-600 µS/cm upgradient of the barrier, to 150-500 µS/cm downgradient. Electrical conductivities were similar in each of the sampling sessions. For comparison, electrical conductivity values were also calculated using Onsager's limiting law expression and observed ground-water constituent concentrations (Hem, 1982). The distribution of electrical conductivity calculated from the ionic concentrations is very similar to the observed electrical conductivity (Figure 66).

Compliance Well Results

Chromium concentrations are below detection in all compliance wells downgradient of the barrier, for all sampling periods (Table 7), suggesting that Cr(VI) is reduced by the granular iron barrier. The results indicate the barrier has removed dissolved Cr throughout the two and one half-year monitoring period with no apparent decline in effectiveness.

In all sampling sessions, TCE concentrations are also below MCL values in MW47 and MW49, located immediately downgradient of the reactive barrier (Figure 5; Table 8). These wells are screened over approximately the same depth interval as the reactive barrier and represent concentrations that are averaged over the screened interval. The low TCE concentrations (< MCL) measured in these compliance wells indicate that the granular iron is reducing TCE concentrations in the ground water that flows through the barrier. The results suggest the effectiveness of the barrier has not declined over the two and one half-year monitoring period.

TCE concentrations in MW46, located near the river and toward the western extent of the barrier (Figure 5), are greater than the MCL value. However, the quality of water at MW46 with respect to TCE, seems to be improving with time. The TCE concentrations at MW46 decreased from high values in November 1996 (256 µg/L) and February 1997 (636 µg/L) to values < 75 µg/L in all sampling sessions other than March 1998. These results suggest that the reactive barrier is not intercepting the western extent of the TCE plume.

TCE concentrations in MW50, a deep well immediately downgradient of the barrier, are greater than the MCL value. MW50 is located below the barrier for the purpose of monitoring the quality of the ground water flowing beneath the barrier. The TCE concentrations in this compliance well tend to increase between sampling sessions, from < 50 µg/L in November 1996 and February 1997 to a maximum value of 548 µg/L in September 1997. Between March 1998 and December 1998, TCE concentrations were lower, between 171 and 390 µg/L. The measurement of high concentrations of TCE in the deepest piezometers in the barrier suggests that portions of the TCE plume extend beneath and are not intercepted.

The concentration of cDCE is equal to or less than MCL values (70 µg/L) in all compliance wells in all sampling sessions (Appendix C). Between November 1996 and September 1997, VC concentrations at the compliance wells downgradient of the barrier were less than or equal to the MCL (2 µg/L). In March 1998 however, VC concentrations in MW 46, 47, 49 and 50 first exceeded MCL, with values between 2.5 and 4.9 µg/L (Table 9). Data collected in 1998 indicate that VC concentrations in the compliance wells started to increase after September 1997. In all of the 1998 sampling sessions, VC values exceeded the MCL in compliance wells downgradient of the barrier. In December 1998, VC concentrations reached a maximum value of 8.7 µg/L at MW46, located near the river and toward the western extent of the barrier. It is probable that water at this compliance well was not fully intercepted and treated by the barrier. VC concentrations at the downgradient compliance wells are not consistently above the MCL. At times, VC concentrations decrease below detection in some of the compliance wells that in a previous session showed VC concentrations that exceeded the MCL. The periodic breakthrough of VC at compliance wells located downgradient of the barrier may be a result of insufficient residence time in the barrier.

Conclusions

A permeable reactive barrier containing Peerless™ granular iron was installed at the U.S. Coast Guard Support Center, Elizabeth City, N.C., in June 1996. The performance of the barrier was monitored on seven occasions between November 1996 and December 1998. The highest concentrations of all major ground-water constituents, including Cr(VI) and chlorinated organics, occur within a higher hydraulic conductivity zone, located at 4.5 to 6.5 m depth upgradient of the barrier. Flow modeling suggests that ground-water flow occurs primarily in this zone, due to confinement by natural low hydraulic conductivity zones upgradient of the barrier. Additional low hydraulic conductivity zones occur discontinuously near the upgradient contact between the aquifer and the barrier. This low hydraulic conductivity possibly results from the mixing of aquifer material and granular iron. Ground water preferentially flows within the higher conductivity zone toward the granular iron barrier, where the Eh and pH change dramatically. The corrosion of granular iron by water, Cr(VI), SO_4, NO_3 and other oxidized species produces extremely low Eh conditions (*e.g.*, Eh values below -500 mV SHE) and high pH conditions (*e.g.*, pH values that exceed 10). These changes in Eh and pH reflect a marked shift in the ground-water chemistry. The only major ground-water constituents that remain unaffected are Na and Cl, two relatively conservative species unaffected by changing redox and pH conditions.

A review of the November 1996, February 1997 and December 1998 data indicates that most inorganic ground-water constituents, including Cr(VI), are removed from the ground water in the vicinity of the reactive barrier by processes including reduction and precipitation, which are favored under the Eh-pH conditions present within the barrier. Oxidized species such as Cr(VI), SO_4 and NO_3 are reduced within the barrier, while aqueous CO_3 (expressed as alkalinity), Mn, Mg, Ca, Fe and Cr(III) concentrations decrease, possibly as a result of carbonate, sulfide and hydroxide mineral precipitation. Geochemical calculations indicate that the saturation indices of various carbonate and hydroxide mineral phases exceed zero within the barrier, suggesting that the precipitation of these minerals is thermodynamically favored. The electrical conductivity of the ground water also decreases, as it is proportional to the concentrations of ionic species within the ground water.

The precipitation of secondary minerals within the barrier may have an important impact upon the performance of the barrier in terms of Cr(VI) reduction and the reductive-dechlorination of TCE and its daughter products. Precipitates may alter the reactivity of the granular iron by making the iron particle surfaces inaccessible, or may alter the ground-water flow velocity and direction if the hydraulic conductivity or porosity of the barrier decrease. However, slug tests performed at the February 1997 sampling session indicate that the hydraulic conductivity of the granular iron is greater than 85 m/day and thus is significantly greater than the hydraulic conductivity of the aquifer (1-16 m/day).

The dominant valence state of Cr in plume water is Cr(VI). Cr(VI) and total Cr concentrations decrease to less than the MCL value of 0.05 mg/L within and downgradient of the barrier. The reactions within the barrier also decrease the TCE, cDCE and VC concentrations to near or below their MCL values of 5 μg/L TCE, 70 μg/L cDCE and 2 μg/L VC. In addition, the TCE plume appears to be heterogeneously distributed with depth. Part of the plume occurs at depths below the barrier and the deepest monitoring points. The presence of TCE concentrations above the MCL value at the deepest downgradient monitoring points may indicate that this part of the plume flows beneath the barrier and is not treated.

TCE concentrations are reduced by orders of magnitude within the barrier, although TCE concentrations of up to 15 μg/L are observed downgradient. Similarly, VC concentrations are significantly reduced within the granular iron barrier, although concentrations of up to 5 μg/L persist downgradient. These concentrations exceed the MCL at only a few downgradient sampling points and may indicate inadequate residence and treatment time within the barrier. Hydraulic conductivity measurements indicate that low hydraulic conductivity zones upgradient of the barrier may focus flow through higher conductivity zones, increasing ground-water velocities within the barrier. The mass of granular iron emplaced in the trench (280 tons) was less than originally planned (450 tons). As a result, the granular iron density may be lower and granular iron zone may be thinner than originally designed. Reactive transport simulations indicate that the observed breakthrough of 5 μg/L VC within transect 2 would occur if the granular iron thickness was less than approximately 6 - 12 cm.

Results from the compliance wells indicate that contaminated ground water flowing through the barrier is treated successfully to below the MCL values for Cr(VI) and cDCE at all times. TCE concentrations in two of the compliance wells (MW 47, MW49) located directly downgradient of the barrier also meet MCL values at all times. The compliance wells, however, give contaminant concentrations that are averaged over a 1.5 or 3 m screened interval. The smaller 15 cm long screened multilevel samplers indicate that breakthrough of TCE and VC slightly above MCL values occurs in localized points downgradient of the barrier.

TCE concentrations in two other compliance wells exceed the MCL value periodically. One of these wells (MW46) is located toward the western extent of the barrier and may represent water that was not fully intercepted and treated by the barrier. The other well (MW50) is screened at depths below the barrier. The ground water in this well did not flow through and was not treated by the barrier. The high TCE concentrations in this well confirm that part of the TCE plume extends below the barrier, at depths greater than 7.3 m.

VC concentrations in the compliance wells downgradient of the barrier were below MCL values between November 1996 and June 1997. Between September 1997 and December 1998, VC concentrations in these wells exceeded the MCL value slightly. The periodic breakthrough of VC at these wells may be a result of insufficient residence time in the barrier, as mentioned above.

The reviewed data suggest that the effectiveness of the granular iron at removing Cr(VI), TCE and cDCE has not diminished over the two and one-half year monitoring period.

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Tables

Table 1. Selected Physical Properties of the Granular Iron Used in the Reactive Barrier

PARAMETER	*Units*	*Laboratory value*	*Anticipated field values*
d_{50}	mm	0.4	0.4
d_{60}/d_{10}		2.7	2.7
Bulk density (ρ_b)	g/cm^3	2.72	1.69 - 2.72
Hydraulic Conductivity (K)	m/day	84.7	> 84.7
Porosity (η)		0.43	0.43 - 0.62
Surface Area	m^2/g	0.813	0.813

Range in field values are estimated values based on the lower mass of iron in the trench.

Table 2. First-order Surface Area Normalized Reaction Rates for Chlorinated Aliphatics with Peerless™ Granular Iron (from O'Hannesin *et al.*, 1995; Blowes *et al.*, 2000)

	Units	*TCE*	*cDCE*	*VC*
K_{SA} (Laboratory values)	[$L\ m^{-2}\ hr^{-1}$]	7.82×10^{-5}	2.76×10^{-5}	8.63×10^{-5}
$t_{1/2}$ (Laboratory values)	[hr]	1.73	4.89	1.57
$t_{1/2}$ (Anticipated field value)	[hr]	1.73 - 2.79	4.89 - 7.89	1.57 - 2.53

Maximum anticipated $t_{1/2}$ (field) calculated assuming ρ_b for emplaced iron of 1.69 g/cm^3

Table 3. Dissolved SO_4 Concentrations and $\delta^{34}S$ Values in Transects 1 and 3 (December 1998)

Sample	*Distance from ML11 (m)*	*SO_4 mg/L*	*$\delta^{34}S$ per mil*
ML11-4	0	97.4	5.01
ML11-4	0	97.4	4.96
ML12-3	1.77	95.7	3.69
ML12-3	1.77	95.7	3.81
ML12-4	1.77	93.2	4.11
ML12-4	1.77	93.2	4.01
ML15-7	3.72	12.5	1.38

Sample	*Distance from ML31 (m)*	*SO_4 mg/L*	*$\delta^{34}S$ per mil*
ML31-5	0	73.2	4.05
ML32-5	1.9	31.2	8.34
ML32-5	1.9	31.2	8.47
ML33-2	2.16	2.79	13.91
ML33-2	2.16	2.79	13.78
ML35-6	3.64	5.31	11.72
ML35-6	3.64	5.31	12.09

Table 4. Concentration Trends for Cr, TCE, cDCE and VC Over All Seven Sampling Sessions at Transects 1 and 3

Well #	Nov-96 Cr mg/L	Feb-97 Cr mg/L	Sep-97 Cr mg/L	Mar-98 Cr mg/L	Jun-98 Cr mg/L	Dec-98 Cr mg/L	Nov-96 TCE (μg/L)	Feb-97 TCE (μg/L)	Jun-97 TCE (μg/L)	Sep-97 TCE (μg/L)	Mar-98 TCE (μg/L)	Jun-98 TCE (μg/L)	Dec-98 TCE (μg/L)
ML11-0	0.208	0.111	0.254	0.11	0.133	0.168	22.8	14.9	12.6	13.2	17.7	10.4	10.5
ML11-1	1.15	1.66	0.856	0.844	0.76	0.681	28.6	18.5	14.7	5.9	8.5	11.9	7.1
ML11-2	1.61	0.575	1.22	0.4	0.294	0.513	15.4	26.9	44.9	32.2	39.7	27.3	12.7
ML11-3	2.92	1.38	1.6	0.805	1.12	2.03	36.4	45	32.8	17	63.0	34.9	47.6
ML11-4	3.08	2.07	1.56	1.21	1.92	2.13	45.8	30	79.6	70.3	49.9	27.1	114
ML11-5	0.106	0.132	0.0839	0.122	0.178	0.0767	65.4	60.6	46.7	28.7	ND	53.0	28.2
ML11-6	0.1008	0.0476	<0.0044	0.146	0.148	0.078	71.2	11.2	15.8	2.6	63.9	11.2	24.0
ML11-7	<0.0012	0.0047	<0.0044	<0.0025	<0.0023	<0.0023	37.7	1.1	13.4	ND	2.9	ND	1.2
ML11-8	<0.0012	0.0047	<0.0044	<0.0025	<0.0023	<0.0023	9.2	BLQ	ND	ND	BLQ	BLQ	ND
ML11-9	0.0019	0.0047	<0.0044	<0.0025	<0.0023	<0.0023	3.7	ND	ND	ND	ND	BLQ	ND
ML11-10	0.0014	0.0047	<0.0044	<0.0025	<0.0023	<0.0023	3.8	ND	ND	ND	ND	ND	ND
ML12-1	1.89	1.36	0.86	0.868	0.581	0.517	17.3	9.2	11.0	30.7	10.4	13.5	12.0
ML12-2	3.22	2.23	1.38	0.575	0.552	1.05	27.1	31.1	18.1	39.7	22.8	34.6	19.0
ML12-3	2.14	2.29	1.56	0.976	1.17	1.58	43.2	30.7	42.0	67.2	20.5	28.5	33.8
ML12-4	0.894	1.09	0.305	0.691	0.827	1.13	43.1	38.9	44.4	49.1	53.1	34.6	41.7
ML12-5	0.0034	0.0913	<0.0028	<0.0025	<0.0023	<0.0024	11.1	18.8	17.9	10.8	61.7	32.1	58.6
ML12-6	<0.0012	0.0138	<0.0028	<0.0025	<0.0023	<0.0023	0.9	ND	ND	ND	1.3	ND	ND
ML12-7	0.0088	0.0111		<0.0025	0.0032	<0.0023	ND	ND	ND	ND	1.0	ND	2.3
ML12-8	0.0044	0.0075	0.0041	<0.0025	<0.0023	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML12-9	<0.0012	0.0071	<0.0028	<0.0025	<0.0023	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML12-10	<0.0012		<0.0028	<0.0025	<0.0023	0.0047	ND	ND	ND	ND	1.0	ND	ND
ML13-0	<0.0029	0.0047	<0.0028	<0.0025	<0.0023	<0.0023	ND	ND	ND	ND	2.5	ND	ND
ML13-1	<0.0029	0.0047	0.0074	<0.0025	<0.0031	<0.0023	1	ND	ND	ND	1.1	1.4	ND
ML13-2	<0.0029	0.0047	<0.0028	<0.0025	<0.0031	0.0024	ND	ND	ND	ND	1.5	ND	ND
ML13-3	<0.0029	0.0047	<0.0028	<0.0025	<0.0031	<0.0023	ND	ND	ND	ND	BLQ	ND	ND
ML13-4	<0.0029	0.0047	<0.0028	<0.0025	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML13-5	<0.0029	0.0071	<0.0028		<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML13-6	<0.0029	0.0047	<0.0028	<0.0025	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	<1.0
ML13-7	<0.0012	0.007	<0.0028	<0.0025	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML13-8	<0.0029	0.0063	<0.0028	<0.0025	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML13-9	<0.0012	0.0006	<0.0028	<0.0025	<0.0031	<0.0023	ND	ND	ND	ND	2.4	ND	ND
ML13-10	<0.0029		<0.0028	<0.0025	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-0	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-1	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-2	<0.0029	0.005	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-3	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-4	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-5	<0.0029	0.0047	<0.0033	<0.0024	<0.0031		ND	ND	ND	ND	ND	ND	
ML14-6	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	0.0031	ND	ND	ND	ND	ND	ND	ND
ML14-7	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-8	<0.0029	0.0047	0.0035	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-9	<0.0029	0.008	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML14-10	0.0171		<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML15-0	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0023	10.8	12.2	4.9	1.0	4.5	1.7	ND
ML15-1	<0.0029	0.0047	<0.0033	<0.0053	<0.0031	<0.0023	ND	ND	ND	2.2	ND	ND	ND
ML15-2	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0023	ND	ND	ND	ND	ND	ND	ND
ML15-3	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	0.0003	ND	ND	ND	ND	ND	ND	ND
ML15-4	<0.0029	0.0047	0.0038	<0.0024	<0.0031	<0.0016	ND	ND	ND	ND	ND	ND	ND
ML15-5	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0016	ND	ND	ND	ND	ND	ND	ND
ML15-6	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	0.0016	ND	BLQ	ND	1.5	BLQ	ND	1.2
ML15-7	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0016	BLQ	1.1	1.0	2.7	1.3	1.5	1.9
ML15-8	<0.0029	0.0047	<0.0033	<0.0024	<0.0031	<0.0016	1.3	1.2	1.1	2.5	2.0	1.4	1.8
ML15-9	0.0068	0.0062	<0.0033	<0.0024	<0.0031	0.0026	2.9	1.3	1.3	3.9	1.3	1.1	2.1
ML15-10	0.0363		<0.0033	<0.0024	0.0033	0.0026	BLQ	BLQ	ND	2.1	1.7	ND	1.0

ND = None detected
BLQ = Below level of quantitation (1 ppb)

Table 4. Concentration Trends for Cr, TCE, cDCE and VC Over All Seven Sampling Sessions at Transects 1 and 3

Well #	Nov-96 Cr mg/L	Feb-97 Cr mg/L	Sep-97 Cr mg/L	Mar-98 Cr mg/L	Jun-98 Cr mg/L	Dec-98 Cr mg/L	Nov-96 TCE (μg/L)	Feb-97 TCE (μg/L)	Jun-97 TCE (μg/L)	Sep-97 TCE (μg/L)	Mar-98 TCE (μg/L)	Jun-98 TCE (μg/L)	Dec-98 TCE (μg/L)
ML31-0	<0.0025	0.0437	<0.0033	<0.0024	<0.0036	0.0022	144	49.5	80.3	110	101.9		
ML31-1	0.0277	0.0664	0.0407	0.08	0.0641	0.0451	240	60.5	66.2	46.6	33.9	87.0	11.0
ML31-2	0.0756	0.119	0.0467	0.0791		0.0083	136	45.6	42.3	29.4	ND	7.3	
ML31-3	0.215	0.0884	0.0408	0.0181	0.013	0.0102	6.4	2.4	2.8	187	2.4		7.7
ML31-4	0.354	0.142	0.0784	0.0382	0.0283	0.0475	108	531	180	950	65.3	8.9	
ML31-5	0.043	0.0905	0.0615	0.0738	0.079	0.0721	396	2000	620	871	288.4	59.1	673
ML31-6	0.0048	0.0043	<0.0033	0.0044	<0.0036	<0.0016	356	680	635	226	312.5	645.5	
ML31-7	<0.0025	0.0028	<0.0033	<0.0041	<0.0036	<0.0016	331	280	475	288	507.4	524.4	320
ML31-8	<0.0025	0.0019	<0.0033	<0.0041	0.0041	0.002	205	73.5	109	18.3	341.2	464.5	
ML31-9	<0.0025	0.0028	<0.0033	<0.0041	<0.0036	<0.0016	8.4	22.3	5.6	5.2	219.9	244.2	21.3
ML31-10	<0.0025		<0.0033	<0.0041	<0.0036	<0.0016	5.4	4.5	3.8	3.1	65.0	45.4	
ML32-0	<0.0025	0.0028	<0.0042		<0.0036	<0.0016	169	80.9	84.6	73.2	61.8	10.4	63.1
ML32-1	0.0089	0.0334	0.0402	0.0579	0.0671	0.0607	304	104	56.4	55.2	18.1	110.6	8.2
ML32-2	0.341	0.219	0.1	0.0641	0.0572	0.0403	78.5	4.7	7.1	13.3	7.5	14.7	4.5
ML32-3	0.329	0.278	0.109	0.103	0.0732	0.027	326	1390	3.1	50.9	322.1	7.8	370
ML32-4	0.045	0.0307	0.0554	0.0829	0.0659	0.0401	465	724	421	324	386.0	289.7	563
ML32-5	<0.0025	0.0028	<0.0042	0.0246	0.0374	<0.0016	254	280	96.7	176	237.6	474.2	425
ML32-6	0.0034	0.0064	<0.0042	<0.0041	<0.0036	<0.0016	48	7.7	9.1	3.7	43.5	410.5	98.0
ML32-7	<0.0025	0.0036	<0.0042	<0.0041	<0.0036	<0.0016	3.8	2.2	1.7	1.4	5.4	57.1	3.2
ML32-8	<0.0025	0.0046	<0.0042	<0.0041	<0.0036	<0.0016	2.5	2.0	1.4	1.1	BLQ	2.8	1.3
ML32-9	<0.0025	0.0036	<0.0042	<0.0041	<0.0036	0.0021	3.5	6.9	3.0	1.8	BLQ	ND	1.2
ML32-10	0.017			<0.0041		0.0028	5.5	4.8	3.0		BLQ	1.3	1.2
ML33-0	<0.0025	0.0036	<0.0042	<0.0041	<0.0036	<0.0016	ND	ND	ND	ND	ND	1.4	ND
ML33-1	0.0029	0.0306	<0.0042	<0.0041	<0.0036	<0.0024	9.7	22.1	3.7	1.9	17.8	ND	6.1
ML33-2	<0.0025	0.0036	<0.0042	<0.0041	<0.0036	<0.0024	23.4	4.9	4.9	ND	21.5	7.5	11.8
ML33-3	<0.0025	0.0069	<0.0042	<0.0041	<0.0036	<0.0024	9.2	22.6	1.7	1.4	27.2	33.0	7.5
ML33-4	<0.0025	0.0036	<0.0042	<0.0041	<0.0036	<0.0024	10.7	BLQ	ND	ND	1.2	15.7	ND
ML33-5	<0.0025	0.0009	<0.0042	<0.0041	<0.0036	<0.0024	5.5	7.1	ND	ND	ND	ND	3.2
ML33-6	0.0028	0.0036	<0.0042	<0.0041	<0.0036	<0.0024	2.2	1.7	ND	ND	ND	3.1	ND
ML33-7	<0.0025	0.0036	<0.0042	<0.0041	<0.0036	<0.0024	4.6	3.0	1.0	ND	BLQ	ND	ND
ML33-8	<0.0025	0.0036	<0.0042	<0.0041	0.0043	<0.0024	6.9	3.7	1.4	ND	ND	ND	ND
ML33-9	<0.0025	0.0036	<0.0042	<0.0041	<0.0036	<0.0024	10.5	1.5	ND	ND	ND	ND	ND
ML33-10	<0.0025		<0.0042	<0.0041	<0.0036	<0.0024	8.5	2.1	0.9	ND	ND	ND	ND
ML34-0	<0.0025	0.0036	<0.0042	<0.0041	<0.0023	<0.0024	ND	ND	ND	ND	ND	ND	ND
ML34-1	<0.0025	0.0036	<0.0042	<0.0041	<0.0023	<0.0024	ND	41.7	3.9	1.5	1.3	ND	ND
ML34-2	<0.0025	0.0036	<0.0042	<0.0041	<0.0023	<0.0024	5.3	8.3	1.2	0.9	3.3	6.0	1.9
ML34-3	<0.0025	0.0036	<0.0042	<0.0041	<0.0023	<0.0024	3	ND	ND	ND	ND	ND	ND
ML34-4	<0.0025	0.0036	<0.0042	<0.0041	<0.0023	<0.0024	ND	ND	ND	ND	ND	ND	ND
ML34-5	<0.0025	0.0074	<0.0042	<0.0041	<0.0023	<0.0024	ND	ND	ND	ND	ND	ND	ND
ML34-6	<0.0025	0.0036	<0.0042	<0.0041	<0.0023	<0.0024	ND	ND	ND	ND	ND	ND	ND
ML34-7	<0.0025	0.0059		<0.0041	<0.0023	<0.0019	ND	ND	ND	ND	BLQ	ND	ND
ML34-8	0.0094	0.0036		<0.0041	<0.0023	<0.0019	ND	ND	ND	ND	ND	ND	ND
ML34-9	<0.0025	0.0042		<0.0041	<0.0023	0.0023	ND	ND	ND	ND	ND	ND	ND
ML34-10	0.0061			<0.0041	<0.0023	0.0044	ND	ND	ND	ND	ND	ND	ND
ML35-0	<0.0025	0.0036	<0.0042	0.0024	<0.0023	0.002	3.7	23.0	2.7	1.6	18.6	4.2	1.1
ML35-1	<0.0025	0.0036	<0.0042	<0.0020	<0.0023		ND	ND	ND	ND	ND	ND	ND
ML35-2	<0.0025	0.0036	<0.0042	0.0032	<0.0023	<0.0019	ND	ND	ND	ND	ND	ND	ND
ML35-3	<0.0025	0.0036	<0.0042	<0.0020	<0.0023		2.2	16.9	6.8	3.2	2.9	2.3	
ML35-4	<0.0025	0.0036	<0.0042	<0.0020	<0.0023	<0.0019	ND	2.8	1.5	ND	1.5	ND	ND
ML35-5	0.0035	0.0036	<0.0042	<0.0020	<0.0023		ND	ND	ND	ND	ND	ND	
ML35-6	<0.0025	0.0036	<0.0042	<0.0020	<0.0023	<0.0019	1.7	0.9	ND	ND	ND	ND	ND
ML35-7	<0.0025	0.0036	<0.0042	<0.0020	<0.0023		2.8	1.5	ND	ND	ND	ND	
ML35-8	<0.0025	0.0036	<0.0042	<0.0020	<0.0023	<0.0019	3.5	BLQ	ND	ND	ND	ND	ND
ML35-9	<0.0025	0.0036	<0.0042	<0.0020	<0.0023	<0.0019	ND	ND	ND	ND	ND	ND	ND
ML35-10	<0.0025		<0.0042	<0.0020	0.0054	<0.0019	ND	ND	ND	ND	ND	ND	ND

ND = None detected
BLQ = Below level of quantitation (1 ppb)

Table 4. Concentration Trends for Cr, TCE, cDCE and VC Over All Seven Sampling Sessions at Transects 1 and 3

Well #	Nov-96 c-DCE (µg/L)	Feb-97 c-DCE (µg/L)	Jun-97 c-DCE (µg/L)	Sep-97 c-DCE (µg/L)	Mar-98 c-DCE (µg/L)	Jun-98 c-DCE (µg/L)	Dec-98 c-DCE (µg/L)	Nov-96 Vinyl Cl (µg/L)	Feb-97 Vinyl Cl (µg/L)	Jun-97 Vinyl Cl (µg/L)	Sep-97 Vinyl Cl (µg/L)	Mar-98 Vinyl Cl (µg/L)	Jun-98 Vinyl Cl (µg/L)	Dec-98 Vinyl Cl (µg/L)
ML11-0	2.8	2.8	1.4	1.7	1.6	1.2	2.0	ND	BLQ	ND	ND	ND	ND	ND
ML11-1	2.6	1.8	1.0	ND	BLQ	ND	ND	ND	ND	ND	ND	ND	ND	ND
ML11-2	BLQ	1.3	2.0	1.3	1.4	1.1	2.4	ND	BLQ	ND	ND	BLQ	ND	ND
ML11-3	1.4	2.4	1.8	BLQ	2.3	1.3	10.6	BLQ	BLQ	ND	ND	BLQ	ND	ND
ML11-4	9.6	4.3	24.6	19.5	1.8	1.6	45.6	BLQ	BLQ	1.0	BLQ	BLQ	ND	<1.0
ML11-5	39.5	33.3	30.1	21.5	ND	30.4	31.3	1	1.1	BLQ	BLQ	ND	BLQ	<1.0
ML11-6	43.3	9.6	13.1	4.6	30.8	8.8	28.1	1.1	BLQ	ND	ND	2.1	ND	<1.0
ML11-7	25.2	3.3	11.1	3.7	3.5	2.9	5.2	BLQ	BLQ	ND	ND	ND	ND	ND
ML11-8	10.7	2.7	2.5	3.2	2.6	3.0	4.6	BLQ	BLQ	ND	ND	ND	ND	ND
ML11-9	6.1	2.5	2.0	2.7	1.8	2.8	4.6	ND	ND	ND	ND	ND	ND	ND
ML11-10	4.2	1.1	1.0	1.3	1.7	1.6	3.7	ND	ND	ND	ND	ND	ND	ND
ML12-1	1.2	BLQ	ND	1.8	BLQ	1.2	1.1	ND	ND	ND	ND	ND	ND	ND
ML12-2	1.3	1.9	0.9	3.6	BLQ	1.4	2.6	ND	BLQ	ND	ND	ND	ND	ND
ML12-3	5.8	6.8	6.5	22.6	BLQ	1.2	7.5	BLQ	BLQ	BLQ	BLQ	ND	ND	ND
ML12-4	18.1	15.2	16.2	27.0	3.4	1.9	13.3	BLQ	BLQ	BLQ	BLQ	BLQ	ND	<1.0
ML12-5	17.6	16.5	14.1	11.8	24.1	14.8	35.2	BLQ	BLQ	BLQ	BLQ	2.7	1.7	4.0
ML12-6	2.9	1.2	0.9	1.0	2.1	1.7	2.7	BLQ	BLQ	ND	ND	2.5	1.5	1.3
ML12-7	1.3	BLQ	ND	0.9	1.8	1.3	3.3	BLQ	ND	ND	ND	BLQ	ND	1.1
ML12-8	1.8	ND	ND	ND	BLQ	ND	1.1	ND	ND	ND	ND	ND	ND	ND
ML12-9	1	ND	ND	ND	ND	ND	<1.0	ND	ND	ND	ND	ND	ND	ND
ML12-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ML13-0	1	BLQ	ND	ND	1.0	ND	1.4	1.4	1.3	1.9	1.2	11.2	17.6	15.0
ML13-1	2.7	ND	1.7	2.0	1.6	2.1	2.1	1.3	BLQ	1.4	1.0	1.9	10.7	11.3
ML13-2	3.1	2.5	2.1	1.6	5.8	3.4	2.8	1.1	0.9	1.0	1.0	3.4	4.8	3.3
ML13-3	ND	1.3	BLQ	ND	3.6	2.4	1.3	1	BLQ	BLQ	BLQ	1.6	2.9	2.0
ML13-4	ND	ND	ND	ND	ND	ND	ND	1	BLQ	BLQ	BLQ	1.4	1.4	1.9
ML13-5	ND	ND	ND	ND	ND	ND	ND	1	BLQ	BLQ	BLQ	1.9	1.7	1.2
ML13-6	ND	ND	ND	ND	ND	ND	<1.0	0.9	BLQ	BLQ	BLQ	1.3	1.4	<1.0
ML13-7	ND	ND	ND	ND	ND	ND	ND	1	BLQ	BLQ	BLQ	1.1	1.2	2.0
ML13-8	ND	ND	ND	ND	BLQ	ND	ND	BLQ	BLQ	BLQ	BLQ	BLQ	1.3	1.3
ML13-9	ND	ND	ND	ND	4.4	ND	ND	BLQ	BLQ	BLQ	BLQ	2.4	1.3	2.2
ML13-10	ND	ND	ND	ND	ND	ND	ND	0.9	ND	BLQ	BLQ	2.4	1.1	ND
ML14-0	ND	ND	ND	ND	ND	ND	ND	1.2	0.9	0.9	1.3	BLQ	5.0	5.3
ML14-1	ND	ND	ND	ND	ND	ND	ND	1	BLQ	BLQ	BLQ	BLQ	7.0	8.1
ML14-2	ND	ND	ND	ND	ND	ND	ND	1.1	ND	BLQ	BLQ	BLQ	3.2	5.6
ML14-3	ND	ND	ND	ND	ND	ND	1.2	0.9	BLQ	BLQ	BLQ	BLQ	ND	2.2
ML14-4	ND	ND	ND	ND	ND	ND	ND	BLQ	BLQ	BLQ	BLQ	ND	ND	1.0
ML14-5	ND	ND	ND	ND	ND	ND		BLQ	BLQ	BLQ	BLQ	BLQ	ND	
ML14-6	ND	ND	ND	ND	ND	ND	ND	1	BLQ	BLQ	BLQ	BLQ	ND	<1.0
ML14-7	ND	ND	ND	ND	ND	ND	ND	1	BLQ	1.8	BLQ	ND	ND	<1.0
ML14-8	ND	ND	ND	ND	ND	ND	ND	0.9	2.1	BLQ	BLQ	BLQ	ND	<1.0
ML14-9	1.2	BLQ	ND	ND	BLQ	ND	ND	BLQ	BLQ	BLQ	BLQ	BLQ	ND	1.3
ML14-10	ND	ND	ND	ND	ND	ND	ND	BLQ	BLQ	BLQ	BLQ	BLQ	ND	<1.0
ML15-0	1.6	2.0	BLQ	ND	BLQ	ND	ND	BLQ	BLQ	0.9	BLQ	1.8	1.1	1.4
ML15-1	ND	ND	ND	ND	ND	ND	ND	1.2	ND	BLQ	1.0	1.4	ND	1.5
ML15-2	1.1	2.2	0.9	1.1	3.3	1.9	5.5	0.9	1.1	1.0	1.0	2.7	7.8	5.3
ML15-3	ND	ND	ND	ND	ND	ND	ND	1.2	BLQ	BLQ	BLQ	1.0	1.9	1.4
ML15-4	ND	ND	ND	ND	ND	ND	ND	1.3	BLQ	BLQ	BLQ	1.0	1.9	1.1
ML15-5	ND	ND	ND	ND	ND	ND	<1.0	1	0.9	BLQ	BLQ	BLQ	BLQ	<1.0
ML15-6	BLQ	1.7	BLQ	1.9	2.2	1.2	3.4	1.2	BLQ	ND	BLQ	1.5	ND	<1.0
ML15-7	4.2	2.3	1.5	3.6	2.0	1.6	3.5	1	BLQ	ND	BLQ	1.4	ND	1.3
ML15-8	4	1.4	1.5	3.5	2.2	1.8	1.9	1.1	BLQ	ND	BLQ	1.6	ND	1.2
ML15-9	2.8	0.9	1.5	4.5	1.0	1.2	2.6	BLQ	ND	ND	1.2	BLQ	ND	<1.0
ML15-10	ND	BLQ	ND	2.1	BLQ	ND	1.0	ND	ND	ND	ND	ND	ND	ND

ND = None detected
BLQ = Below level of quantitation (1 ppb)

Table 4. Concentration Trends for Cr, TCE, cDCE and VC Over All Seven Sampling Sessions at Transects 1 and 3

Well #	Nov-96 c-DCE (µg/L)	Feb-97 c-DCE (µg/L)	Jun-97 c-DCE (µg/L)	Sep-97 c-DCE (µg/L)	Mar-98 c-DCE (µg/L)	Jun-98 c-DCE (µg/L)	Dec-98 c-DCE (µg/L)	Nov-96 Vinyl Cl (µg/L)	Feb-97 Vinyl Cl (µg/L)	Jun-97 Vinyl Cl (µg/L)	Sep-97 Vinyl Cl (µg/L)	Mar-98 Vinyl Cl (µg/L)	Jun-98 Vinyl Cl (µg/L)	Dec-98 Vinyl Cl (µg/L)
ML31-0	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND		
ML31-1	ND	ND	ND	ND	3.1	ND	ND	ND	ND	ND	ND	2.5	ND	ND
ML31-2	ND	BLQ	ND	ND	ND	ND		ND	ND	ND	ND	4.1	ND	
ML31-3	ND	ND	ND	1.5	ND		ND	ND	ND	ND	ND	ND		ND
ML31-4	ND	BLQ	ND	24.6	ND	ND		ND	ND	ND	7.4	ND	ND	
ML31-5	13	16.5	21.6	49.0	3.2	ND	17.2	5.3	5.9	9.1	23.2	1.0	ND	6.4
ML31-6	49.3	52.2	42.9	19.2	40.7	11.3		31.3	30	29.7	14.3	25.9	3.1	
ML31-7	48.1	31.5	39.4	26.8	80.2	53.9	42.2	29.1	17.7	23.2	20.9	54.8	31.7	32.4
ML31-8	34.1	14.1	14.9	9.7	59.9	48.6		19.9	7.5	13.6	14.5	42.5	28.1	
ML31-9	4.1	7.4	12.0	11.8	45.5	33.7	14.8	5.3	6.8	24.5	27.4	41.6	20.0	38.8
ML31-10	2.2	2.1	6.3	7.3	20.9	17.4		2.8	3.6	10.4	11.9	41.6	33.6	
ML32-0	1.7	6.6	1.7	7.9	1.2	7.8	12.4	BLQ	BLQ	ND	ND	ND	26.8	<1.0
ML32-1	1.3	1.0	1.0	1.8	ND	11.1	ND	ND	ND	ND	ND	ND	BLQ	ND
ML32-2	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ML32-3	8.2	15.2	7.2	1.8	3.2	ND	2.3	2.4	3.3	9.3	ND	BLQ	ND	ND
ML32-4	47.8	64.9	25.1	57.6	19.3	ND	13.4	26	36.8	11.7	17.8	4.6	ND	5.8
ML32-5	28.5	23.3	23.6	22.3	21.8	25.2	49.9	16.3	16.3	12.7	11.2	10.5	4.9	19.5
ML32-6	7.3	3.3	7.3	6.2	10.7	50.2	35.2	4.1	2.9	6.3	3.8	9.8	20.8	23.3
ML32-7	2.2	2.3	3.6	3.1	4.8	19.9	7.1	1.3	3.4	8.3	8.7	11.3	20.0	27.8
ML32-8	1.3	1.3	5.1	4.4	3.5	6.1	6.0	BLQ	BLQ	7.3	5.2	21.0	31.9	20.2
ML32-9	BLQ	1.1	ND	ND	BLQ	4.1	ND	ND	ND	ND	ND	ND	25.7	ND
ML32-10	BLQ	BLQ	ND		ND	ND	ND	ND	ND	ND		ND	ND	ND
ML33-0	1.3	BLQ	ND	ND	ND	ND	ND	1.4	1.1	0.9	2.3	ND	ND	<1.0
ML33-1	6.5	26.5	6.3	2.6	7.5	ND	3.1	1.7	6.0	3.0	2.2	5.9	ND	<1.0
ML33-2	13.4	26.5	3.4	BLQ	11.0	3.8	4.3	3.5	28.8	16.3	17.2	9.9	ND	14.2
ML33-3	10.6	27.1	7.0	2.2	37.1	12.0	7.2	5.3	7.2	14.5	4.8	35.2	23.2	9.5
ML33-4	13.8	1.8	3.2	1.3	5.9	8.2	7.6	5.5	2.0	2.9	1.7	7.2	5.4	18.3
ML33-5	8.2	8.7	2.9	2.2	5.1	3.3	3.3	3.4	2.7	2.3	3.0	15.0	21.6	17.0
ML33-6	3.3	1.8	1.2	0.9	2.3	6.2	1.5	1.2	1.1	2.1	1.6	7.5	14.3	13.0
ML33-7	1.4	1.9	2.0	1.4	5.1	3.2	2.9	BLQ	1.5	3.5	2.9	24.7	17.9	16.7
ML33-8	2.4	1.4	1.1	1.1	1.2	3.7	ND	BLQ	ND	BLQ	BLQ	1.0	22.9	2.2
ML33-9	3.7	1.1	ND	ND	ND	ND	<1.0	BLQ	ND	ND	ND	ND	1.4	<1.0
ML33-10	3.8	1.3	ND	1.1	ND	ND	<1.0	BLQ	ND	ND	ND	ND	ND	<1.0
ML34-0	ND	ND	ND	ND	ND	ND	ND	1.4	BLQ	BLQ	ND	BLQ	ND	2.1
ML34-1	6.4	24.0	3.1	1.2	1.3	ND	<1.0	2.4	4.2	1.9	1.7	2.1	ND	5.2
ML34-2	16.4	18.1	5.1	3.7	8.2	7.3	4.7	5.7	4.4	1.7	2.4	2.3	ND	<1.0
ML34-3	12.4	1.4	1.1	BLQ	BLQ	1.3	1.0	5.6	2.2	3.6	1.4	2.5	ND	<1.0
ML34-4	1.5	BLQ	ND	ND	ND	1.2	ND	1.9	1.5	1.2	1.5	1.1	2.3	3.3
ML34-5	BLQ	ND	ND	ND	BLQ	ND	1.1	1.4	1.9	1.4	1.3	3.1	2.1	3.5
ML34-6	BLQ	BLQ	ND	ND	ND	1.1	ND	1.2	1.7	1.3	1.3	1.5	4.0	3.7
ML34-7	1.7	0.9	ND	ND	1.5	1.0	<1.0	1.4	1.5	1.6	1.4	3.9	4.0	4.9
ML34-8	1.3	1.1	ND	ND	BLQ	ND	ND	1.6	1.2	1.1	1.3	1.8	2.3	2.6
ML34-9	BLQ	1.6	ND	ND	ND	ND	ND	BLQ	1.9	1.1	1.0	2.4	2.2	2.1
ML34-10	BLQ	2.0	ND	ND	ND	ND	ND	ND	1.6	1.0	1.0	1.3	1.0	1.6
ML35-0	BLQ	ND	ND	ND	BLQ	ND	ND	1.1	ND	BLQ	0.9	1.1	1.5	1.3
ML35-1	1.2	BLQ	ND	ND	ND	ND	ND	1.3	3.2	1.6	1.7	ND	4.9	5.3
ML35-2	1.1	BLQ	ND	1.0	ND	ND	ND	1.1	1.5	1.8	1.6	2.6	5.7	4.0
ML35-3	10.9	17.3	10.4	5.4	5.7	7.7		5	2.5	3.4	2.2	5.5	ND	
ML35-4	6.5	22.4	9.0	5.2	10.5	5.3	2.1	2.2	3.7	3.0	1.9	3.3	BLQ	3.3
ML35-5	2	4.4	2.2	1.2	3.3	1.2		1.4	1.4	1.4	BLQ	1.5	ND	
ML35-6	1.2	1.4	ND	1.0	BLQ	ND	1.1	1.6	2.7	1.8	1.7	2.2	1.5	2.3
ML35-7	2.5	2.3	BLQ	1.4	1.8	BLQ		3	4.0	2.0	1.8	3.7	1.8	
ML35-8	2.9	1.5	1.3	1.8	1.7	1.1	1.6	4.9	4.2	3.2	2.1	3.9	2.1	3.0
ML35-9	BLQ	1.0	1.2	1.9	BLQ	1.1	1.7	1.3	3.4	2.5	1.9	1.7	2.3	3.4
ML35-10	ND	1.3	1.8	3.1	BLQ	BLQ	2.6	ND	1.6	1.7	1.4	BLQ	BLQ	1.3

ND = None detected
BLQ = Below level of quantitation (1 ppb)

Table 5. Parameters Used in Ground-water Flow and FRAC3D Reactive-transport Simulations

CONTAMINANT PARAMETERS			
	TCE	***cDCE***	***VC***
Source Concentration[1] (µg/L)	300	286	65
Diffusion Coefficient[2] (m^2/d)	8.73×10^{-5}	9.84×10^{-5}	11.47×10^{-5}
SIMULATION PARAMETERS			
	Simulation 1	***Simulation 2***	***Simulation 3***
k_{TCE} (d^{-1})	9.62	5.96	5.96
k_{cDCE} (d^{-1})	3.4	2.11	2.11
k_{VC} (d^{-1})	10.61	6.58	6.58
Hydraulic conductivity[3] (m/d)	100	100	100
Porosity	0.43 [4]	0.43 [4]	0.62 [5]

[1] *Source concentrations are taken from November 1996 data for Transect 2 (Figure 40)*
[2] *Diffusion coefficients (20°C) calculated using correlation equation (Wilke and Chang, 1955)*
[3] *Estimated average hydraulic conductivity for granular iron zone (Figure 8)*
[4] *Porosity measured in laboratory column experiments (O'Hannesin* et al.*, 1995)*
[5] *Porosity calculated assuming ρ_b (Fe)=1.69 g/cm³ and granular iron occupies entire trench*

Table 6. Simulated (FRAC3D) Travel Distance (cm) within the Barrier Before Contaminant Concentration Falls Below Target Concentration

	Target Concentration (µg/L)	**Simulation 1**	**Simulation 2**	**Simulation 3**
TCE	5 (MCL)	6 cm	8 cm	8 cm
cDCE	70 (MCL)	4 cm	4 cm	6 cm
VC	2 (MCL)	12 cm	12 cm	16 cm
VC	5 (Observed breakthrough)	8 cm	10 cm	12 cm

Table 7. Cr(VI) Concentration (mg/L) Trends Observed in Compliance Wells

Well information			**Sampling Date**			
Location	***Well***	***Screen interval***	***November 1996***	***February 1997***	***June 1997***	***December 1998***
DOWNGRADIENT	MW46	4.3 - 7.3 m	BQL	BQL	BQL	BQL
	MW47	4.3 - 7.3 m	BQL	N/A	BQL	0.01
	MW49	4.3 - 7.3 m	BQL	BQL	BQL	BQL
	MW50	7.6 - 9.1 m	BQL	BQL	BQL	0.08
	MW35D	16.1 – 19.1 m	BQL	BQL	BQL	0.0
UPGRADIENT	MW48	4.3 - 7.3 m	1.26	0.6	0.4	0.34
	MW13	4.3 - 7.3 m	2.83	3.5	2.6	2.5
	MW18	4.3 - 7.3 m	BQL	BQL	N/A	BQL
	MW38	4.3 - 7.3 m	BQL	BQL	BQL	BQL

BQL: Below quantitation level (0.01 mg/L)
N/A: Not available
MCL: 0.05 mg/L

Table 8. TCE Concentration (µg/L) Trends Observed in Compliance Wells

Well information			**Sampling Date**			
Location	***Well***	***Screen interval***	***November 1996***	***February 1997***	***June 1997***	***December 1998***
DOWNGRADIENT	MW46	4.3 - 7.3 m	***256***	***636***	***63.9***	***51.9***
	MW47	4.3 - 7.3 m	1.1	BQL	1.5	BQL
	MW49	4.3 - 7.3 m	2.8	2.8	N/A	BQL
	MW50	7.6 - 9.1 m	***41***	3.4	***156***	***290***
	MW35D	16.1 - 19.1 m	BQL	0.9	BQL	BQL
UPGRADIENT	MW48	4.3 - 7.3 m	517	471	535	347
	MW13	4.3 - 7.3 m	21.6	61.9	24	8.2
	MW18	4.3 - 7.3 m	32.6	14	7.7	BQL
	MW38	4.3 - 7.3 m	BQL	1.3	0.9	BQL

BQL: Below quantitation level (1 µg/L)
N/A: Not available
Underlined *italicized number indicates TCE concentration greater than MCL (5 µg/L) downgradient of barrier*

Table 9. VC Concentration (µg/L) Trends Observed in Compliance Wells

Well information			**Sampling Date**			
Location	***Well***	***Screen interval***	***November 1996***	***February 1997***	***June 1997***	***December 1998***
DOWNGRADIENT	MW46	4.3 - 7.3 m	1.3	1.6	1.9	***8.7***
	MW47	4.3 - 7.3 m	1.6	1.8	1.7	***2.7***
	MW49	4.3 - 7.3 m	1.4	BQL	NA	***2.0***
	MW50	7.6 - 9.1 m	BQL	BQL	BQL	***2.9***
	MW35D	16.1 - 19.1 m	BQL	BQL	BQL	BQL
UPGRADIENT	MW48	4.3 - 7.3 m	BQL	BQL	BQL	5.8
	MW13	4.3 - 7.3 m	BQL	BQL	BQL	BQL
	MW18	4.3 - 7.3 m	2.1	1.3	BQL	BQL
	MW38	4.3 - 7.3 m	BQL	BQL	BQL	BQL

BQL: Below quantitation level (1 µg/L)
N/A: Not available
Underlined *italicized number indicates TCE concentration greater than MCL (5 µg/L) downgradient of barrier*

Figures

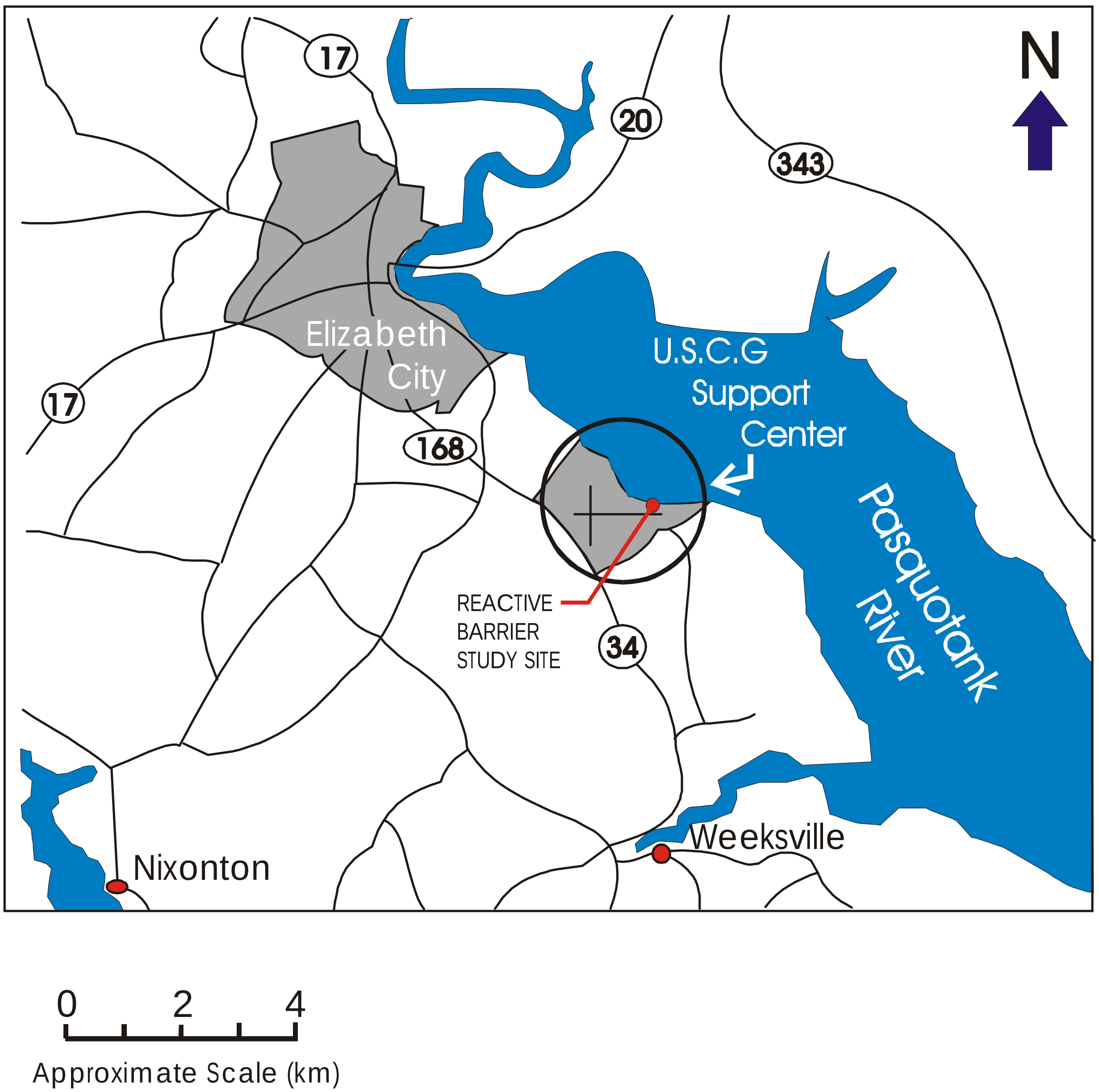


Figure 1. Location map showing U.S. Coast Guard Support Center, Elizabeth City, North Carolina.

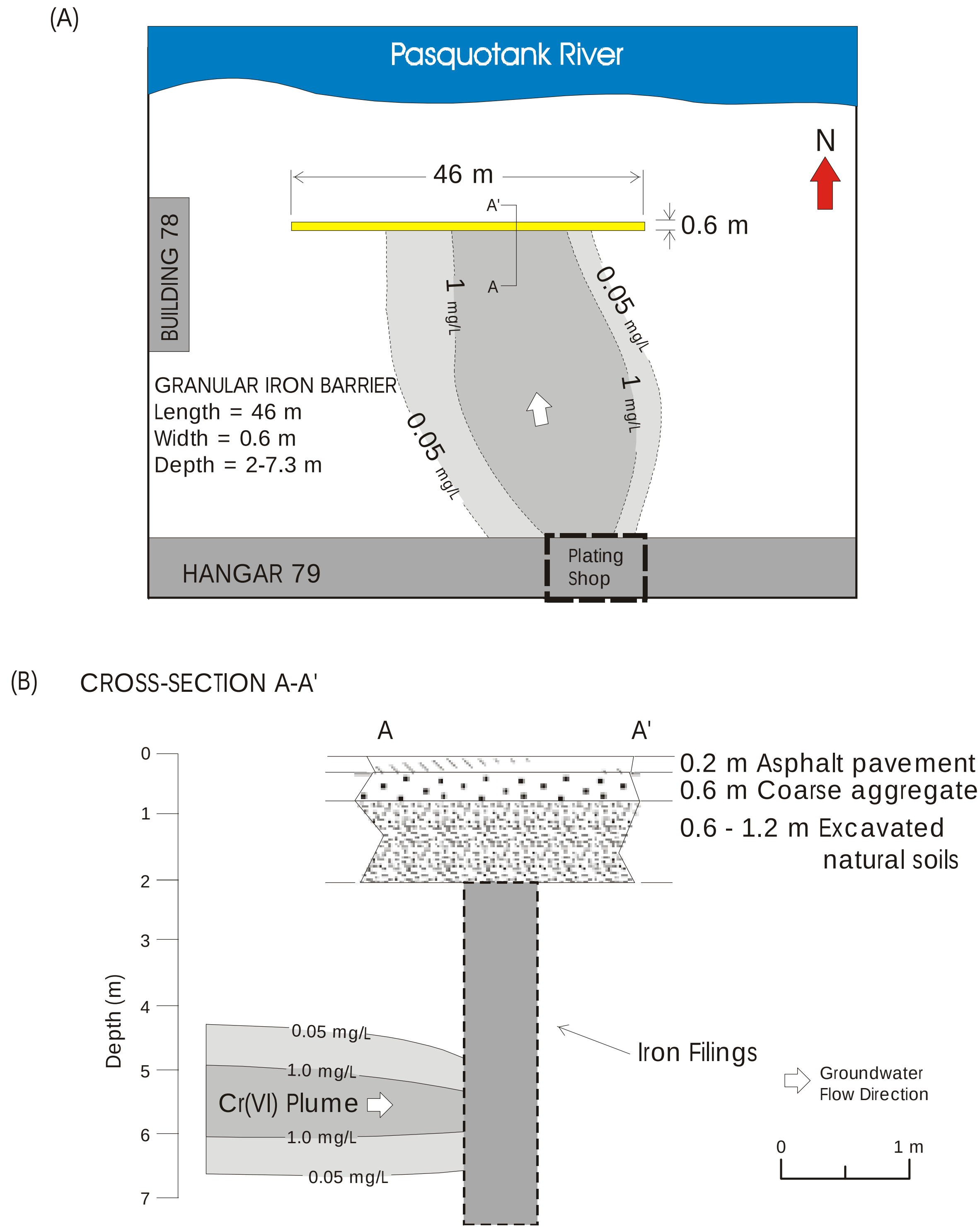


Figure 2. (A) Plan view and (B) cross-sectional view of reactive barrier.

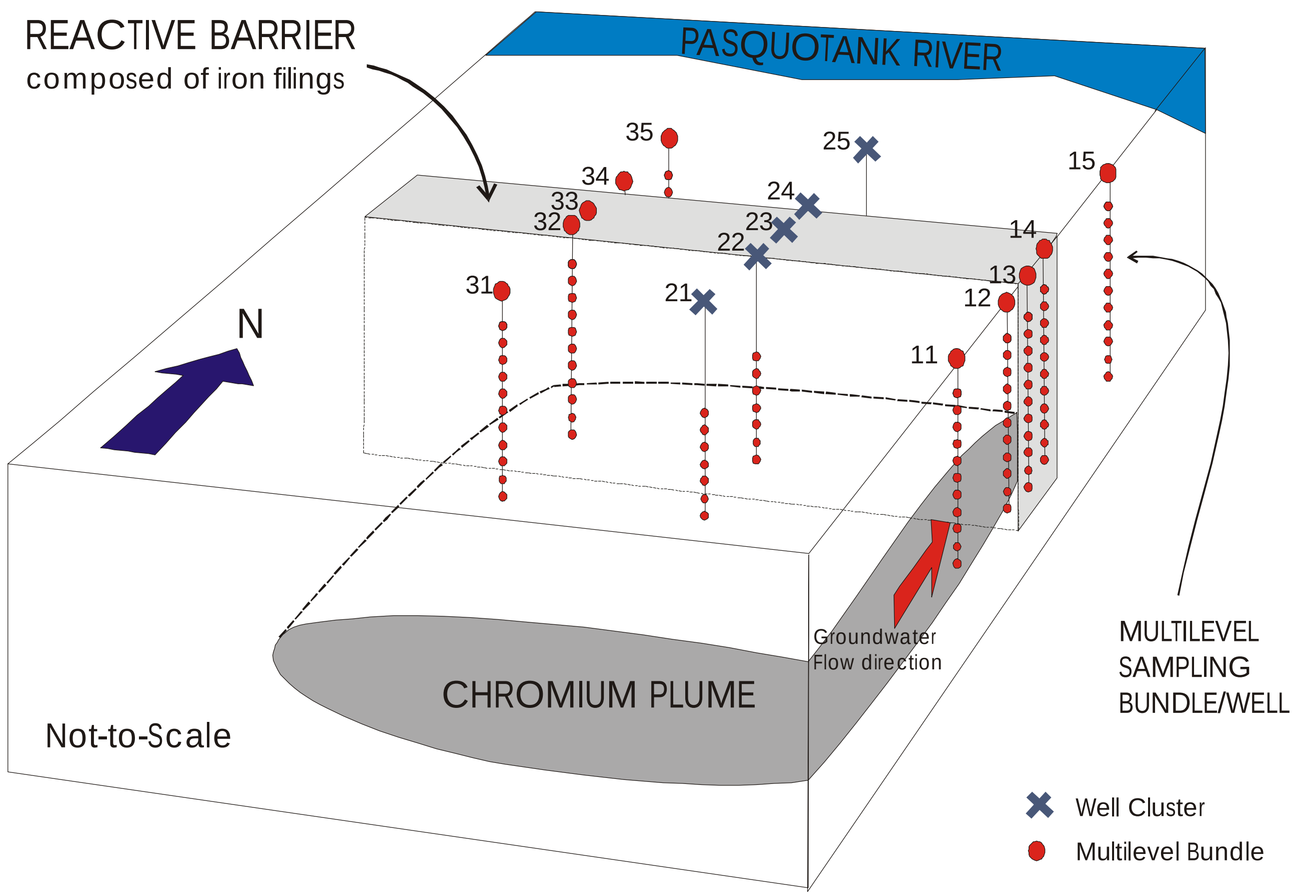


Figure 3. Orientation of monitoring wells with respect to barrier and groundwater flow direction.

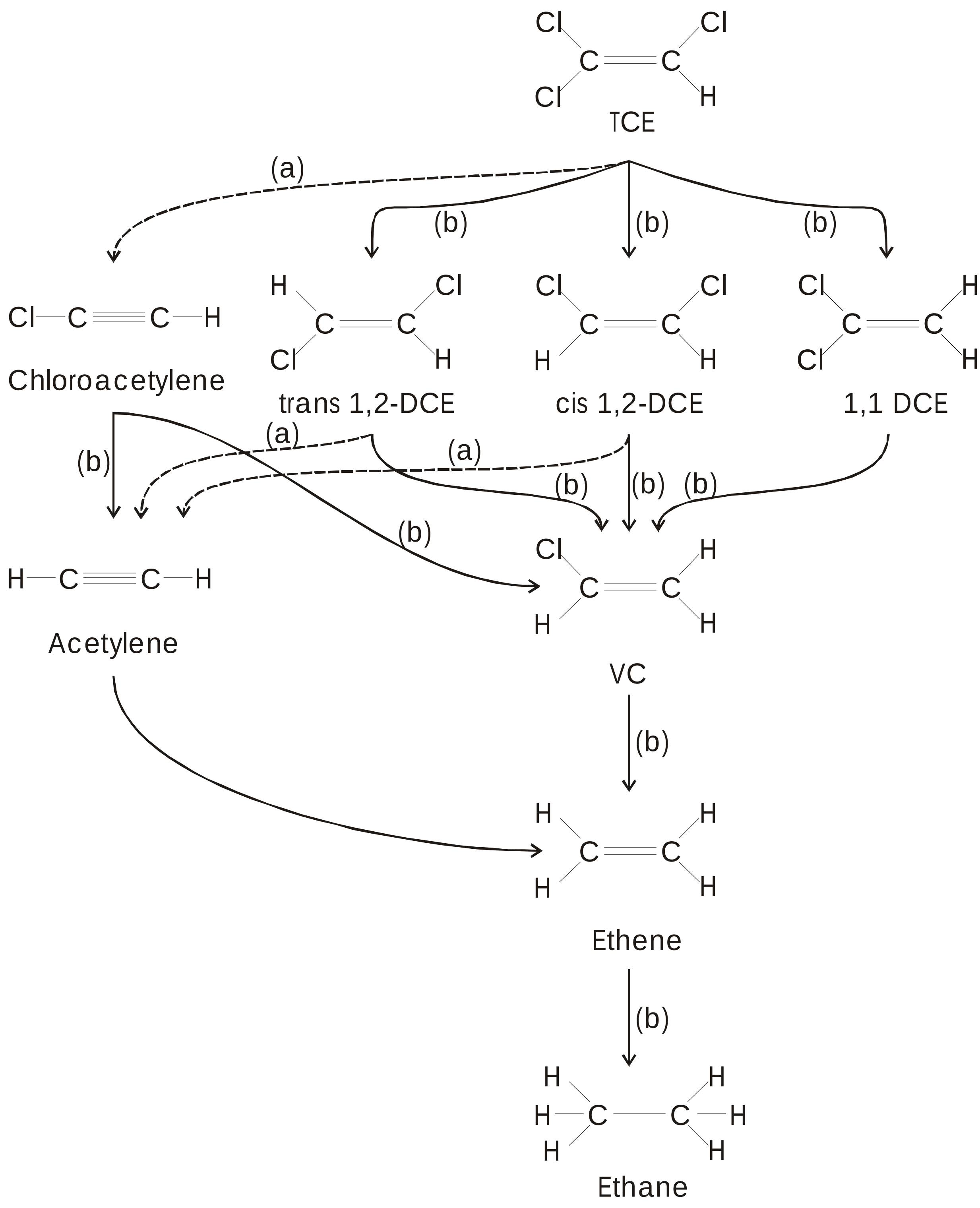


Figure 4. a) Reductive β-elimination, and (b) hydrogenolysis reaction steps in degradation of TCE (after Arnold and Roberts, 1997).

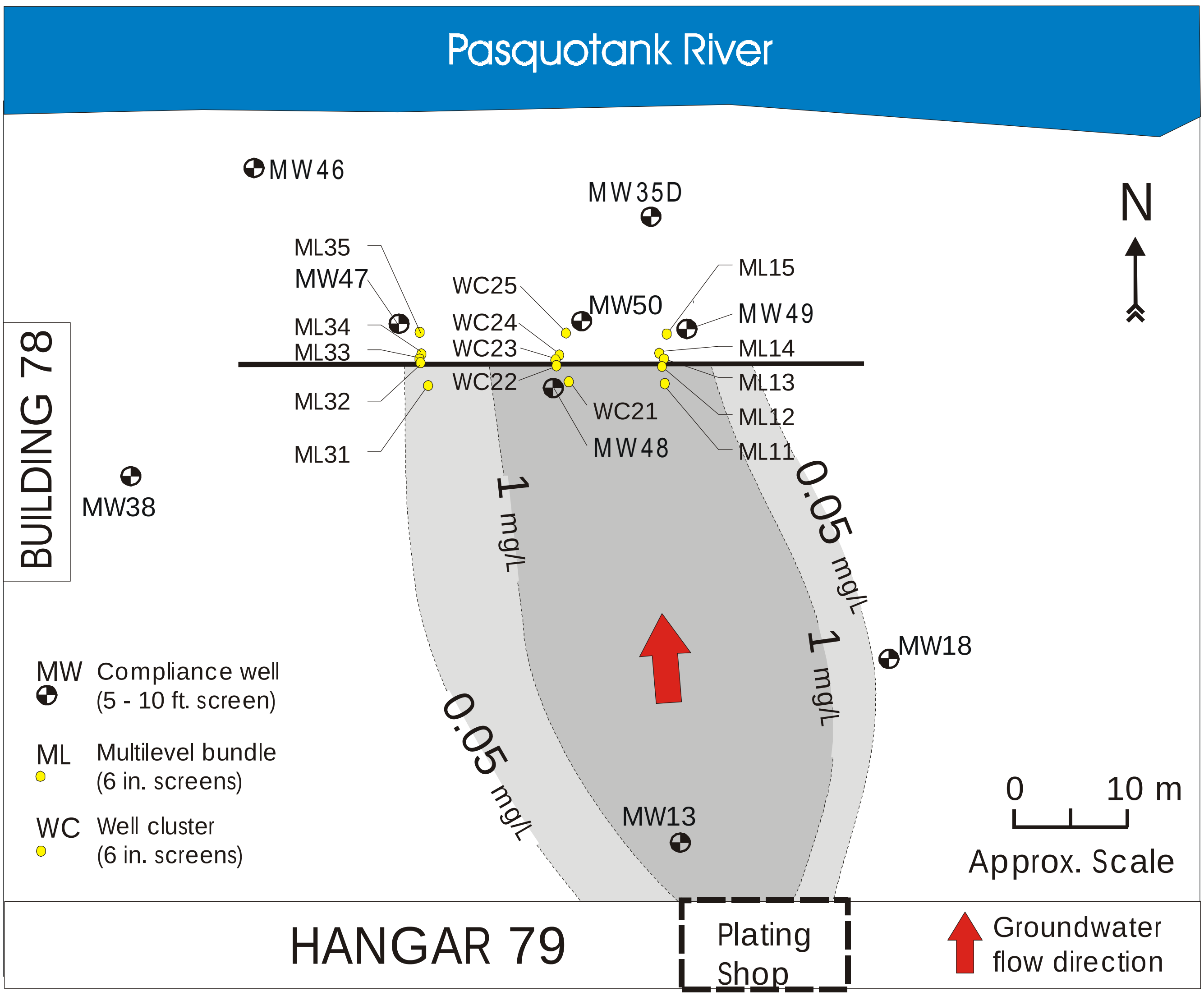
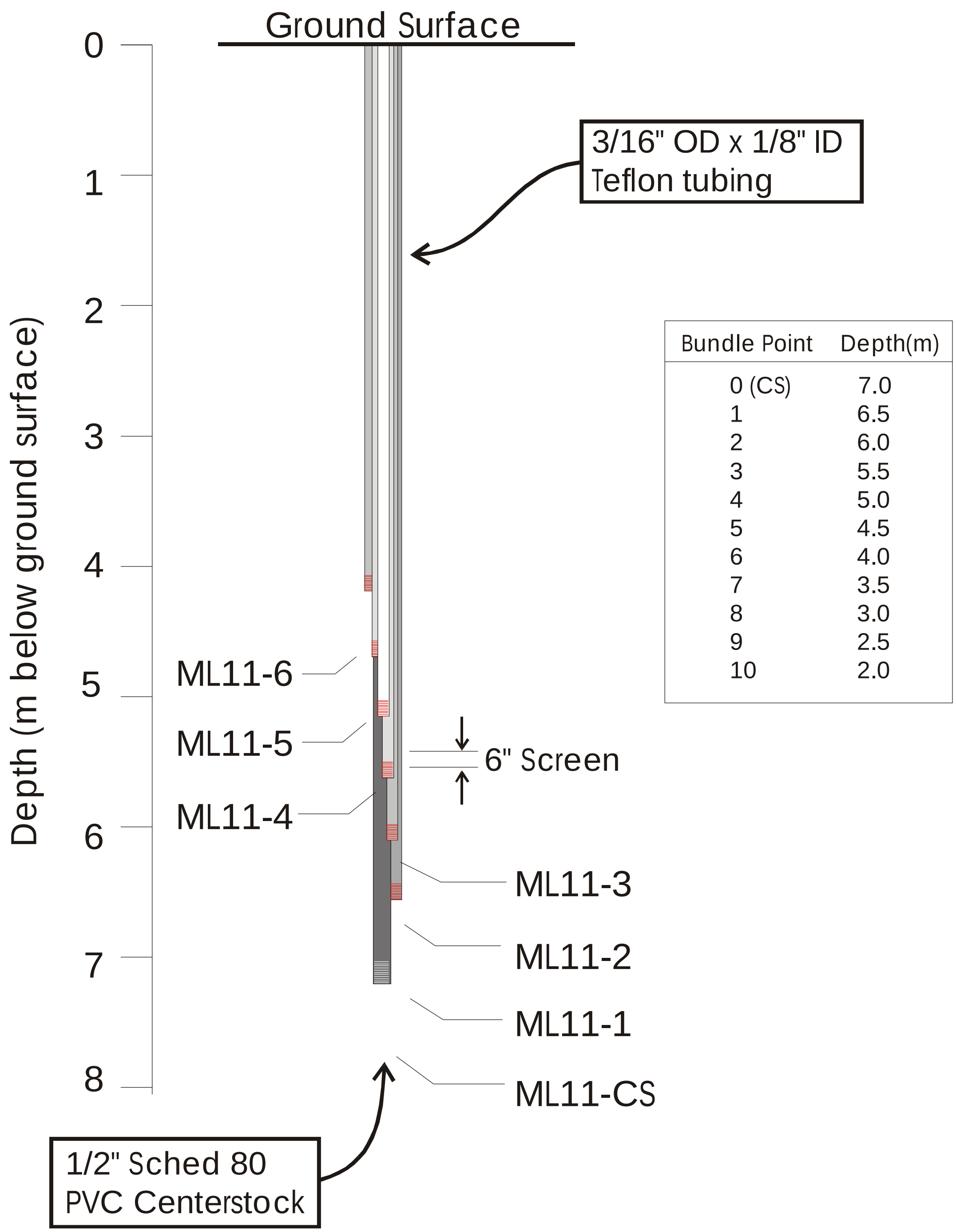


Figure 5. Plan view map showing compliance well, bundle and well cluster locations relative to granular iron barrier and Cr plume (June 1994 data).



Bundle Point	Depth(m)
0 (CS)	7.0
1	6.5
2	6.0
3	5.5
4	5.0
5	4.5
6	4.0
7	3.5
8	3.0
9	2.5
10	2.0

Figure 6. Schematic of multilevel bundle.

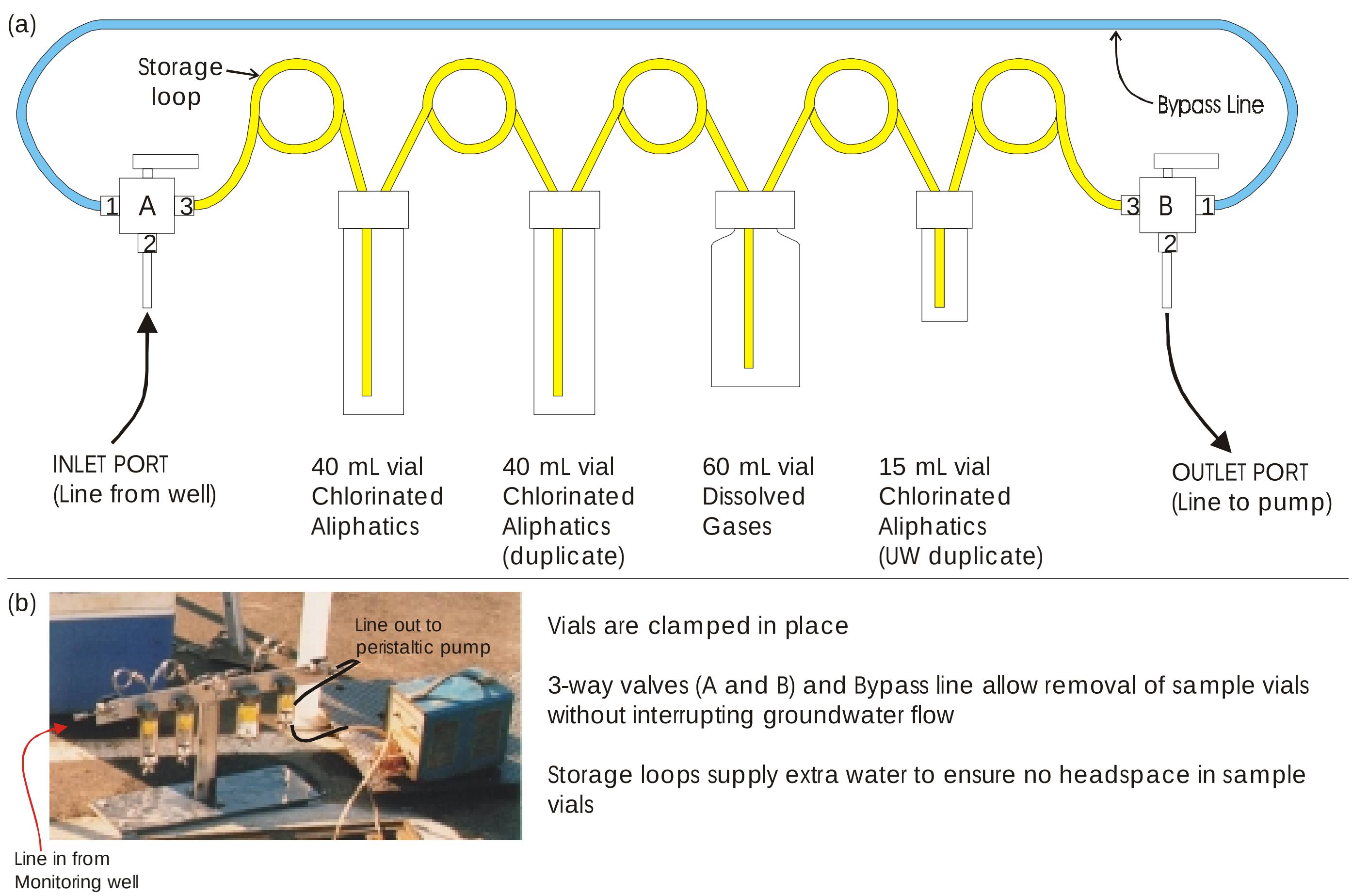


Figure 7. (a) Schematic and (b) picture of organic sampling manifold developed at the University of Waterloo.

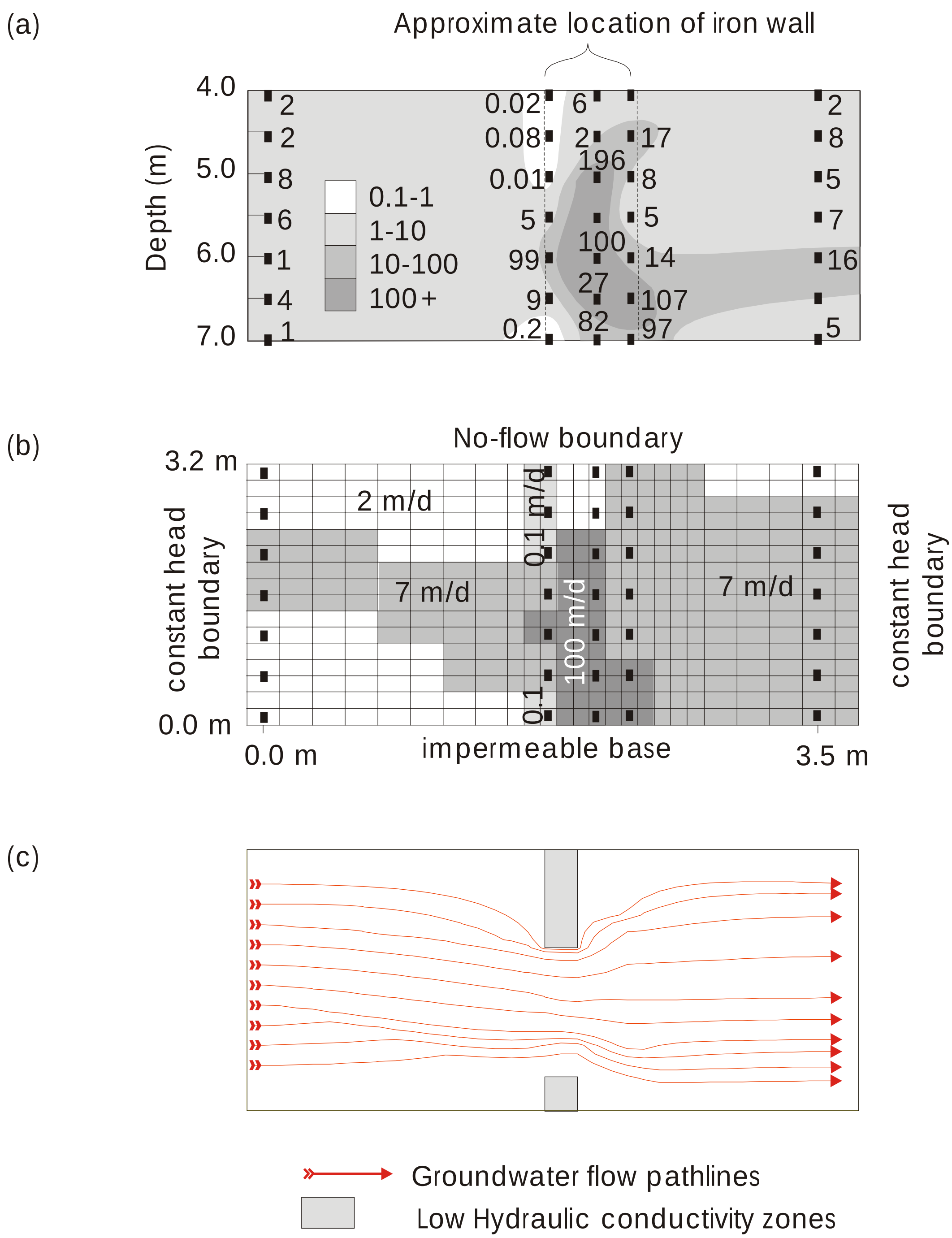


Figure 8. (a) Distribution of hydraulic conductivity (m/d) in transect 2, (b) 2D simulation domain and boundary conditions and (c) flow pathlines.

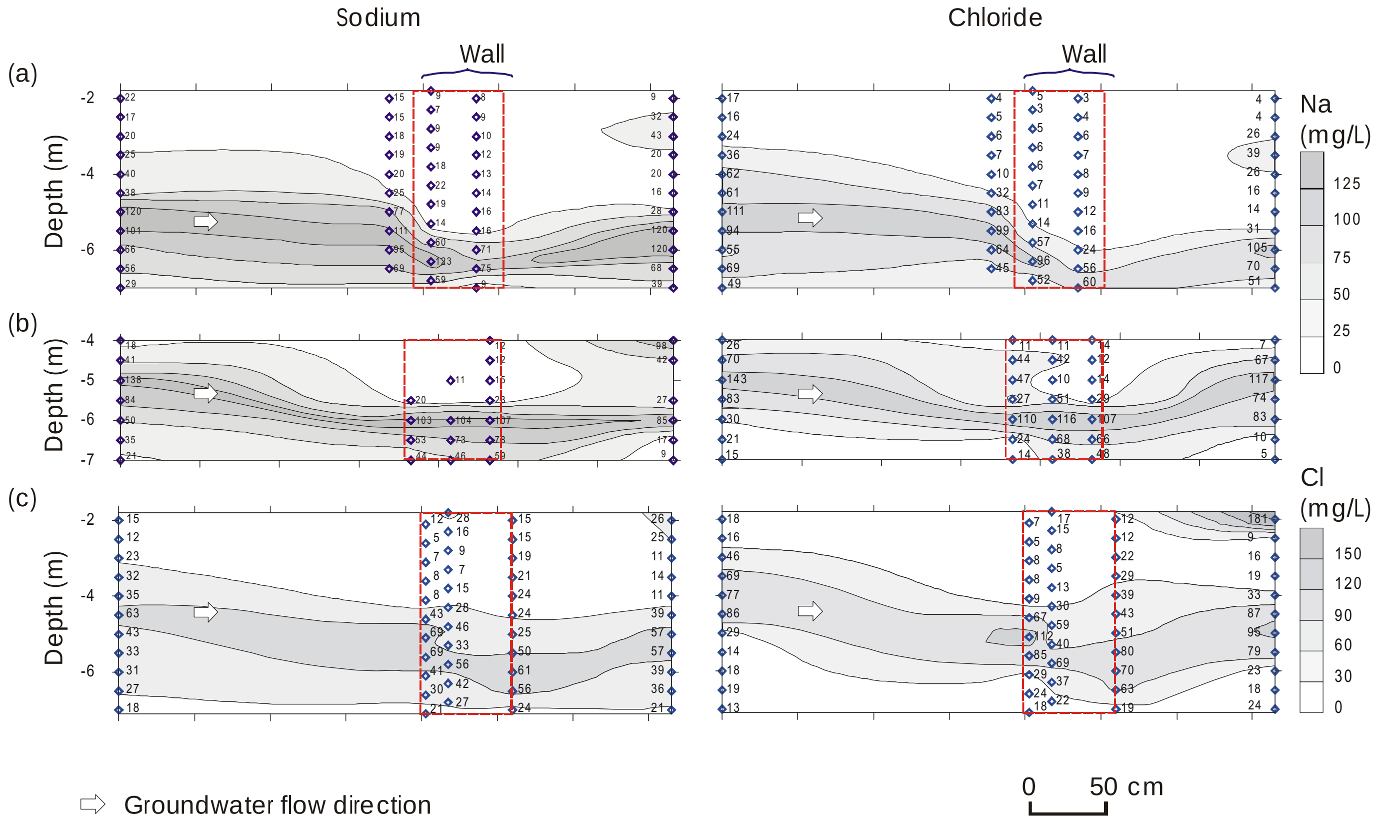


Figure 9. Sodium and chloride concentrations (mg/L) in (a) transect 1, (b) transect 2 and (c) transect 3 (November 1996 (Day 150) - 0.45 ìm filtered samples).

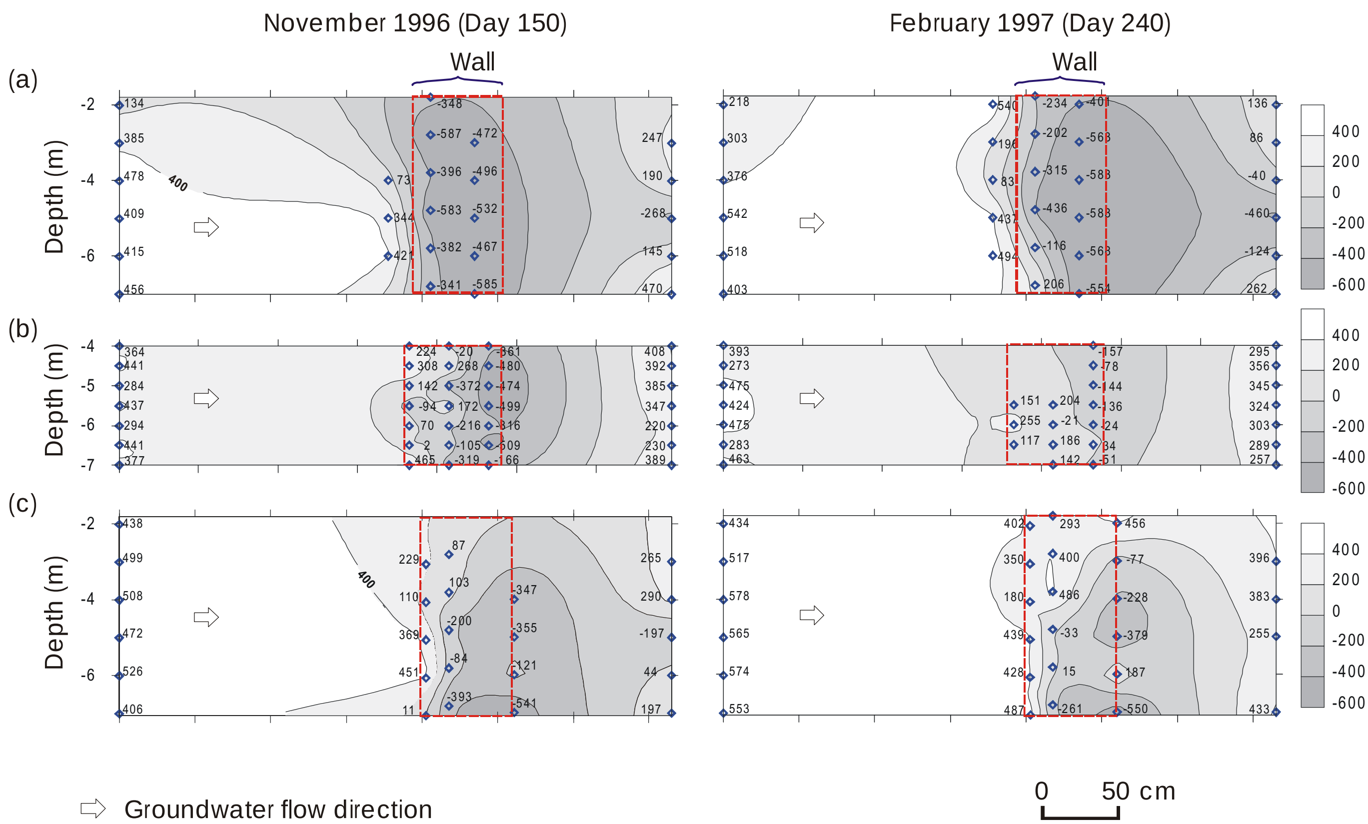


Figure 10. Eh values (mV vs. SHE) in (a) transect 1, (b) transect 2 and (c) transect 3 (November 1996 and February 1997).

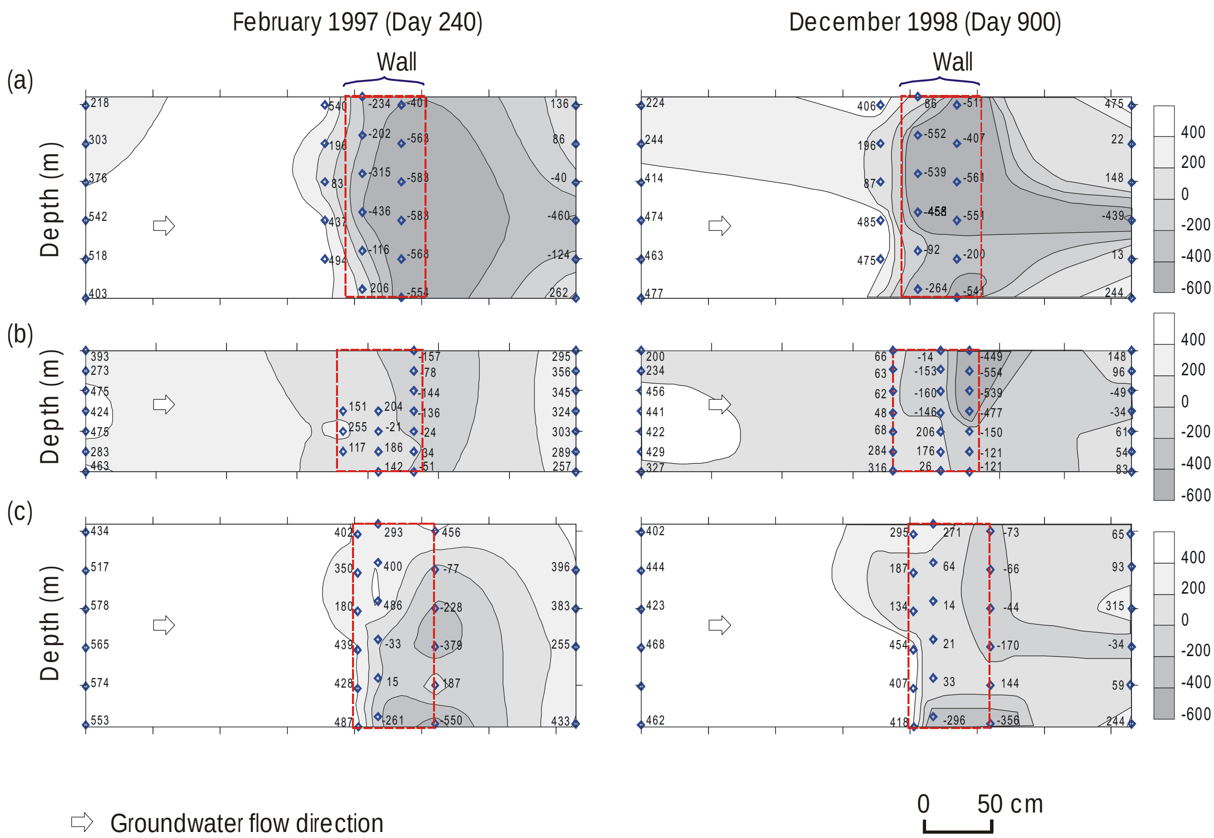


Figure 11. Eh values (mV vs. SHE) in (a) transect 1, (b) transect 2 and (c) transect 3 (February 1997 and December 1998).

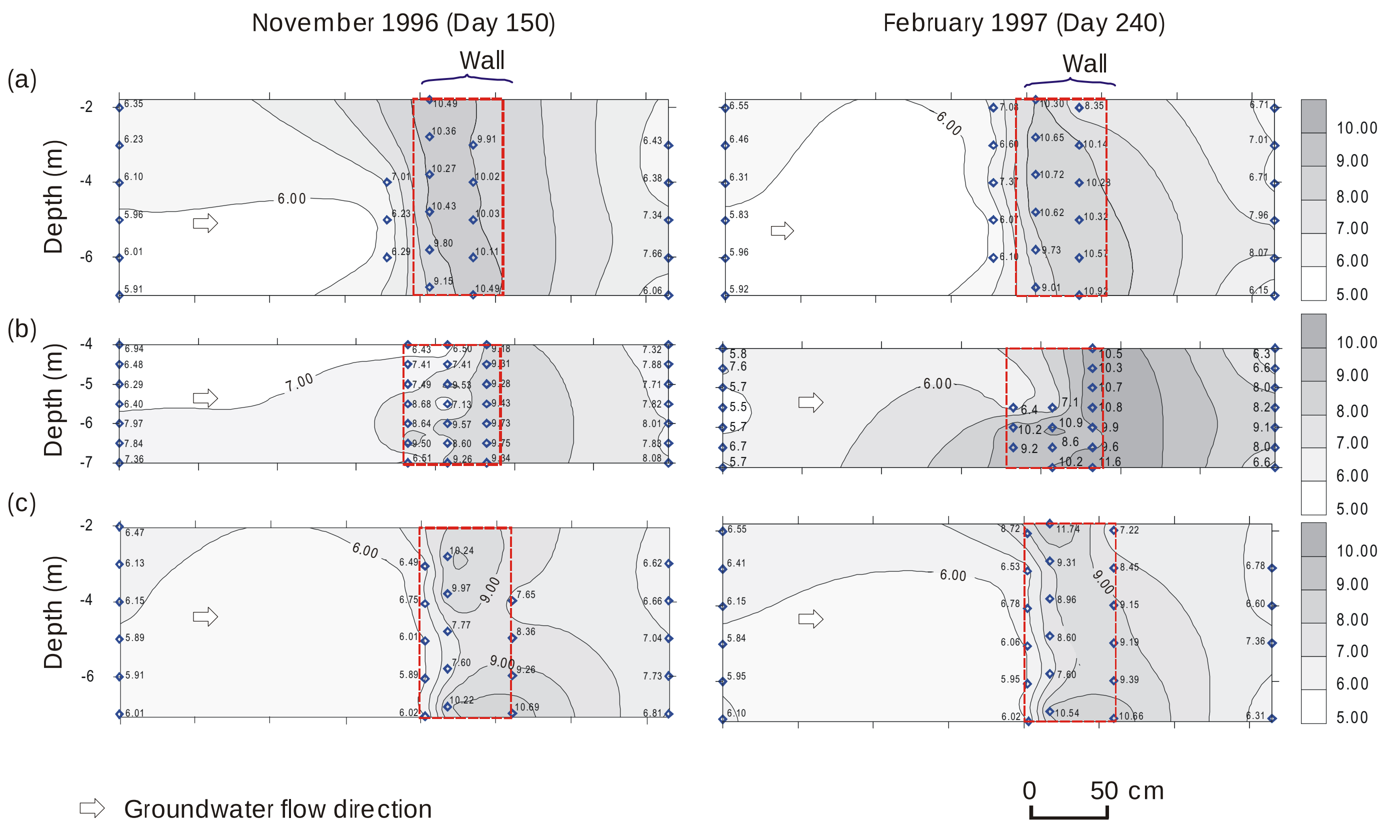


Figure 12. pH values in (a) transect 1, (b) transect 2 and (c) transect 3 (November 1996 and February 1997).

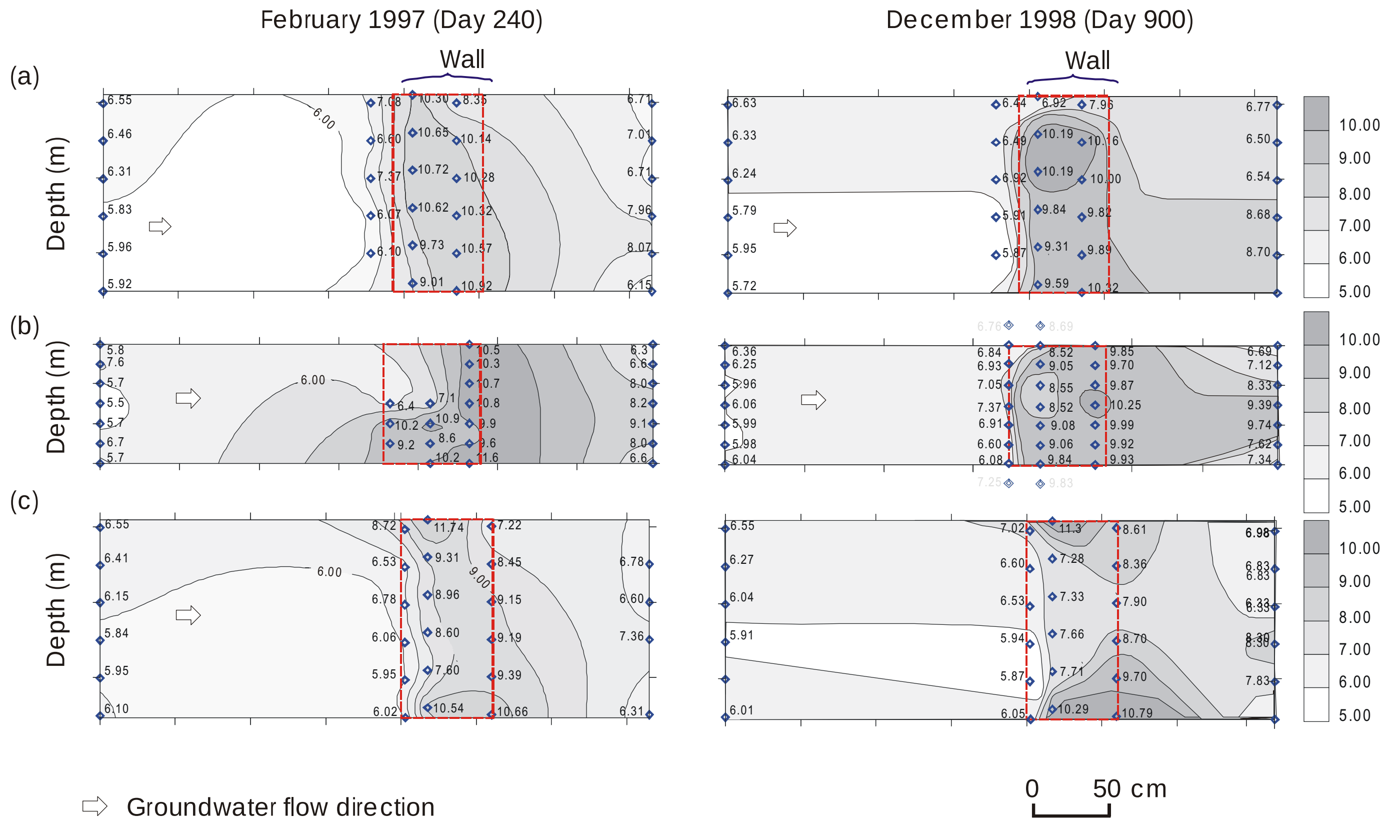


Figure 13. pH values in (a) transect 1, (b) transect 2 and (c) transect 3 (February 1997 and December 1998).

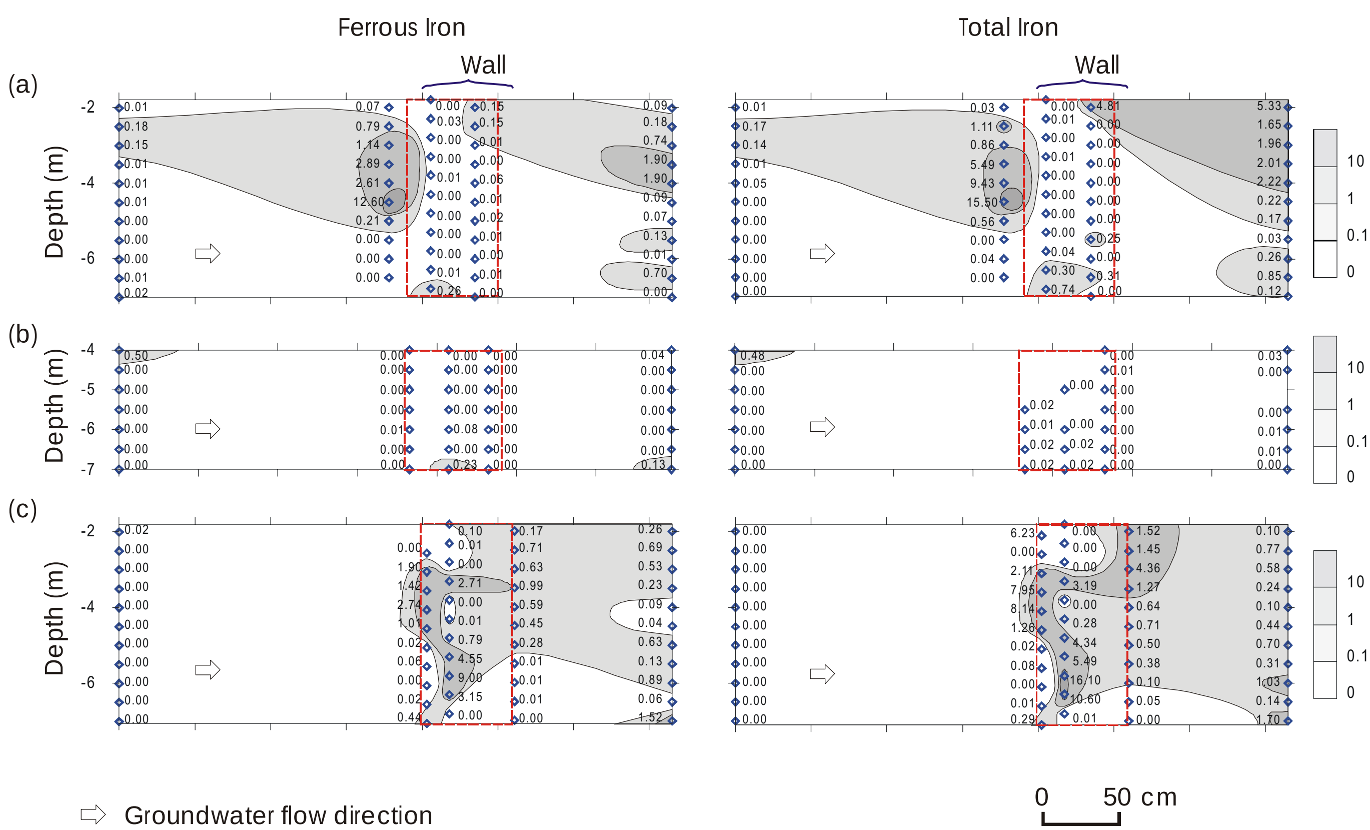


Figure 14. Ferrous and total iron concentrations (mg/L) in (a) transect 1, (b) transect 2 and (c) transect 3 (November 1996 (Day 150) - 0.45 µm filtered samples for total iron).

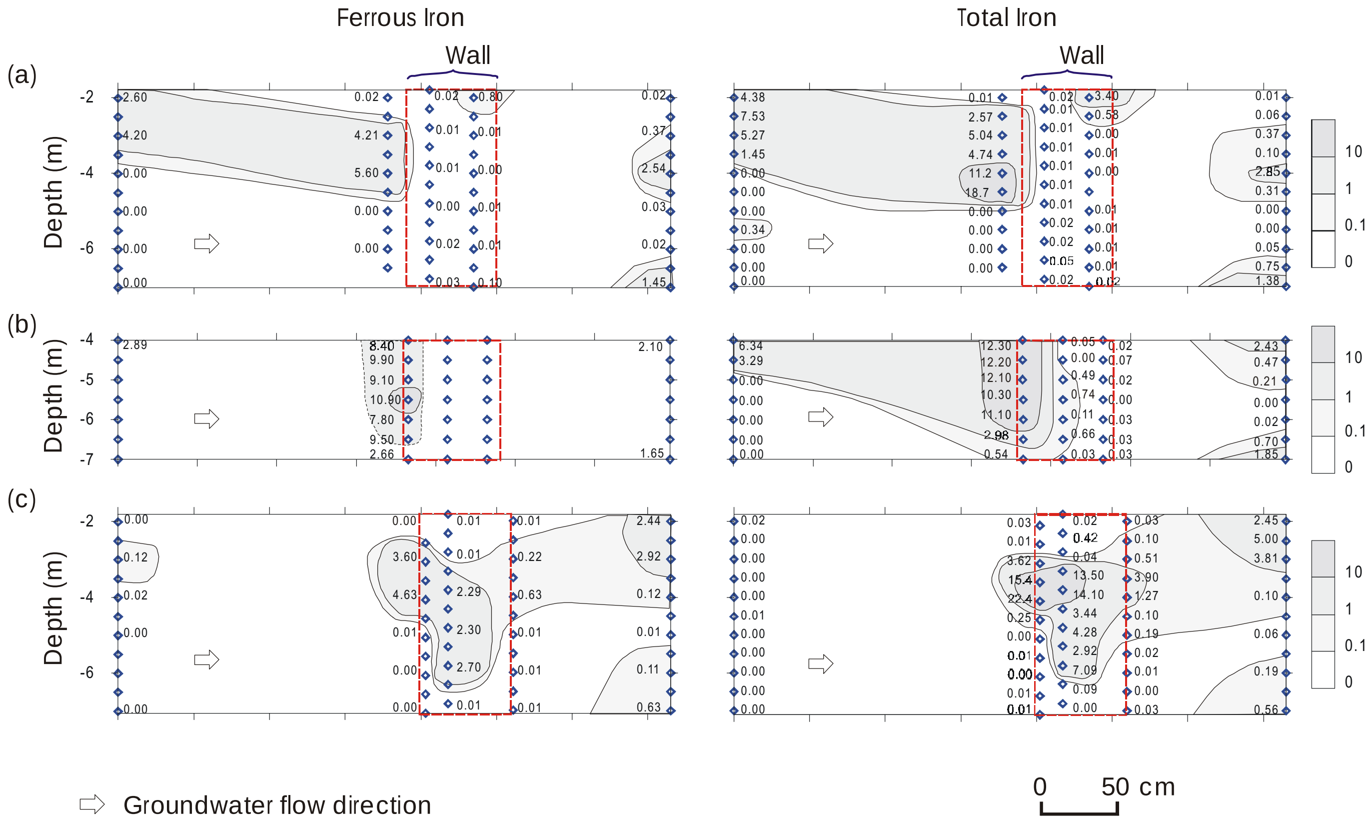


Figure 15. Ferrous and total iron concentrations (mg/L) in (a) transect 1, (b) transect 2 and (c) transect 3 (December 1998 (Day 900) - 0.45 µm filtered samples for total iron).

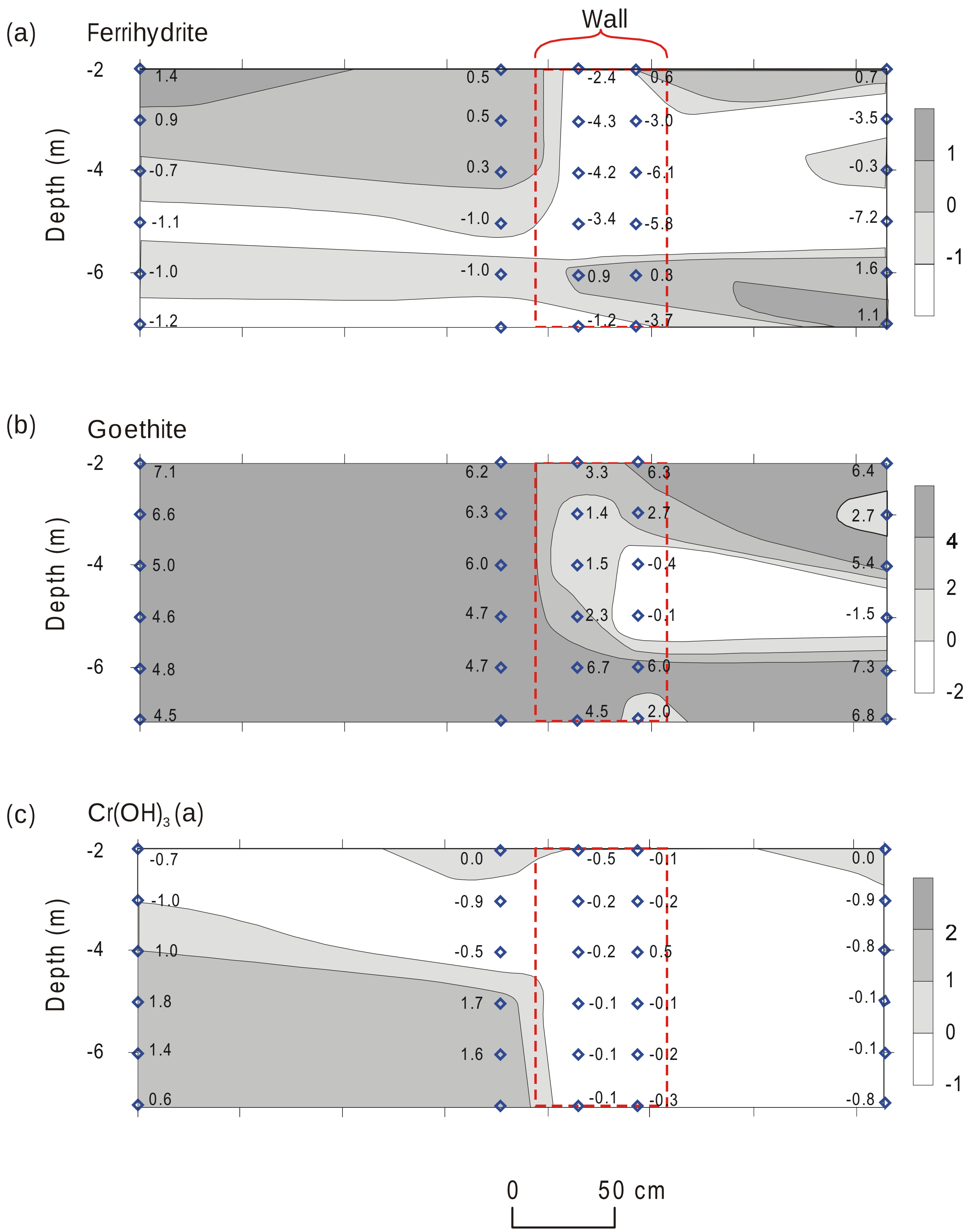


Figure 16. Saturation indices for a) ferrihydrite, b) goethite and c) $Cr(OH)_3$ (a) in transect 1 (December 1998 (Day 900)).

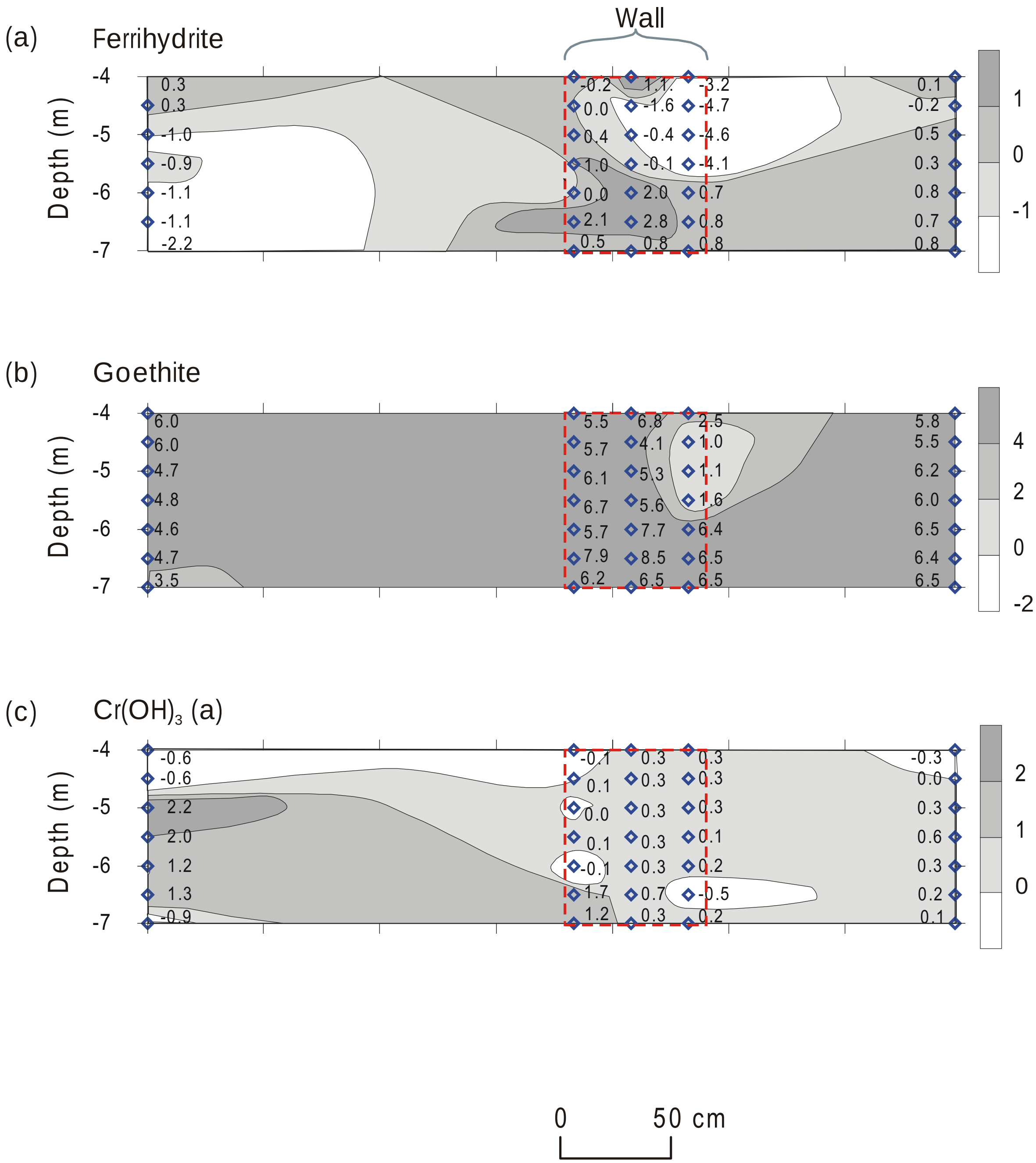


Figure 17. Saturation indices for a) ferrihydrite, b) goethite and c) $Cr(OH)_3$ (a) in transect 2 (December 1998 (Day 900)).

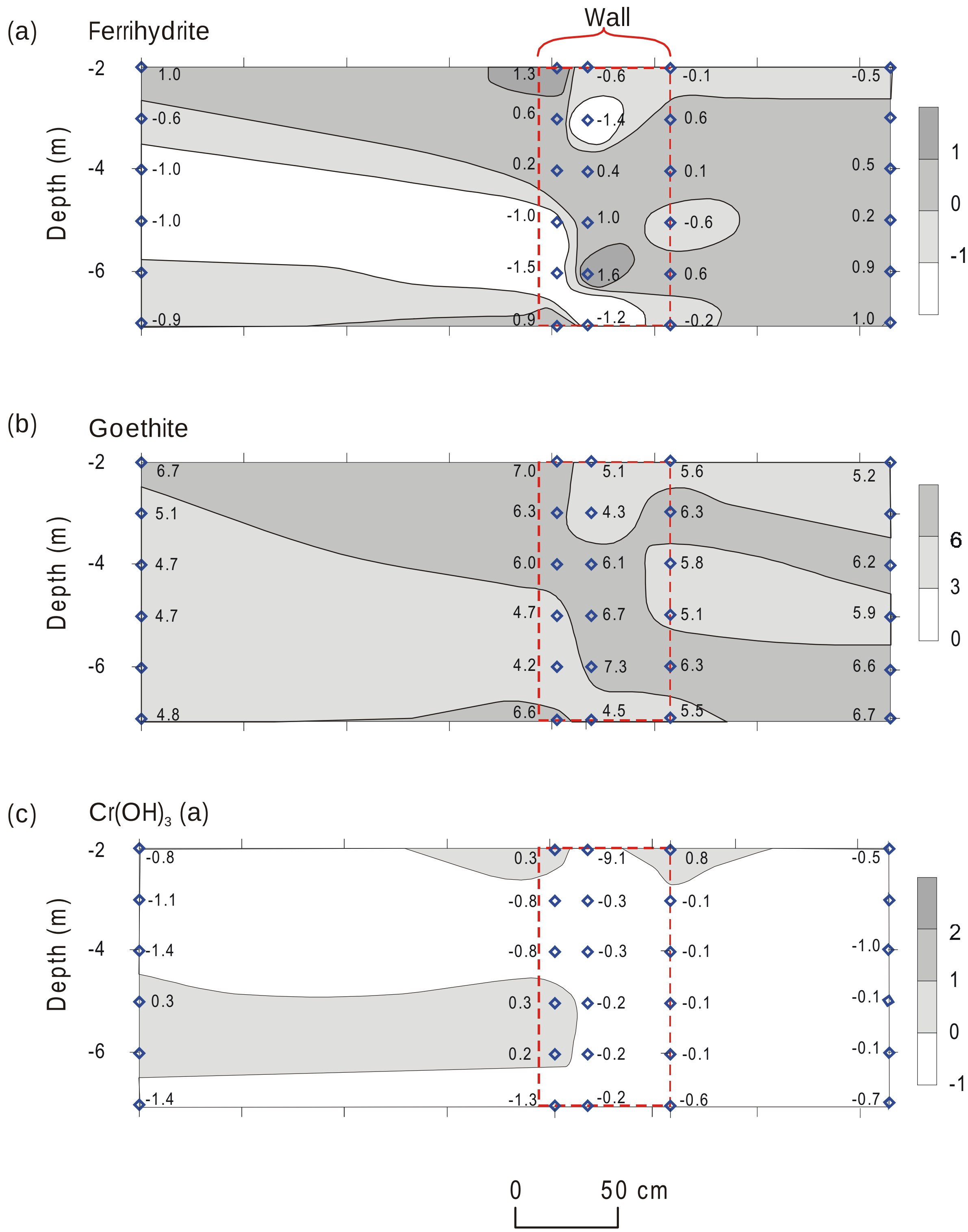


Figure 18. Saturation indices for a) ferrihydrite, b) goethite and c) $Cr(OH)_3$ (a) in transect 3 (December 1998 (Day 900)).

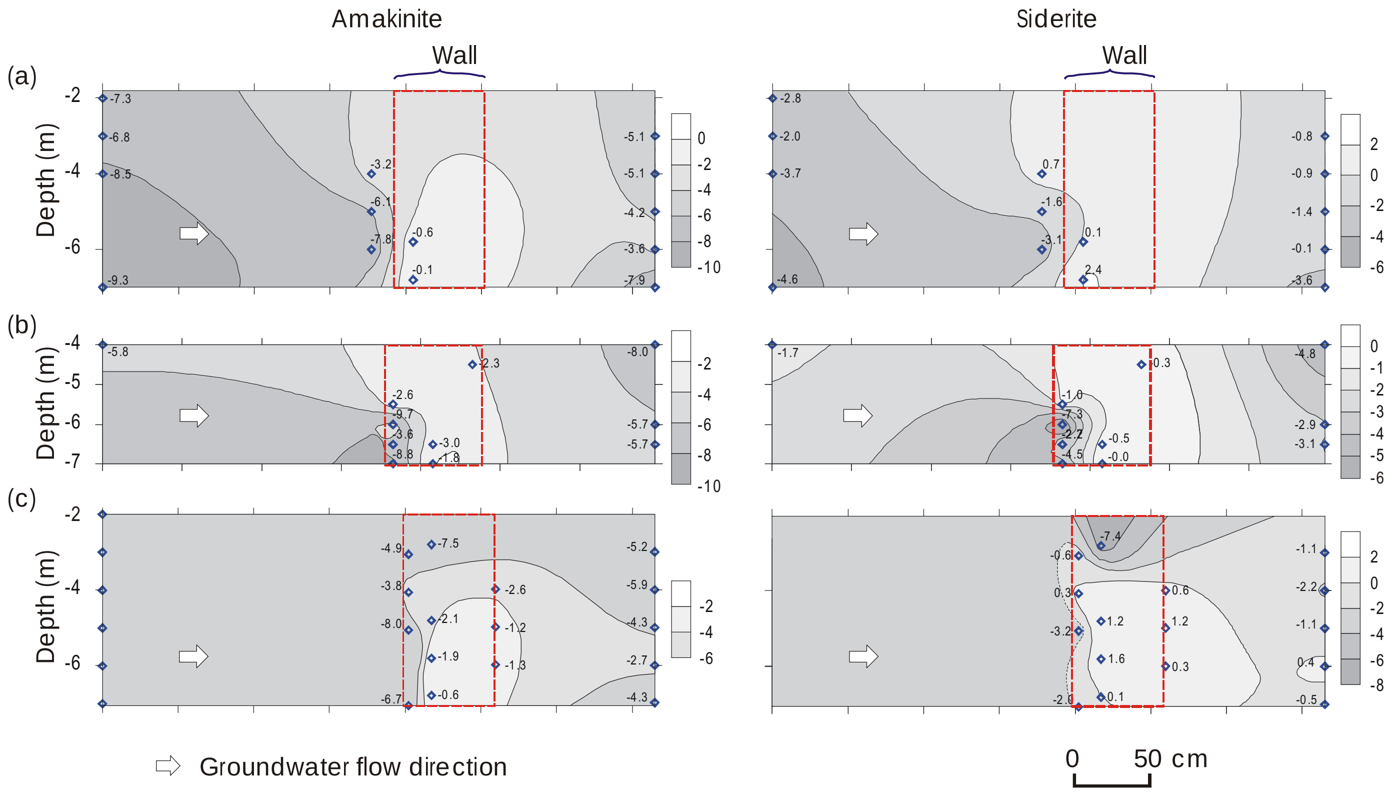


Figure 19. Saturation indices for amakinite and siderite (d) in (a) transect 1, (b) transect 2 and (c) transect 3 (November 1996 (Day 150)).

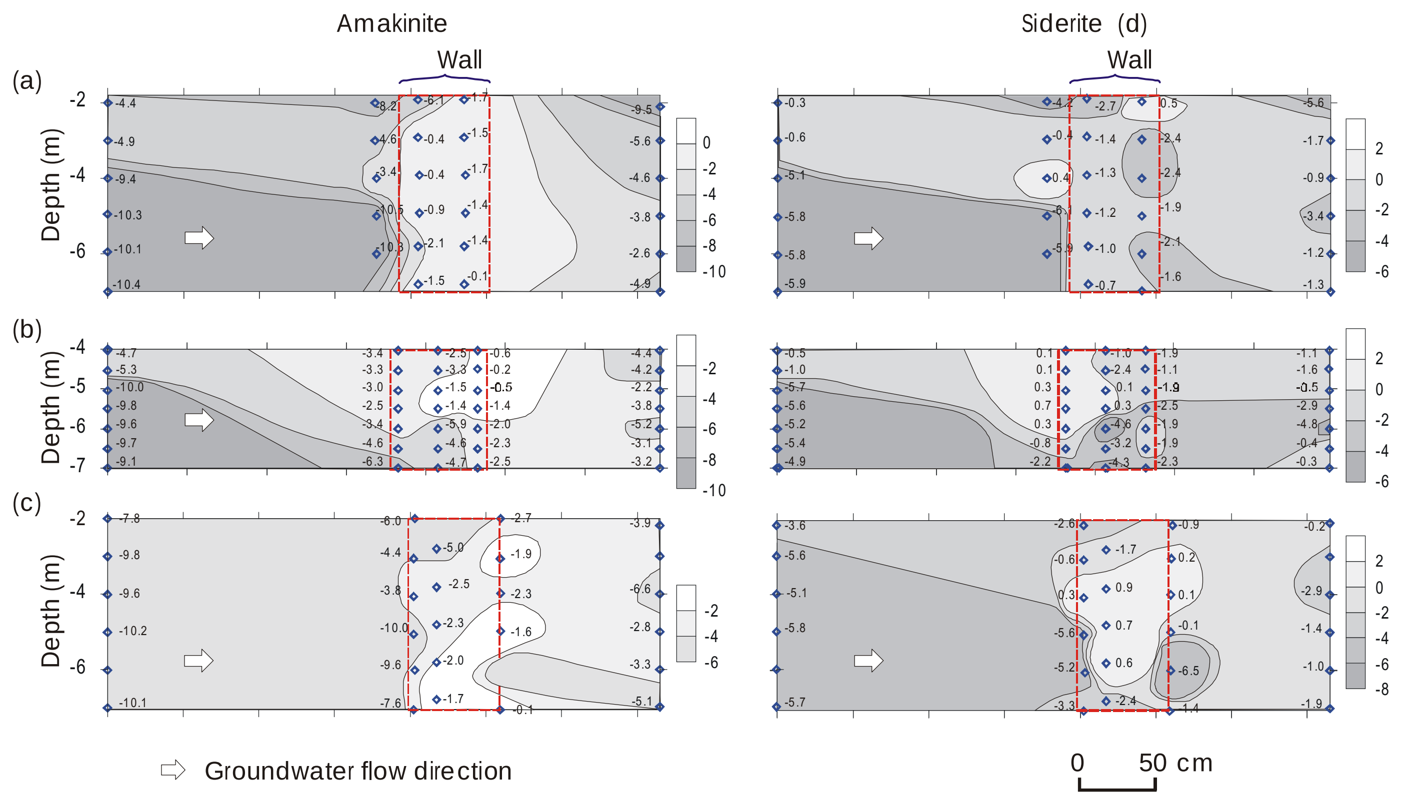


Figure 20. Saturation indices for amakinite and siderite (d) in (a) transect 1, (b) transect 2 and (c) transect 3 (December 1998 (Day 900)).

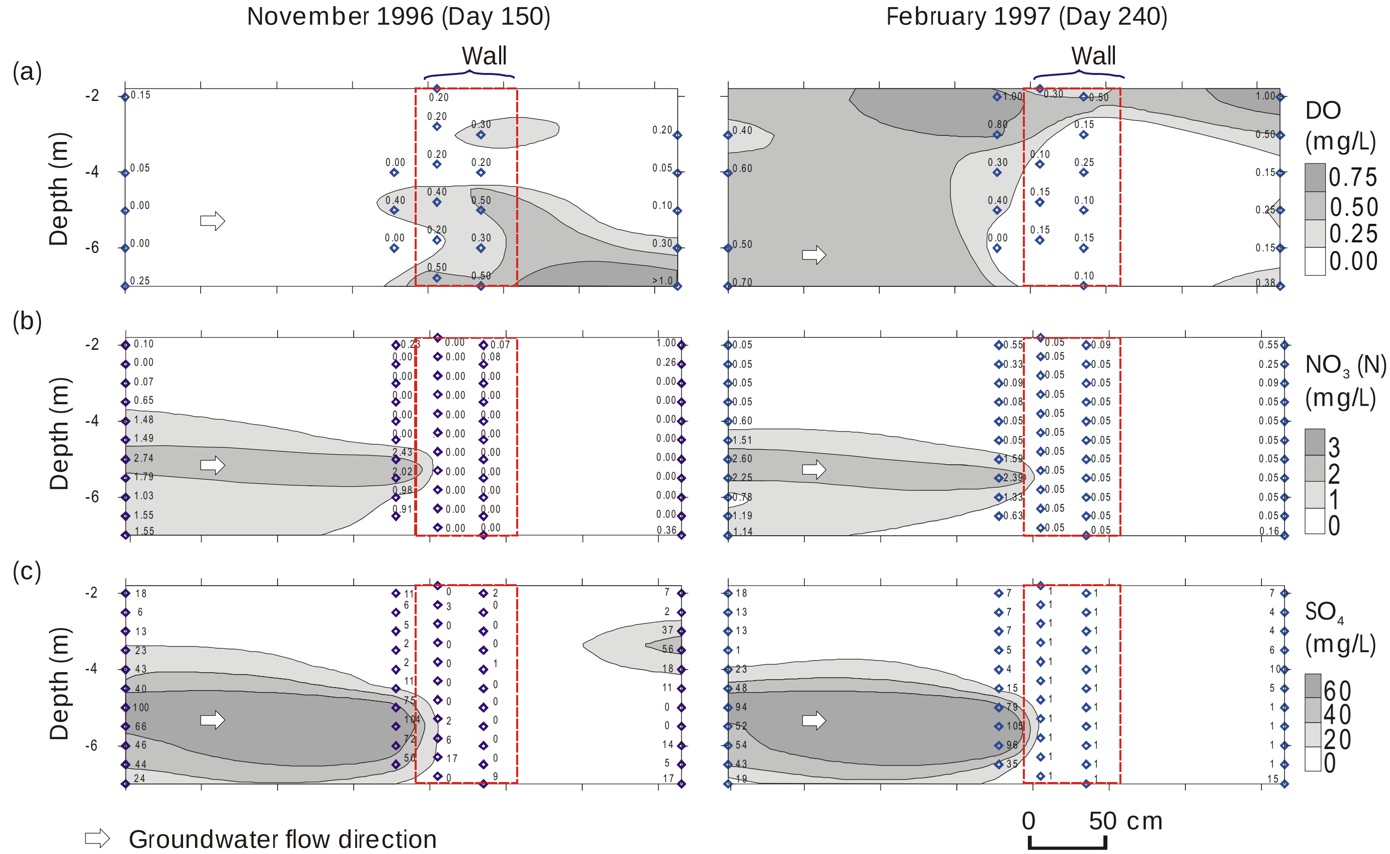


Figure 21. (a) Dissolved oxygen, (b) nitrate and (c) sulfate concentrations (mg/L) in transect 1 (November 1996 and February 1997).

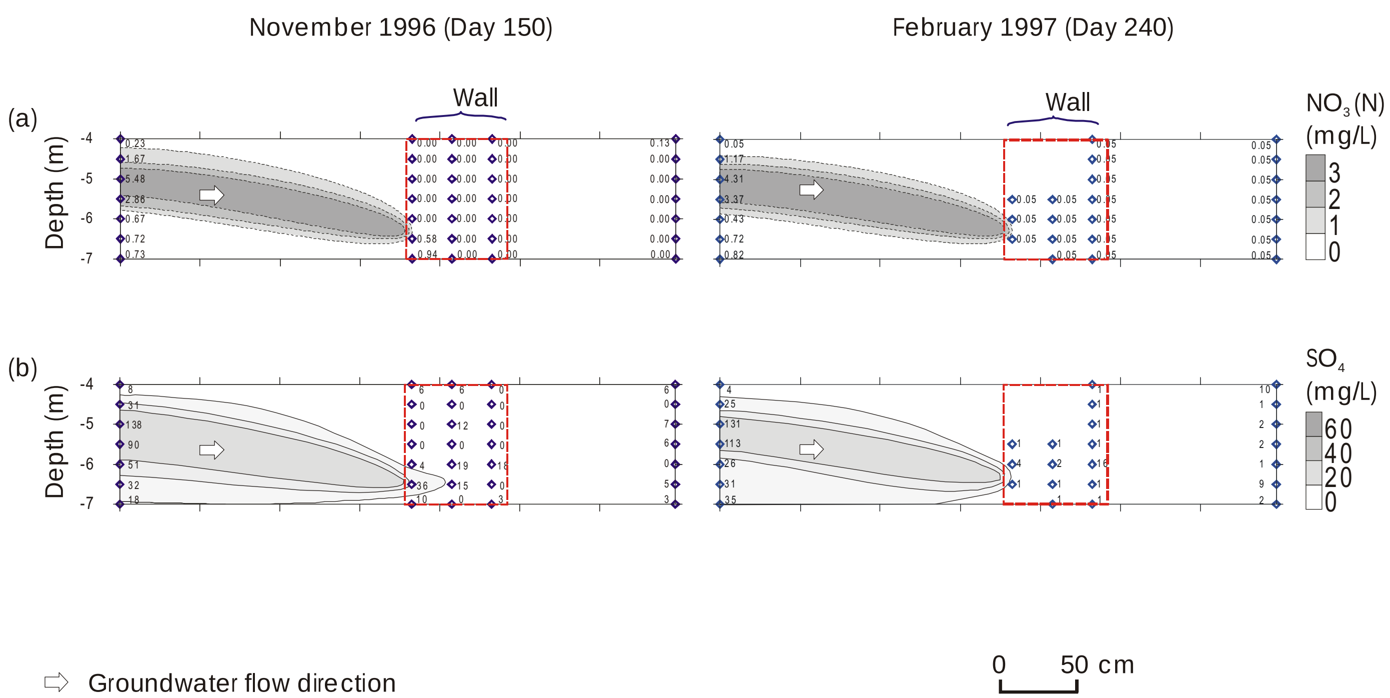


Figure 22. (a) Nitrate and (c) sulfate concentrations (mg/L) in transect 2 (November 1996 and February 1997).

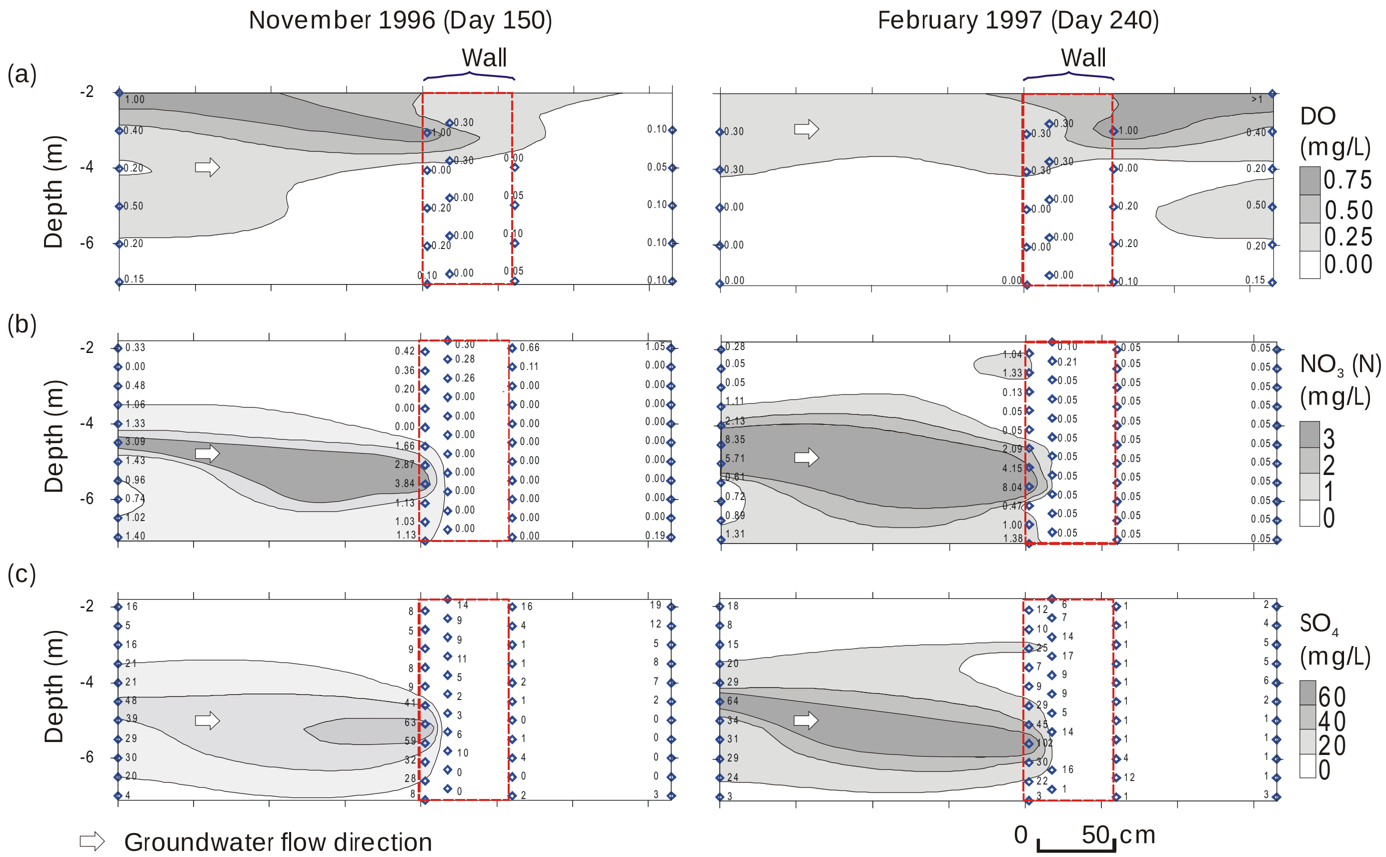


Figure 23. (a) Dissolved oxygen, (b) nitrate and (c) sulfate concentrations (mg/L) in transect 3 (November 1996 and February 1997).

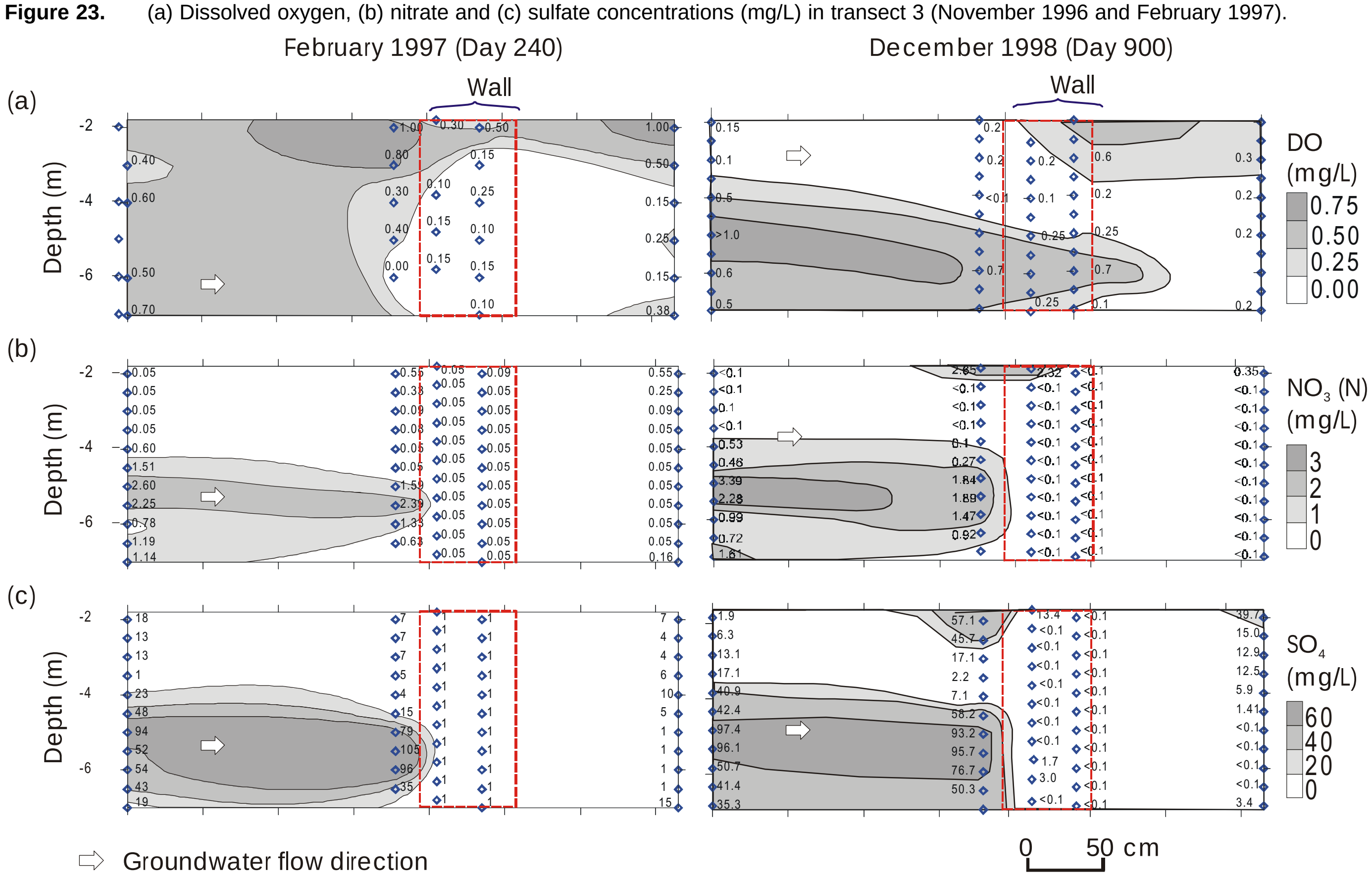


Figure 24. (a) Dissolved oxygen, (b) nitrate and (c) sulfate concentrations (mg/L) in transect 1 (February 1997 and December 1998).

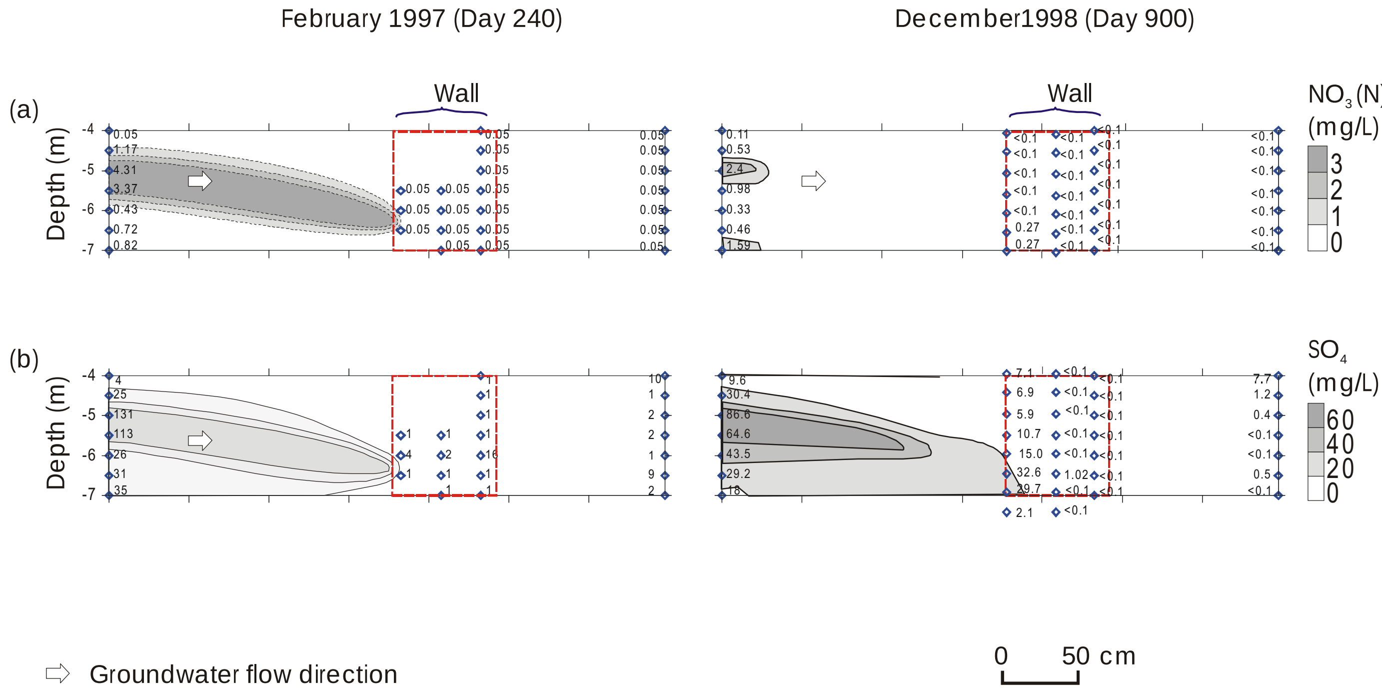


Figure 25. (a) Nitrate and (c) sulfate concentrations (mg/L) in transect 2 (February 1997 and December 1998).

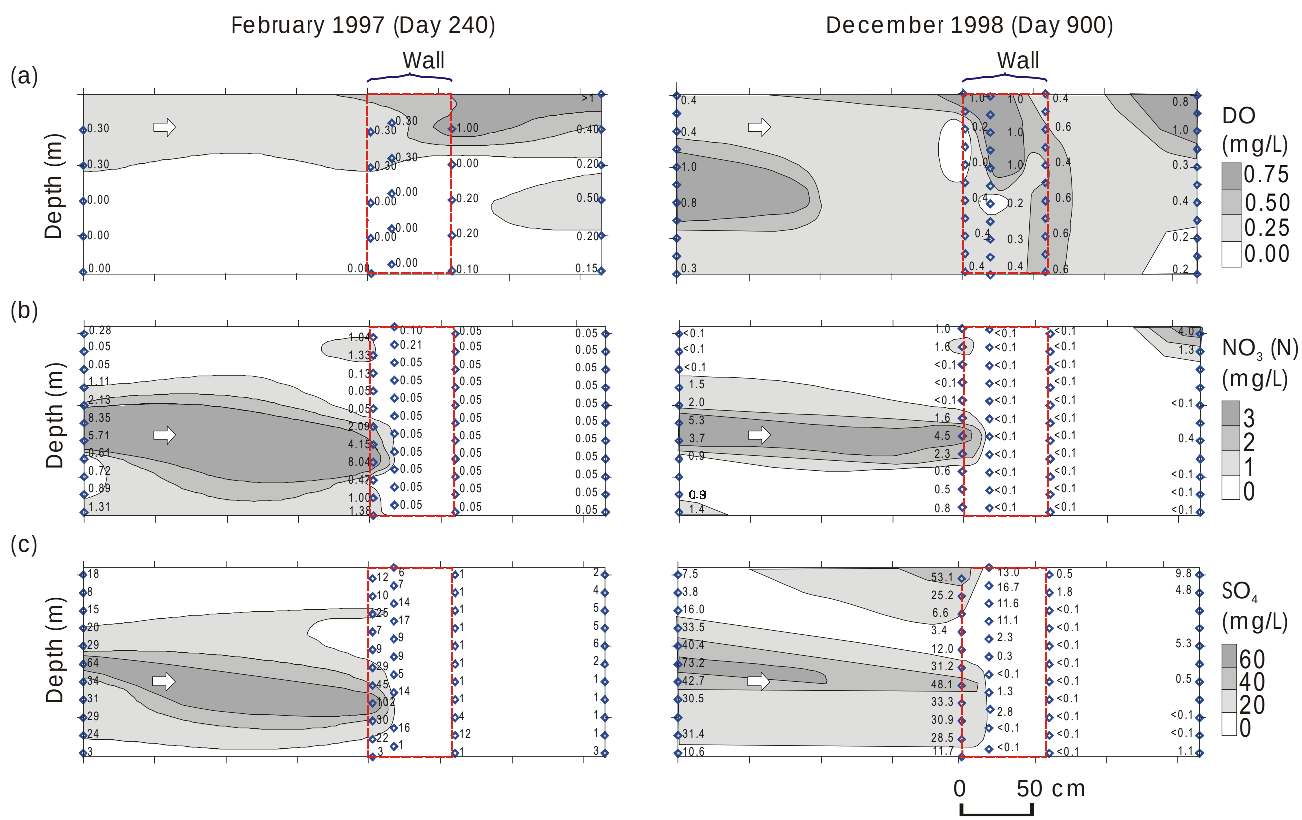


Figure 26. (a) Dissolved oxygen, (b) nitrate and (c) sulfate concentrations (mg/L) in transect 3 (February 1997 and December 1998).

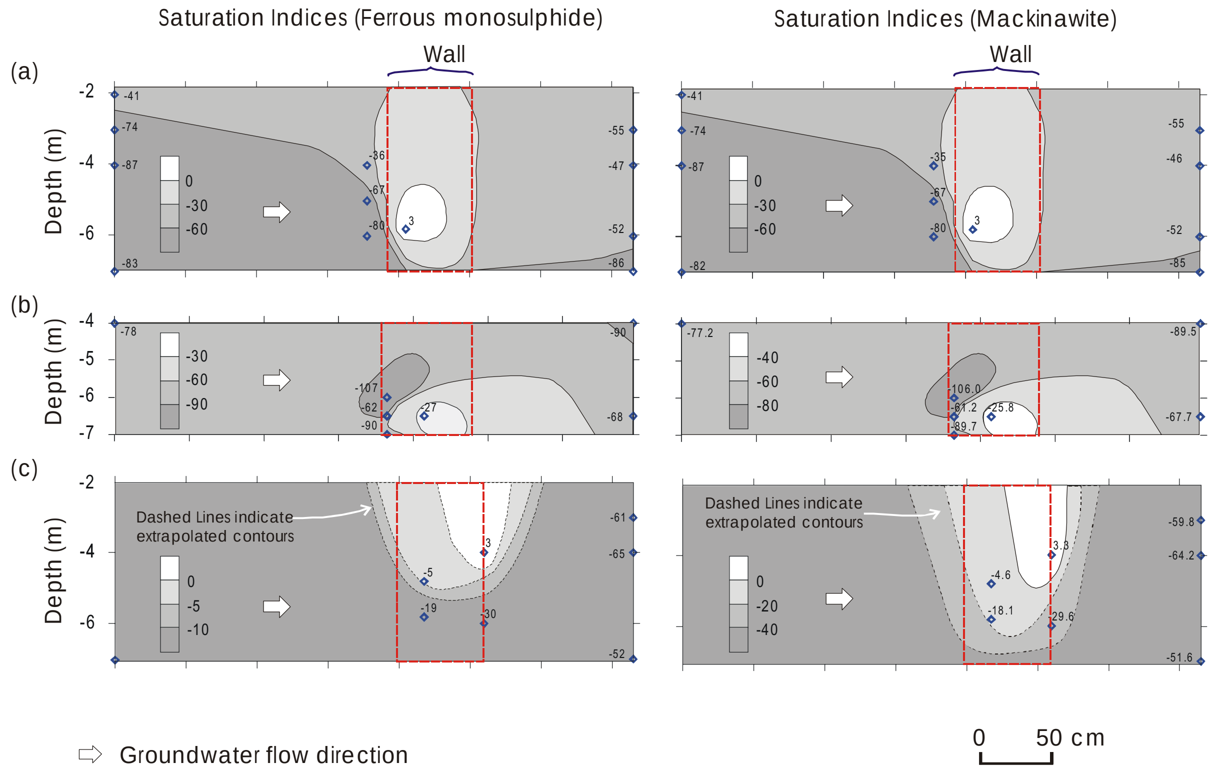


Figure 27. Saturation indices for ferrous monosulphide and mackinawite in (a) transect 1, (b) transect 2 and (c) transect 3 (November 1996 (Day 150) 0.45 µm filtered samples) In areas where Fe and SO4 are below detection, the Fe and SO4 concentrations specified for the MINTEQA2 calculations were set at 0.001 mg/L (20% MDL) and 0.01 mg/L (10% MDL) respectively.

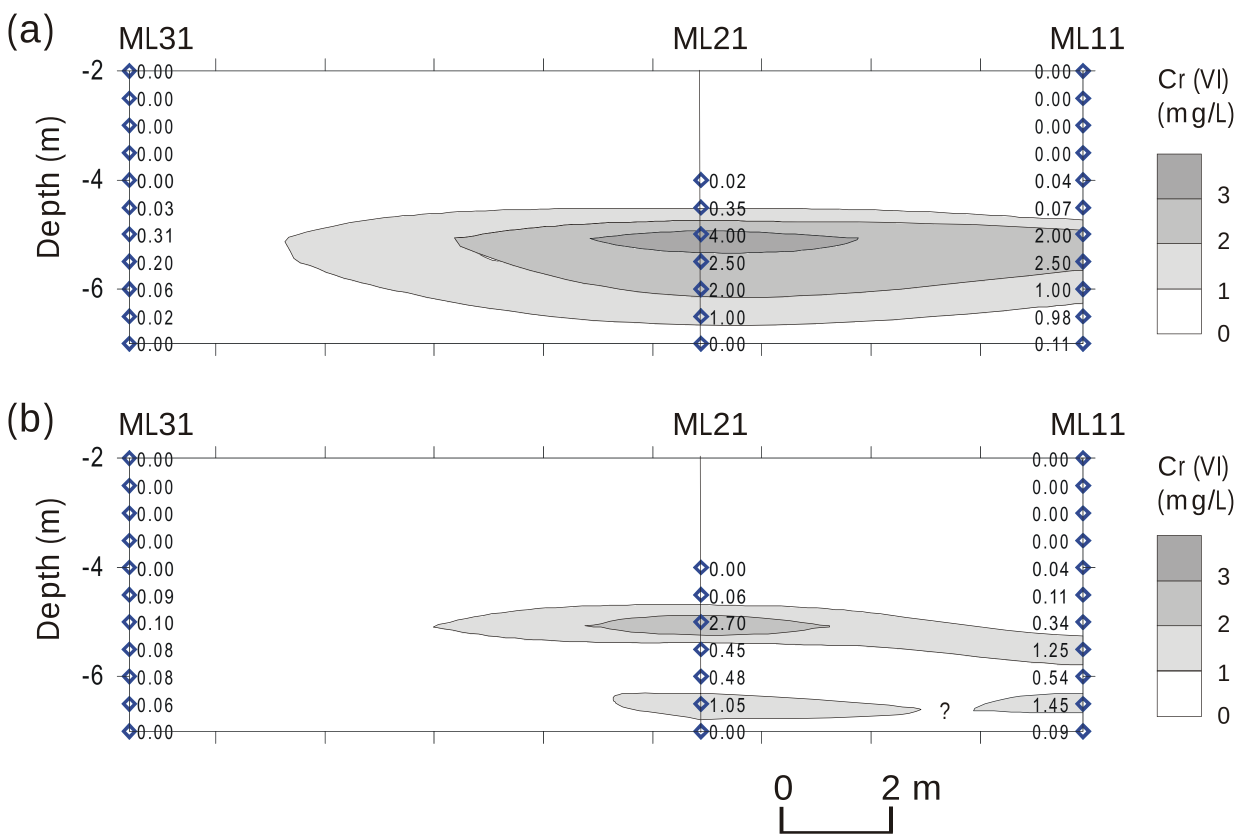


Figure 28. Cr(VI) concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) November 1996 (Day 150) and (b) February 1997 (Day 240).

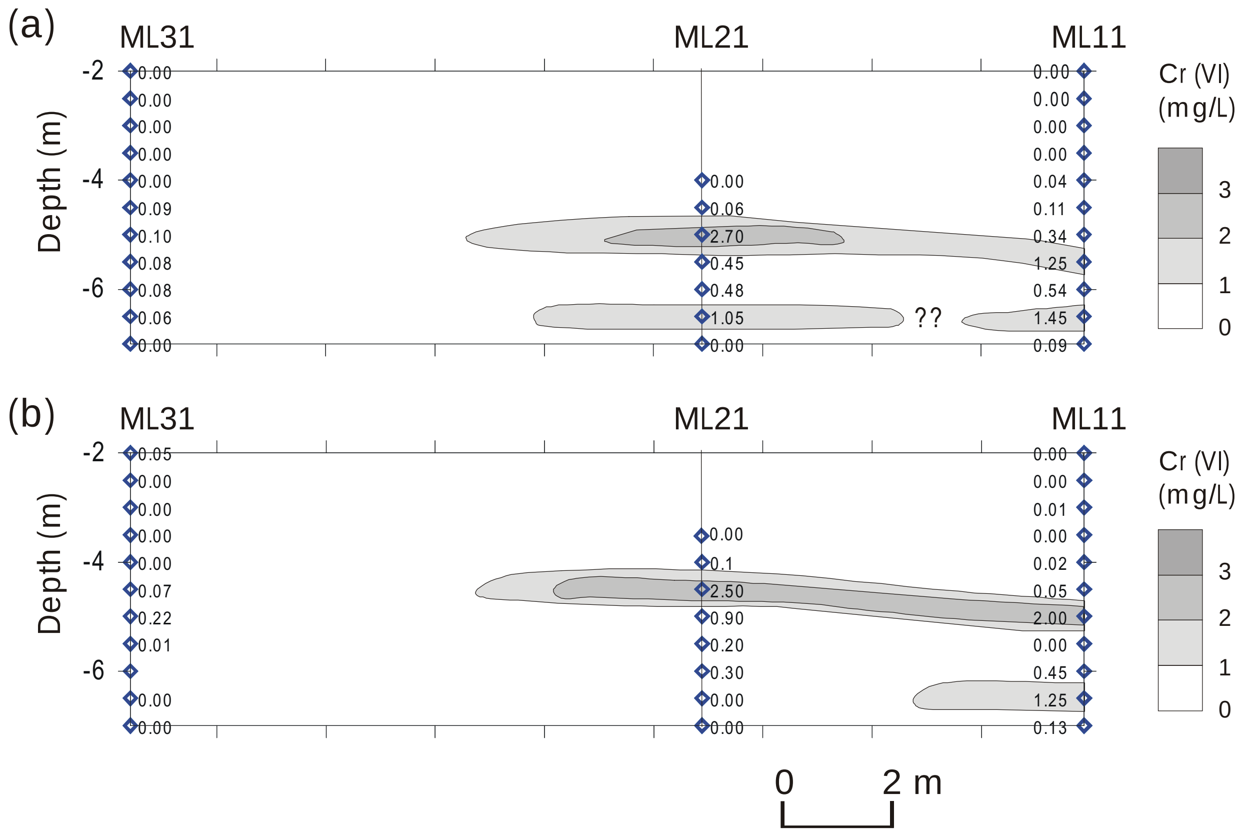


Figure 29. Cr(VI) concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) February 1997 (Day 240) and (b) December 1998 (Day 900).

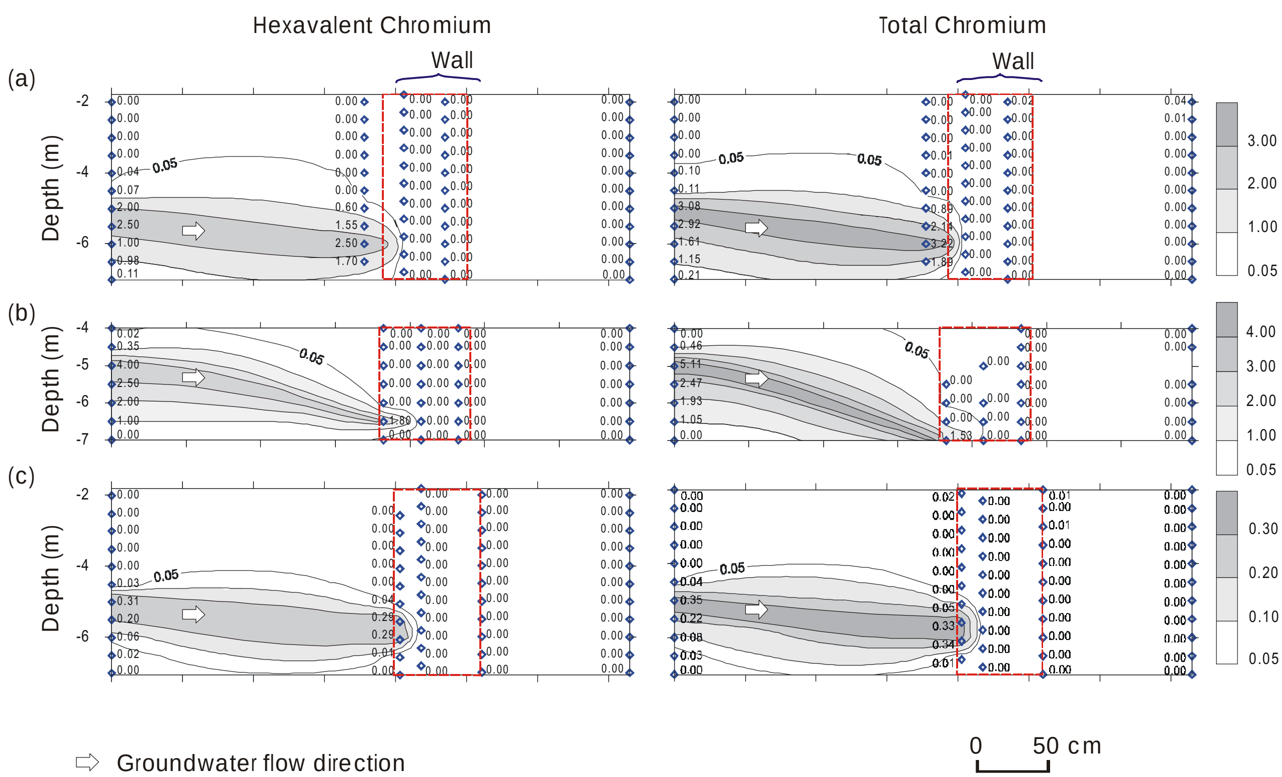


Figure 30. Hexavalent and total chromium concentrations (mg/L) in (a) transect 1, transect 2 and (c) transect 3 (November 1996 (Day 150) - Total Cr results from 0.45 µm filtered samples).

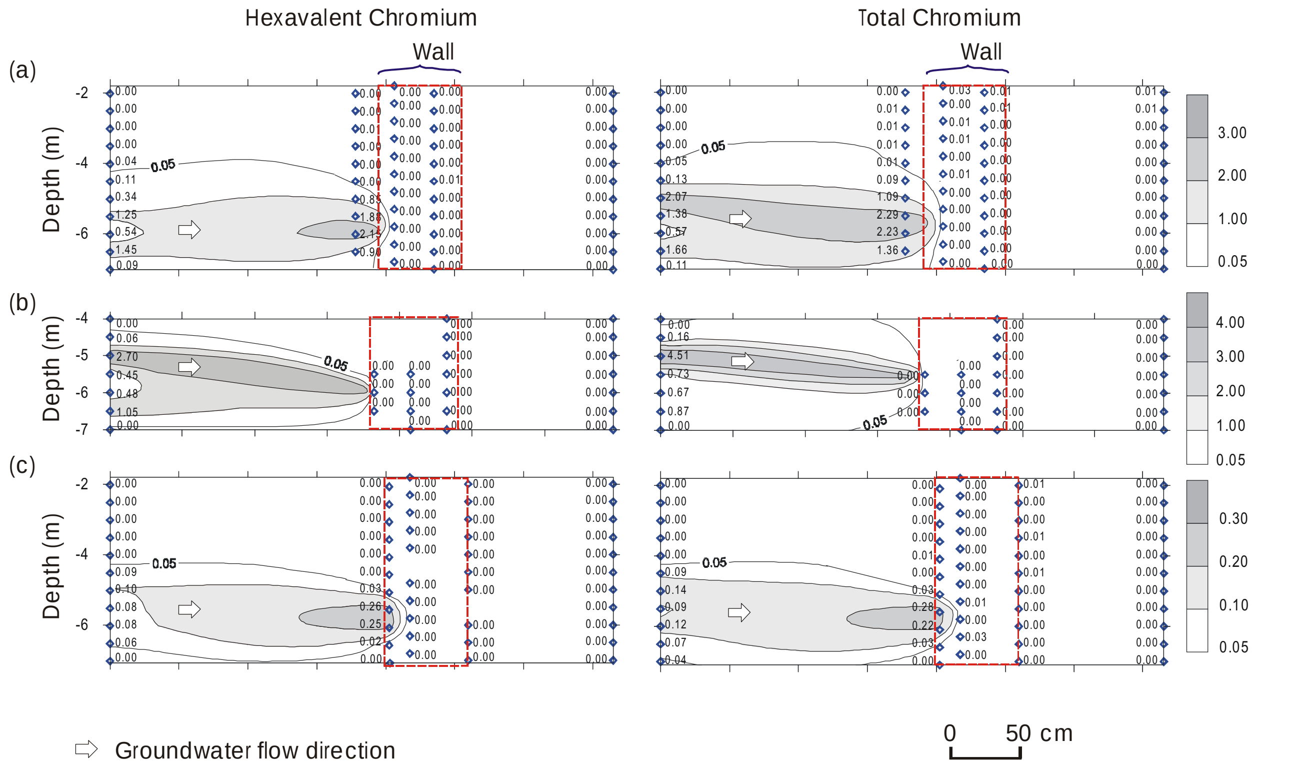


Figure 31. Hexavalent and total chromium concentrations (mg/L) in (a) transect 1, transect 2 and (c) transect 3 (February 1997 (Day 240) - Total Cr results from 0.45 μm filtered samples).

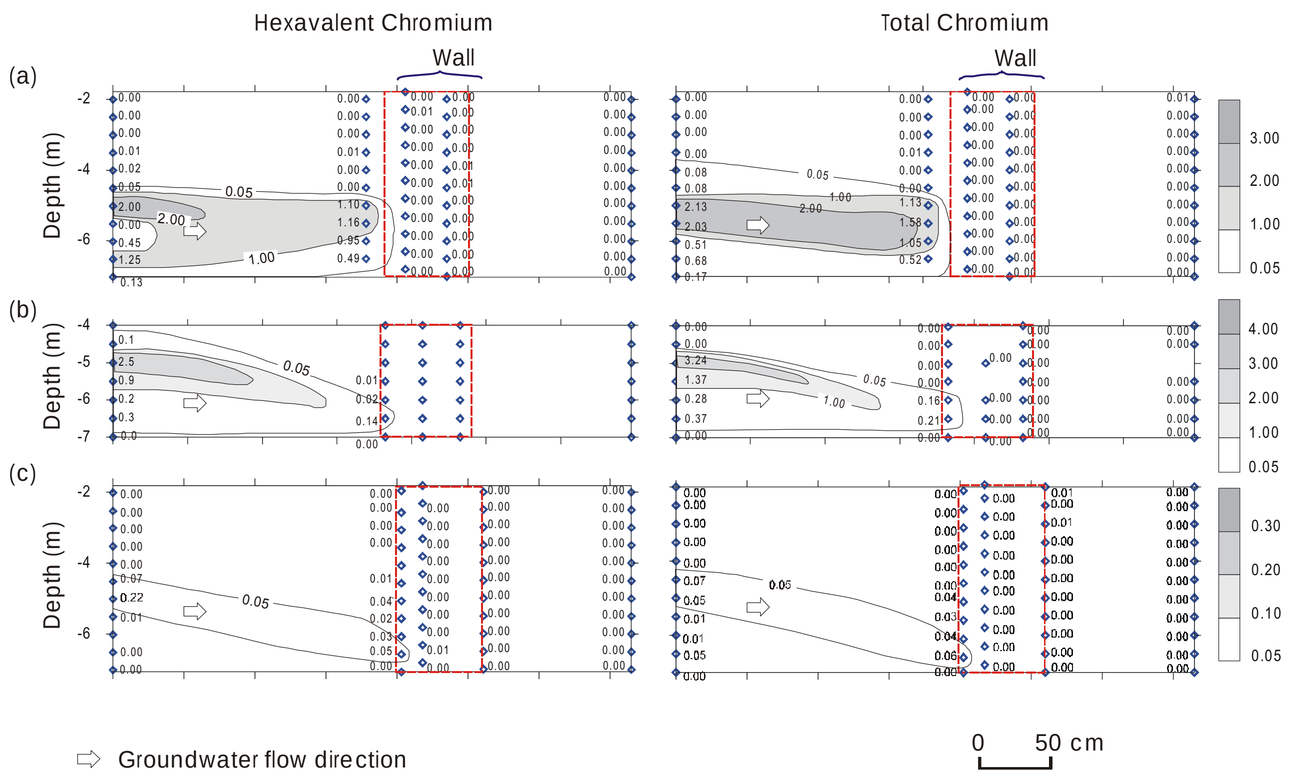


Figure 32. Hexavalent and total chromium concentrations (mg/L) in (a) transect 1, transect 2 and (c) transect 3 (December 1998 (Day 900) - Total Cr results from 0.45 μm filtered samples).

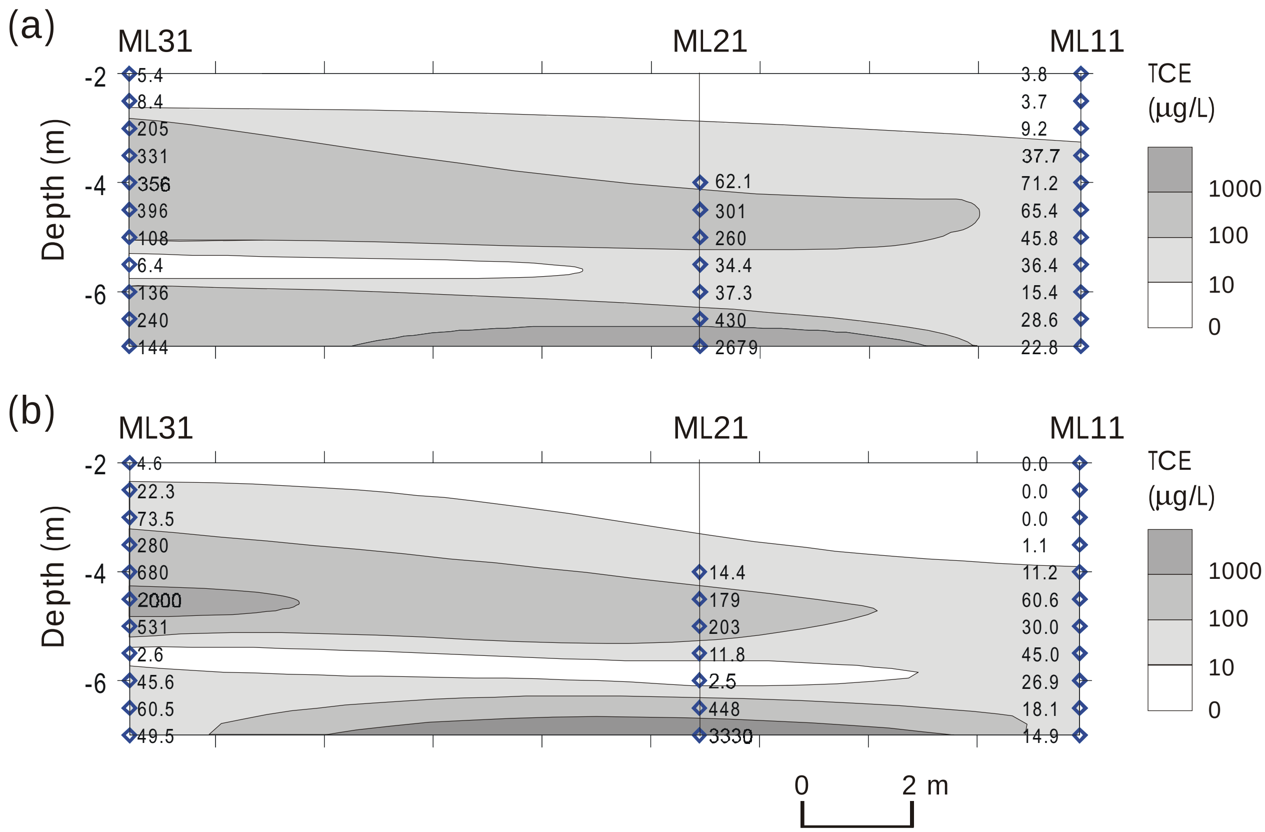


Figure 33. TCE concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) November 1996 (Day 150) and (b) February 1997 (Day 240).

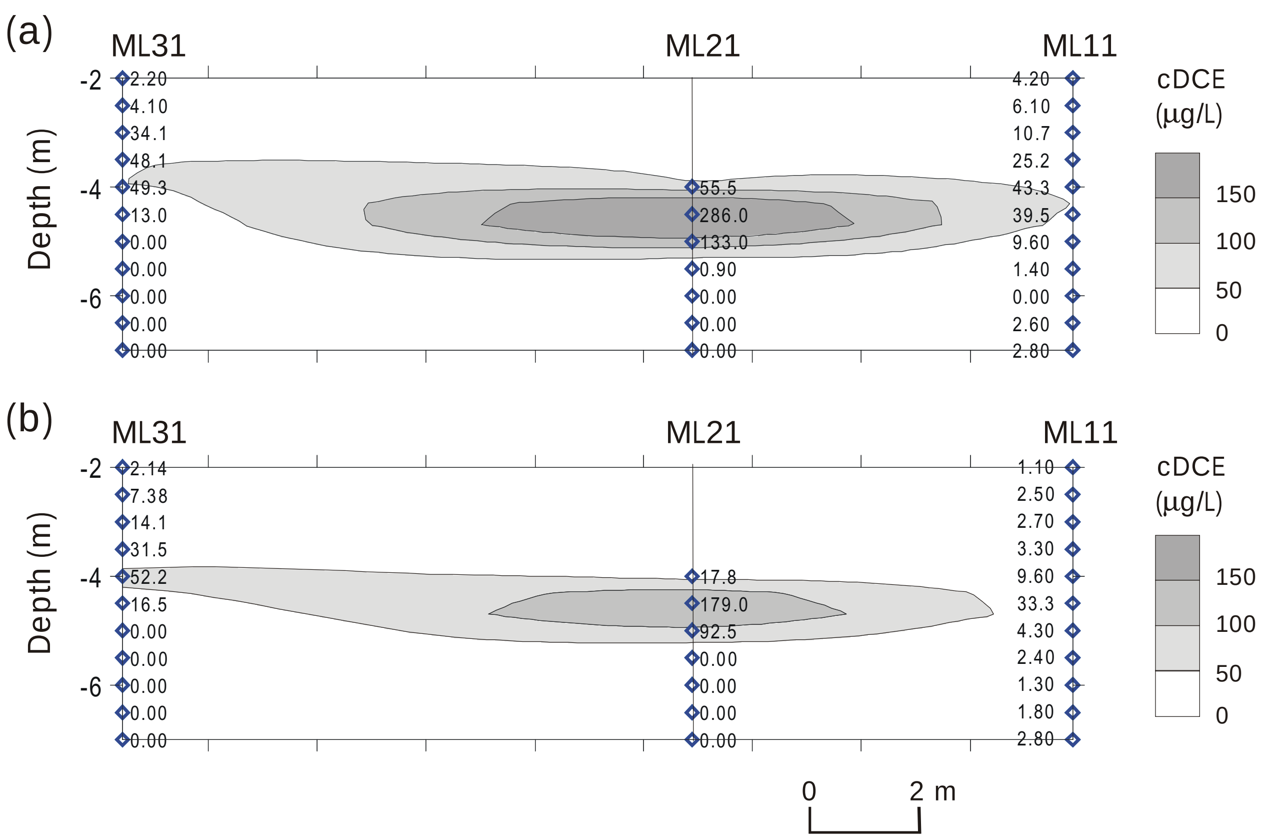


Figure 34. cDCE concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) November 1996 (Day 150) and (b) February 1997 (Day 240).

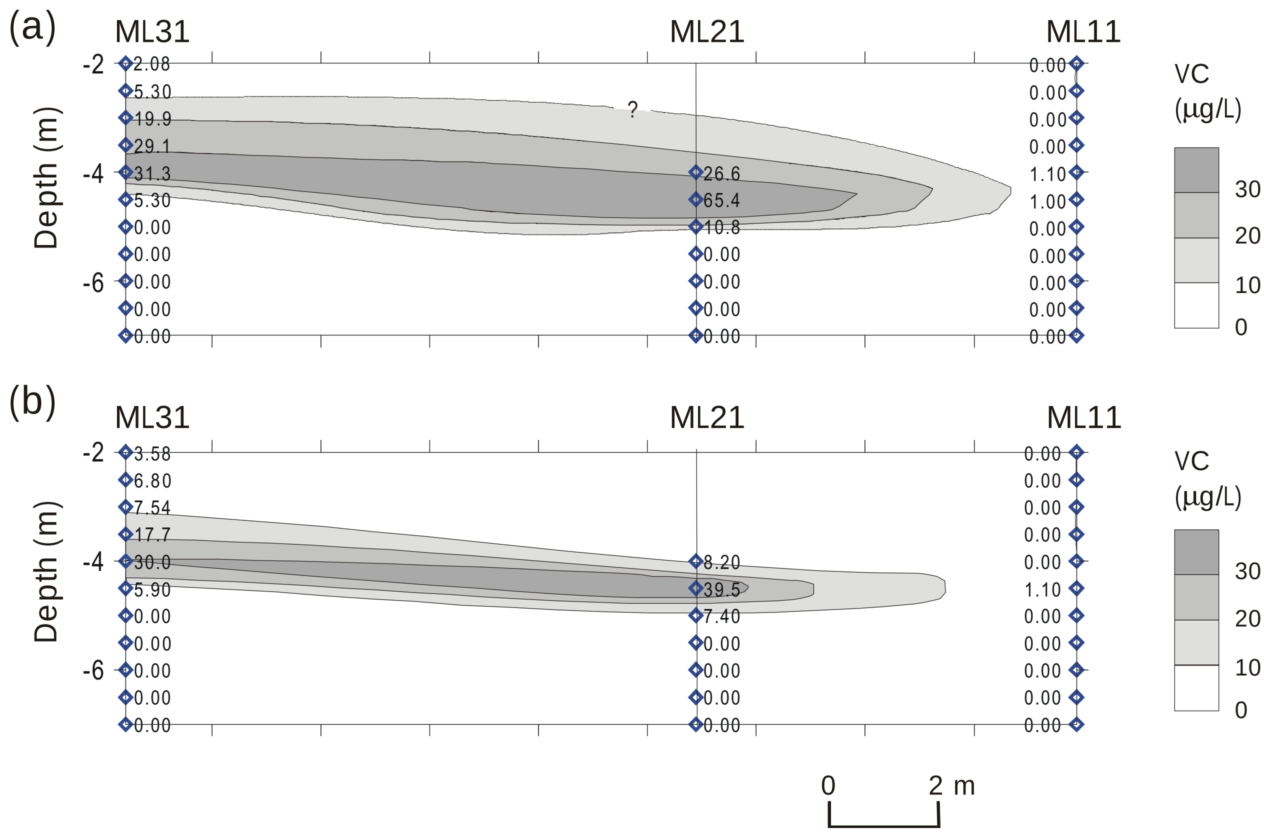


Figure 35. VC concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) November 1996 (Day 150) and (b) February 1997 (Day 240).

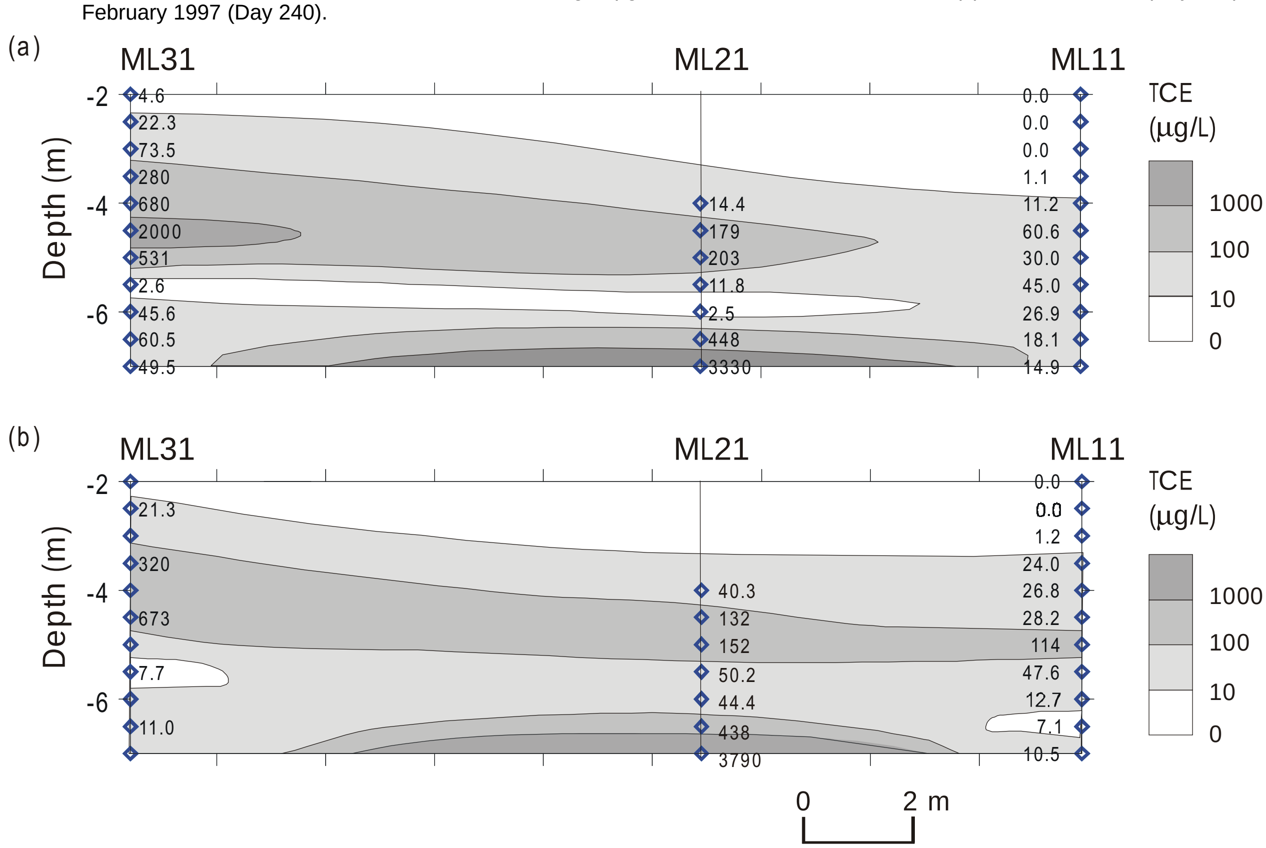


Figure 36. TCE concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) February 1997 (Day 240) and (b) December 1998 (Day 900).

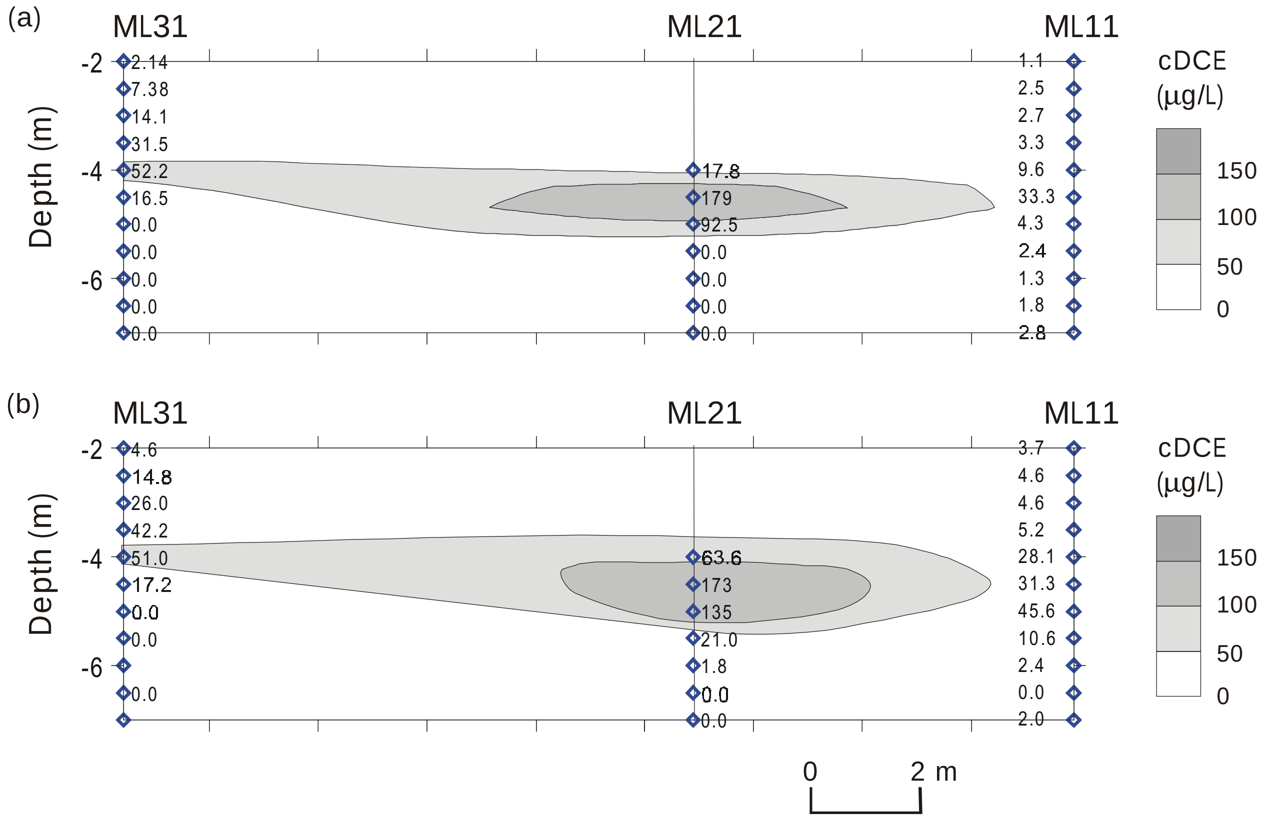


Figure 37. cDCE concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) February 1997 (Day 240) and (b) December 1998 (Day 900).

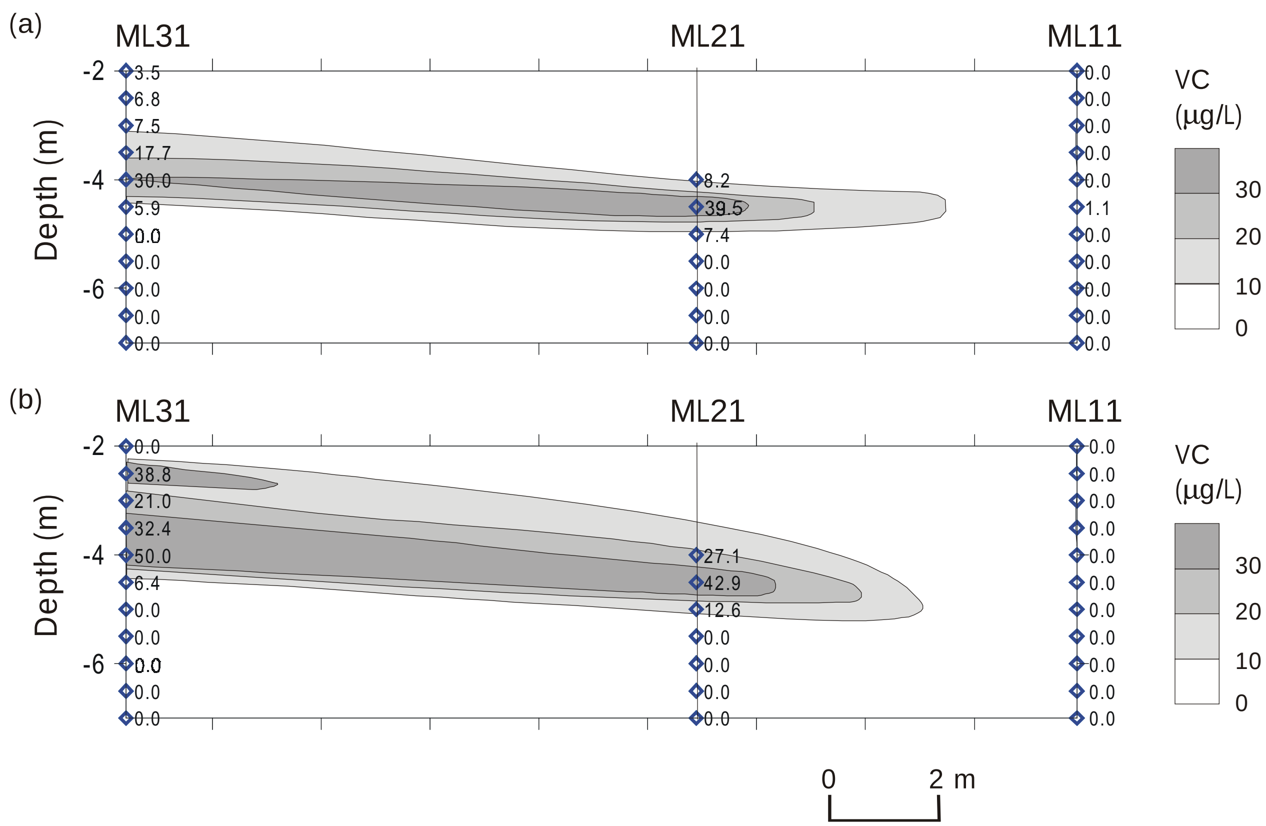


Figure 38. VC concentrations in transverse cross-section through upgradient wells ML11, 21 and 31 in (a) February 1997 (Day 240) and (b) December 1998 (Day 900).

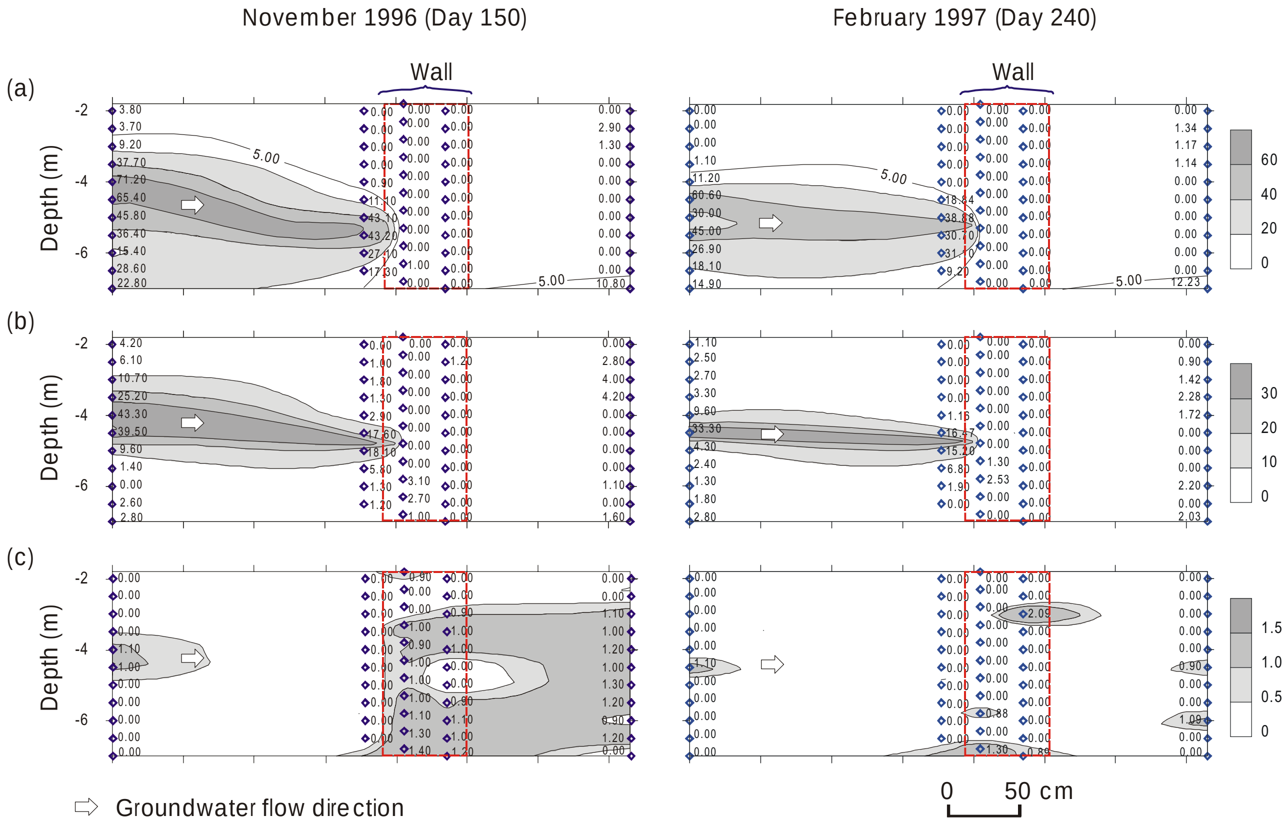


Figure 39. (a) TCE, (b) cDCE and (c) VC concentrations (µg/L) in transect 1, November 1996 and February 1997.

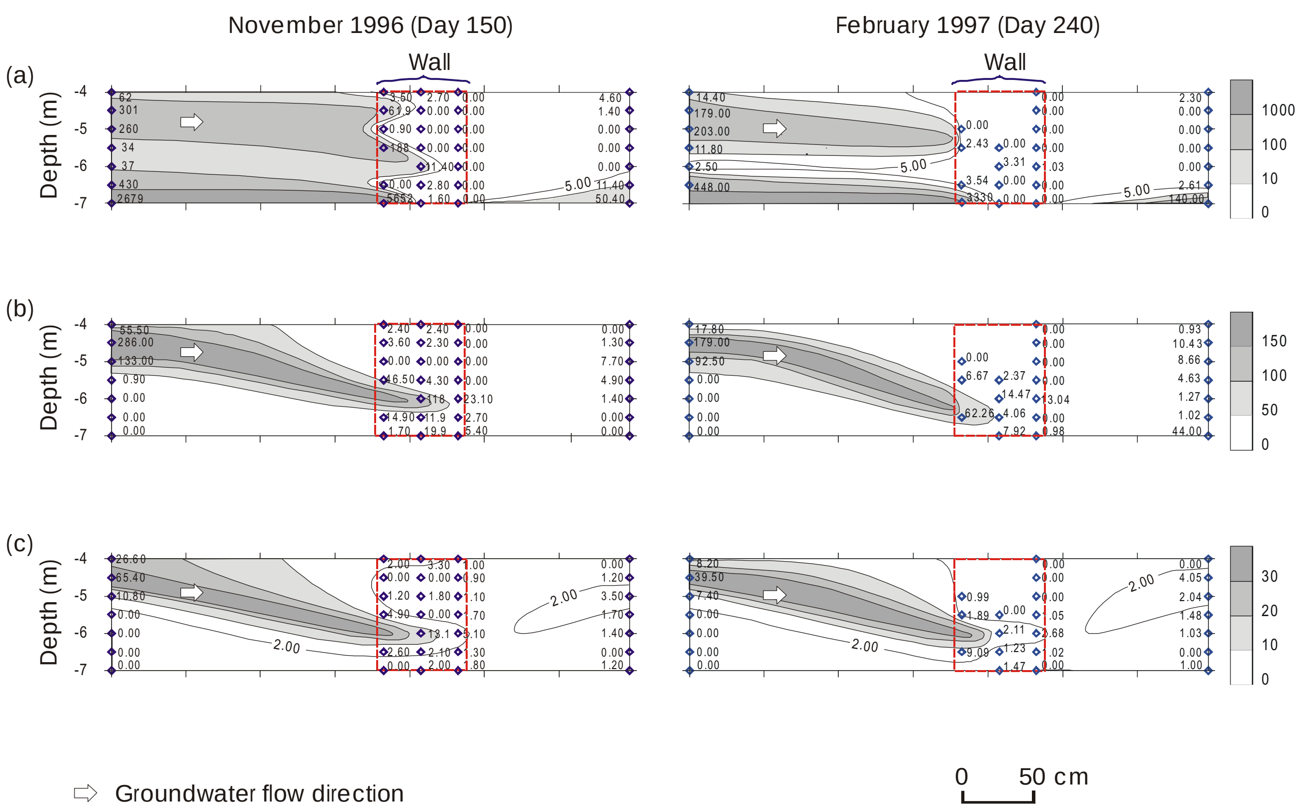


Figure 40. (a) TCE, (b) cDCE and (c) VC concentrations (µg/L) in transect 2, November 1996 and February 1997.

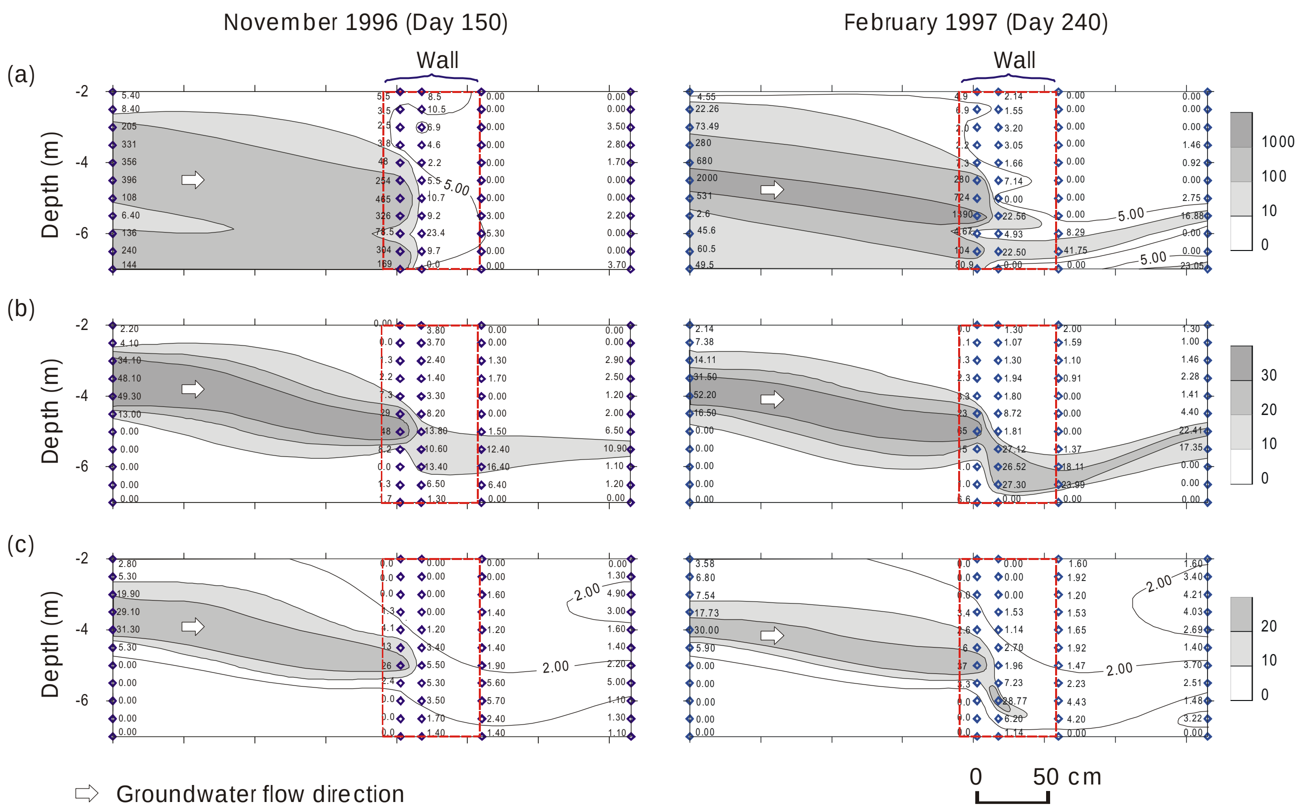


Figure 41. (a) TCE, (b) cDCE and (c) VC concentrations (µg/L) in transect 3, November 1996 and February 1997.

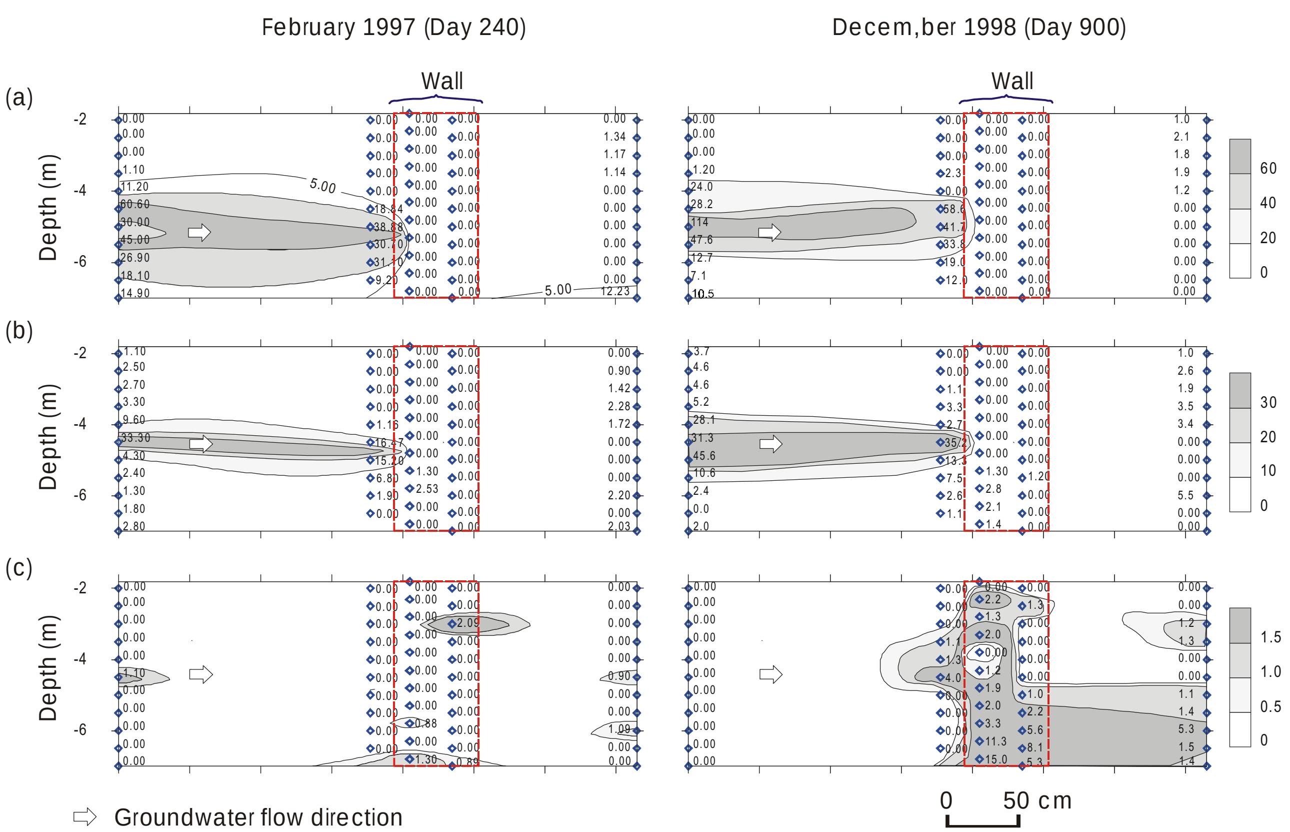


Figure 42. (a) TCE, (b) cDCE and (c) VC concentrations (µg/L) in transect 1, February 1997 and December 1998.

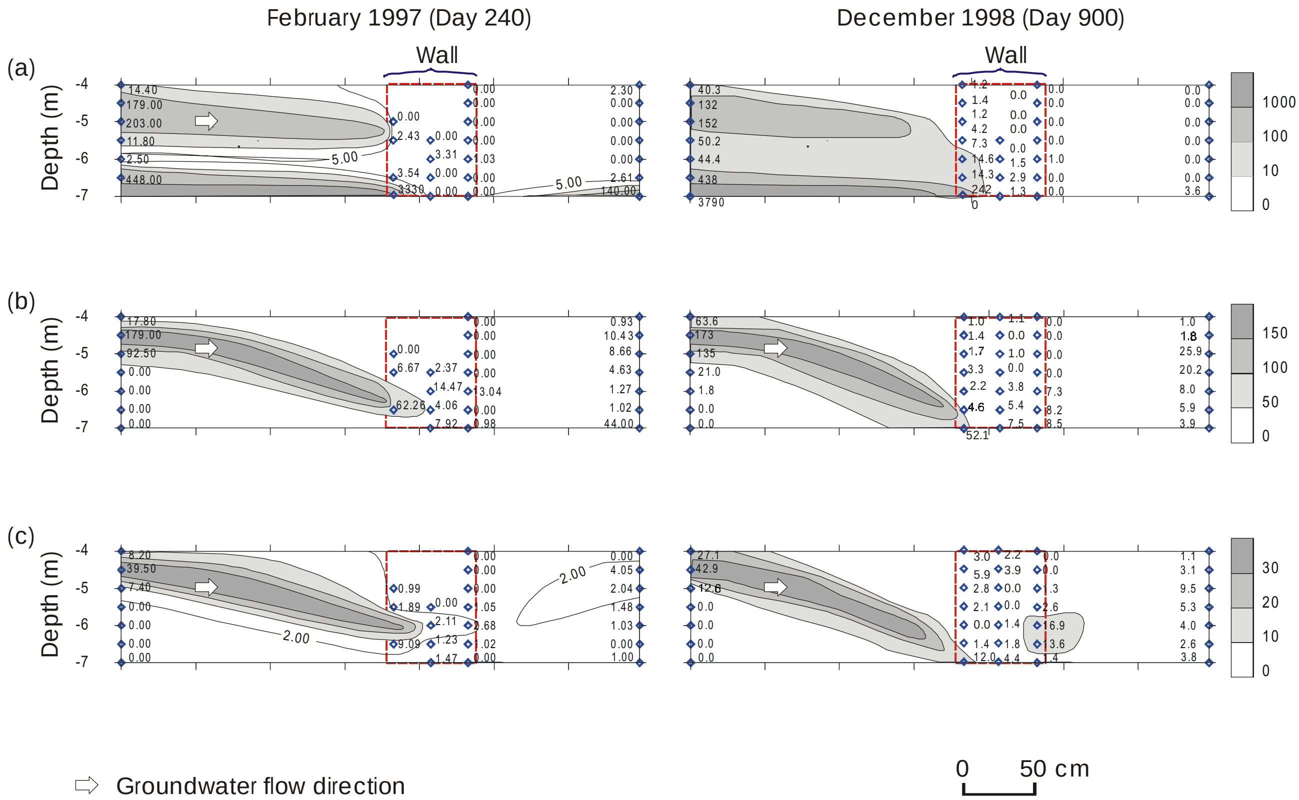


Figure 43. (a) TCE, (b) cDCE and (c) VC concentrations (µg/L) in transect 2, February 1997 and December 1998.

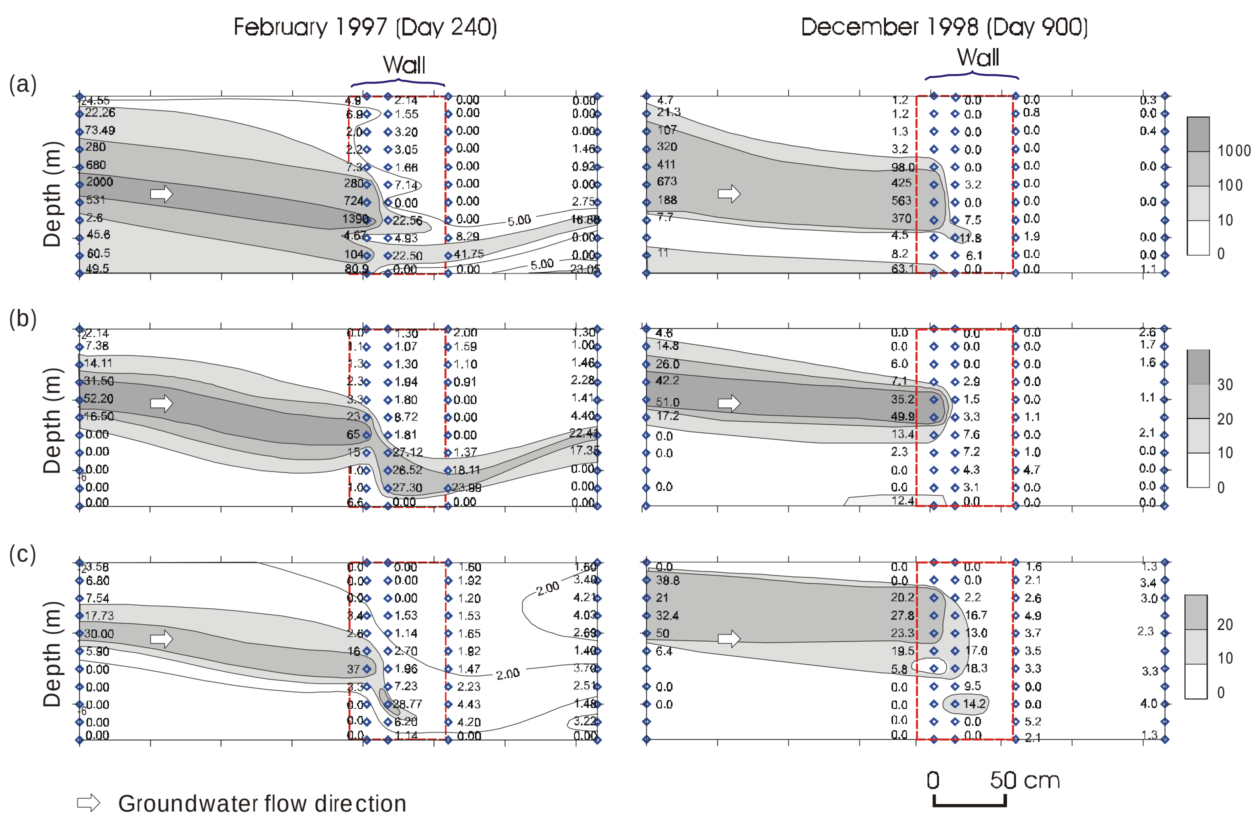


Figure 44. (a) TCE, (b) cDCE and (c) VC concentrations (µg/L) in transect 3, February 1997 and December 1998.

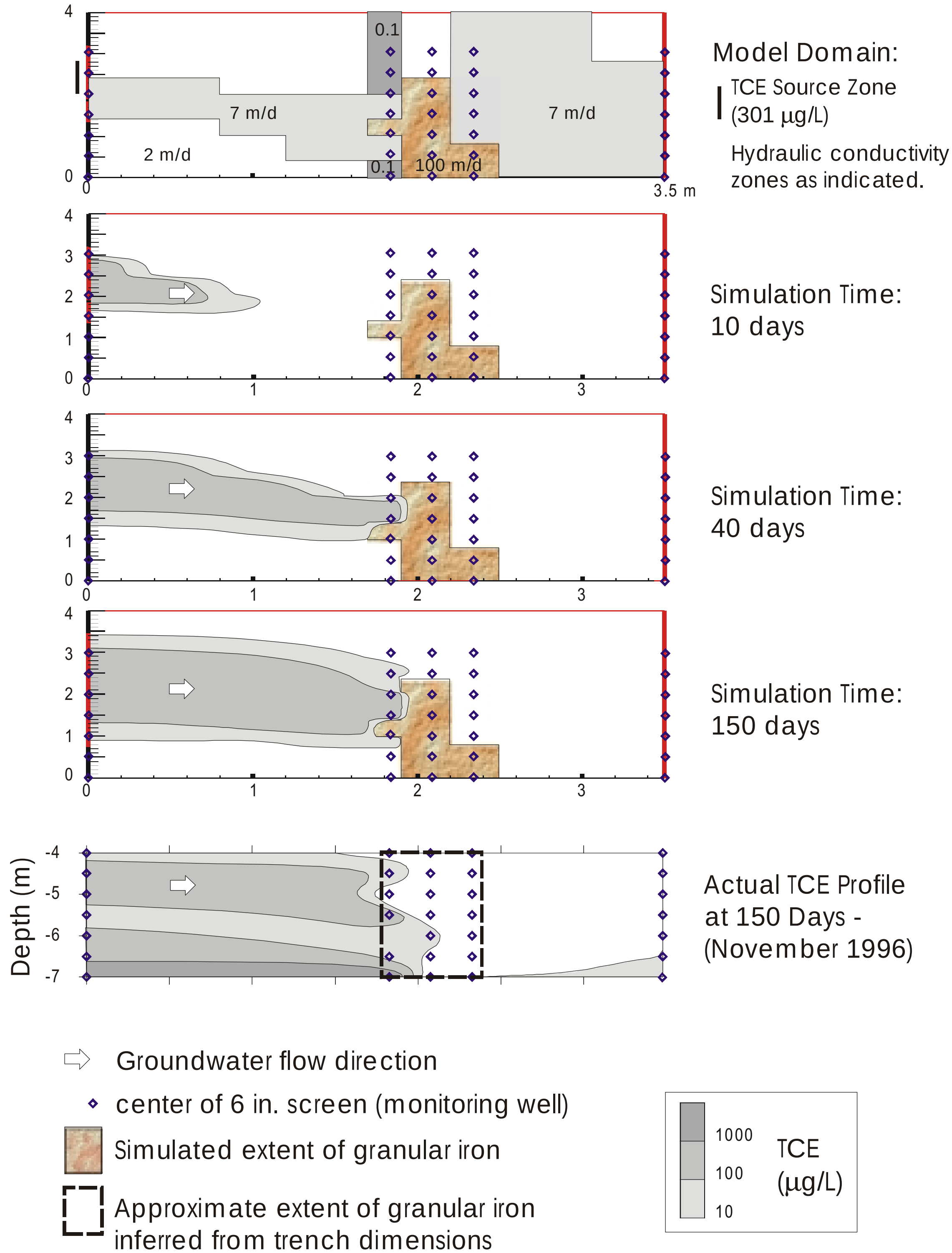


Figure 45. Reactive transport simulations of the upper portion of the TCE plume in transect 2.

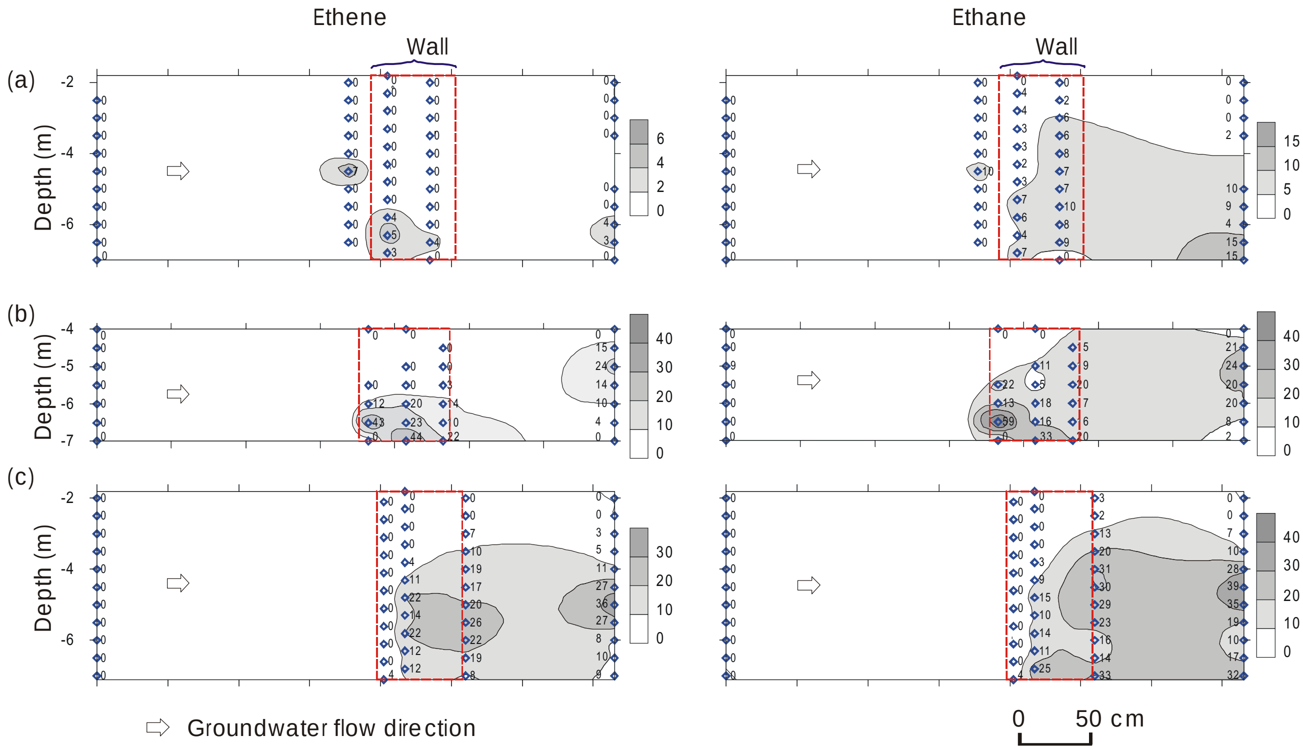


Figure 46. Ethene and ethane concentrations (µg/L) in (a) transect 1, (b) transect 2, (c) transect 3 (November 1996 (Day 150)).

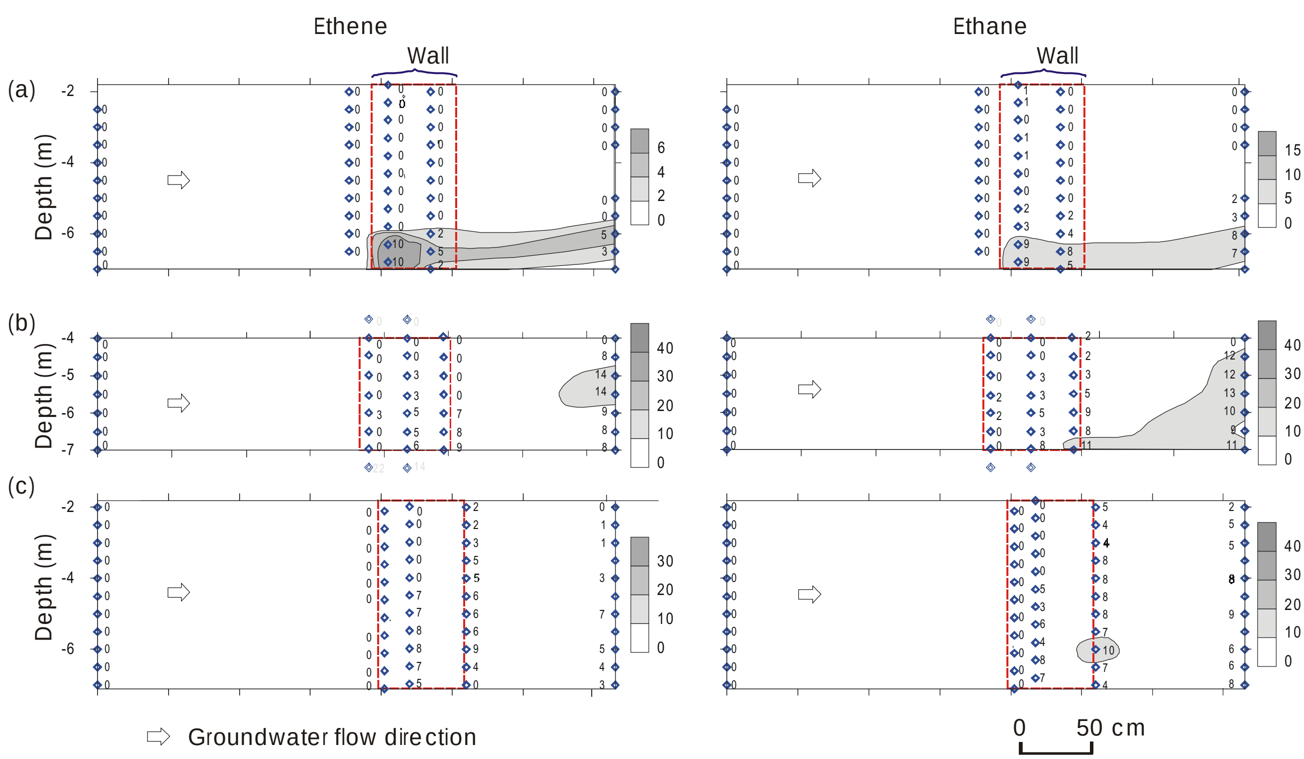


Figure 47. Ethene and ethane concentrations (µg/L) in (a) transect 1, (b) transect 2, (c) transect 3 (December 1998 (Day 900)).

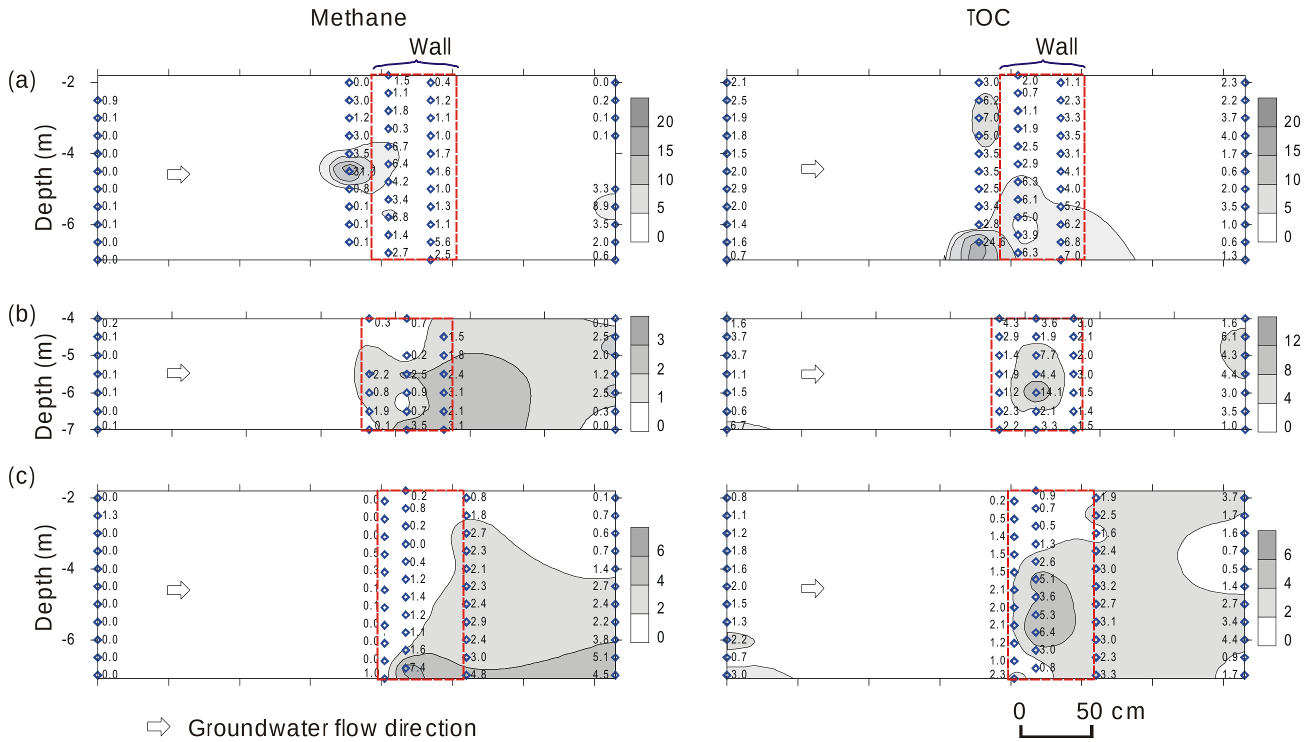


Figure 48. Methane and TOC concentrations (mg/L) in (a) transect 1, (b) transect 2, (c) transect 3 (November 1996 (Day 150)).

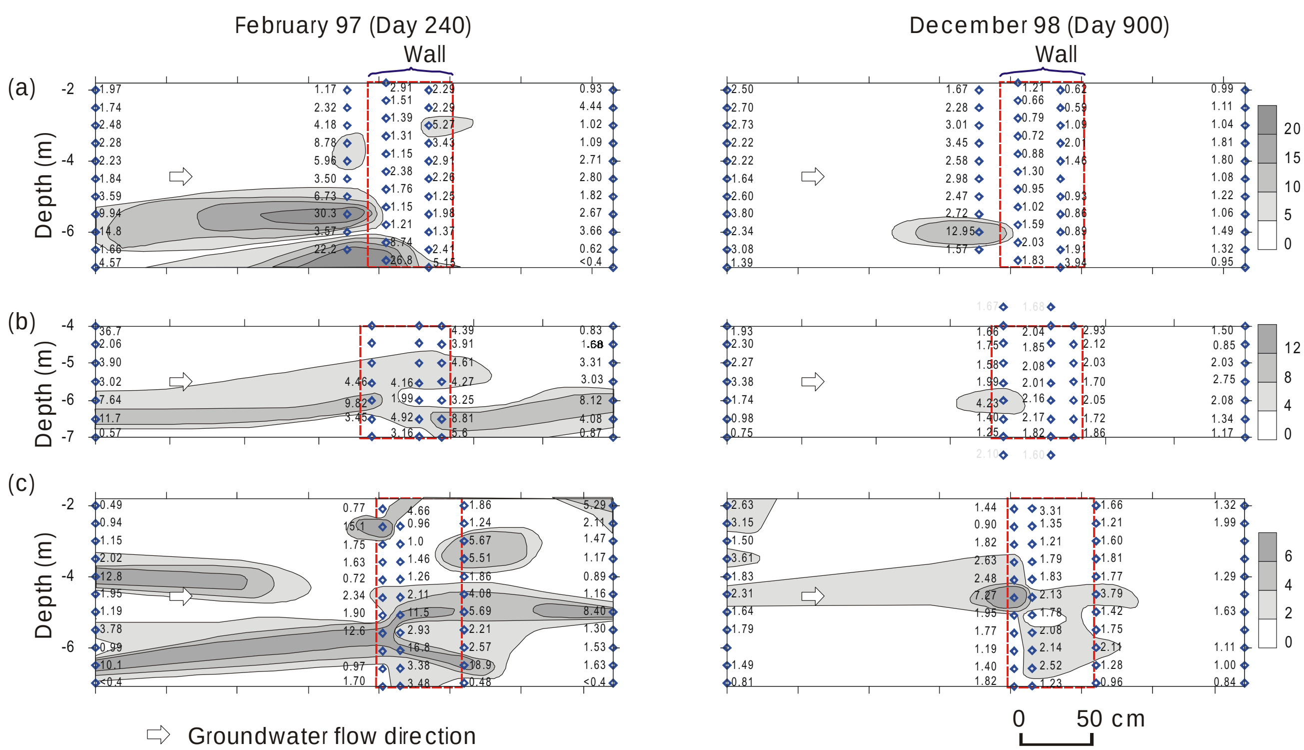


Figure 49. TOC concentrations (mg/L) in (a) transect 1, (b) transect 2, (c) transect 3 (February 1997 and December 1998).

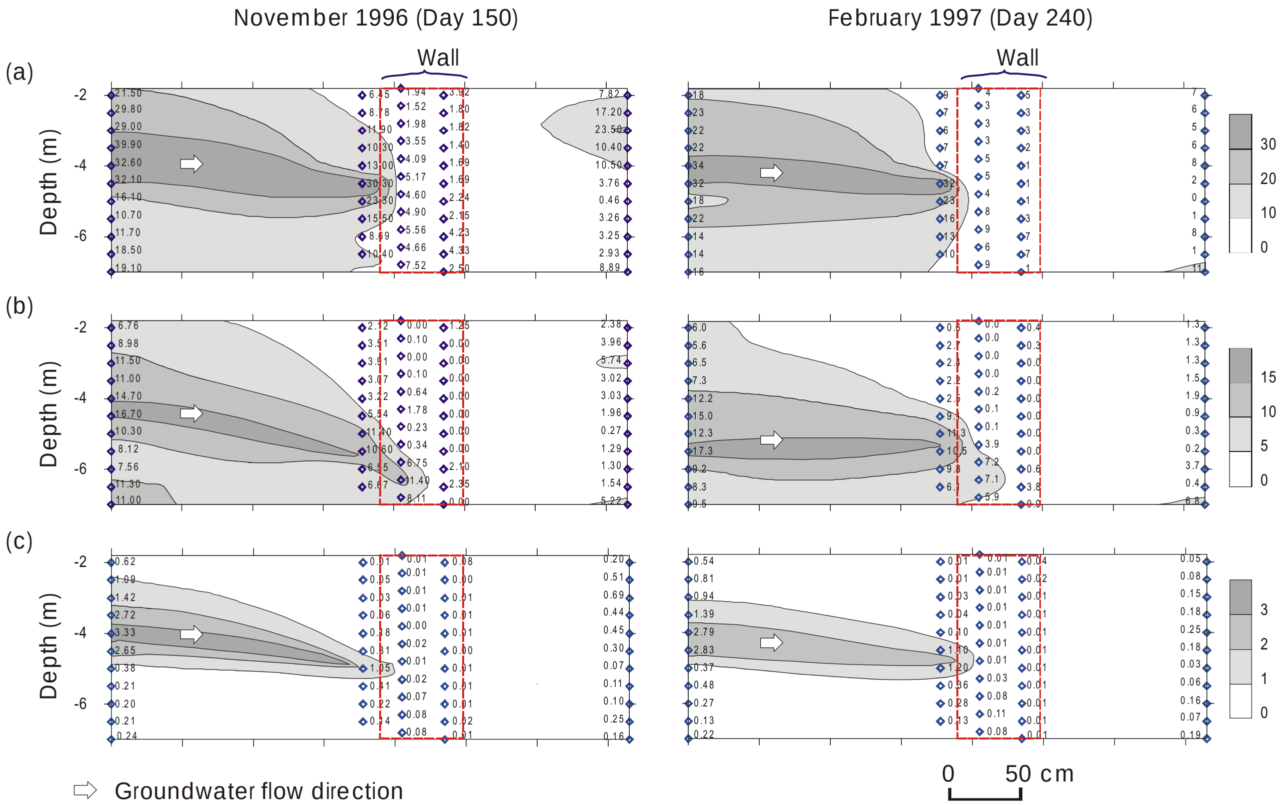


Figure 50. (a) Calcium, (b) magnesium and (c) manganese concentrations (mg/L) in transect 1 (0.45 µm filtered samples, November 1996 and February 1997).

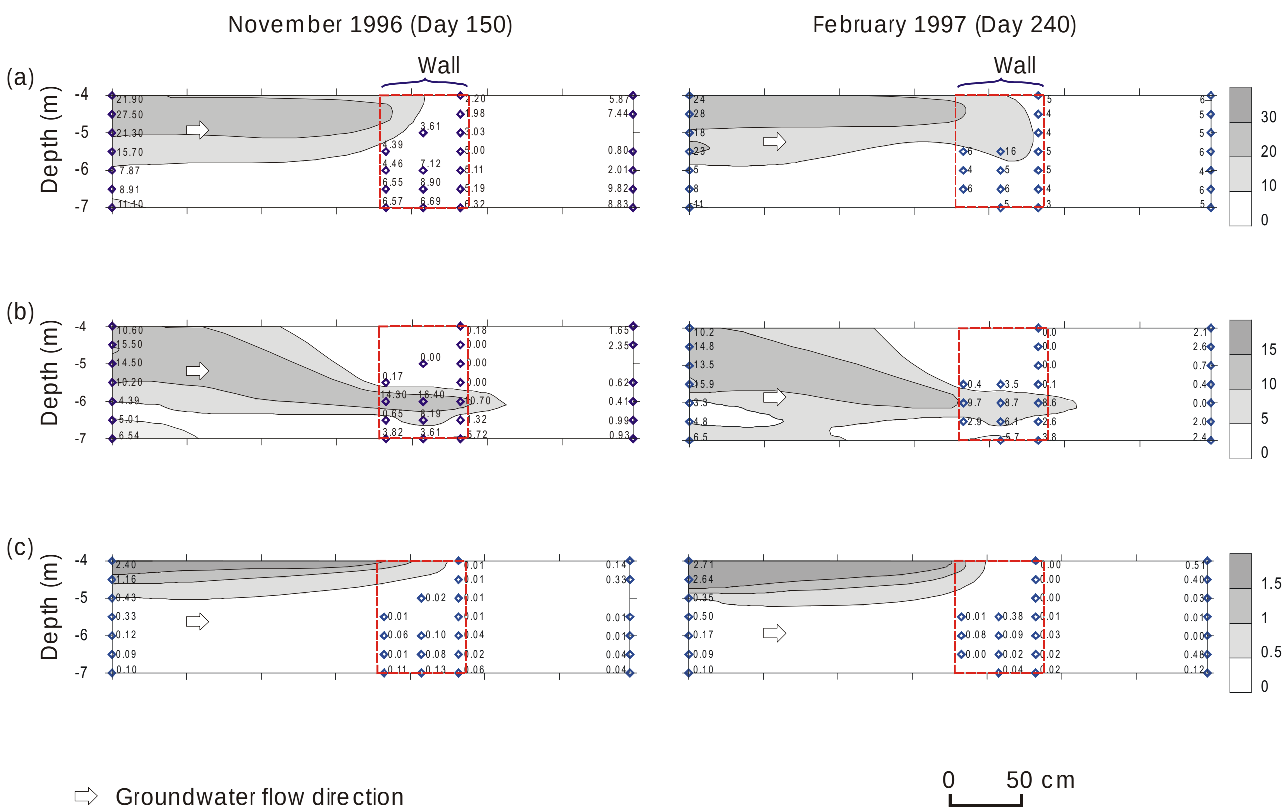


Figure 51. (a) Calcium, (b) magnesium and (c) manganese concentrations (mg/L) in transect 2 (0.45 µm filtered samples, November 1996 and February 1997).

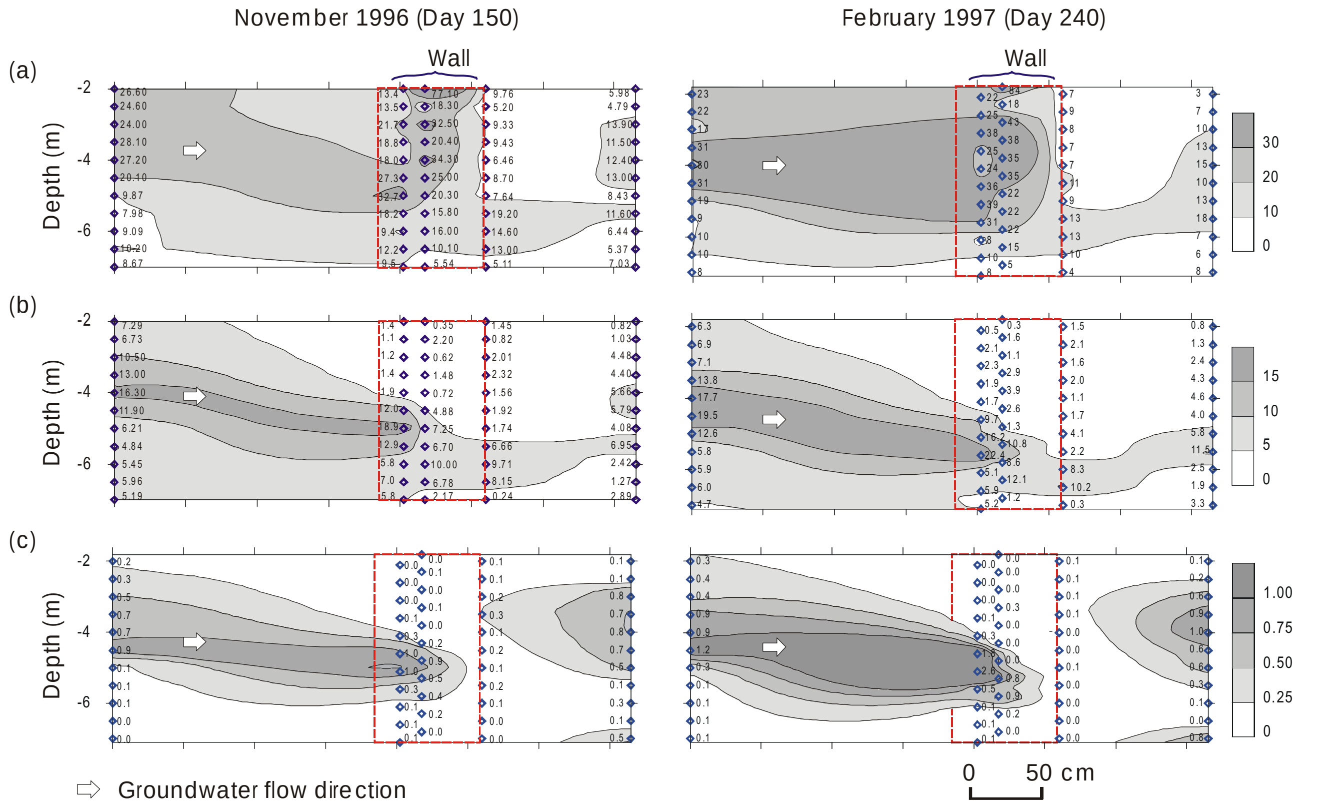


Figure 52. (a) Calcium, (b) magnesium and (c) manganese concentrations (mg/L) in transect 3 (0.45 µm filtered samples, November 1996 and February 1997).

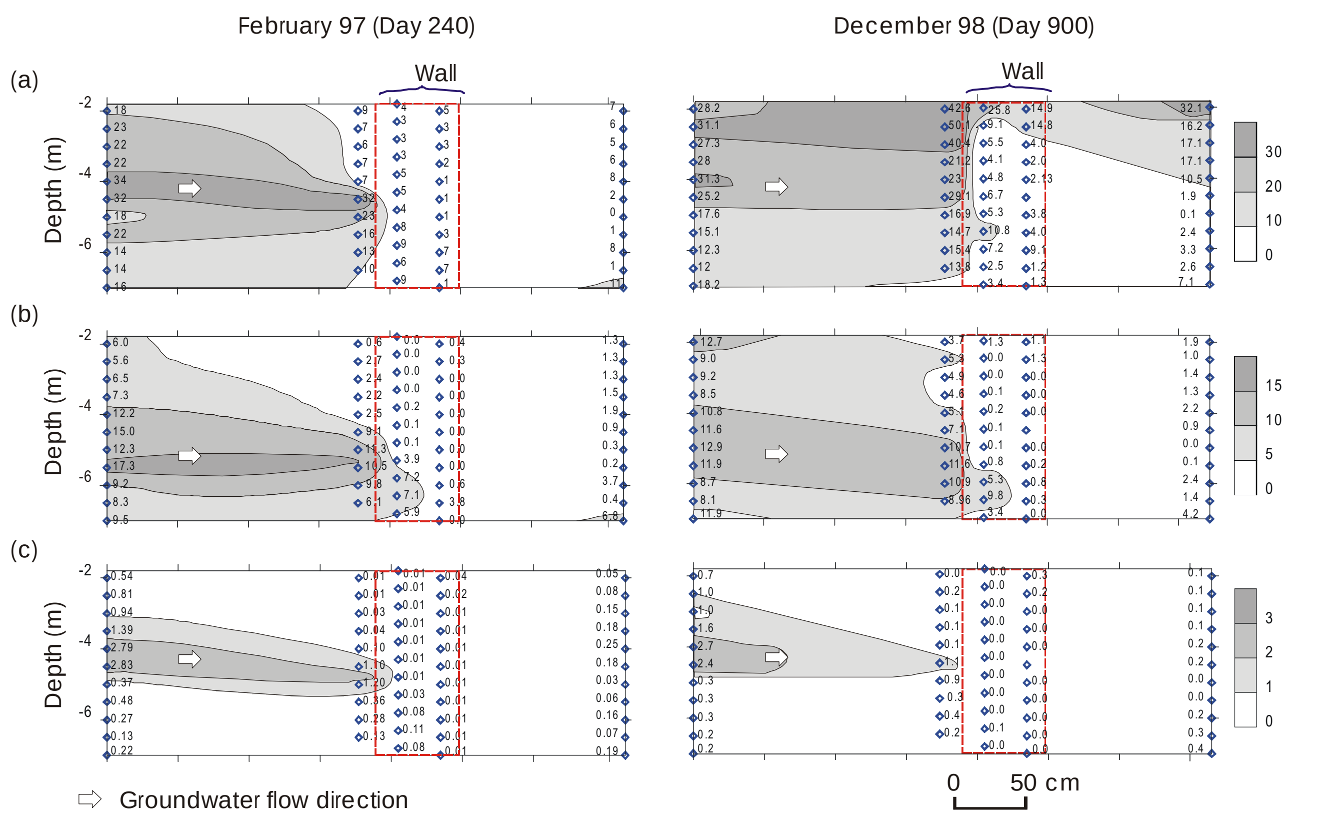


Figure 53. (a) Calcium, (b) magnesium and (c) manganese concentrations (mg/L) in transect 1 (0.45 µm filtered samples, February 1997 and December 1998).

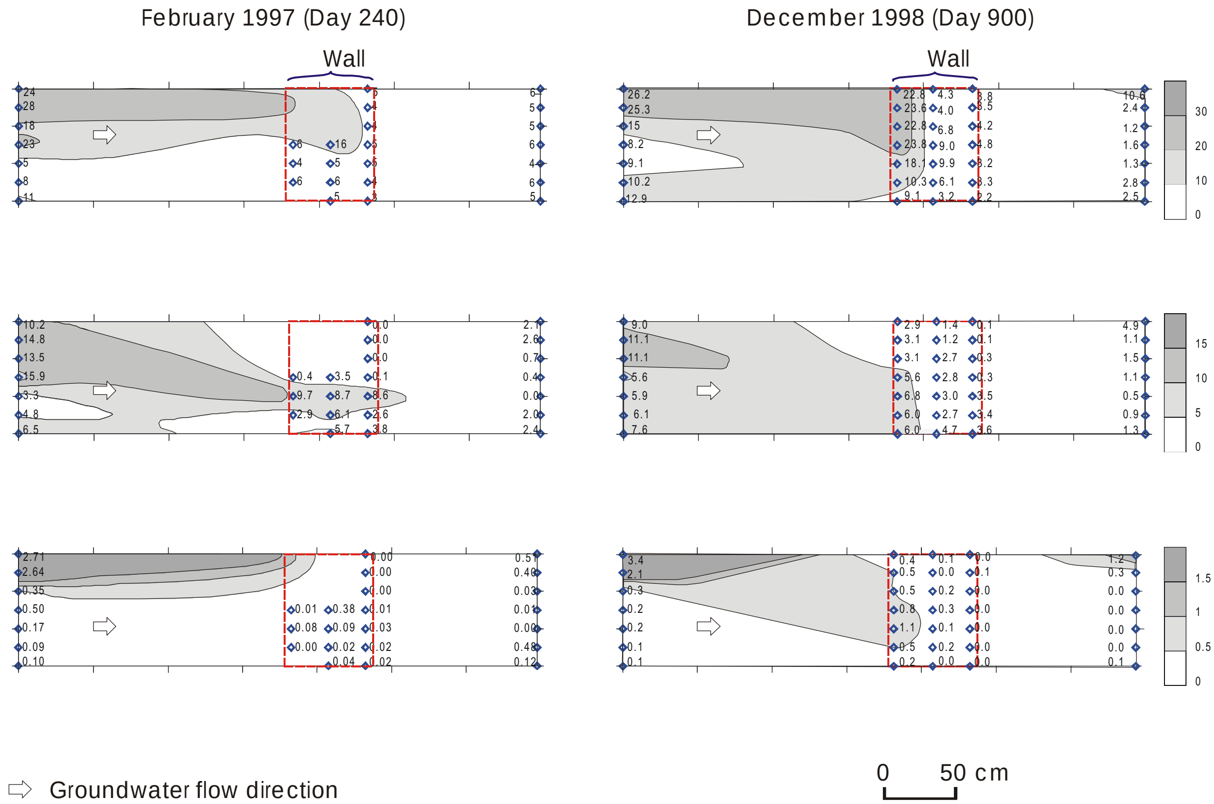


Figure 54. (a) Calcium, (b) magnesium and (c) manganese concentrations (mg/L) in transect 2 (0.45 µm filtered samples, February 1997 and December 1998).

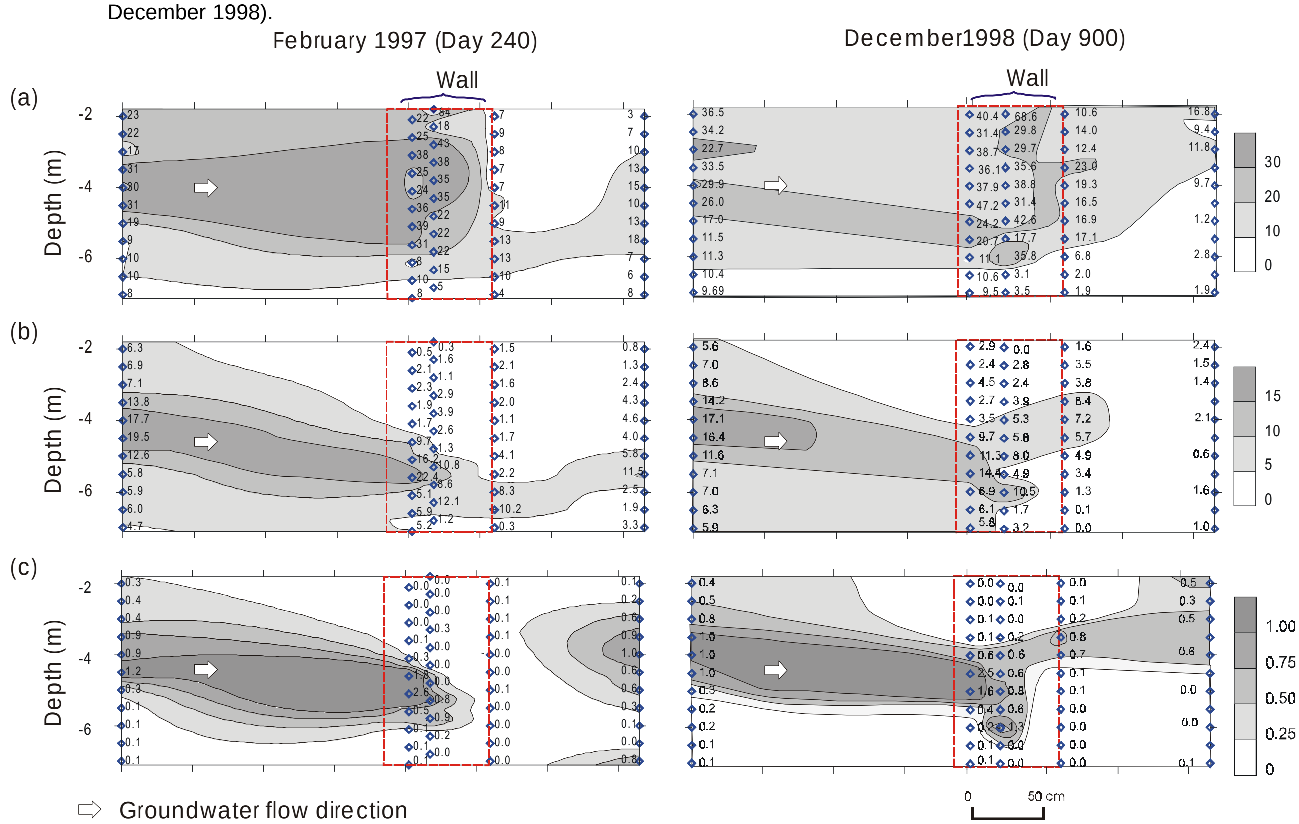


Figure 55. (a) Calcium, (b) magnesium and (c) manganese concentrations (mg/L) in transect 3 (0.45 µm filtered samples, February 1997 and December 1998).

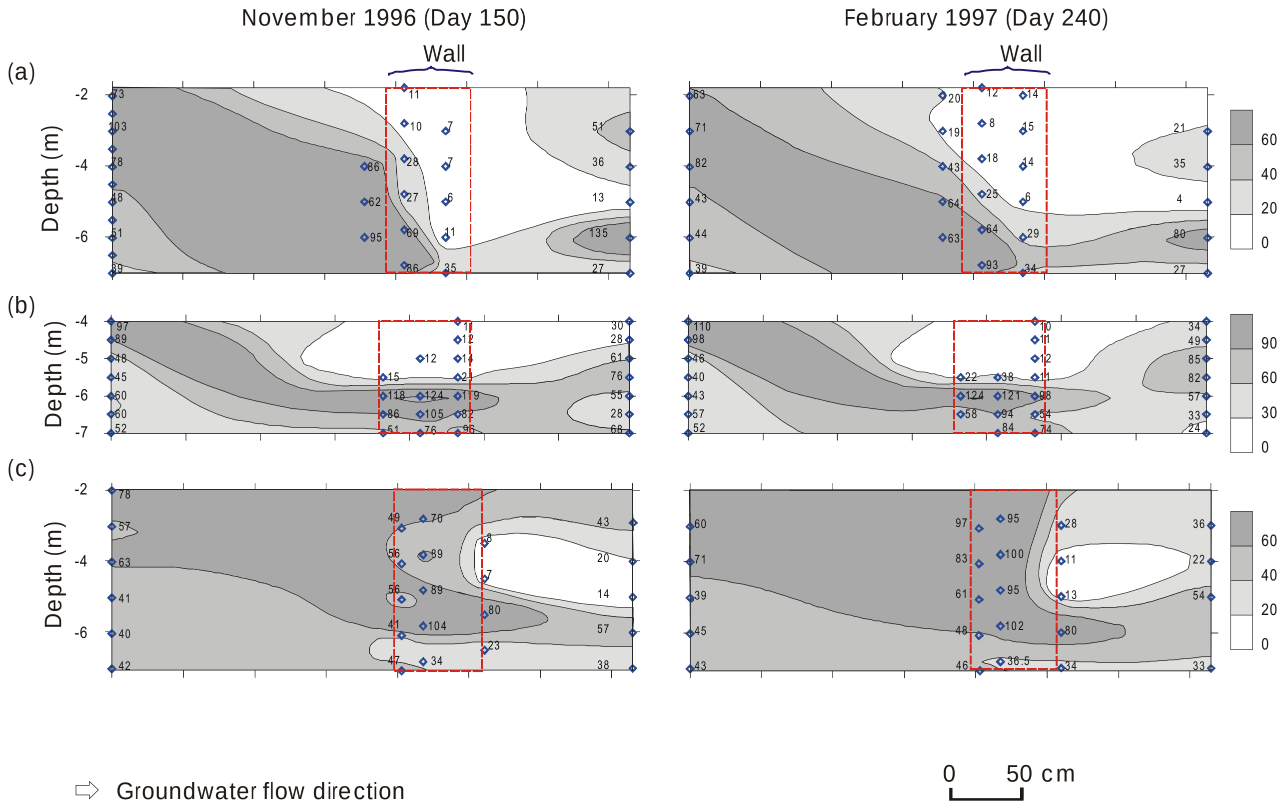


Figure 56. Alkalinity (mg/L $CaCO_3$) in (a) transect 1, (b) transect 2 and (c) transect 3 (November 1996 and February 1997).

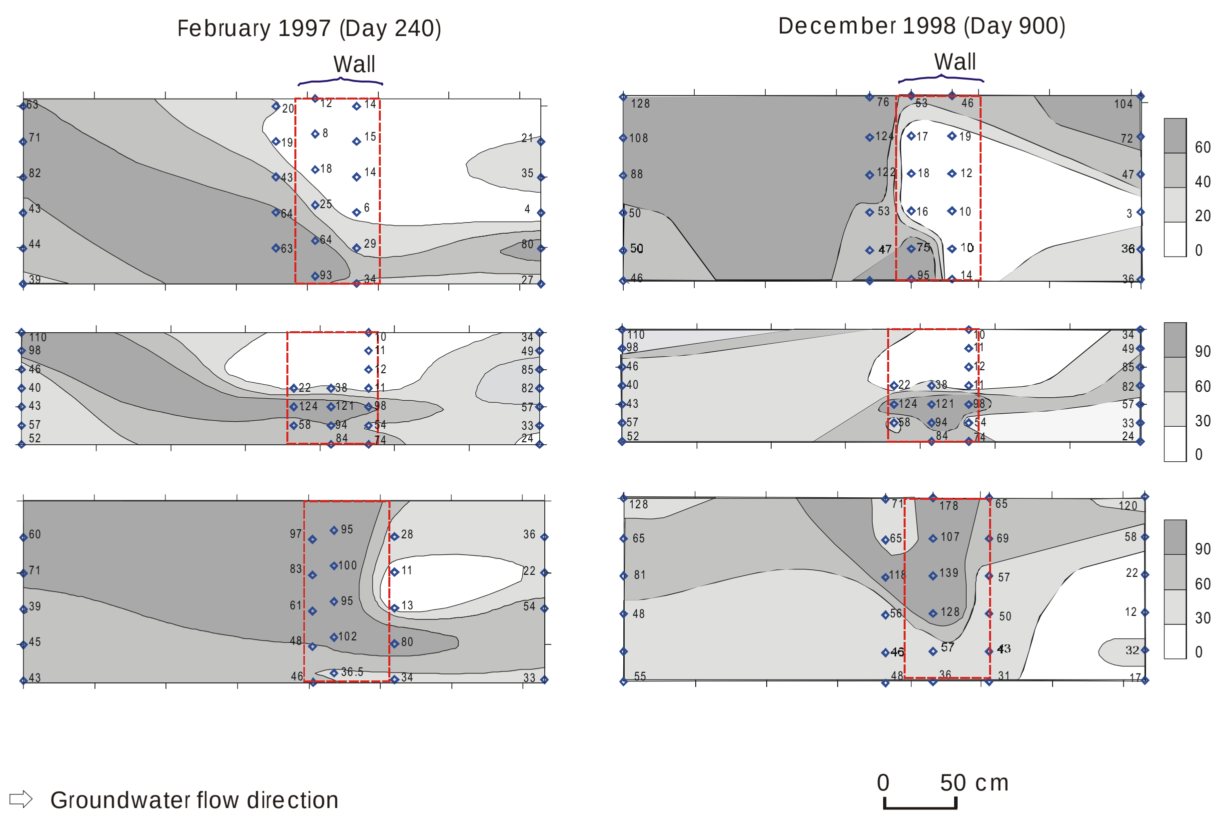


Figure 57. Alkalinity (mg/L $CaCO_3$) in (a) transect 1, (b) transect 2 and (c) transect 3 (February 1997 and December 1998).

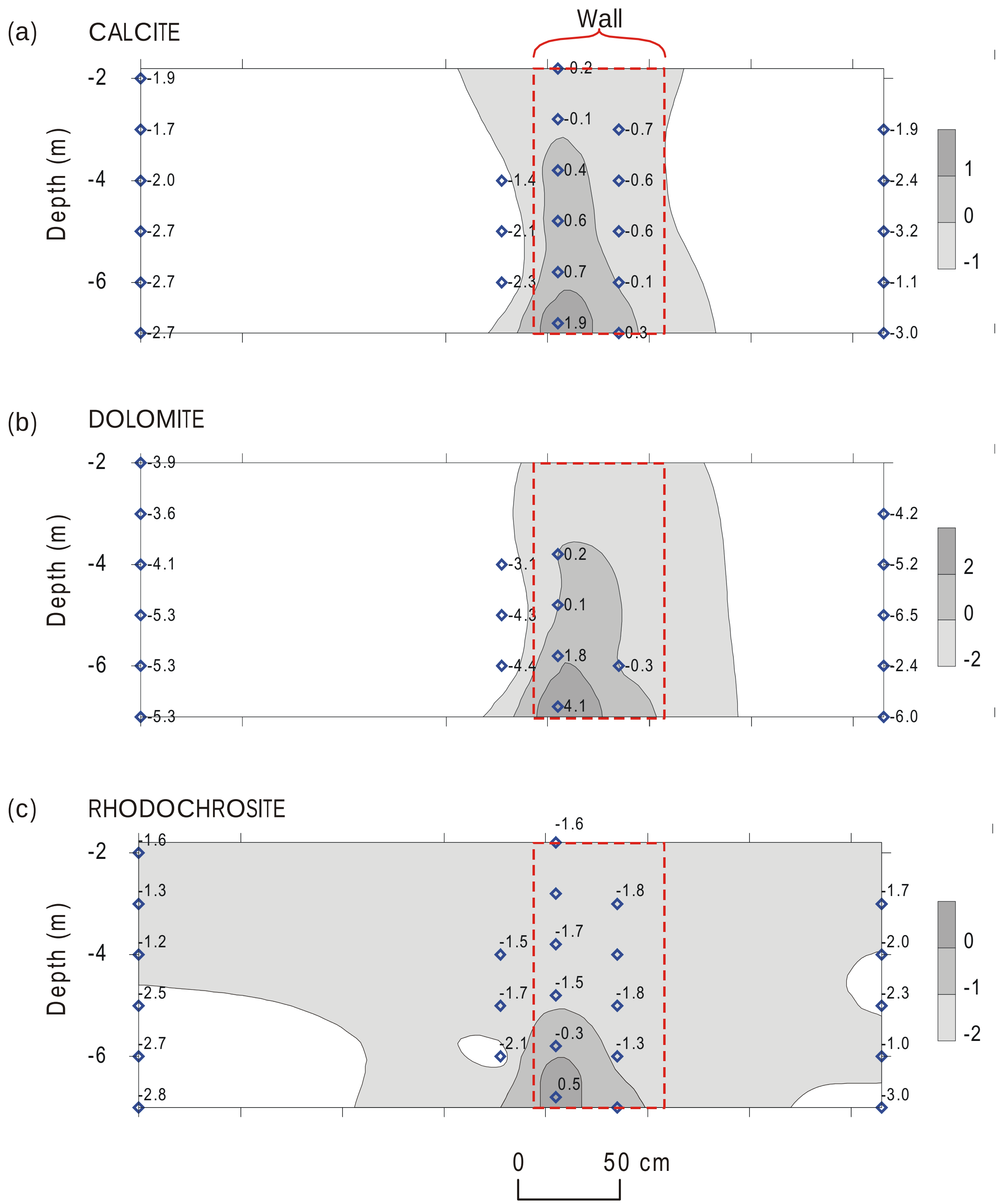


Figure 58. Saturation indices for (a) calcite, (b) dolomite and (c) rhodochrosite (transect 1 (November 1996 (Day 150)).

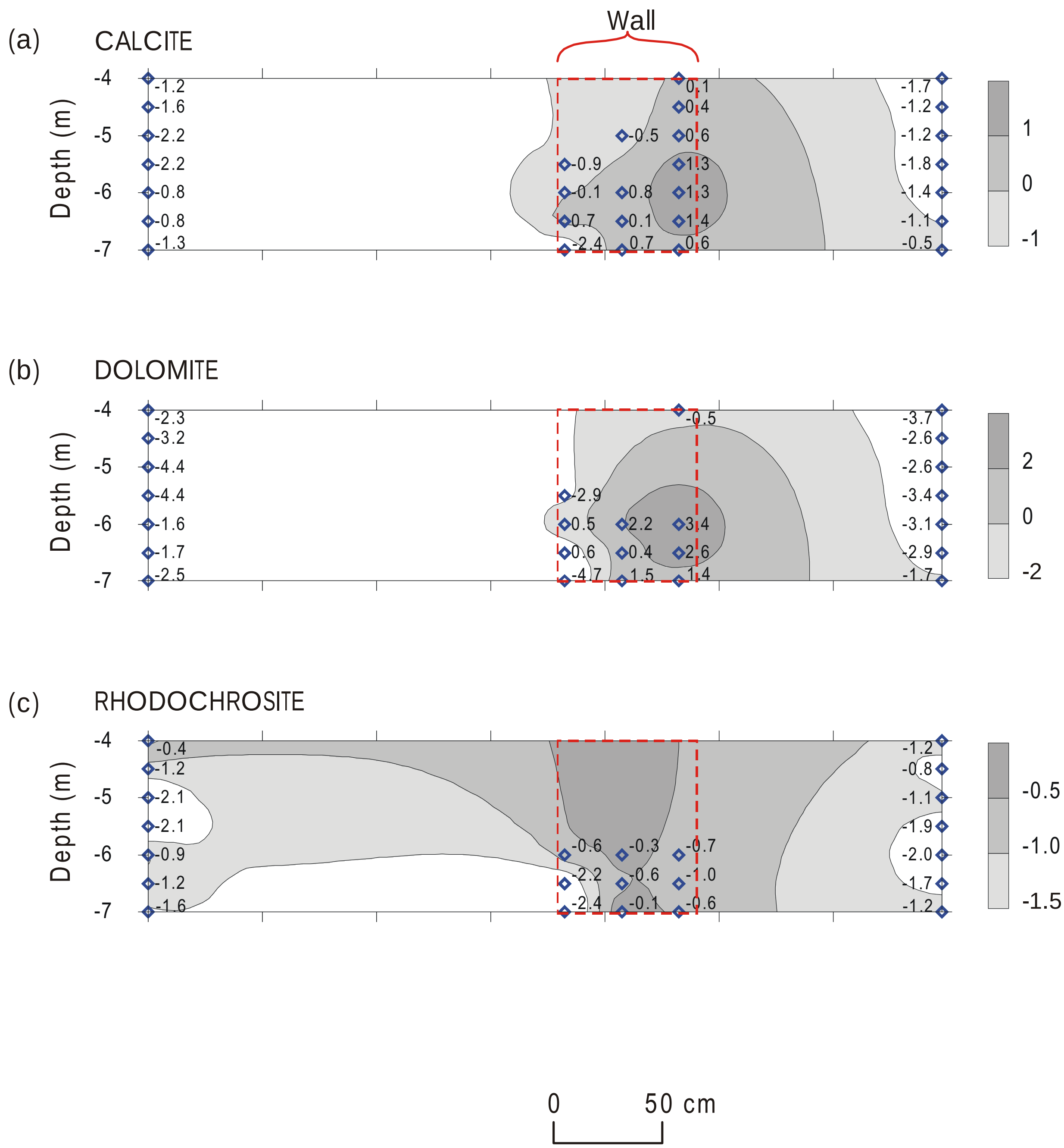


Figure 59. Saturation indices for (a) calcite, (b) dolomite and (c) rhodochrosite (transect 2 (November 1996 (Day 150)).

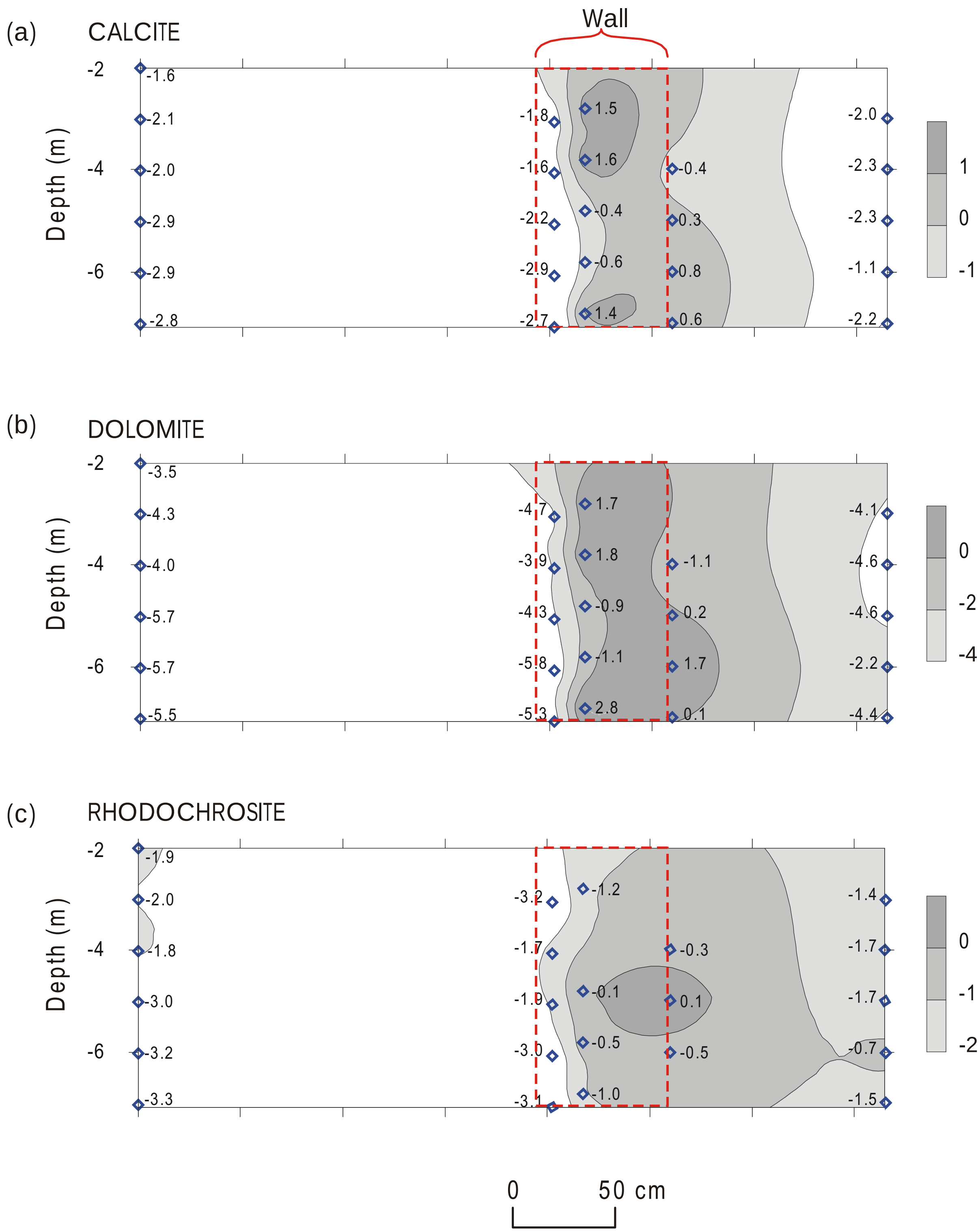


Figure 60. Saturation indices for (a) calcite, (b) dolomite and (c) rhodochrosite (transect 3 (November 1996 (Day 150)).

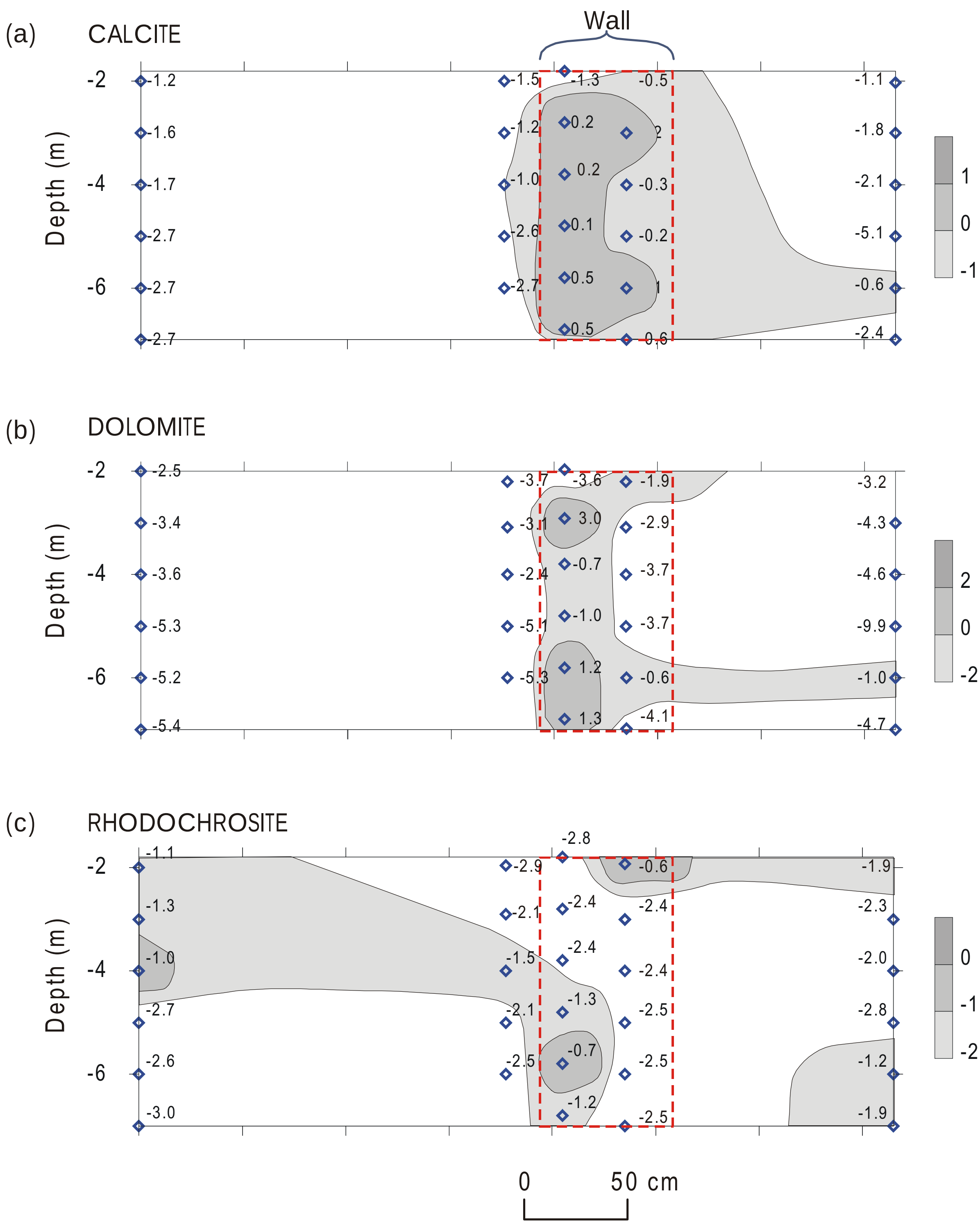


Figure 61. Saturation indices for (a) calcite, (b) dolomite and (c) rhodochrosite (transect 1 (December 1998 (Day 900)).

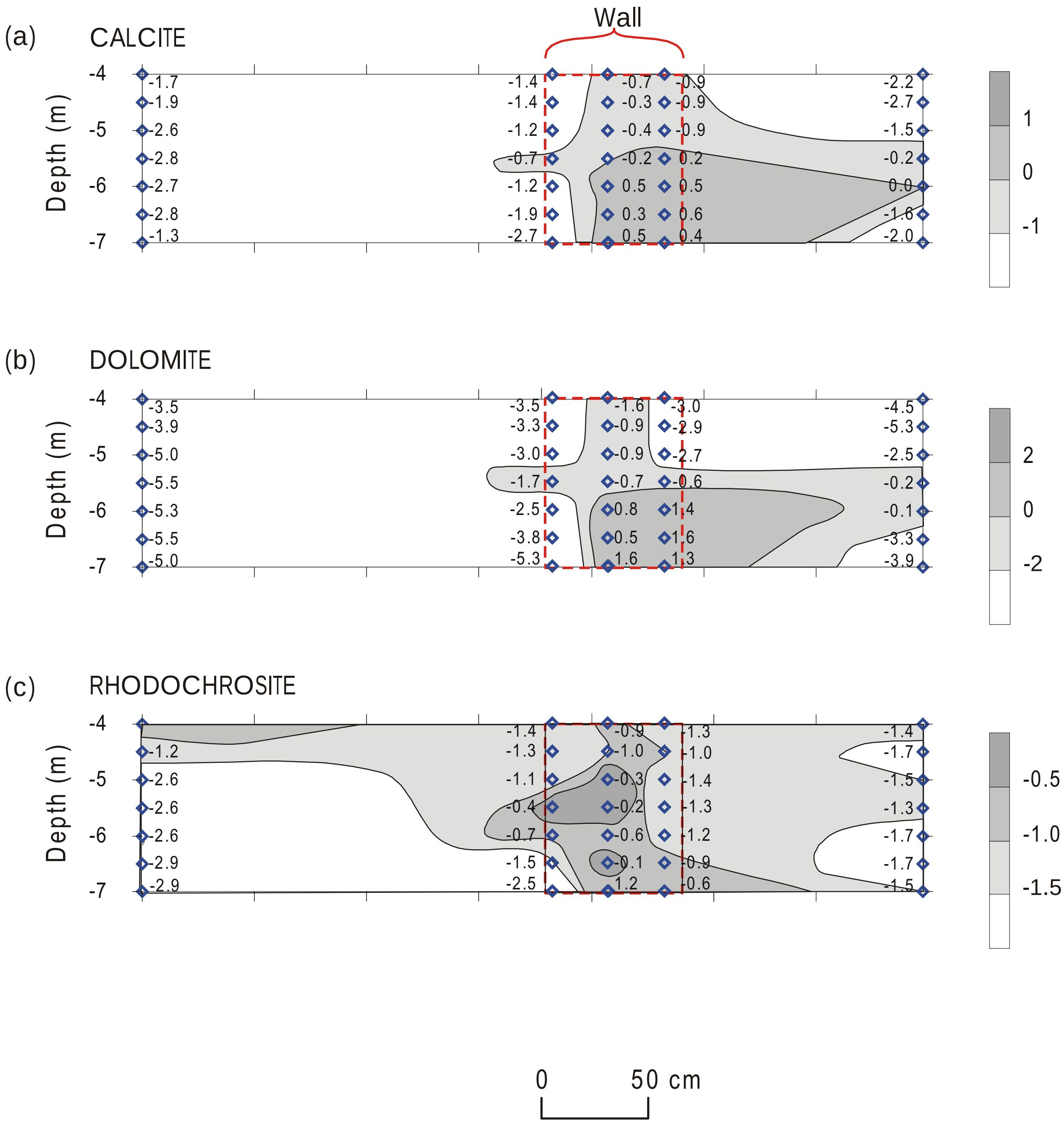


Figure 62. Saturation indices for (a) calcite, (b) dolomite and (c) rhodochrosite (transect 2 (December 1998 (Day 900)).

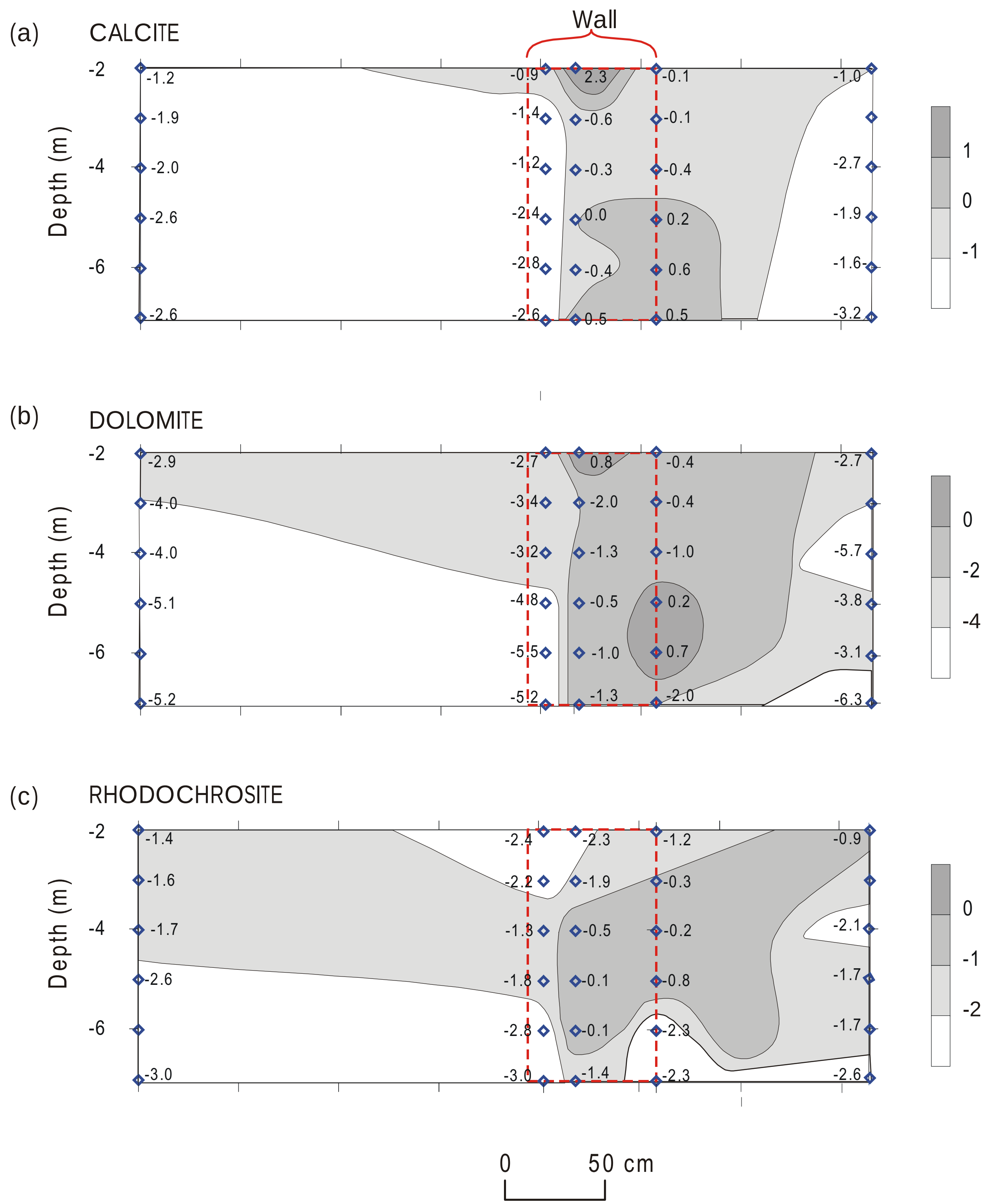


Figure 63. Saturation indices for (a) calcite, (b) dolomite and (c) rhodochrosite (transect 3 (December 1998 (Day 900)).

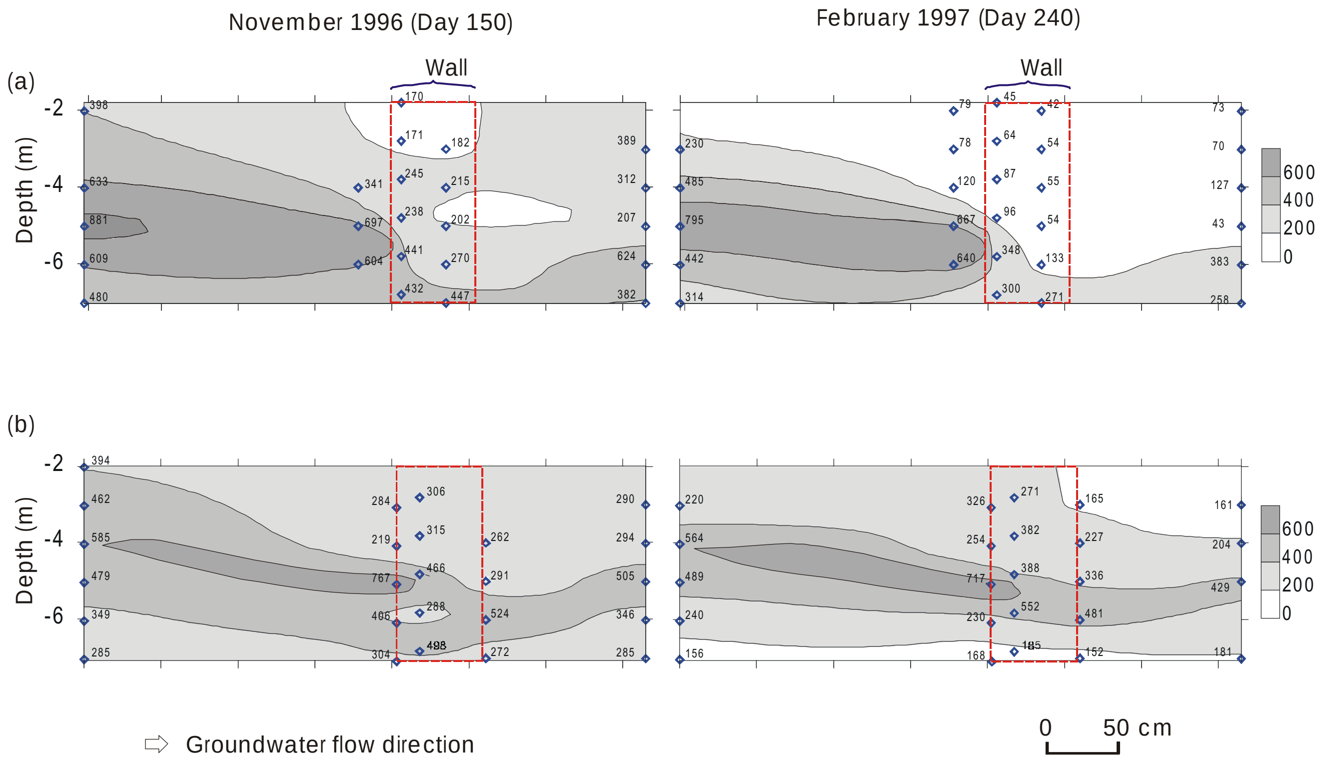


Figure 64. Electrical conductivity (µS/cm) in (a) transect 1 and (b) transect 3 (November 1996 and February 1997).

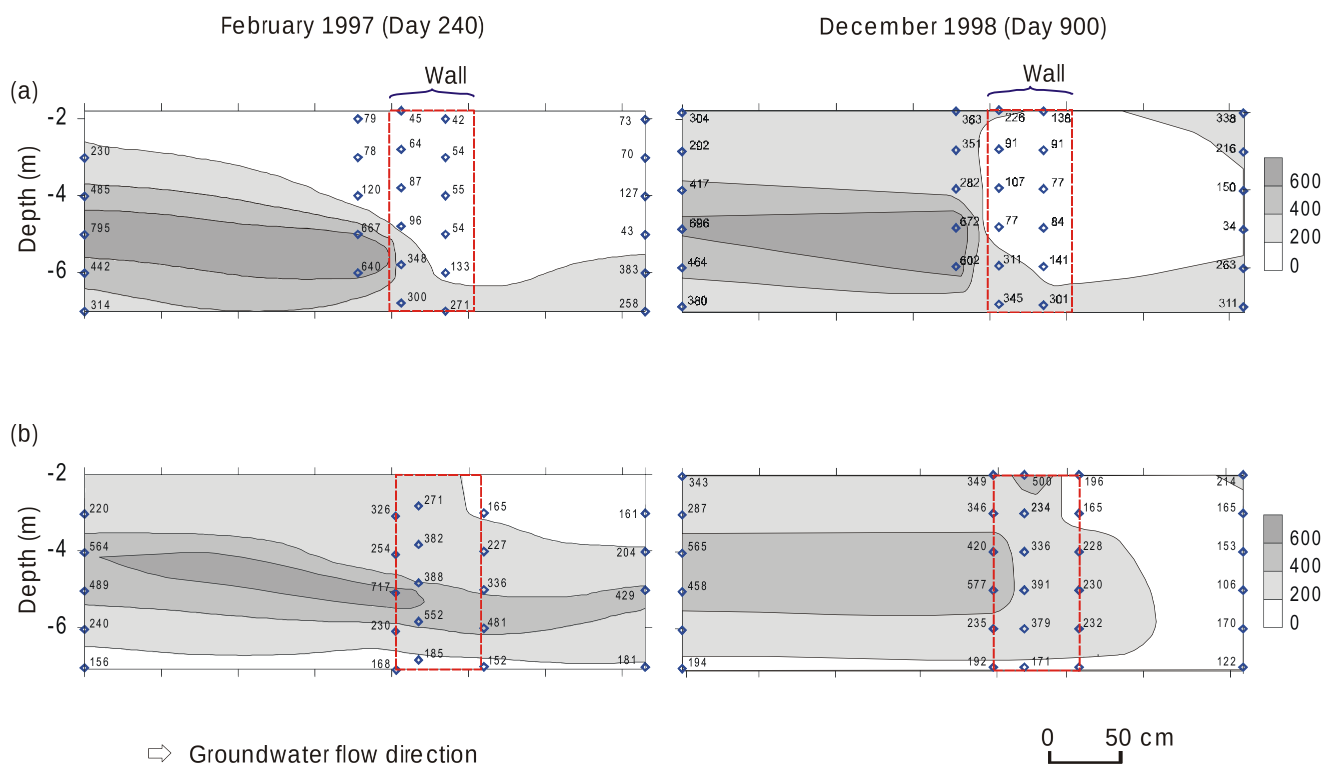


Figure 65. Electrical conductivity (µS/cm) in (a) transect 1 and (b) transect 3 (February 1997 and December 1998).

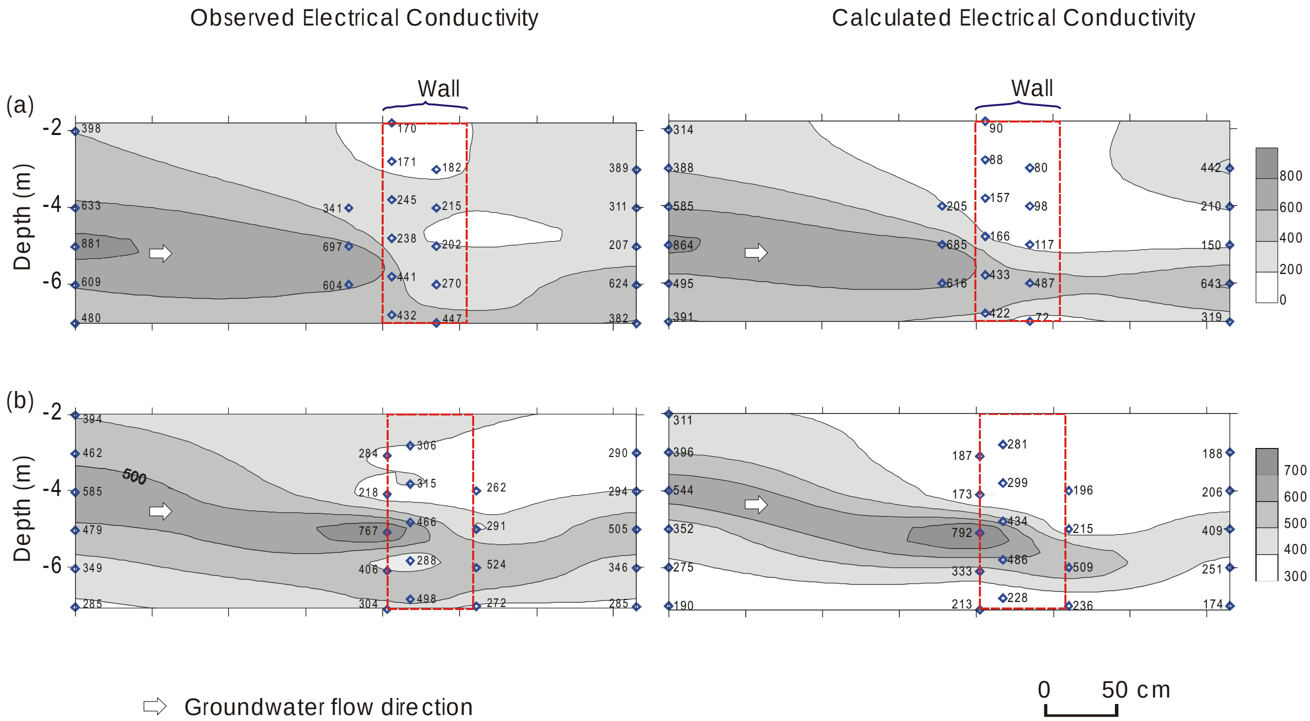


Figure 66. Comparison of observed and calculated electrical conductivity (µS/cm) in (a) transect 1 and (b) transect 3 (November 1996 (Day 150)).

Appendix Tables

Appendix A Survey Locations of Sampling Wells

(all measurements in meters)

Well Name	Northing	Easting	Elevation[1]	Depth[2]
ML11-0	282419.4432	864537.8861	1.865	7.015
ML11-1	282419.4432	864537.8861	1.865	6.515
ML11-2	282419.4432	864537.8861	1.865	6.015
ML11-3	282419.4432	864537.8861	1.865	5.515
ML11-4	282419.4432	864537.8861	1.865	5.015
ML11-5	282419.4432	864537.8861	1.865	4.515
ML11-6	282419.4432	864537.8861	1.865	4.015
ML11-7	282419.4432	864537.8861	1.865	3.515
ML11-8	282419.4432	864537.8861	1.865	3.015
ML11-9	282419.4432	864537.8861	1.865	2.515
ML11-10	282419.4432	864537.8861	1.865	2.015
ML12-1	282421.203	864537.7334	na	6.51
ML12-2	282421.203	864537.7334	na	6.01
ML12-3	282421.203	864537.7334	na	5.51
ML12-4	282421.203	864537.7334	na	5.01
ML12-5	282421.203	864537.7334	na	4.51
ML12-6	282421.203	864537.7334	na	4.01
ML12-7	282421.203	864537.7334	na	3.51
ML12-8	282421.203	864537.7334	na	3.01
ML12-9	282421.203	864537.7334	na	2.51
ML12-10	282421.203	864537.7334	na	2.01
ML13-0	282421.5642	864537.8778	na	6.8
ML13-1	282421.5642	864537.8778	na	6.3
ML13-2	282421.5642	864537.8778	na	5.8
ML13-3	282421.5642	864537.8778	na	5.3
ML13-4	282421.5642	864537.8778	na	4.8
ML13-5	282421.5642	864537.8778	na	4.3
ML13-6	282421.5642	864537.8778	na	3.8
ML13-7	282421.5642	864537.8778	na	3.3
ML13-8	282421.5642	864537.8778	na	2.8
ML13-9	282421.5642	864537.8778	na	2.3
ML13-10	282421.5642	864537.8778	na	1.8
ML14-0	282421.8097	864537.7985	1.734	7.01
ML14-1	282421.8097	864537.7985	1.734	6.51
ML14-2	282421.8097	864537.7985	1.734	6.01
ML14-3	282421.8097	864537.7985	1.734	5.51
ML14-4	282421.8097	864537.7985	1.734	5.01
ML14-5	282421.8097	864537.7985	1.734	4.51
ML14-6	282421.8097	864537.7985	1.734	4.01
ML14-7	282421.8097	864537.7985	1.734	3.51
ML14-8	282421.8097	864537.7985	1.734	3.01
ML14-9	282421.8097	864537.7985	1.734	2.51
ML14-10	282421.8097	864537.7985	1.734	2.01
ML15-0	282423.0352	864538.2564	1.862	7.02
ML15-1	282423.0352	864538.2564	1.862	6.52
ML15-2	282423.0352	864538.2564	1.862	6.02
ML15-3	282423.0352	864538.2564	1.862	5.52
ML15-4	282423.0352	864538.2564	1.862	5.02
ML15-5	282423.0352	864538.2564	1.862	4.52

Elevation[1]: elevation of TOC above sea level (m)
Depth[2]: approximate depth below ground surface to center of screen (m)

Well Name	Northing	Easting	Elevation[1]	Depth[2]
ML15-6	282423.0352	864538.2564	1.862	4.02
ML15-7	282423.0352	864538.2564	1.862	3.52
ML15-8	282423.0352	864538.2564	1.862	3.02
ML15-9	282423.0352	864538.2564	1.862	2.52
ML15-10	282423.0352	864538.2564	1.862	2.02
ML21-1	282419.8637	864530.8944	1.795	7
ML21-2	282419.8637	864530.8944	na	6.5
ML21-3	282419.8637	864530.8944	na	6
ML21-4	282419.8637	864530.8944	na	5.5
ML21-5	282419.8637	864530.8944	na	5
ML21-6	282419.8637	864530.8944	na	4.5
ML21-7	282419.8637	864530.8944	na	4
ML22-1	282421.5084	864529.9575	1.744	7
ML22-2	282421.5084	864529.9575	na	6.5
ML22-3	282421.5084	864529.9575	na	6
ML22-4	282421.5084	864529.9575	na	5.5
ML22-5	282421.5084	864529.9575	na	5
ML22-6	282421.5084	864529.9575	na	4.5
ML22-7	282421.5084	864529.9575	na	4
ML23-1	282421.727	864529.9957	1.756	7
ML23-2	282421.727	864529.9957	na	6.5
ML23-3	282421.727	864529.9957	na	6
ML23-4	282421.727	864529.9957	na	5.5
ML23-5	282421.727	864529.9957	na	5
ML23-6	282421.727	864529.9957	na	4.5
ML23-7	282421.727	864529.9957	na	4
ML24-1	282422.0111	864530.1619	1.704	7
ML24-2	282422.0111	864530.1619	na	6.5
ML24-3	282422.0111	864530.1619	na	6
ML24-4	282422.0111	864530.1619	na	5.5
ML24-5	282422.0111	864530.1619	na	5
ML24-6	282422.0111	864530.1619	na	4.5
ML24-7	282422.0111	864530.1619	na	4
ML25-1	282423.1574	864530.5443	1.707	7
ML25-2	282423.1574	864530.5443	na	6.5
ML25-3	282423.1574	864530.5443	na	6
ML25-4	282423.1574	864530.5443	na	5.5
ML25-5	282423.1574	864530.5443	na	5
ML25-6	282423.1574	864530.5443	na	4.5
ML25-7	282423.1574	864530.5443	na	4
ML31-0	282419.664	864520.4187	1.85	7.02
ML31-1	282419.664	864520.4187	1.85	6.52
ML31-2	282419.664	864520.4187	1.85	6.02
ML31-3	282419.664	864520.4187	1.85	5.52
ML31-4	282419.664	864520.4187	1.85	5.02
ML31-5	282419.664	864520.4187	1.85	4.52
ML31-6	282419.664	864520.4187	1.85	4.02
ML31-7	282419.664	864520.4187	1.85	3.52
ML31-8	282419.664	864520.4187	1.85	3.02

Elevation[1]: elevation of TOC above sea level (m)
Depth[2]: approximate depth below ground surface to center of screen (m)

Well Name	Northing	Easting	Elevation[1]	Depth[2]
ML31-9	282419.664	864520.4187	1.85	2.52
ML31-10	282419.664	864520.4187	1.85	2.02
ML32-0	282421.6384	864519.979	na	7.07
ML32-1	282421.6384	864519.979	na	6.57
ML32-2	282421.6384	864519.979	na	6.07
ML32-3	282421.6384	864519.979	na	5.57
ML32-4	282421.6384	864519.979	na	5.07
ML32-5	282421.6384	864519.979	na	4.57
ML32-6	282421.6384	864519.979	na	4.07
ML32-7	282421.6384	864519.979	na	3.57
ML32-8	282421.6384	864519.979	na	3.07
ML32-9	282421.6384	864519.979	na	2.57
ML32-10	282421.6384	864519.979	na	2.07
ML33-0	282421.7434	864519.9856	na	6.81
ML33-1	282421.7434	864519.9856	na	6.31
ML33-2	282421.7434	864519.9856	na	5.81
ML33-3	282421.7434	864519.9856	na	5.31
ML33-4	282421.7434	864519.9856	na	4.81
ML33-5	282421.7434	864519.9856	na	4.31
ML33-6	282421.7434	864519.9856	na	3.81
ML33-7	282421.7434	864519.9856	na	3.31
ML33-8	282421.7434	864519.9856	na	2.81
ML33-9	282421.7434	864519.9856	na	2.31
ML33-10	282421.7434	864519.9856	na	1.81
ML34-0	282422.1833	864519.961	1.798	6.99
ML34-1	282422.1833	864519.961	1.798	6.49
ML34-2	282422.1833	864519.961	1.798	5.99
ML34-3	282422.1833	864519.961	1.798	5.49
ML34-4	282422.1833	864519.961	1.798	4.99
ML34-5	282422.1833	864519.961	1.798	4.49
ML34-6	282422.1833	864519.961	1.798	3.99
ML34-7	282422.1833	864519.961	1.798	3.49
ML34-8	282422.1833	864519.961	1.798	2.99
ML34-9	282422.1833	864519.961	1.798	2.49
ML34-10	282422.1833	864519.961	1.798	1.99
ML35-0	282423.1943	864519.7553	1.814	6.995
ML35-1	282423.1943	864519.7553	1.814	6.495
ML35-2	282423.1943	864519.7553	1.814	5.995
ML35-3	282423.1943	864519.7553	1.814	5.495
ML35-4	282423.1943	864519.7553	1.814	4.995
ML35-5	282423.1943	864519.7553	1.814	4.495
ML35-6	282423.1943	864519.7553	1.814	3.995
ML35-7	282423.1943	864519.7553	1.814	3.495
ML35-8	282423.1943	864519.7553	1.814	2.995
ML35-9	282423.1943	864519.7553	1.814	2.495
ML35-10	282423.1943	864519.7553	1.814	1.995
MW46	282435.0242	864507.9287	1.536	4.24-7.27
MW47	282423.7451	864519.0386	1.768	4.24-7.27
MW48	282419.7277	864530.3085	1.747	4.24-7.27
MW49	282423.0584	864539.1529	1.817	4.24-7.27
MW50	282423.3124	864531.2874	1.68	7.58-9.09

Elevation[1]: elevation of TOC above sea level (m)
Depth[2]: approximate depth below ground surface to center of screen (m)

Appendix B Field Analysis Results

TABLE B-1. November 1996 Field Data (University of Waterloo)

Well Point	Depth (m)	Eh (SCE) (mV)	Eh (SHE) (mV)	pH	$Temp_{bath}$ (°c)	Cr (VI) (mg/L)	Fe(II) (mg/L)	DO (mg/L)	$Temp_{water}$ (°c)	Alkalinity (mg/L CaCO3)	Conductvty (µS/cm)
11-0	-7.02	205	***456***	5.91	9.8	0.11	0.02	0.3	16.3	39	480.32
11-1	-6.52					0.98	0.01				
11-2	-6.02	163	***415***	6.01	8.6	1	0	0.6	17.2	51	609.43
11-3	-5.52					2.5	0				
11-4	-5.02	157	***409***	5.96	8.3	2	0	0.8	15.8	48	881.37
11-5	-4.52					0.07	0.01				
11-6	-4.02	225	***478***	6.1	7.7	0.04	0.01	0.05	15	78	633.05
11-7	-3.52					0	0.01				
11-8	-3.02	133	***385***	6.23	8.6	0	0.15			103	
11-9	-2.52					0	0.18				
11-10	-2.02	-118	***134***	6.35	8.3	0	0.01	0.15	18.6	73	398.49
12-1	-6.51					1.7	0				
12-2	-6.01	174	***421***	6.29	16.2	2.5	0	>1.0	17.3	95	604.22
12-3	-5.51					1.55	0				
12-4	-5.01	95	***344***	6.23	12.9	0.6	0.21	0.8	15.3	61.5	697.42
12-5	-4.51					0	12.6				
12-6	-4.01	-178	***73***	7.01	10.4	0	2.61	0	17	85.5	340.85
12-7	-3.51					0	2.89				
12-8	-3.01					0	1.14				
12-9	-2.51					0	0.79				
12-10	-2.01					0	0.07				
13-0	-6.8	-590	***-341***	9.15	12.4	0	0.26	0.5	15.5	86	432
13-1	-6.3					0	0.01				
13-2	-5.8	-629	***-382***	9.8	15.3	0	0	0.2	na	69	441
13-3	-5.3					0	0				
13-4	-4.8	-831	***-583***	10.4	14.5	0	0	0.4	15.6	26.5	237.79
13-5	-4.3					0	0				
13-6	-3.8	-649	***-396***	10.3	7.5	0	0.01	0.2	14.2	28	244.73
13-7	-3.3					0	0				
13-8	-2.8	-833	***-587***	10.4	17.5	0	0	0.2	20.4	9.6	170.71
13-9	-2.3					0	0.03				
13-10	-1.8	-593	***-348***	10.5	18	0	0	0.2	17.4	10.5	170.01
14-0	-7.01	-833	***-585***	10.5	13.8	0	0	0.5	16	35	446.95
14-1	-6.51					0	0.01				
14-2	-6.01	-717	***-467***	10.1	11.2	0	0	0.3	17.9	11	269.96
14-3	-5.51					0	0.01				
14-4	-5.01	-780	***-532***	10	13.9	0	0.02	0.5	14.4	6.4	201.61
14-5	-4.51					0	0.01				
14-6	-4.01	-748	***-496***	10	9.1	0	0.06	0.2	14	7.3	215.15
14-7	-3.51					0	0				
14-8	-3.01	-725	***-472***	9.91	7.8	0	0.01	0.3	15.3	6.8	182.42
14-9	-2.51					0	0.15				
14-10	-2.01					0	0.15				

TABLE B-1. November 1996 Field Data (University of Waterloo)

Well Point	Depth (m)	Eh (SCE) (mV)	Eh (SHE) (mV)	pH	$Temp_{bath}$ (^{o}c)	Cr (VI) (mg/L)	Fe(II) (mg/L)	DO (mg/L)	$Temp_{water}$ (^{o}c)	Alkalinity (mg/L $CaCO_3$)	Conductvty (µS/cm)
15-1	-6.52					0	0.7				
15-2	-6.02	-106	***145***	7.66	10.7	0	0.01	0.3	18.5	135	623.7
15-3	-5.52					0	0.13				
15-4	-5.02	-517	***-268***	7.34	13	0	0.07	0.1	13.4	12.5	207.11
15-5	-4.52					0	0.09				
15-6	-4.02	-59	***190***	6.38	12.8	0	1.9	0.05	17.7	35.5	311.38
15-7	-3.52					0	1.9				
15-8	-3.02	-2	***247***	6.43	12.3	0	0.74	0.2	18	51	388.75
15-9	-2.52					0	0.18				
15-10	-2.02					0	0.09				
31-0	-7.02	157	***405.8***	6.01	13.1	0	0	0.15	19.2	41.8	285.23
31-1	-6.52					0.02	0				
31-2	-6.02	275	526.21	5.91	9.7	0.06	0	0.2	19.8	40.3	348.97
31-3	-5.52					0.2	0				
31-4	-5.02	222	472.23	5.89	11.1	0.31	0	0.5	19.5	41	478.6
31-5	-4.52					0.03	0				
31-6	-4.02	256.00	507.63	6.15	9.10	0.00	0	0.2	19.5	63	584.6
31-7	-3.52					0.00	0				
31-8	-3.02	247.00	499.05	6.13	8.50	0.00	0	0.4	19.2	57.3	462.23
31-9	-2.52					0.00	**0**				
31-10	-2.02	188.00	438.44	6.47	10.80	0.00	**0.02**	**>1**	**19.6**	**78**	394.39
32-0	-7.07	-236.00	10.87	6.02	15.90	0.00	0.44	0.1	19.7	46.8	304.18
32-1	-6.57					0.01	0.02				
32-2	-6.07	203.00	451.13	5.89	14.10	0.30	0	0.2	19.5	40.6	405.6
32-3	-5.57					0.29	0.06				
32-4	-5.07	121.00	368.78	6.01	14.60	0.04	0.02	0.2	19.9	56.3	766.76
32-5	-4.57					0.00	1.01				
32-6	-4.07	-138.00	110.06	6.75	14.20	0.00	2.74	0	19.5	55.8	218.6
32-7	-3.57					0.00	1.42				
32-8	-3.07	-20.00	228.55	6.49	13.50	0.00	1.905	>1	19.3	49.3	284.02
32-9	-2.57					0.00	0				
32-10	-2.07										
33-0	-6.81	-641.00	-393.22	10.2	14.60	0.00	0	0	20.5	33.5	497.5
33-1	-6.31					0.00	3.15				
33-2	-5.81	-328.00	-83.93	7.6	19.90	0.00	9	0	19.9	104	287.76
33-3	-5.31					0.00	4.55				
33-4	-4.81	-450.00	-200.33	7.77	11.90	0.00	0.79	0	20.2	89	466.13
33-5	-4.31					0.00	0.01				
33-6	-3.81	-144.00	102.73	9.97	16.10	0.00	0	0.3	20.1	88.5	315.34
33-7	-3.31					0.00	2.71				
33-8	-2.81	-160.00	86.87	10.2	15.90	0.00	0	0.3	20	69.5	305.55
33-9	-2.31					0	0.01				
33-10	-1.81					0	0.1				

TABLE B-1. November 1996 Field Data (University of Waterloo)

Well Point	Depth (m)	Eh (SCE) (mV)	Eh (SHE) (mV)	pH	$Temp_{bath}$ (°c)	Cr (VI) (mg/L)	Fe(II) (mg/L)	DO (mg/L)	$Temp_{water}$ (°c)	Alkalinity (mg/L CaCO3)	Conductvty (µS/cm)
34-0	-6.99	-792	-541	10.7	9.3	0	0	0.05	18.7	22.9	272.28
34-1	-6.49					0	0.01				
34-2	-5.99	-371	-121	9.26	11	0	0.013	0.1	20.3	80	523.92
34-3	-5.49					0	0.01				
34-4	-4.99	-598	-355	8.36	20.9	0	0.28	0.05	21	6.5	291.45
34-5	-4.49					0	0.45				
34-6	-3.99	-592	-347	7.65	18.9	0	0.59	0	21.5	8.4	262.4
34-7	-3.49					0	0.99				
34-8	-2.99					0	0.63				
34-9	-2.49					0	0.71				
34-10	-1.99					0	0.17				
35-0	-7	-56	197.24	6.81	6.8	0	1.52	0.1	16.9	38	285.06
35-1	-6.5					0	0				
35-2	-6	-207	44.35	7.73	9.5	0	1	0.1	20.5	57	345.5
35-3	-5.5					0	0				
35-4	-5	-448	-196.93	7.04	9.9	0	1	0.1	19.4	14.1	504.81
35-5	-4.5					0	0				
35-6	-4	39	290.07	6.66	9.9	0	0	0.05	21.1	20	294.24
35-7	-3.5					0	0				
35-8	-3	14	265.14	6.62	9.8	0	1	0.1	19.1	42.5	290.44
35-9	-2.5					0	1				
35-10	-2					0	0				

TABLE B-2. February 1997 Field Data (University of Waterloo)

Well Point	Depth (m)	Eh (SCE) (mV)	Eh (SHE) (mV)	pH	$Temp_{bath}$ (°c)	$Temp_{water}$ (°c)	Cr (VI) (mg/L)	Fe(II) (mg/L)	DO (mg/L)	Alkalinity (mg/L $CaCO_3$)	Conduct. (µS/cm)
11-0	7.02	156	***403***	5.92	16	19.5	0.09	0.19	0.8	39	314
11-1							1.45	0			
11-2	6.02	271	***518***	5.96	15.2	18.1	0.54	0.07	0.8	44	442
11-3							1.25	0			
11-4	5.02	295	***542***	5.83	15.7	17.6	0.34	0.04		43	795
11-5							0.11	0			
11-6	4.02	130	***376***	6.31	17.2	18.5	0.04	0.03	0.6	82	485
11-7							0	0.36			
11-8	3.02	56	***303***	6.46	15.6	17.6	0	0.34	0.4	71	230
11-9							0	0.23			
11-10	2.02	-24	***218***	6.55	22.7		0	0.48		63	
12-1							0.9	0.02			
12-2	6.01	245	***494***	6.1	12.8	16.3	2.15	0.01	0.8	62.5	640
12-3							1.88	0.01			
12-4	5.01	189	***437***	6.07	14.4	16.7	0.85	0.01	0.4	63.5	667
12-5							0	13.2			
12-6	4.01	-161	***83***	7.37	20.4	18	0	2.75	0.3	43	120
12-7							0	2.36			
12-8	3.01	-48	***196***	6.6	20.2	15.8	0.01	1.26	0.8	19	78
12-9							0	0.07			
12-10	2.01	293	***540***	7.08	15.9	15.5	0	0.01	1	20	79
13-0	6.8	-35	***206***	9.01	24		0	0.01		92.5	300
13-1							0	0			
13-2	5.8	-358	***-116***	9.73	23.5	17.9	0	0	0.15	63.5	348
13-3							0	0			
13-4	4.8	-678	***-436***	10.62	23	17.2	0	0.01	0.15	24.5	96
13-5							0	0.01			
13-6	3.8	-558	***-315***	10.72	22	15.6	0	0.01	0.1	17.5	87
13-7							0	0			
13-8	2.8	-445	***-202***	10.65	21	14.1	0	0.44		8	64
13-9							0	0.02			
13-10	1.8	-483	***-234***	10.3	12.6	13.3	0	0.01	0.3	11.6	45
14-0	7.01	-819	***-572***	10.88	15	17.1	0	0	0.1	34	271
14-1							0	0.01			
14-2	6.01	-816	***-569***	10.57	15	15.8	0	0	0.15	28.5	133
14-3							0	0			
14-4	5.01	-827	***-583***	10.32	20	16	0	0	0.1	6	54
14-5							0.01	0.01			
14-6	4.01	-826	***-583***	10.28	22	17.2	0	0	0.25	14	55
14-7							0	0			
14-8	3.01	-806	***-563***	10.14	22	17.5	0	0.01	0.15	14.5	54
14-9							0	0.2			
14-10	2.01	-643	***-401***	8.35	23	15.8	0	0.08	0.5	13.5	42
15-0	7.02	13	***262***	6.15	13	17.3	0	0.1	0.375	26.5	258
15-1							0	0.26			
15-2	6.02	-375	***-124***	8.07	10	15.5	0	0.25	0.15	82	383
15-3							0	0.08			
15-4	5.02	-710	***-460***	7.96	12	16.7	0	0.03	0.25	4	43
15-5							0	0.3			
15-6	4.02	-287	***-40***	6.71	16	16	0	1.65	0.15	35	127
15-7							0	0.73			
15-8	3.02	-160	***86***	7.01	16.5	14.9	0	0.44	0.5	21	70
15-9							0	0.06			
15-10	2.02	-111	***136***	6.71	16	13.7	0	0.03	1		73

TABLE B-2. February 1997 Field Data (University of Waterloo)

Well Point	Depth (m)	Eh (SCE) (mV)	Eh (SHE) (mV)	pH	$Temp_{bath}$ (^{o}c)	$Temp_{water}$ (^{o}c)	Cr (VI) (mg/L)	Fe(II) (mg/L)	DO (mg/L)	Alkalinity (mg/L $CaCO_3$)	Conduct. (µS/cm)
31-0	-7.02	307	553	6.1	16.5	18	0	0.01	0	43	156
31-1	-6.52						0.06	0.03			
31-2	-6.02	326	574	5.95	15	17	0.08	0	0	45	240
31-3	-5.52						0.08	0.02			
31-4	-5.02	317	565	5.84	14.1	17.1	0.1	0.01	0	39	489
31-5	-4.52						0.09	0.02			
31-6	-4.02	330	578	6.15	14.4	16.4	0	0.01	0.3	71	564
31-7	-3.52						0	0.01			
31-8	-3.02	269	517	6.41	15	15.7	0	0	0.3	60	220
31-9	-2.52						0	0			
31-10	-2.02	186	434	6.55	15		0	0.02			
32-0	-7.07	242	487	6.02	18.5	19.6	0	0.8	0	46	168
32-1	-6.57						0.02	0.04			
32-2	-6.07	182	428	5.95	17.5	18.1	0.25	0	0	48	230
32-3	-5.57						0.26	0.01			
32-4	-5.07	193	439	6.06	17.6	17.7	0.03	0.15	0	61	717
32-5	-4.57						0	2.87			
32-6	-4.07	-64	180	6.78	19.5	17.2	0	14.8	0.3	83	254
32-7	-3.57						0	10.15			
32-8	-3.07	106	350	6.53	19.7	16.2	0	1.5	0.3	97	326
32-9	-2.57						0	0.03			
32-10	-2.07	158	402	8.72	19.7		0	0.02			
33-0	-6.81	-505	-261	10.54	20.3	19.5	0	0.01	0	36.5	185
33-1	-6.31						0	0.21			
33-2	-5.81	-229	15	7.6	19.5	19.1	0	1.85	0	102	552
33-3	-5.31						0	7.45			
33-4	-4.81	-278	-33	8.6	18.5	18.7	0	0.19	0	95	388
33-5	-4.31							0.02			
33-6	-3.81	242	486	8.96	19.3	18.1	0	0.01	0.3	100	382
33-7	-3.31						0	6.95			
33-8	-2.81	154	400	9.31	17.8	17	0	0	0.3	95	271
33-9	-2.31						0	0.03			
33-10	-1.81	47	293	11.74	17.8		0	0.09			
34-0	-6.99	-797	-550	10.66	15.2	17.7	0	0.01	0.1	34	152
34-1	-6.49						0	0.01			
34-2	-5.99	-60	187	9.39	15.7	17.2	0	0	0.2	80	481
34-3	-5.49										
34-4	-4.99	-627	-379	9.19	14.7	17.1	0	0.03	0.2	12.8	336
34-5	-4.49						0	0.01			
34-6	-3.99	-474	-228	9.15	17.7	17.6	0	0.03	0	10.6	227
34-7	-3.49						0	0.16			
34-8	-2.99	-322	-77	8.45	18.8	16.5	0	0.21	>1	27.8	165
34-9	-2.49						0	0.25			
34-10	-1.99	211	456	7.22	18.8		0	0.08			
35-0	-7.00	186	433	6.31	15.7	18.4	0	2.11	0.15	33.4	181
35-1	-6.50						0	0.01			
35-2	-6.00	63	311	7.65	15		0	0.77	0.2		
35-3	-5.50						0	0.09			
35-4	-5.00	5	255	7.36	11.4	17.5	0	2.24	0.5	54	429
35-5	-4.50						0	0.55			
35-6	-4.00	137	383	6.6	16.7	17.3	0	0.08	0.2	22	204
35-7	-3.50						0	0.31			
35-8	-3.00	150	396	6.78	16.5	16.3	0	0.7	0.4	36.3	161
35-9	-2.50						0	0.42			
35-10	-2.00						0	0.17	>1		

TABLE B-3. June 1997 Field Data (University of Waterloo)

Well Point	Depth b.g.s.(m)	Eh (SCE) (mV)	Eh (SHE) (mV)	pH	$Temp_{bath}$ (°c)	$Temp_{water}$ (°c)	Cr (VI) (mg/L)	Fe(II) (mg/L)	S^{2-} (mg/L)	DO (mg/L)	Alkalinity (mg/L CaCO3)	Conductivity (µS/cm)	Turbidity (ntu)
11-0	-7.02	231	***474***	5.84	22	22	0.14	0.01		0.4	38	368	0.6
11-1	-6.52						0.73	0.00					
11-2	-6.02	255	***496***	5.85	24	23.1	0.75	0.00		0.6	43	545	21.0
11-3	-5.52						2.05	0.00					
11-4	-5.02	255	***497***	5.78	23	23.1	1.49	0.00		0.6	45.6	758	8.5
11-5	-4.52						0.14	0.00					
11-6	-4.02	168	***410***	6.11	23	23.8	0.08	0.01		0.4	100	400	1.5
11-7	-3.52						0.00	0.30					
11-8	-3.02	42	***283***	6.36	24	23.4	0.00	0.40		0.3	78	219	4.4
11-9	-2.52						0.00	0.52					
11-10	-2.02	-27	***215***	6.47	23	24.4	0.00	1.25		1	56	181	turbid
12-1	-6.51						0.85	0.01					
12-2	-6.01	205	***446***	5.87	24	22.4	0.75	0.00		0.4	52	369	4.9
12-3	-5.51						1.70	0.00					
12-4	-5.01	113	***354***	6.03	24	22.2	0.70	0.11		0.5	69	600	11.7
12-5	-4.51						0.00	2.89					
12-6	-4.01	-201	***39***	7.4	26.2	22.6	0.00	2.59		0.2	26	99	90.6
12-7	-3.51						0.00	1.70					
12-8	-3.01	-193	***47***	6.78	26	22.7	0.00	1.32		0.15	21	84	60.4
12-9	-2.51						0.00	0.08					
12-10	-2.01	-10	***230***	6.74	26	22.7	0.00	0.12		1	24	104	52.8
13-0	-6.8	-501	***-259***	9.61	23.5	23.6	0.00	0.00	0.01	0.25	45	410	1.0
13-1	-6.3						0.00	0.02					
13-2	-5.8	-434	***-194***	9.84	26.4	22	0.00	0.00	0.00	0.3	48	329	2.2
13-3	-5.3						0.00	0.01					
13-4	-4.8	-676	***-434***	10.27	22.9	21.8	0.00	0.00	0.00	0.2	11	87	0.5
13-5	-4.3						0.00	0.00					
13-6	-3.8	-689	***-449***	10.55	25.4	22.2	0.00	0.00	0.01	0.1	19	88	21.2
13-7	-3.3						0.00	0.01					
13-8	-2.8	-628	***-385***	10.51	21.7	22.5	0.00	0.00	0.00	0.4	17	62	1.4
13-9	-2.3						0.00	0.00					
13-10	-1.8	-578	***-339***	10.17	26.7	27.2	0.00	0.01	0.04	0.6	10	69	11.7
14-0	-7.01	-657	***-412***	10.11	19	23	0.00	0.02	0.01	0.1	13	300	8.1
14-1	-6.51						0.00	0.00					
14-2	-6.01	-556	***-314***	10.12	23	21.7	0.00	0.00	0.01	0.1	32	282	3.3
14-3	-5.51						0.00	0.00					
14-4	-5.01	-790	***-545***	10.23	18.8	23.8	0.00	0.01	0.00	0.15	8	63	0.8
14-5	-4.51						0.00	0.00					
14-6	-4.01	-770	***-525***	10.2	18.7	22.7	0.00	0.00	0.00	0.1	8	58	1.2
14-7	-3.51						0.00	0.00					
14-8	-3.01	-705	***-460***	10.08	19	24.4	0.00	0.01	0.01	0.1	8	56	0.4
14-9	-2.51						0.00	0.01					
14-10	-2.01	-493	***-249***	9.44	20.6	25.3	0.00	0.01	0.01	0.15	12	52	18.1
15-0	-7.02	60	***304***	6.12	20	22.7	0.00	0.29		0.1	15.5	241	1.9
15-1	-6.52						0.00	0.44					
15-2	-6.02	-213	***32***	8.38	18.2	24	0.00	0.02	0.01	0.15	51	304	6.2
15-3	-5.52						0.00	0.01					
15-4	-5.02	-677	***-432***	7.96	18.3	24.5	0.00	0.04	0.01	0.2	2.1	32	23.5
15-5	-4.52						0.00	0.10					
15-6	-4.02	-87	***156***	6.79	20.8	23.8	0.00	0.86		0.15	22	89	18.4
15-7	-3.52						0.00	0.43					
15-8	-3.02	-225	***19***	6.81	19.6	25.3	0.00	0.17		0.25	26	80	30.4
15-9	-2.52						0.00	0.03					
15-10	-2.02	200	***444***	6.9	19.9	26.4	0.00	0.01		1	29	99	13.4
31-0	-7.02	232	***473***	6.04	24.2	20.5	0.00	0.01		0.15	36	167	62.2
31-1	-6.52						0.04	0.00					
31-2	-6.02	235	***474***	5.89	27.5	21.7	0.04	0.00		0.15	43	220	24.9
31-3	-5.52						0.03	0.00					
31-4	-5.02	166	***405***	5.87	27.8	21.3	0.06	0.00		0.13	38	423	4.5
31-5	-4.52						0.06	0.00					
31-6	-4.02	188	***429***	6.05	24.6	21.9	0.00	0.00		0.2	61	570	13.8

TABLE B-3. June 1997 Field Data (University of Waterloo)

Well Point	Depth b.g.s.(m)	Eh (SCE) (mV)	Eh (SHE) (mV)	pH	$Temp_{bath}$ (°c)	$Temp_{water}$ (°c)	Cr (VI) (mg/L)	Fe(II) (mg/L)	S^{2-} (mg/L)	DO (mg/L)	Alkalinity (mg/L CaCO3)	Conductivity (µS/cm)	Turbidity (ntu)
31-7	-3.52						0.00	0.00					
31-8	-3.02	211	***452***	6.25	24.1	23.6	0.00	0.02		0.8	72	355	6.8
31-9	-2.52						0.00	0.01					
31-10	-2.02	219	***457***	6.4	28.4	24.8	0.00	0.01		0.3	99	301	na
32-0	-7.07	160	***402***	6.03	23	23.4	0.00	0.32		0.3	43	167	1.6
32-1	-6.57						0.03	0.00					
32-2	-6.07	244	***486***	5.88	22.5	24.1	0.11	0.00		1	51	218	6.5
32-3	-5.57						0.00	2.99					
32-4	-5.07	215	***457***	6.04	23.5	22.5	0.06	0.01		0.15	56	448	5.9
32-5	-4.57						0.00	3.10					
32-6	-4.07	-108	***132***	6.64	26.4	22.6	0.00	9.87		0	80	273	2.4
32-7	-3.57						0.00	1.06					
32-8	-3.07	-26	***213***	6.47	26.5	22.3	0.00	2.14		0.4	94	289	2.3
32-9	-2.57						0.00	0.01					
32-10	-2.07	210	***450***	7.91	26.2	23.7	0.00	0.01		1	49	193	19.3
33-0	-6.81	-613	***-373***	10.43	25.5	20.8	0.00	0.00	0.012	0.25	22	155	2.5
33-1	-6.31						0.00	0.01	0.002				
33-2	-5.81	-232	***10***	7.4	23.5	24	0.00	1.98		0.25	40	235	4.1
33-3	-5.31						0.00	6.73					
33-4	-4.81	-242	***0***	7.86	23	24.3	0.00	0.33		0.4	67	284	na
33-5	-4.31						0.00	0.00	0.005				
33-6	-3.81	-263	***-22***	7.85	24.5	24.9	0.00	0.90		1	94	250	29.8
33-7	-3.31						0.00	6.40					
33-8	-2.81	-16	***226***	9.22	23.5	25.5	0.00	0.01	0.019	0.3	81	231	23.8
33-9	-2.31						0.00	0.02					
33-10	-1.81	-102	***140***	11.56	23.5	28	0.00	0.01	0.001	1	224	800	turbid
34-0	-6.99	-678	***-439***	10.5	27.1	21	0.00	0.00	0.003	0.18	24	153	1.8
34-1	-6.49						0.00	0.00					
34-2	-5.99	-367	***-126***	9.47	24.9	22.1	0.00	0.02	0.009	0.35	42	221	1.1
34-3	-5.49						0.00	0.00					
34-4	-4.99	-583	***-343***	9.25	26.4	21.3	0.00	0.00	0.004	0.25	9	202	6.4
34-5	-4.49						0.00	0.01					
34-6	-3.99	-548	***-308***	9.27	25.9	22	0.00	0.01	0.031	0.45	7	141	7.6
34-7	-3.49						0.00	0.13					
34-8	-2.99	-341	***-99***	8.96	23	25	0.00	0.00	0.018	1	16	113	91.0
34-9	-2.49						0.00	0.08					
34-10	-1.99	-341	***-99***	8.7	23	25	0.00	0.03	0.093	1	13	100	85.0
35-0	-7.00	27	***272***	6.46	19	20.6	0.00	0.72		0.3	28	118	na
35-1	-6.50						0.00	0.00					
35-2	-6.00	-234	***9***	7.89	22	23.8	0.00	0.19		0.7	67	196	0.6
35-3	-5.50						0.00	0.26	0.010				
35-4	-5.00	-222	***19***	7.71	24	24.2	0.01	0.24		0.7	14	223	8.4
35-5	-4.50						0.00	0.44					
35-6	-4.00	68	***309***	6.52	24	23.2	0.00	0.07		0.5	15	225	1.6
35-7	-3.50						0.00	0.30					
35-8	-3.00	-50	***192***	6.55	23	24.2	0.00	1.58		0.4	31	175	2.5
35-9	-2.50						0	0.70					
35-10	-2.00	-47	***195***	6.81	23	25.2	0	0.22		0.6	27	143	176

Table B 4. December 1998 Field Data (University of Waterloo)

Piezometer Location	Eh	Eh SHE	pH	DO CHEMet	Fe(II) DR2010	Cr(VI) DR2010	Alkalinity Hach	Turbidity	Conductivity 25C	S^{2-}
	mV	mV		mg/L	mg/L	mg/L	mg/L $CaCO_3$	NTU	µS/cm	mg/L
ML11-10	-20	224	6.63	0.15	2.60	0.00	128	27	304	
ML11-8	0	244	6.33	0.1	4.2	0.01	108	4.3	292	
ML11-6	170	414	6.24	0.5	0.00	0.02	88	0.8	417	0.00
ML11-4	230	474	5.79	>1	0.00	2.00	50	0.7	696	0.00
ML11-2	219	463	5.95	0.6	0.00	0.45	50	10	464	0.00
ML11-0	233	477	5.72	0.5	0.00	0.13	46	5	380	
ML12-10	162	406	6.44	0.2	0.02	0.00	76	1.9	363	
ML12-8	-48	196	6.49	0.2	4.21	0.00	124	4.1	351	
ML12-6	-157	87	6.92	<.1	5.60	0.00	122	2.5	282	0.09
ML12-4	241	485	5.91		0.00	1.10	53	0.4	672	0.00
ML12-2	231	475	5.87	0.7	0.00	0.95	47	1.5	602	0.00
ML13-10	-158	86	6.92	>1	0.02	0.00	53	18.0	226	
ML13-8	-796	-552	10.19	0.2	0.01	0.00	17	0.5	91	
ML13-6	-783	-539	10.19	0.1	0.01	0.00	18	0.6	107	0.00
ML13-4	-702	-458	9.84	0.25	0.00	0.00	16	0.4	77	0.00
ML13-2	-336	-92	9.31		0.02	0.00	75		311	0.04
ML13-0	-508	-264	9.59	0.25	0.03	0.00	95	1.1	345	
ML14-10	-295	-51	7.96	0	0.80	0.00	46		138	
ML14-8	-651	-407	10.16	0.6	0.01	0.00	19	0.5	91	
ML14-6	-805	-561	10.00	0.2	0.00	0.00	12	0.5	77	0.04
ML14-4	-795	-551	9.82	0.25	0.01	0.00	10	0.5	84	0.08
ML14-2	-444	-200	9.89	0.7	0.01	0.00	10	0.35	141	0.00
ML14-0	-785	-541	10.32	0.1	0.10	0.00	14	1.1	301	
ML15-10	231	475	6.77	0.5	0.02	0.00	104	3.8	338	
ML15-8	-222	22	6.5	0.3	0.37	0.00	72	0.6	216	
ML15-6	-96	148	6.54	0.2	2.54	0.00	47	7	150	0.01
ML15-4	-683	-439	8.68	0.2	0.03	0.00	3	31	34	0.01
ML15-2	-231	13	8.7	n/a	0.02	0.00	36	5.3	263	
ML15-0	0	244	6.58	0.2	1.45	0.00	36	28	311	
ML25-7	-51.9	148	6.69	0.50	2.1	NA	27	0.32	147	
ML25-6	-103.9	96	7.12	0.50	NA	NA	14	2.19	80	
ML25-5	-248.5	-49	8.33	0.60	NA	NA	32	6.93	215	
ML25-4	-233.5	-34	9.39	5.2	NA	NA	57	3.77	222	
ML25-3	-139.3	61	9.74	0.46	NA	NA	64	2.77	274	
ML25-2	-146.4	54	7.62	0.65	NA	NA	51	1.33	204	
ML25-1	-117.2	83	7.34	1.2	1.65	0.00	47	0.94	223	
ML24-7	-648.6	-449	9.85	1.98	NA	0.00	4	0.48	71	
ML24-6	-754.3	-554	9.70	0.35	NA	0.00	4	0.71	69	
ML24-5	-738.7	-539	9.87	0.39	NA	0.00	4	0.57	95	
ML24-4	-677.0	-477	10.25	0.33	NA	0.00	18	0.17	135	
ML24-3	-350.0	-150	9.99	0.70	NA	0.00	70	1.20	277	
ML24-2	-321.3	-121	9.92	0.38	NA	0.00	96	0.21	284	
ML24-1	-309.0	-109	9.93	0.44	NA	0.00	74	0.19	265	

Table B 4. December 1998 Field Data (University of Waterloo)

Piezometer Location	Eh	Eh SHE	pH	DO CHEMet	Fe(II) DR2010	Cr(VI) DR2010	Alkalinity Hach	Turbidity	Conductivity 25C	S^{2-}
	mV	mV		mg/L	mg/L	mg/L	mg/L $CaCO_3$	NTU	µS/cm	mg/L
ML23.5-8	-365.3	-165	8.69	1.36	NA	0.0	77	11.8	91	
ML23.5-7	-213.5	-14	8.52	1.10	NA	0.0	32	12.8	91	
ML23.5-6	-353.4	-153	9.05	1.02	NA	0.0	29	5.10	86	
ML23.5-5	-359.7	-160	8.55	0.95	NA	0.0	25	0.80	143	
ML23.5-4	-345.6	-146	8.52	0.79	NA	0.0	36	0.79	163	
ML23.5-3	5.9	206	9.08	1.80	NA	0.0	45	0.16	216	
ML23.5-2	-23.7	176	9.06	1.66	NA	0.0	79	2.33	267	
ML23.5-1	-174.2	26	9.84	1.36	NA	0.0	78	0.33	226	
ML23.5-0	-281.2	-81	9.83	1.39	NA	0.0	82	0.20	213	
ML22.5-8	-129.1	71	6.76	1.08	1.15	0.0	93	13.1	189	
ML22.5-7	-134.2	66	6.84	1.15	8.4	0.0	44	5.99	197	
ML22.5-6	-137.0	63	6.93	0.91	9.9	0.0	54	8.47	214	
ML22.5-5	-137.8	62	7.05	1.12	9.1	0.6	51	5.91	227	
ML22.5-4	-151.9	48	7.37	1.37	10.9	0.0	56	3.28	252	
ML22.5-3	-131.8	68	6.91	0.67	7.8	0.0	92	1.17	319	
ML22.5-2	84.00	284	6.6	1.31	9.5	0.01	117	4.64	250	
ML22.5-1	116.00	316	6.08	1.19	2.66	0.02	72	0.57	204	
ML22.5-0	-182.4	18	7.25	0.62	0.8	0.14	41	0.30	220	
ML21-7	-0.1	200	6.36	1.22	2.89	0.0	96	0.51	296	
ML21-6	33.7	234	6.25	1.04	NA	0.1	80	1.65	381	
ML21-5	256.0	456	5.96	0.99	NA	2.5	51	0.90	484	
ML21-4	241.3	441	6.06	1.11	NA	0.9	42	5.81	313	
ML21-3	222.2	422	5.99	1.03	NA	0.2	55	11.2	212	
ML21-2	228.5	429	5.98	1.12	NA	0.3	40	6.43	184	
ML21-1	126.5	327	6.04	1.05	NA	0.0	49	5.70	203	
ML31-10	158	402	6.55	0.4	0.00	0.05	128	21	343	
ML31-8	200	444	6.27	0.4	0.12	0.00	65	3.5	287	
ML31-6	179	423	6.04	1	0.02	0.00	81	5.8	565	0.00
ML31-4	224	468	5.91	0.8	0.00	0.22	48	16	458	0.00
ML31-2										
ML31-0	218	462	6.01	0.3	0.00	0.00	55	29	194	
ML32-10	51	295	7.02	1	0.00	0.00	71	6	349	
ML32-8	-57	187	6.6	0.2	3.60	0.00	65	1.2	346	
ML32-6	-110	134	6.53	0	4.63	0.00	118	4.6	420	0.00
ML32-4	210	454	5.94	0.4	0.01	0.04	56	3	577	0.00
ML32-2	163	407	5.87	0.4	0.00	0.03	46	2.2	235	0.00
ML32-0	174	418	6.05	0.4	0.00	0.00	48	3.7	192	
ML33-10	27	271	11.3	1	0.01	0.00	178		500	
ML33-8	-180	64	7.28	1	0.01	0.00	107	2.3	234	
ML33-6	-230	14	7.33	1	2.29	0.00	139	1.7	336	0.01
ML33-4	-223	21	7.66	0.2	2.30	0.00	128	1.1	391	0.00
ML33-2	-211	33	7.71	0.3	2.7	0.00	57	2.5	379	0.01
ML33-0	-540	-296	10.29	0.4	0.01	0.00	36	3.1	171	

Table B 4. December 1998 Field Data (University of Waterloo)

Piezometer Location	Eh	Eh SHE	pH	DO CHEMet	Fe(II) DR2010	Cr(VI) DR2010	Alkalinity Hach	Turbidity	Conductivity 25C	S^{2-}
	mV	mV		mg/L	mg/L	mg/L	mg/L $CaCO_3$	NTU	µS/cm	mg/L
ML34-10	-317	-73	8.61	0.4	0.01	0.00	65	5.3	196	
ML34-8	-310	-66	8.36	0.6	0.22	0.00	69	3.5	165	
ML34-6	-288	-44	7.9	0.4	0.63	0.00	57	1.1	228	0.00
ML34-4	-414	-170	8.7	0.6	0.01	0.00	50	1.5	230	0.00
ML34-2	-103	141	9.7	0.6	0.01	0.00	43	1.9	232	
ML34-0	-600	-356	10.79	0.6	0.01	0.00	31	2.9	190	
ML35-10	-179	65	6.98	0.8	2.44	0.00	120	50	214	
ML35-8	-151	93	6.83	1	2.92	0.00	58	4.8	165	
ML35-6	71	315	6.33	0.3	0.12	0.00	22	1.4	153	0.00
ML35-4	-278	-34	8.30	0.4	0.01	0.00	12	14.7	106	0.08
ML35-2	-185	59	7.83	0.2	0.11	0.00	32	2.2	170	0.01
ML35-0	0	244	6.65	0.15	0.63	0.00	17	26	122	
Monitoring Wells										
MW13	166.7	367	6.38	1.52	NA	2.5	102	0.82	801	
MW18	77.3	277	5.97	1.50	1.61	0.0	60	2.87	610	
MW35D	-45.8	154	6.37	0.68	5.24	0.0	62	2.97	198	
MW38	185.1	385	6.20	2.54	NA	0.0	63	0.77	157	
MW46	56.4	256	6.37	0.45	NA	0.0	61	0.28	175	
MW47	-108.8	91	7.56	0.36	NA	0.01	26	8.47	115	
MW48	213.2	413	5.98	3.12	NA	0.34	63	2.28	328	
MW49	-243.3	-43	7.44	4.16	NA	0.0	51	2.45	280	
MW50	-191.8	8	6.37	0.89	NA	0.08	36	42.2	188	
MW52	2.70	203	6.69	0.40	NA	0.0	36	2.41	167	

NOTE*****Samples collected by Waterloo were taken every second sample.

(Field measurements (Eh, pH, alk, eg.) taken at every second sample, but samples collected for cation, anion, org. analysis, etc. at every point.)

Appendix C Lab Analysis Results (VOCs and Dissolved Gases)

TABLE C-1. November 1996 VOC Results Analyzed at ManTech

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)	Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML11-0	ND	2.8	22.8	ML15-0	BLQ	1.6	10.8
ML11-1	ND	2.6	28.6	ML15-1	1.2	ND	ND
ML11-2	ND	BLQ	15.4	ML15-2	0.9	1.1	ND
ML11-3	BLQ	1.4	36.4	ML15-3	1.2	ND	ND
ML11-4	BLQ	9.6	45.8	ML15-4	1.3	ND	ND
ML11-5	1	39.5	65.4	ML15-5	1	ND	ND
ML11-6	1.1	43.3	71.2	ML15-6	1.2	BLQ	ND
ML11-7	BLQ	25.2	37.7	ML15-7	1	4.2	BLQ
ML11-8	BLQ	10.7	9.2	ML15-8 11/11	1.1	4	1.3
ML11-9	ND	6.1	3.7	ML15-9 11/11	BLQ	2.8	2.9
ML11-10	ND	4.2	3.8	ML15-10	ND	ND	BLQ
				ML31-0	ND	ND	144
ML12-1	ND	1.2	17.3	ML31-1	ND	ND	240
ML12-2	ND	1.3	27.1	ML31-2	ND	ND	136
ML12-3	BLQ	5.8	43.2	ML31-3	ND	ND	6.4
ML12-4	BLQ	18.1	43.1	ML31-4	ND	ND	108
ML12-5	BLQ	17.6	11.1	ML31-5	5.3	13	396
ML12-6	BLQ	2.9	0.9	ML31-6	31.3	49.3	356
ML12-7	BLQ	1.3	ND	ML31-7	29.1	48.1	331
ML12-8	ND	1.8	ND	ML31-8	19.9	34.1	205
ML12-9	ND	1	ND	ML31-9	5.3	4.1	8.4
ML12-10	ND	ND	ND	ML31-10	2.8	2.2	5.4
ML13-0	1.4	1	ND	ML32-0	BLQ	1.7	169
ML13-1	1.3	2.7	1	ML32-1	ND	1.3	304
ML13-2	1.1	3.1	ND	ML32-2	ND	ND	78.5
ML13-3	1	ND	ND	ML32-3	2.4	8.2	326
ML13-4	1	ND	ND	ML32-4	26	47.8	465
ML13-5	1	ND	ND	ML32-5	16.3	28.5	254
ML13-6	0.9	ND	ND	ML32-6	4.1	7.3	48
ML13-7	1	ND	ND	ML32-7	1.3	2.2	3.8
ML13-8	BLQ	ND	ND	ML32-8	BLQ	1.3	2.5
ML13-9	BLQ	ND	ND	ML32-9	ND	BLQ	3.5
ML13-10	0.9	ND	ND	ML32-10	ND	BLQ	5.5
ML14-0	1.2	ND	ND	ML33-0	1.4	1.3	ND
ML14-1	1	ND	ND	ML33-1	1.7	6.5	9.7
ML14-2	1.1	ND	ND	ML33-2	3.5	13.4	23.4
ML14-3	0.9	ND	ND	ML33-3	5.3	10.6	9.2
ML14-4	BLQ	ND	ND	ML33-4	5.5	13.8	10.7
ML14-5	BLQ	ND	ND	ML33-5	3.4	8.2	5.5
ML14-6	1	ND	ND	ML33-6	1.2	3.3	2.2
ML14-7	1	ND	ND	ML33-7	BLQ	1.4	4.6
ML14-8	0.9	ND	ND	ML33-8	BLQ	2.4	6.9
ML14-9	BLQ	1.2	ND	ML33-9	BLQ	3.7	10.5
ML14-10	BLQ	ND	ND	ML33-10	BLQ	3.8	8.5

Appendix C Lab Analysis Results (VOCs and Dissolved Gases)

TABLE C-1. November 1996 VOC Results Analyzed at ManTech

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)	Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML11-0	ND	2.8	22.8	ML15-0	BLQ	1.6	10.8
ML11-1	ND	2.6	28.6	ML15-1	1.2	ND	ND
ML11-2	ND	BLQ	15.4	ML15-2	0.9	1.1	ND
ML11-3	BLQ	1.4	36.4	ML15-3	1.2	ND	ND
ML11-4	BLQ	9.6	45.8	ML15-4	1.3	ND	ND
ML11-5	1	39.5	65.4	ML15-5	1	ND	ND
ML11-6	1.1	43.3	71.2	ML15-6	1.2	BLQ	ND
ML11-7	BLQ	25.2	37.7	ML15-7	1	4.2	BLQ
ML11-8	BLQ	10.7	9.2	ML15-8 11/11	1.1	4	1.3
ML11-9	ND	6.1	3.7	ML15-9 11/11	BLQ	2.8	2.9
ML11-10	ND	4.2	3.8	ML15-10	ND	ND	BLQ
				ML31-0	ND	ND	144
ML12-1	ND	1.2	17.3	ML31-1	ND	ND	240
ML12-2	ND	1.3	27.1	ML31-2	ND	ND	136
ML12-3	BLQ	5.8	43.2	ML31-3	ND	ND	6.4
ML12-4	BLQ	18.1	43.1	ML31-4	ND	ND	108
ML12-5	BLQ	17.6	11.1	ML31-5	5.3	13	396
ML12-6	BLQ	2.9	0.9	ML31-6	31.3	49.3	356
ML12-7	BLQ	1.3	ND	ML31-7	29.1	48.1	331
ML12-8	ND	1.8	ND	ML31-8	19.9	34.1	205
ML12-9	ND	1	ND	ML31-9	5.3	4.1	8.4
ML12-10	ND	ND	ND	ML31-10	2.8	2.2	5.4
ML13-0	1.4	1	ND	ML32-0	BLQ	1.7	169
ML13-1	1.3	2.7	1	ML32-1	ND	1.3	304
ML13-2	1.1	3.1	ND	ML32-2	ND	ND	78.5
ML13-3	1	ND	ND	ML32-3	2.4	8.2	326
ML13-4	1	ND	ND	ML32-4	26	47.8	465
ML13-5	1	ND	ND	ML32-5	16.3	28.5	254
ML13-6	0.9	ND	ND	ML32-6	4.1	7.3	48
ML13-7	1	ND	ND	ML32-7	1.3	2.2	3.8
ML13-8	BLQ	ND	ND	ML32-8	BLQ	1.3	2.5
ML13-9	BLQ	ND	ND	ML32-9	ND	BLQ	3.5
ML13-10	0.9	ND	ND	ML32-10	ND	BLQ	5.5
ML14-0	1.2	ND	ND	ML33-0	1.4	1.3	ND
ML14-1	1	ND	ND	ML33-1	1.7	6.5	9.7
ML14-2	1.1	ND	ND	ML33-2	3.5	13.4	23.4
ML14-3	0.9	ND	ND	ML33-3	5.3	10.6	9.2
ML14-4	BLQ	ND	ND	ML33-4	5.5	13.8	10.7
ML14-5	BLQ	ND	ND	ML33-5	3.4	8.2	5.5
ML14-6	1	ND	ND	ML33-6	1.2	3.3	2.2
ML14-7	1	ND	ND	ML33-7	BLQ	1.4	4.6
ML14-8	0.9	ND	ND	ML33-8	BLQ	2.4	6.9
ML14-9	BLQ	1.2	ND	ML33-9	BLQ	3.7	10.5
ML14-10	BLQ	ND	ND	ML33-10	BLQ	3.8	8.5

Appendix C Lab Analysis Results (VOCs and Dissolved Gases)

TABLE C-1. November 1996 VOC Results Analyzed at ManTech

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)	Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML34-0	1.4	ND	ND	ML35-0	1.1	BLQ	3.7
ML34-1	2.4	6.4	ND	ML35-1	1.3	1.2	ND
ML34-2	5.7	16.4	5.3	ML35-2	1.1	1.1	ND
ML34-3	5.6	12.4	3	ML35-3	5	10.9	2.2
ML34-4	1.9	1.5	ND	ML35-4	2.2	6.5	ND
ML34-5	1.4	BLQ	ND	ML35-5	1.4	2	ND
ML34-6	1.2	BLQ	ND	ML35-6	1.6	1.2	1.7
ML34-7	1.4	1.7	ND	ML35-7	3	2.5	2.8
ML34-8	1.6	1.3	ND	ML35-8	4.9	2.9	3.5
ML34-9	BLQ	BLQ	ND	ML35-9	1.3	BLQ	ND
ML34-10	ND	BLQ	ND	ML35-10	ND	ND	ND
ML21-1	BLQ	BLQ	2679	ML25-1	1.2	ND	50.4
ML21-2	ND	ND	430	ML25-2	BLQ	ND	11.4
ML21-3	ND	ND	37.3	ML25-3	1.4	1.4	ND
ML21-4	ND	0.9	34.4	ML25-4	1.7	4.9	ND
ML21-5	10.8	133	260	ML25-5	3.5	7.7	ND
ML21-6	65.4	286	301	ML25-6	1.2	1.3	1.4
ML21-7	26.6	55.5	62.1	ML25-7	BLQ	ND	4.6
ML22-1	BLQ	1.7	5652	MW1	1.3	7.6	256
ML22-2	2.6	14.9	ND	MW2	1.6	1.4	1.1
ML22-2A	ND	ND	188	MW3	BLQ	4.1	517
ML22-3	4.9	46.5	ND	MW4	1.4	BLQ	2.8
ML22-4	1.2	ND	0.9	MW5	ND	1	41
ML22-5	BLQ	3.6	61.9	MW6	1.8	11.3	ND
ML22-7	2	2.4	3.5	MW13	ND	BLQ	21.6
ML23-1	2	19.9	1.6	MW18	2.1	15.4	32.6
ML23-2	2.1	11.9	2.8	MW18dup	2.1	15	31.7
ML23-3	13.1	118	11.4	MW35D	ND	ND	ND
ML23-4	BLQ	4.3	ND	MW38	ND	ND	ND
ML23-5	1.8	ND	ND	Decon Blank	ND	ND	ND
ML23-6	BLQ	2.3	ND	Equipment Blank	ND	ND	ND
ML23-7	3.3	2.4	2.7	Field Blank 11/7	ND	ND	ND
ML24-1	1.8	5.4	ND	Field Blank 11/9	ND	ND	ND
ML24-2	1.3	2.7	ND	Field Blank 11/12	ND	ND	ND
ML24-3	5.1	23.1	ND	Trip Blank	ND	ND	ND
ML24-4	1.7	BLQ	ND	1 ppm Std	1.1	1	2.1
ML24-5	1.1	ND	ND	10 ppb Std	9.9	10.1	10.3
ML24-6	0.9	ND	ND	100 ppb Std	98.5	96	97.2
ML24-7	1	ND	ND	Lab Blank 1	ND	ND	ND
				Lab Blank 2	ND	ND	ND
				Lab Blank 3	ND	ND	ND

TABLE C-2. February 1997 VOC Results Analyzed at ManTech

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)	Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML11-0	BLQ	2.8	14.9	ML15-0	BLQ	2.0	12.2
ML11-1	ND	1.8	18.5	ML15-1	ND	ND	ND
ML11-1 dup	ND	1.8	17.7	ML15-1 dup	ND	ND	ND
ML11-2	BLQ	1.3	26.9	ML15-2	1.1	2.2	ND
ML11-3	BLQ	2.4	45	ML15-3	BLQ	ND	ND
ML11-4	BLQ	4.3	30	ML15-4	BLQ	ND	ND
ML11-5	1.1	33.3	60.6	ML15-5	0.9	ND	ND
ML11-6	BLQ	9.6	11.2	ML15-6	BLQ	1.7	BLQ
ML11-7	BLQ	3.3	1.1	ML15-7	BLQ	2.3	1.1
ML11-8	BLQ	2.7	BLQ	ML15-8	BLQ	1.4	1.2
ML11-9	ND	2.5	ND	ML15-9	ND	0.9	1.3
ML11-10	ND	1.1	ND	ML15-10	ND	BLQ	BLQ
				ML31-0	ND	ND	49.5
ML12-1	ND	BLQ	9.2	ML31-1	ND	ND	60.5
ML12-2	BLQ	1.9	31.1	ML31-2	ND	BLQ	45.6
ML12-3	BLQ	6.8	30.7	ML31-3	ND	ND	2.4
ML12-4	BLQ	15.2	38.9	ML31-3 dup	ND	ND	2.8
ML12-5	BLQ	16.5	18.8	ML31-4	ND	BLQ	531
ML12-6	BLQ	1.2	ND	ML31-5	5.9	16.5	2000
ML12-7	ND	BLQ	ND	ML31-6	30	52.2	680
ML12-7 dup	ND	BLQ	ND	ML31-7	17.7	31.5	280
ML12-8	ND	ND	ND	ML31-8	7.5	14.1	73.5
ML12-9	ND	ND	ND	ML31-9	6.8	7.4	22.3
ML12-10	ND	ND	ND	ML31-10	3.6	2.1	4.5
ML13-0	1.3	BLQ	ND	ML32-0	BLQ	6.6	80.9
ML13-1	BLQ	ND	ND	ML32-1	ND	1.0	104
ML13-1 dup	BLQ	ND	ND	ML32-2	ND	1.0	4.7
ML13-2	0.9	2.5	ND	ML32-3	3.3	15.2	1390
ML13-3	BLQ	1.3	ND	ML32-4	36.8	64.9	724
ML13-4	BLQ	ND	ND	ML32-5	16.3	23.3	280
ML13-5	BLQ	ND	ND	ML32-6	2.9	3.3	7.7
ML13-6	BLQ	ND	ND	ML32-6 dup	2.3	3.2	6.8
ML13-7	BLQ	ND	ND	ML32-7	3.4	2.3	2.2
ML13-8	BLQ	ND	ND	ML32-8	BLQ	1.3	2.0
ML13-9	BLQ	ND	ND	ML32-9	ND	1.1	6.9
ML13-10	ND	ND	ND	ML32-10	ND	BLQ	4.8
ML14-0	0.9	ND	ND	ML33-0	1.1	BLQ	ND
ML14-1	BLQ	ND	ND	ML33-1	6.0	26.5	22.1
ML14-2	ND	ND	ND	ML33-1 dup	6.4	28.0	22.9
ML14-3	BLQ	ND	ND	ML33-2	28.8	26.5	4.9
ML14-4	BLQ	ND	ND	ML33-3	7.2	27.1	22.6
ML14-5	BLQ	ND	ND	ML33-4	2.0	1.8	BLQ
ML14-6	BLQ	ND	ND	ML33-5	2.7	8.7	7.1
ML14-7	BLQ	ND	ND	ML33-6	1.1	1.8	1.7
ML14-8	2.1	ND	ND	ML33-7	1.5	1.9	3.0
ML14-9	BLQ	BLQ	ND	ML33-8	ND	1.4	3.7
ML14-9 dup	BLQ	ND	ND	ML33-8 dup	ND	1.2	2.7
ML14-10	BLQ	ND	ND	ML33-9	ND	1.1	1.5

TABLE C-2. February 1997 VOC Results Analyzed at ManTech

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)	Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML34-0	BLQ	ND	ND	ML35-0	ND	ND	23.0
ML34-0 dup	BLQ	ND	ND	ML35-1	3.2	BLQ	ND
ML34-1	4.2	24.0	41.7	ML35-2	1.5	BLQ	ND
ML34-2	4.4	18.1	8.3	ML35-2 dup	1.5	BLQ	ND
ML34-3	2.2	1.4	ND	ML35-3	2.5	17.3	16.9
ML34-4	1.5	BLQ	ND	ML35-4	3.7	22.4	2.8
ML34-5	1.9	ND	ND	ML35-5	1.4	4.4	ND
ML34-6	1.7	BLQ	ND	ML35-6	2.7	1.4	0.9
ML34-7	1.5	0.9	ND	ML35-7	4.0	2.3	1.5
ML34-8	1.2	1.1	ND	ML35-8	4.2	1.5	BLQ
ML34-9	1.9	1.6	ND	ML35-9	3.4	1.0	ND
ML34-10	1.6	2.0	ND	ML35-10	1.6	1.3	ND
ML21-1	BLQ	ND	3330	ML25-1	0.9	42.5	133
ML21-2	ND	ND	448	ML25-1 dup	1.1	45.5	147
ML21-3	ND	ND	2.5	ML25-2	BLQ	1.0	2.6
ML21-4	ND	ND	11.8	ML25-3	1.0	1.3	ND
ML21-5	7.3	91.3	195	ML25-4	1.5	4.6	ND
ML21-5 dup	7.5	93.7	210	ML25-5	2.0	8.7	ND
ML21-6	39.5	179	179	ML25-6	4.0	10.4	ND
ML21-7	8.2	17.8	14.4	ML25-7	BLQ	0.9	2.3
ML22-2	9.1	62.3	3.5	MW13	BLQ	2.2	61.9
ML22-3	1.9	6.7	2.4	MW18	1.3	7.9	14.0
ML22-4	1.0	ND	BLQ	MW35D	ND	ND	0.9
ML22-4 dup	0.9	ND	ND	MW38	ND	ND	1.3
ML23-1	1.5	7.9	BLQ	MW38 dup	ND	ND	1.2
ML23-2	1.2	4.1	ND	MW46	1.6	10.6	636
ML23-3	2.1	14.5	3.3	MW47	1.8	1.0	BLQ
ML23-4	BLQ	2.4	ND	MW48	BLQ	2.4	471
ML24-1	BLQ	1.0	ND	MW49	BLQ	ND	2.8
ML24-2	1.0	BLQ	ND	MW50	ND	ND	3.4
ML24-3	2.7	13.0	1.0				
ML24-4	1.1	ND	ND				
ML24-5	BLQ	ND	ND				
ML24-5	BLQ	ND	ND				
ML24-6	BLQ	ND	ND				
ML24-7	BLQ	ND	ND				

BLQ = Below limit of quantitation 1 ppb
ND = None detected

TABLE C-3. June 1997 VOC Results Analyzed at ManTech

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)	Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML11-0	ND	1.4	12.6	ML15-0	0.9	BLQ	4.9
ML11-1	ND	1.0	14.7	ML15-1	BLQ	ND	ND
ML11-2	ND	2.0	44.9	ML15-2	1.0	0.9	ND
ML11-3	ND	1.8	32.8	ML15-3	BLQ	ND	ND
ML11-4	1.0	24.6	79.6	ML15-4	BLQ	ND	ND
ML11-5	BLQ	30.1	46.7	ML15-5	BLQ	ND	ND
ML11-6	ND	13.1	15.8	ML15-6	ND	BLQ	ND
ML11-7	ND	11.1	13.4	ML15-7	ND	1.5	1.0
ML11-8	ND	2.5	ND	ML15-8	ND	1.5	1.1
ML11-9	ND	2.0	ND	ML15-9	ND	1.5	1.3
ML11-10	ND	1.0	ND	ML15-10	ND	ND	ND
				ML31-0	ND	ND	80.3
ML12-1	ND	ND	11.0	ML31-1	ND	ND	66.2
ML12-2	ND	0.9	18.1	ML31-2	ND	ND	42.3
ML12-3	BLQ	6.5	42.0	ML31-3	ND	ND	2.8
ML12-4	BLQ	16.2	44.4	ML31-4	ND	ND	180
ML12-5	BLQ	14.1	17.9	ML31-5	9.1	21.6	620
ML12-6	ND	0.9	ND	ML31-6	29.7	42.9	635
ML12-7	ND	ND	ND	ML31-7	23.2	39.4	475
ML12-8	ND	ND	ND	ML31-8	13.6	14.9	109
ML12-9	ND	ND	ND	ML31-9	24.5	12.0	5.6
ML12-10	ND	ND	ND	ML31-10	10.4	6.3	3.8
ML13-0	1.9	ND	ND	ML32-0	ND	1.7	84.6
ML13-1	1.4	1.7	ND	ML32-1	ND	1.0	56.4
ML13-2	1.0	2.1	ND	ML32-2	ND	ND	7.1
ML13-3	BLQ	BLQ	ND	ML32-3	9.3	7.2	3.1
ML13-4	BLQ	ND	ND	ML32-4	11.7	25.1	421
ML13-5	BLQ	ND	ND	ML32-5	12.7	23.6	96.7
ML13-6	BLQ	ND	ND	ML32-6	6.3	7.3	9.1
ML13-7	BLQ	ND	ND	ML32-7	8.3	3.6	1.7
ML13-8	BLQ	ND	ND	ML32-8	7.3	5.1	1.4
ML13-9	BLQ	ND	ND	ML32-9	ND	ND	3.0
ML13-10	BLQ	ND	ND	ML32-10	ND	ND	3.0
ML14-0	0.9	ND	ND	ML33-0	0.9	ND	ND
ML14-1	BLQ	ND	ND	ML33-1	3.0	6.3	3.7
ML14-2	BLQ	ND	ND	ML33-2	16.3	3.4	4.9
ML14-3	BLQ	ND	ND	ML33-3	14.5	7.0	1.7
ML14-4	BLQ	ND	ND	ML33-4	2.9	3.2	ND
ML14-5	BLQ	ND	ND	ML33-5	2.3	2.9	ND
ML14-6	BLQ	ND	ND	ML33-6	2.1	1.2	ND
ML14-7	1.8	ND	ND	ML33-7	3.5	2.0	1.0
ML14-8	BLQ	ND	ND	ML33-8	BLQ	1.1	1.4
ML14-9	BLQ	ND	ND	ML33-9	ND	ND	ND
ML14-10	BLQ	ND	ND	ML33-10	ND	ND	0.9

TABLE C-3. June 1997 VOC Results Analyzed at ManTech

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML34-0	BLQ	ND	ND
ML34-1	1.9	3.1	3.9
ML34-2	1.7	5.1	1.2
ML34-3	3.6	1.1	ND
ML34-4	1.2	ND	ND
ML34-5	1.4	ND	ND
ML34-6	1.3	ND	ND
ML34-7	1.6	ND	ND
ML34-8	1.1	ND	ND
ML34-9	1.1	ND	ND
ML34-10	1.0	ND	ND
ML21-1	Not sampled-tracer		
ML21-2	Not sampled-tracer		
ML21-3	ND	ND	7.5
ML21-4	ND	BLQ	21.1
ML21-5	12.7	116	206
ML21-6	37.0	152	156
ML21-7	19.7	28.2	21.1
ML22-1	ND	1.6	4320
ML22-2	3.4	41.2	ND
ML22-3	7.3	27.6	0.9
ML22-4	BLQ	ND	ND
ML22-5	1.4	5.2	72.9
ML22-6	dry		
ML22-7	dry		
ML23-1	3.0	25.9	ND
ML23-2	1.8	5.7	ND
ML23-3	8.6	52.2	3.3
ML23-4	1.0	2.0	ND
ML23-5	0.9	ND	12.7
ML23-6	BLQ	ND	9.2
ML23-7	10.7	8.9	8.5
ML24-1	2.0	8.9	ND
ML24-2	1.5	2.4	ND
ML24-3	1.8	5.5	ND
ML24-4	1.0	ND	ND
ML24-5	BLQ	ND	ND
ML24-6	BLQ	ND	ND
ML24-7	BLQ	ND	ND

Well #	Vinyl Cl (µg/L)	c-DCE (µg/L)	TCE (µg/L)
ML35-0	BLQ	ND	2.7
ML35-1	1.6	ND	ND
ML35-2	1.8	ND	ND
ML35-3	3.4	10.4	6.8
ML35-4	3.0	9.0	1.5
ML35-5	1.4	2.2	ND
ML35-6	1.8	ND	ND
ML35-7	2.0	BLQ	ND
ML35-8	3.2	1.3	ND
ML35-9	2.5	1.2	ND
ML35-10	1.7	1.8	ND
ML25-1	1.4	14.8	81.6
ML25-2	1.2	1.9	ND
ML25-3	1.6	6.0	ND
ML25-4	5.6	8.1	ND
ML25-5	8.3	28.0	ND
ML25-6	1.4	3.9	ND
ML25-7	ND	ND	1.1
MW12	ND	1.2	4.7
MW13	ND	0.7	24.0
MW18	BLQ	4.5	7.7
MW35D	ND	ND	ND
MW38	ND	ND	BLQ
MW46	1.9	6.2	63.3
MW47	1.7	2.6	1.5
MW48	ND	4.7	535
MW49	Samples Broken		
MW50	BLQ	3.7	156

BLQ=<1 ppb
ND=none detected

	Benzene	Toluene	Ethylbenzene
MW12	ND	ND	ND

TABLE C-4. December 1998 VOC Results Analyzed at ManTech

Piezometer	Vinyl Chloride (ppb)	cDCE (ppb)	TCE (ppb)	Piezometer	Vinyl Chloride (ppb)	cDCE (ppb)	TCE (ppb)
ML11-10	ND	3.7	ND	ML-15-10	ND	1.0	1.0
ML11-9	ND	4.6	ND	ML-15-9	<1.0	2.6	2.1
ML11-8	ND	4.6	ND	ML-15-8	1.2	1.9	1.8
ML11-7 dup	ND	4.6	1.2	ML-15-7	1.3	3.5	1.9
ML11-7	ND	5.2	1.2	ML-15-6	<1.0	3.4	1.2
ML11-6	<1.0	28.1	24.0	ML-15-5 dup	<1.0	<1.0	ND
ML11-5 dup	<1.0	33.2	26.8	ML-15-5	<1.0	<1.0	ND
ML11-5	<1.0	31.3	28.2	ML-15-4	1.1	ND	ND
ML11-4	<1.0	45.6	114	ML-15-3	1.4	ND	ND
ML11-3	ND	10.6	47.6	ML-15 -2	5.3	5.5	ND
ML11-2	ND	2.4	12.7	ML-15 -1	1.5	ND	ND
ML11-1	ND	ND	7.1	ML-15 -0	1.4	ND	ND
ML11-0	ND	2.0	10.5				
ML12-10	ND	ND	ND	ML-31-10			
ML12-9	ND	<1.0	ND	ML-31-9	38.8	14.8	21.3
ML12-8	ND	1.1	ND	ML-31-8			
ML12-7	1.1	3.3	2.3	ML-31-7	32.4	42.2	320
ML12-6	1.3	2.7	ND	ML-31-6			
ML12-5	4.0	35.2	58.6	ML-31-5	6.4	17.2	673
ML12-4	<1.0	13.3	41.7	ML-31-4			
ML12-3	ND	7.5	33.8	ML-31-3 dup	ND	ND	6.8
ML12-2	ND	2.6	19.0	ML-31-3	ND	ND	7.7
ML12-1 dup	ND	<1.0	11.8	ML-31-1	ND	ND	11.0
ML12-1	ND	1.1	12.0	ML-31-0			
ML13-10	ND	ND	ND	ML-32-10	ND	ND	1.2
ML13-9	2.2	ND	ND	ML-32-9	ND	ND	1.2
ML13-8	1.3	ND	ND	ML-32-8	20.2	6.0	1.3
ML13-7	2.0	ND	ND	ML-32-7	27.8	7.1	3.2
ML13-6	<1.0	<1.0	<1.0	ML-32-6	23.3	35.2	98.0
ML13-5 dup	1.0	ND	ND	ML-32-5 dup	17.8	48.1	470
ML13-5	1.2	ND	ND	ML-32-5	19.5	49.9	425
ML13-4	1.9	ND	ND	ML-32-4	5.8	13.4	563
ML13-3	2.0	1.3	ND	ML-32-3	ND	2.3	370
ML13-2	3.3	2.8	ND	ML-32-2	ND	ND	4.5
ML13-1	11.3	2.1	ND	ML-32-1	ND	ND	8.2
ML13-0	15.0	1.4	ND	ML-32-0	<1.0	12.4	63.1
ML-14-10	<1.0	ND	ND	ML-33-10	<1.0	<1.0	ND
ML-14-9	1.3	ND	ND	ML-33-9	<1.0	<1.0	ND
ML-14-8	<1.0	ND	ND	ML-33-8	2.2	ND	ND
ML-14-7 dup	<1.0	ND	ND	ML-33-7 dup	15.6	2.8	ND
ML-14-7	<1.0	ND	ND	ML-33-7	16.7	2.9	ND
ML-14-6	<1.0	ND	ND	ML-33-6	13.0	1.5	ND
				ML-33-5	17.0	3.3	3.2
ML-14-4	1.0	ND	ND	ML-33-4	18.3	7.6	ND
ML-14-3	2.2	1.2	ND	ML-33-3	9.5	7.2	7.5
ML-14-2	5.6	ND	ND	ML-33-2	14.2	4.3	11.8
ML-14-1	8.1	ND	ND	ML-33-1	<1.0	3.1	6.1
ML-14-0	5.3	ND	ND	ML-33-0	<1.0	ND	ND

TABLE C-4. December 1998 VOC Results Analyzed at ManTech

Piezometer	Vinyl Chloride (ppb)	cDCE (ppb)	TCE (ppb)	Piezometer	Vinyl Chloride (ppb)	cDCE (ppb)	TCE (ppb)
ML-34-10	1.6	ND	ND	ML-23.5-8	1.6	1.7	ND
ML-34-9	2.1	ND	ND	ML-23.5-7	2.2	1.1	ND
ML-34-8	2.6	ND	ND	ML-23.5-6	3.9	ND	ND
ML-34-7	4.9	<1.0	ND	ML-23.5-5	<1.0	1.0	ND
ML-34-6	3.7	ND	ND	ML-23.5-4	<1.0	<1.0	ND
ML-34-5 dup	2.9	1.1	ND	ML-23.5-3	1.4	3.8	ND
ML-34-5	3.5	1.1	ND	ML-23.5-2	1.8	5.4	1.5
ML-34-4	3.3	ND	ND	ML-23.5-1 dup	4.1	7.0	3.0
ML-34-3	<1.0	1.0	ND	ML-23.5-1	4.4	7.5	2.9
ML-34-2	<1.0	4.7	1.9	ML-23.5-0	4.6	20.2	1.3
ML-34-1	5.2	<1.0	ND				
ML-34-0	2.1	ND	ND				
ML-35-10	1.3	2.6	ND	ML-24-7 dup	ND	ND	ND
ML-35-9	3.4	1.7	ND	ML-24-7	<1.0	ND	ND
ML-35-8	3.0	1.6	ND	ML-24-6	<1.0	ND	ND
ML-35-7				ML-24-5	1.3	ND	ND
ML-35-6	2.3	1.1	ND	ML-24-4	2.6	ND	ND
ML-35-5				ML-24-3	16.9	7.3	1.0
ML-35-4	3.3	2.1	ND	ML-24-2	13.6	8.2	ND
ML-35-3				ML-24-1 dup	1.2	7.8	ND
ML-35-2	4.0	ND	ND	ML-24-1	1.4	8.5	ND
ML-35-1	5.3	ND	ND				
ML-35-0	1.3	ND	1.1				
ML-21-7	27.1	63.6	40.3	ML-25-7	1.1	1.0	ND
ML-21-6	42.9	173	132	ML-25-6	3.1	1.8	ND
ML-21-5 dup	11.7	137	156	ML-25-5	9.5	25.9	ND
ML-21-5	12.6	135	152	ML-25-4 dup	4.8	19.0	ND
ML-21-4	<1.0	21.0	50.2	ML-25-4	5.3	20.2	ND
ML-21-3	ND	1.8	44.4	ML-25-3	4.0	8.0	ND
ML-21-2	<1.0	ND	438	ML-25-2	2.6	5.9	ND
ML-21-1	ND	ND	3790	ML-25-1	3.8	3.9	3.6
ML-22.5-0	2.9	3.7	ND	**Monitoring Wells**			
ML-22.5-8	2.3	1.3	1.2				
ML-22.5-7	3.0	1.0	1.4	MW-13	ND	ND	8.2
ML-22.5-6	5.9	1.4	1.2	MW-18 dup	ND	ND	ND
ML-22.5-5	2.8	1.7	4.2	MW-18	ND	ND	ND
ML-22.5-4	2.1	3.3	7.3	MW-35D	ND	ND	ND
ML-22.5-3	<1.0	2.2	14.6	MW-38	ND	ND	ND
ML-22.5-2 dup	<1.0	2.9	14.3	MW-46	8.7	45.6	51.9
ML-22.5-2	1.4	4.6	159	MW-47	2.7	1.2	ND
ML-22.5-1	12.0	52.1	242	MW-48	5.8	60.0	347
				MW-49	2.0	ND	<1.0
Blanks				MW-50	2.9	17.3	290
TRIP BLANK 12\1	ND	ND	ND	MW-52	1.4	50.6	164
FIELD BLANK 12'	ND	ND	ND				
FIELD BLANK12/(	ND	1.7	ND				
FIELD BLANK12/'	<1.0	ND	ND				
FIELD BLANK12/	<1.0	1.2	ND				
ML31-BLANK	ND	2.4	ND				
ML32-BLANK	ND	ND	ND				
ML33-BLANK	ND	ND	ND				

TABLE C-5. November 1996 Dissolved Gas Results Analyzed at ManTech

Well #	Methane mg/L	Ethene mg/L	Ethane mg/L	Well #	Methane mg/L	Ethene mg/L	Ethane mg/L
ML11-0	BLQ	ND	ND	ML15-0	0.592	BLQ	0.015
ML11-1	0.038	ND	ND	ML15-1	2	0.003	0.015
ML11-1 dup	0.033	ND	ND	ML15-2	3.47	0.004	0.004
ML11-2	0.085	ND	ND	ML15-3	8.85	BLQ	0.009
ML11-3	0.087	ND	ND	ML15-4	3.4	BLQ	0.01
ML11-4	0.038	ND	ND	ML15-4 dup	3.24	BLQ	0.01
ML11-5	0.027	ND	ND	ML15-5			
ML11-6	0.027	ND	ND	ML15-6			
ML11-6 dup	0.024	ND	ND	ML15-7	0.102	ND	0.002
ML11-7	0.042	ND	ND	ML15-8 11/1	0.082	ND	BLQ
ML11-8	0.127	ND	ND	ML15-9 11/1	BLQ	ND	ND
ML11-9	0.919	ND	ND	ML15-9 11/1:	0.24	ND	ND
ML11-10		BROKEN		ML15-9 dup	0.227	ND	ND
				ML15-10	0.003	ND	ND
ML12-1	0.071	ND	ND	ML31-0	BLQ	ND	ND
ML12-2	0.094	ND	ND	ML31-0 dup	BLQ	ND	ND
ML12-3	0.06	ND	ND	ML31-1	0.009	ND	ND
ML12-3 dup	0.057	ND	ND	ML31-2	0.015	ND	ND
ML12-4	0.793	ND	BLQ	ML31-3	0.027	ND	ND
ML12-5	30.96	0.007	0.01	ML31-4	BLQ	ND	ND
ML12-6	3.5	BLQ	BLQ	ML31-5	0.002	ND	ND
ML12-7	3.03	ND	BLQ	ML31-6	BLQ	BLQ	ND
ML12-8	1.17	ND	ND	ML31-7	BLQ	ND	ND
ML12-9	3.03	ND	ND	ML31-8	0.043	ND	ND
ML12-10	BLQ	ND	ND	ML31-9	1.3	ND	ND
				ML31-9 dup	1.19	ND	ND
				ML31-10	BLQ	ND	ND
ML13-0	2.74	0.003	0.007	ML32-0	0.995	0.004	0.004
ML13-1	1.36	0.005	0.004	ML32-1	0.01	ND	ND
ML13-2	7.04	0.004	0.006	ML32-2	0.044	ND	ND
ML13-2 dup	6.53	0.003	0.005	ML32-3	0.043	ND	ND
ML13-3	3.39	BLQ	0.007	ML32-4	0.099	BLQ	ND
ML13-4	4.17	BLQ	0.003	ML32-5	0.09	BLQ	BLQ
ML13-5	6.38	BLQ	0.002	ML32-6	0.279	BLQ	BLQ
ML13-6	6.7	BLQ	0.003	ML32-7	0.549	BLQ	BLQ
ML13-7	0.294	BLQ	0.003	ML32-7 dup	0.503	ND	BLQ
ML13-8	1.77	BLQ	0.004	ML32-8	BLQ	ND	ND
ML13-9	1.09	BLQ	0.004	ML32-9	BLQ	ND	ND
ML13-10	1.54	BLQ	BLQ	ML32-10	BLQ	ND	ND
ML14-0	2.54	BLQ	BLQ	ML33-0	7.39	0.012	0.025
ML14-1	5.62	0.004	0.009	ML33-1	1.63	0.012	0.011
ML14-2	1.16	BLQ	0.008	ML33-2	1.07	0.022	0.014
ML14-2 dup	1.08	BLQ	0.007	ML33-3	1.17	0.014	0.01
ML14-3	1.32	BLQ	0.01	ML33-4	1.39	0.022	0.015
ML14-4	0.955	BLQ	0.007	ML33-5	1.21	0.011	0.009
ML14-5	1.61	BLQ	0.007	ML33-6	0.379	0.004	0.003
ML14-6	1.67	BLQ	0.008	ML33-6 dup	0.361	0.004	0.003
ML14-7	1.05	BLQ	0.006	ML33-7	BLQ	ND	ND

TABLE C-5. November 1996 Dissolved Gas Results Analyzed at ManTech

Well #	Methane mg/L	Ethene mg/L	Ethane mg/L
ML14-8	1.09	BLQ	0.006
ML14-9	1.16	ND	0.002
ML14-10	0.358	ND	BLQ
ML34-0	4.75	0.008	0.033
ML34-1	2.99	0.019	0.014
ML34-2	2.42	0.022	0.016
ML34-3	2.93	0.026	0.023
ML34-4	2.36	0.02	0.029
ML34-5	2.29	0.017	0.03
ML34-6	2.19	0.019	0.031
ML34-6 dup	2.05	0.018	0.032
ML34-7	2.29	0.01	0.02
ML34-8	2.73	0.007	0.013
ML34-9	1.83	BLQ	0.002
ML34-10	0.849	BLQ	0.003
ML21-1	0.077	ND	ND
ML21-2	0.028	ND	ND
ML21-3	0.062	ND	ND
ML21-4	0.054	ND	ND
ML21-5	0.022	BLQ	0.009
ML21-6	0.149	BLQ	ND
ML21-7	0.216	BLQ	ND
ML22-1	0.112	ND	ND
ML22-2	1.88	0.043	0.059
ML22-2A	0.05	ND	ND
ML22-3	0.832	0.012	0.013
ML22-3 dup	0.77	0.011	0.012
ML22-4	2.21	blq	0.022
ML22-5			
ML22-7	0.287	nd	nd
ML23-1	3.45	0.044	0.033
ML23-2	0.746	0.023	0.016
ML23-3	0.918	0.021	0.018
ML23-3 dup	0.847	0.019	0.017
ML23-4	2.45	BLQ	0.005
ML23-5	0.207	BLQ	0.011
ML23-6			
ML23-7	0.671	ND	ND

Well #	Methane mg/L	Ethene mg/L	Ethane mg/L
ML33-8	0.217	ND	BLQ
ML33-9	0.817	BLQ	BLQ
ML33-10	0.155	ND	BLQ
ML35-0	4.52	0.009	0.032
ML35-1	5.13	0.01	0.017
ML35-2	3.8	0.008	0.01
ML35-3	2.22	0.027	0.019
ML35-4	2.43	0.036	0.036
ML35-4 dup	2.39	0.035	0.034
ML35-5	2.66	0.027	0.039
ML35-6	1.37	0.011	0.028
ML35-7	0.73	0.005	0.01
ML35-8	0.567	0.003	0.007
ML35-9	0.74	BLQ	BLQ
ML35-10	0.068	ND	ND
ML24-1	3.07	0.022	0.02
ML24-2	2.09	0.01	0.016
ML24-3	3.07	0.014	0.017
ML24-4	2.36	0.003	0.02
ML24-5	1.78	BLQ	0.019
ML24-6	1.66	BLQ	0.015
ML24-6 dup	1.54	BLQ	0.014
ML25-1	0.026	BLQ	0.002
ML25-2	0.354	0.004	0.008
ML25-2dup	0.323	0.003	0.007
ML25-3	2.55	0.01	0.02
ML25-4	1.24	0.014	0.02
ML25-5	1.98	0.024	0.024
ML25-6	2.45	0.015	0.021
ML25-7	ND	ND	ND
MW1	0.019	0.002	0.005
MW13	0.023	ND	ND
MW18	0.13	ND	ND
MW2	4.78	0.012	0.0025
MW2 dup	4.48	0.011	0.024
MW3	0.036	ND	ND
MW35D	0.103	ND	ND
MW38	BLQ	ND	ND
MW4	3.45	0.003	0.009
MW5	0.002	ND	BLQ

TABLE C-5. November 1996 Dissolved Gas Results Analyzed at ManTech

Well #	Methane mg/L	Ethene mg/L	Ethane mg/L	Well #	Methane mg/L	Ethene mg/L	Ethane mg/L
Decon Blank 11/19	BLQ	ND	ND				
Decon Blank 11/20	BLQ	ND	ND				
Decon Blank 11/20 dup	BLQ	ND	ND				
Lab Blank1	BLQ	ND	ND				
Lab Blank2	BLQ	ND	ND				
Lab Blank3	BLQ	ND	ND				
Lab Blank4	BLQ	ND	ND				
Lab Blank5	BLQ	ND	ND				
10 ppm CH4	10.05	NA	NA				
100 ppm Ch4	99.95	NA	NA				
1000 ppm CH4	1002.39	NA	NA				
1% CH4	1.03	NA	NA				
10% CH4	10.02	NA	NA				
10 ppm C2H4	NA	10.14	NA				
100 ppm C2H4	NA	99.96	NA				
1000 ppm C2H4	NA	1000.56	NA				
10 ppm C2H6	NA	NA	9.96				
100 ppm C2H6	NA	NA	100.05				
1000 ppm C2H6	NA	NA	999.56				
Limits of Quantitation	0.001	0.003	0.002				

BLQ = Below Limit of Quantitation
ND = None Detected
NA = Not Analyzed

TABLE C-6. February 1997 Dissolved Gas Results Analyzed at ManTech

Well #	Methane mg/L	Ethene mg/L	Ethane mg/L	Well #	Methane mg/L	Ethene mg/L	Ethane mg/L
ML11-0	0.016	ND	ND	ML14-5	0.354	BLQ	0.003
ML11-1	0.05	ND	ND	ML14-6	0.393	BLQ	0.002
ML11-2	0.112	ND	ND	ML14-7	0.413	ND	0.003
ML11-3	0.062	ND	ND	ML14-8	0.605	BLQ	ND
ML11-4	0.035	ND	ND	ML14-9	1.695	ND	BLQ
ML11-4 dup	0.03	ND	ND	ML14-9 dup	1.677	ND	BLQ
ML11-5	0.219	ND	ND	ML14-10	1.208	ND	BLQ
ML11-6	0.764	ND	ND	ML15-0	1.28	BLQ	0.013
ML11-7	1.104	ND	ND	ML15-1	9.851	0.003	0.008
ML11-8	1.211	ND	ND	ML15-2		No Sample	
ML11-9	1.248	ND	ND	ML15-3	8.679	BLQ	0.004
ML11-9 dup	1.118	ND	ND	ML15-4	3.637	BLQ	0.004
ML11-10	1.187	ND	BLQ	ML15-5	1.688	ND	0.006
ML12-1	0.061	ND	ND	ML15-5 dup	1.642	ND	0.006
ML12-2	0.118	ND	ND	ML15-6	0.585	ND	0.003
ML12-3	0.082	ND	ND	ML15-7		No Sample	
ML12-4	0.086	ND	ND	ML15-8	0.44	ND	ND
ML12-5	Sample	Broken		ML15-9	0.193	ND	ND
ML12-6	11.678	ND	ND	ML15-10	0.028	ND	ND
ML12-7	0.342	ND	ND	ML21-1	0.016	ND	ND
ML12-7 dup	0.339	ND	ND	ML21-2		No Sample	
ML12-8	0.043	ND	ND	ML21-3	0.031	ND	ND
ML12-9	0.023	ND	ND	ML21-3 dup	0.026	ND	ND
ML12-10	0.004	ND	ND	ML21-4	0.029	ND	ND
ML13-0	4.094	0.004	0.004	ML21-4 dup	0.028	ND	ND
ML13-1	2.705	ND	0.002	ML21-5	0.026	ND	ND
ML13-2	9.528	0.003	0.004	ML21-6	0.098	ND	ND
ML13-2 dup	9.881	0.003	0.003	ML21-7	0.0381	ND	ND
ML13-3	11.135	ND	0.003	ML22-2	5.026	0.034	0.027
ML13-4	5.067	ND	0.002	ML22-3	0.926	0.007	0.008
ML13-5	7.105	BLQ	0.002	ML22-4	3.631	BLQ	0.006
ML13-5 dup	7.105	BLQ	0.002	ML23-1	5.304	0.026	0.018
ML13-6	5.544	ND	0.002	ML23-1 dup	5.076	0.024	0.018
ML13-7	2.666	ND	0.002	ML23-2	3.207	0.005	0.005
ML13-8	1.71	ND	0.002	ML23-2 dup	2.696	0.004	0.004
ML13-9	1.37	BLQ	0.002	ML23-3	0.067	0.004	0.003
ML13-10	0.612	ND	BLQ	ML23-4	0.76	ND	ND
ML13-10 dup	0.63	BLQ	BLQ	ML24-1	3.391	ND	ND
ML14-0	2.242	BLQ	0.013	ML24-2	3.163	0.004	0.006
ML14-1	11.35	0.003	0.007	ML24-3	4.049	0.008	0.010
ML14-2	9.851	BLQ	0.003	ML24-4	2.871	BLQ	0.007
ML14-3	2.019	ND	ND	ML24-4 dup	2.524	ND	0.006
ML14-4	0.406	ND	0.003	ML24-5	0.985	ND	0.006
ML14-4 dup	0.379	BLQ	0.004	ML24-5 dup	0.959	ND	0.005
ML24-6	1.022	BLQ	0.005	ML33-6	0.036	ND	ND

TABLE C-6. February 1997 Dissolved Gas Results Analyzed at ManTech

Well #	Methane mg/L	Ethene mg/L	Ethane mg/L	Well #	Methane mg/L	Ethene mg/L	Ethane mg/L
ML24-7	1.023	BLQ	0.004	ML33-7	0.398	ND	ND
ML25-1	2.373	0.004	0.007	ML33-8	0.013	ND	ND
ML25-2	0.276	ND	BLQ	ML33-9	0.693	ND	ND
ML25-3	3.763	0.007	0.012	ML33-10	0.228	ND	ND
ML25-4	2.372	0.004	0.004	ML34-0	2.722	0.003	0.016
ML25-5	1.572	0.004	0.004	ML34-1	4.485	0.046	0.027
ML25-6	4.515	0.026	0.024	ML34-2	5.381	0.028	0.021
ML25-6 dup	4.127	0.024	0.022	ML34-3	6.753	0.026	0.023
ML25-7	0.245	ND	ND	ML34-4	7.326	0.032	0.025
ML31-0	0.026	ND	ND	ML34-5	3.469	0.011	0.010
ML31-1	0.009	ND	ND	ML34-5 dup	3.069	0.009	0.009
ML31-2	0.011	ND	ND	ML34-6	3.396	0.009	0.010
ML31-3	0.035	ND	ND	ML34-7	2.916	0.008	0.008
ML31-4	0.012	ND	ND	ML34-8	2.030	0.005	0.006
ML31-4 dup	0.011	ND	ND	ML34-9	6.981	0.018	0.023
ML31-5	0.025	ND	ND	ML34-9 dup	6.404	0.016	0.021
ML31-6	0.062	ND	ND	ML34-10	3.004	0.006	0.008
ML31-7	0.028	ND	ND	ML35-0	0.231	ND	0.003
ML31-8	0.024	ND	ND	ML35-1	3.518	BLQ	0.003
ML31-9	0.987	ND	ND	ML35-2	6.102	0.006	0.007
ML31-10	0.704	ND	ND	ML35-3	0.723	0.013	0.008
ML31-10 dup	0.717	ND	ND	ML35-4	1.600	0.019	0.012
ML32-0	0.023	ND	ND	ML35-5	4.441	0.032	0.030
ML32-1	0.027	ND	ND	ML35-6	0.704	0.004	0.007
ML32-2	0.028	ND	ND	ML35-7	0.934	0.004	0.008
ML32-2 dup	0.026	ND	ND	ML35-8	0.624	BLQ	0.002
ML32-3	0.031	ND	ND	ML35-8 dup	0.551	BLQ	0.002
ML32-4	0.03	ND	ND	ML35-9	2.504	0.004	0.007
ML32-5	0.086	ND	ND	ML35-9 dup	2.282	0.004	0.006
ML32-6#	0.237	ND	ND	ML35-10	0.735	BLQ	BLQ
ML32-7	0.815	ND	ND	MW13	0.022	ND	ND
ML32-8	0.483	ND	ND	MW18	0.069	ND	ND
ML32-8 dup	0.482	ND	ND	MW35D	0.092	ND	ND
ML32-9	ND	ND	ND	MW38	0.003	ND	ND
ML32-10	0.006	ND	ND	MW46	0.316	ND	ND
ML33-0	3.403	BLQ	0.005	MW47	6.468	ND	ND
ML33-0 dup	3.117	BLQ	0.004	MW48	0.013	ND	ND
ML33-1	3.438	0.042	0.026	MW48 dup	0.014	ND	ND
ML33-1 dup	3.334	0.040	0.025	MW49	5.388	BLQ	0.005
ML33-2	1.443	0.003	0.002	MW50	0.069	ND	ND
ML33-3		Sample Broken		MW50 dup	0.02	ND	ND
ML33-4	1.058	BLQ	0.002	ND=non-detect			
ML33-5	0.604	0.004	0.002	BLQ=Below limit of quantitation			

TABLE C-7. December 1998 Dissolved Gas Results Analyzed at ManTech

Piezometer	Ethene (mg/L in liquid)	Ethane (mg/L in liquid)
ML11-10	ND	ND
ML11-9	ND	ND
ML11-8	ND	ND
ML11-7(8:40)	ND	ND
ML11-7(8:20)	ND	ND
ML11-6	ND	ND
ML11-5(16:45)	ND	ND
ML11-5 (17:14)	ND	ND
ML11-4	ND	ND
ML11-3	ND	ND
ML11-2	ND	ND
ML11-1	ND	ND
ML12-10	ND	ND
ML12-9	ND	ND
ML12-8	ND	ND
ML12-7	ND	ND
ML12-6	ND	ND
ML12-5	ND	ND
ML12-4	ND	ND
ML12-3	ND	ND
ML12-2	ND	ND
ML12-1 FDup	ND	ND
ML12-1	ND	ND
ML13-10	ND	0.001
ML13-9	ND	0.001
ML13-8	ND	ND
ML13-7 FDup	ND	ND
ML13-7	ND	0.001
ML13-6	ND	0.001
ML13-5 FDup	ND	0.001
ML13-5	ND	ND
ML13-4	ND	ND
ML13-3	<0.003	0.002
ML13-2	0.00	0.003
ML13-1	0.01	0.009
ML13-0	0.01	0.009
ML14-10	ND	ND
ML14-9	ND	ND
ML14-8	ND	ND
ML14-7(9:15)	ND	ND
ML14-7(10:05)	ND	ND
ML14-6	ND	ND
ML14-4	ND	ND
ML14-3	<0.003	0.002
ML14-2	0.002	0.004
ML14-1	0.005	0.008
ML14-0	0.002	0.005
ML15-10	ND	ND
ML15-9	ND	ND
ML15-8	ND	ND
ML15-7	ND	ND
ML15-6	ND	ND
ML15-5	ND	<0.002
ML15-4	<0.003	0.002
ML15-3	<0.003	0.003
ML15-2 FDup	0.005	0.008
ML15-2	0.005	0.008
ML15-1	0.003	0.007
ML15-0	<0.003	0.004

Piezometer	Ethene (mg/L in liquid)	Ethane (mg/L in liquid)
ML21-7	ND	ND
ML21-6	ND	ND
ML21-5	ND	ND
ML21-4	ND	ND
ML21-3	ND	ND
ML21-2	ND	ND
ML21-1	ND	ND
ML22.5-0	0.022	0.010
ML22.5-0 FDup	0.023	0.010
ML22.5-8	ND	ND
ML22.5-7 FDup	ND	ND
ML22.5-7	ND	ND
ML22.5-6	<0.003	ND
ML22.5-5	<0.003	ND
ML22.5-4	<0.003	0.002
ML22.5-3	0.003	0.002
ML22.5-2	ND	ND
ML22.5-1	ND	ND
ML23.5-0	0.014	ND
ML23.5-8	<0.003	ND
ML23.5-7	<0.003	<0.002
ML23.5-6	ND	ND
ML23.5-5	0.003	0.003
ML23.5-4	0.003	0.003
ML23.5-3 FDup	0.004	0.005
ML23.5-3	0.005	0.005
ML23.5-2	0.005	0.008
ML23.5-1	0.006	0.008
ML24-7	ND	0.002
ML24-6	ND	0.002
ML24-5 FDup	ND	0.002
ML24-5	ND	0.003
ML24-4	<0.003	0.005
ML24-3	0.007	0.009
ML24-2	0.008	0.008
ML24-1	0.009	0.011
ML25-7	ND	ND
ML25-6	0.008	0.012
ML25-5	0.014	0.012
ML25-4	0.014	0.013
ML25-3	0.009	0.010
ML25-2	0.008	0.009
ML25-1	0.008	0.011

TABLE C-7. December 1998 Dissolved Gas Results Analyzed at ManTech

Piezometer	Ethene (mg/L in liquid)	Ethane (mg/L in liquid)
ML31-10	<0.003	ND
ML31-9	ND	ND
ML31-8	ND	ND
ML31-7	ND	ND
ML31-6	ND	ND
ML31-5	ND	ND
ML31-4	ND	ND
ML31-3D	ND	ND
ML31-3	ND	ND
ML31-1	ND	ND
ML31-0	ND	ND
ML32-10	ND	ND
ML32-9	ND	ND
ML32-8	ND	ND
ML32-7	<0.003	ND
ML32-6	ND	ND
ML32-5 D	ND	ND
ML32-5	ND	ND
ML32-4	ND	ND
ML32-3	ND	ND
ML32-2	ND	ND
ML32-1	ND	ND
ML32-0	ND	ND
ML33-10	ND	ND
ML33-9	ND	ND
ML33-8	<0.003	ND
ML33-7 D	ND	ND
ML33-7	ND	ND
ML33-6	<0.003	ND
ML33-5	0.007	0.005
ML33-4	0.007	0.003
ML33-3	0.008	0.006
ML33-2	0.008	0.004
ML33-1	0.007	0.008
ML33-0	0.005	0.007
ML34-10	0.002	0.005
ML34-9	0.002	0.004
ML34-8	0.003	0.004
ML34-7	0.005	0.008
ML34-6	0.005	0.008
ML34-5 FDup	0.006	0.009
ML34-5	0.006	0.008
ML34-4	0.006	0.008
ML34-3	0.006	0.007
ML34-2	0.009	0.010
ML34-1	0.004	0.007
ML34-0	<0.003	0.004
ML35-10	ND	0.002
ML35-9	0.001	0.005
ML35-8	0.001	0.005
ML35-6	0.003	0.008
ML35-4	0.007	0.009
ML35-2	0.005	0.006
ML35-1	0.004	0.006
ML35-0	0.003	0.008

Monitoring Wells

Piezometer	Ethene (mg/L in liquid)	Ethane (mg/L in liquid)
MW13	ND	ND
MW18	ND	ND
MW35D	ND	ND
MW38	ND	ND
MW46	<0.003	ND
MW47	0.004	0.007
MW48	ND	ND
MW49	0.003	0.006
MW50	<0.003	0.006
MW52	0.006	0.018

Blanks

Piezometer	Ethene (mg/L in liquid)	Ethane (mg/L in liquid)
Trip Blank(12-1-98)	ND	ND
Field Blank(12-3-98)	ND	ND
Field Blank(12-4-98)	ND	ND
Field Blank(12-5-98)	ND	ND
Field Blank(12-6-98)	ND	ND
Field Blank(12-9-98)	ND	ND
Field Blank(12-10-98)	ND	ND
ML31-Blank	ND	ND
ML32-Blank	ND	ND
ML33-Blank	ND	ND
Detection Limit	0.003	0.002

FDup represents the Piezometer taken in duplicate
ND = not analyzed

TABLE C-8. Chlorinated Organics Analyzed at the University of Waterloo (μg/L)

Well	NOVEMBER 1996				FEBRUARY 1997				JUNE 1997				DECEMBER 1998		
Point	**TCE**	**cDCE**	**VC**	**Freon**	**TCE**	**cDCE**	**VC**	**Freon**	**TCE**	**cDCE**	**VC**	**Freon**	**TCE**	**cDCE**	**VC**
31-0	149	6	ND	1.8	53	6	ND	1.8	93	ND	ND	n/a			
31-2	135	0	ND	218	50	ND	ND	218	23	ND	ND	n/a			
31-4	111	ND	ND	945	545	ND	ND	945	198	ND	ND	n/a	188	ND	ND
31-6	352	88	55.7	300	692	54	37	300	663	63	39	n/a	411	51	50
31-8	213	75	28.4	29	84	13	7	29	92	8.6	ND	n/a	107	26	21
31-10	5.4	ND	2.8	ND	6	ND	ND	ND	3.8	ND	ND	n/a	4.7	4.6	0
32-0	188	ND	ND	76	74	10	ND	ND	92	ND	ND	n/a	91	15	ND
32-2	74	ND	ND	573	644	ND	ND	193	7	ND	ND	n/a	5.2	ND	ND
32-4	482	63	18.3	561	6.1	68	27	86	396	2.5	3.9	n/a	555	12	ND
32-6	46	ND	4.5	49	7	ND	6	0.3	11	ND	ND	n/a	110	38	ND
32-8	2.6	ND	ND	ND	2.1	ND	ND	ND	1.1	ND	ND	n/a	1.1	8.9	ND
32-10					ND	ND	ND	ND	3.1	0.3	ND	n/a	1.1	ND	ND
33-0	1	ND	ND	21	ND	ND	ND	0.6	ND	ND	ND	n/a	ND	ND	ND
33-2	20	ND	1.2	262	2.8	20	20	0.7	2.7	ND	16	n/a	11	5.7	ND
33-4	9.8	ND	2.3	124	ND	ND	ND	ND	ND	ND	ND	n/a	0.5	ND	ND
33-6	2.7	ND	ND	5.6	1.4	ND	ND	ND	ND	ND	ND	n/a	0.7	ND	ND
33-8	7.8	ND	ND	0	0	ND	ND	ND	1	0.5	ND	n/a	0.7	ND	ND
33-10	8.4	ND	ND	9.4	2.9	ND	ND	ND	ND	ND	ND	n/a	0.5	ND	ND
34-0	ND	ND	ND	5.6	ND	ND	ND	ND	ND	ND	ND	n/a	ND	ND	ND
34-2	5.3	28	3.1	156	6.5	20	ND	11	0.3	2.6	ND	n/a	1.9	3.8	ND
34-4	ND	ND	ND	4.5	ND	ND	ND	5	ND	ND	ND	n/a	ND	ND	ND
34-6	ND	ND	ND	ND	ND	ND	ND	3.1	ND	ND	ND	n/a	ND	ND	ND
34-8	1.1	ND	ND	ND					ND	ND	ND	n/a	0.8	ND	ND
34-10	1.8	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	n/a	ND	ND	ND
35-0	3.7	ND	ND	4.2	20	ND	ND	0	2.4	ND	ND	n/a	1	ND	ND
35-2	1.1	ND	ND	42	0	ND	ND	7.3	ND	ND	ND	n/a	ND		ND
35-4	ND	ND	ND	8.3	2.6	31	ND	103	1.1	5.2	ND	n/a	ND	ND	ND
35-6	1.7	ND	ND	2.1	1	ND	ND	ND	ND	ND	ND	n/a	ND	ND	ND
35-8	2.6	ND	2.6	ND	ND	ND	ND	ND	ND	ND	ND	n/a	0.4	ND	ND
35-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	n/a	0.3	ND	ND

ND = Non-Detect = <1 μg/L
n/a = not analysed

Appendix D Lab Analysis Results (Metals)

TABLE D-1. November 1996 Metal Concentrations Analyzed at ManTech

0.45 µm filtered samples, all concentrations in ***mg/L***

Well	Na	K	Ca	Mg	Fe	Mn	Co	Mo	Al	As	Se	Cd	Be
11.0	29.4	0.82	19.1	11	0.0045	0.239	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.1	55.5	0.91	18.5	11.3	<0.0029	0.211	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.2	65.6	<0.68	11.7	7.56	<0.0028	0.196	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.3	101	<0.68	10.7	8.12	<0.0028	0.214	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.4	120	1.41	16.1	10.3	<0.0029	0.379	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.5	38.2	5.76	32.1	16.7	<0.0030	2.65	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.6	40.3	6.69	32.6	14.7	0.046	3.33	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.7	25.1	5.81	39.9	11	0.0074	2.72	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.8	20.2	4.88	29	11.5	0.145	1.42	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.9	16.7	4.78	29.8	8.98	0.175	1.09	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
11.10	22.1	5.53	21.5	6.76	0.015	0.617	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
12.1	68.9	<2.2	10.4	6.67	<0.012	0.145	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
12.2	94.8	2.2	8.69	6.55	0.038	0.221	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
12.3	111	1.73	15.5	10.6	<0.0029	0.409	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
12.4	76.9	3	23.3	11.4	0.559	1.05	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
12.5	24.8	5.6	30.3	5.54	15.5	0.807	<0.0078	<0.034	<0.050	0.043	<0.039	<0.0027	<0.0035
12.6	20.2	4.56	13	3.22	9.43	0.177	<0.0094	<0.0040	0.691	<0.025	<0.032	<0.0015	<0.0009
12.7	19	4.96	10.3	3.07	5.49	0.0608	<0.0094	0.0071	4.83	<0.025	<0.031	0.0004	<0.0009
12.8	17.7	5.41	11.9	3.91	0.86	0.0251	<0.0094	0.0071	0.121	<0.025	<0.031	<0.0015	<0.0009
12.9	14.6	4.93	8.78	3.51	1.11	0.0478	<0.0094	<0.0040	1.19	<0.025	<0.031	<0.0015	<0.0009
12.10	14.7	4.17	6.45	2.12	0.0287	0.0066	<0.0094	0.0075	<0.098	<0.025	<0.031	<0.0015	<0.0009
13.0	59.4	<2.2	7.52	8.11	0.742	0.0755	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
13.1	123	<2.2	4.66	11.4	0.299	0.0768	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
13.2	60.4	3.3	5.56	6.75	0.042	0.0702	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
13.3	14.1	<2.2	4.9	0.34	<0.012	0.017	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
13.4	18.9	<2.2	4.6	0.23	<0.012	0.0058	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	0.0105
13.5	22.2	3.9	5.17	1.78	<0.012	0.0163	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
13.6	18	<2.2	4.09	0.64	<0.012	0.0045	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
13.7	9.03	1.9	3.55	0.1	0.0061	0.0068	<0.0094	0.0075	<0.098	<0.025	<0.031	<0.0015	<0.0009
13.8	8.78	<2.2	1.98	<0.14	<0.012	<0.0043	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
13.9	7.08	1.76	1.52	0.1	0.0061	<0.0037	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
13.10	8.67	<2.2	1.94	<0.14	<0.012	0.0059	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
14.0	8.98	<2.2	2.5	<0.14	<0.012	<0.0043	<0.0078	<0.034	0.059	<0.031	<0.036	<0.0027	<0.0035
14.1	75	<2.2	4.33	2.35	0.311	0.0202	<0.0078	<0.034	0.212	<0.031	<0.036	<0.0027	<0.0035
14.2	71.3	<2.2	4.23	2.1	<0.012	0.0137	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
14.3	15.6	<2.2	2.15	<0.14	0.25	0.0058	<0.0078	<0.034	0.222	<0.031	<0.036	<0.0027	<0.0035
14.4	15.7	<2.2	2.24	<0.14	<0.012	0.0059	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	0.009
14.5	14	<2.2	1.69	<0.14	<0.012	0.0046	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
14.6	12.9	<2.2	1.69	<0.14	<0.012	<0.0043	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
14.7	11.9	<2.2	1.4	<0.14	<0.012	<0.0043	<0.0078	<0.034	0.059	<0.031	<0.036	<0.0027	<0.0035
14.8	9.97	<2.2	1.82	<0.14	<0.012	0.0059	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
14.9	8.91	<2.2	1.8	<0.14	<0.012	0.0001	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
14.10	7.71	<2.2	3.92	1.25	4.81	0.0753	<0.0078	<0.034	8.6	<0.032	<0.036	<0.0027	<0.0035
15.0	39.3	<2.2	8.89	5.22	0.123	0.159	<0.0078	<0.034	0.086	<0.031	<0.036	<0.0027	<0.0035
15.1	67.7	<2.2	2.93	1.54	0.845	0.251	<0.0078	<0.034	0.193	<0.031	<0.036	<0.0027	<0.0035
15.2	120	<2.2	3.25	1.3	0.26	0.104	<0.0078	<0.034	0.222	<0.031	<0.036	<0.0027	<0.0035

TABLE D-1. November 1996 Metal Concentrations Analyzed at ManTech

0.45 µm filtered samples, all concentrations in ***mg/L***

Well	Cu	Cr		Ni	Zn	Ag	Tl	Pb	Sr	V	Ba	B	Ti
15.3	120	<2.2	3.26	1.29	0.026	0.107	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
15.4	27.9	<2.2	0.46	0.27	0.174	0.0679	<0.0078	<0.034	0.107	<0.031	<0.036	<0.0027	<0.0035
15.5	15.9	<2.2	3.76	1.96	0.219	0.301	<0.0078	<0.034	0.087	<0.031	<0.036	<0.0027	<0.0035
15.6	20.4	2.7	10.5	3.03	2.22	0.447	<0.0078	<0.034	0.24	<0.031	<0.036	<0.0027	<0.0035
15.7	20.4	3.1	10.4	3.02	2.01	0.435	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
15.8	42.9	5.6	23.5	5.74	1.96	0.688	<0.0078	<0.034	<0.050	<0.031	<0.036	<0.0027	<0.0035
15.9	31.7	4.8	17.2	3.96	1.65	0.509	<0.0078	<0.034	2.79	<0.031	<0.036	<0.0027	<0.0035
15.10	8.72	7.4	7.82	2.38	5.33	0.197	<0.0078	<0.034	9.63	<0.032	<0.036	<0.0027	<0.0035
21.1	20.6	<1.6	11.1	6.54	0	0.097	<0.0077	<0.032	<0.055	0	<0.032	<0.0020	<0.0034
21.2	35.3	1.7	8.91	5.01	<0.012	0.0864	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
21.3	50.4	<1.6	7.87	4.39	<0.012	0.119	0.0079	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
21.4	83.6	1.9	15.7	10.2	<0.012	0.327	0.0103	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
21.5	138	2.6	21.3	14.5	<0.012	0.432	0.0141	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
21.6	40.8	4.9	27.5	15.5	<0.012	1.16	0.0002	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
21.7	18.2	5.8	21.9	10.6	0.482	2.4	0.0174	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
22.1	43.8	<1.6	6.57	3.82	0.021	0.11	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
22.2	53	2.1	6.55	0.65	0.023	<0.0051	<0.0077	<0.032	0.679	<0.014	<0.032	<0.0020	<0.0034
22.2a	44.8	<1.6	6.65	3.95	0.014	0.117	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
22.3	103	2.6	4.46	14.3	0.014	0.0645	0.0009	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
22.4	20.1	1.8	4.39	0.17	0.02	<0.0051	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
23.1	45.5	2.2	6.69	3.61	0.019	0.13	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
23.2	72.6	2.5	8.9	8.19	0.018	0.0758	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
23.3	104	0.9	7.12	16.4	<0.012	0.104	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	0.0113
23.5	11.2	<1.6	3.61	<0.11	<0.012	0.0207	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
24.1	58.8	<1.6	6.32	5.72	<0.012	0.057	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
24.2	78	<1.6	5.19	1.32	<0.012	0.0168	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
24.3	107	1.6	5.11	10.7	<0.012	0.0368	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
24.4	22.9	<1.6	5	<0.11	<0.012	<0.0051	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
24.5	12.6	2.04	2.75	0.1	0.0035	0.0054	<0.0094	<0.0040	<0.098	<0.025	<0.031	<0.0015	<0.0009
24.6	11.6	<1.6	1.98	<0.11	0.013	<0.0051	<0.0077	<0.032	0.088	<0.014	0.045	<0.0020	<0.0034
24.7	12	<1.6	2.2	0.18	<0.012	<0.0051	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
25.1	8.61	<1.6	8.83	0.93	<0.012	0.0444	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
25.2	17.4	<1.6	9.82	0.99	0.012	0.0419	<0.0077	<0.032	0.059	<0.014	<0.032	<0.0020	<0.0034
25.3	84.8	<1.6	2.01	0.41	0.013	0.0106	<0.0077	<0.032	0.134	<0.014	<0.032	<0.0020	<0.0034
25.4	26.9	10.3	0.8	0.62	<0.012	0.0119	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
25.5	98	<1.6	5.87	1.65	<0.012	0.142	<0.0077	<0.032	<0.055	0.028	0.033	<0.0020	<0.0034
25.6	42	2.4	7.44	2.35	<0.012	0.332	<0.0077	<0.032	<0.055	<0.014	<0.032	<0.0020	<0.0034
25.7	7.76	2.7	6.96	1.96	0.025	0.368	<0.0077	<0.032	<0.055	0.018	0.04	<0.0020	<0.0034
31.0	17.7	1.5	8.67	5.19	<0.010	0.0452	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
31.1	26.8	<1.3	10.2	5.96	<0.010	0.0488	<0.0065	<0.012	<0.029	0.015	<0.021	<0.0018	<0.0013
31.2	31.4	1.7	9.09	5.45	<0.010	0.0796	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
31.3	33.1	<1.3	7.98	4.84	<0.010	0.103	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
31.4	42.8	1.6	9.87	6.21	<0.010	0.127	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
31.5	63.3	3.5	20.1	11.9	<0.010	0.858	0.0082	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
31.6	34.7	6.6	27.2	16.3	<0.010	0.734	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
31.7	31.6	7	28.2	13	<0.010	0.718	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014

TABLE D-1. November 1996 Metal Concentrations Analyzed at ManTech

0.45 µm filtered samples, all concentrations in ***mg/L***

Well	Na	K	Ca	Mg	Fe	Mn	Co	Mo	Al	As	Se	Cd	Be
31.8	23	6.3	24	10.5	<0.010	0.515	<0.0065	<0.012	<0.029	0.01	<0.021	<0.0018	<0.0014
31.9	12.3	4.8	24.6	6.73	<0.010	0.311	0.0093	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
31.10	14.7	5	26.6	7.29	<0.010	0.223	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
32.0	20.6	<1.3	9.49	5.79	0.289	0.062	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
32.1	29.8	1.6	12.2	7.04	0.015	0.0911	0.008	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
32.2	40.7	1.5	9.42	5.78	<0.010	0.133	<0.0065	<0.012	<0.029	<0.010	0.023	<0.0018	<0.0013
32.3	69.2	2.1	18.2	12.9	0.076	0.344	0.0104	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
32.4	68.8	4.7	32.7	18.9	0.019	1.04	0.0113	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
32.5	43.4	4.3	27.3	12	1.26	1.02	0.0112	<0.012	<0.029	0.015	<0.021	<0.0018	<0.0014
32.6	8.07	4.1	18	1.91	8.14	0.266	<0.0065	<0.012	<0.029	0.033	<0.022	<0.0018	<0.0014
32.7	7.94	3.6	18.8	1.42	7.95	0.0801	<0.0065	<0.012	<0.029	0.016	<0.022	<0.0018	<0.0014
32.8	7.02	5.1	21.7	1.2	2.11	0.018	<0.0065	<0.012	0.038	0.01	<0.021	<0.0018	<0.0014
32.9	5.04	5.8	13.5	1.09	<0.010	0.0088	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
32.10	12.1	8.1	13.4	1.4	6.23	0.0316	<0.0065	<0.012	12.2	0.019	0.023	<0.0018	<0.0014
33.0	26.6	2.4	5.54	2.17	0.014	0.0095	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
33.1	42	1.9	10.1	6.78	10.6	0.222	<0.0065	<0.012	<0.029	<0.010	<0.024	<0.0018	<0.0013
33.2	56.4	1.9	16	10	16.1	0.392	<0.0065	<0.012	<0.029	0.018	<0.027	<0.0018	<0.0014
33.3	32.5	2.5	15.8	6.7	5.49	0.535	<0.0065	<0.012	<0.029	<0.010	<0.022	<0.0018	<0.0014
33.4	46.1	2.5	20.3	7.25	4.34	0.855	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
33.5	27.6	2.8	25	4.88	0.283	0.241	0.0099	<0.012	0.057	0.024	<0.021	<0.0018	<0.0014
33.6	14.5	2.9	34.3	0.72	<0.010	<0.0063	<0.0065	<0.012	0.278	0.012	<0.021	<0.0018	<0.0014
33.7	6.88	2.8	20.4	1.48	3.19	0.114	<0.0065	<0.012	<0.029	0.013	<0.021	<0.0018	<0.0014
33.8	9.27	2.4	32.5	0.62	0.003	0.0137	<0.0065	<0.012	0.556	0.009	0.001	<0.0018	<0.0014
33.9	16.1	2.3	18.3	2.2	<0.010	0.0589	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
33.10	27.5	10.7	77.1	0.35	<0.010	<0.0063	<0.0065	<0.012	1.65	<0.010	<0.021	<0.0018	<0.0015
34.0	24	2.3	5.11	0.24	<0.010	<0.0063	0.0075	0.016	0.061	<0.010	<0.021	<0.0018	<0.0013
34.1	56.2	2.6	13	8.15	0.047	0.0355	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
34.2	60.6	2.9	14.6	9.71	0.097	0.0764	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
34.3	50.4	3.3	19.2	6.66	0.383	0.152	0.0101	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
34.4	25	2.6	7.64	1.74	0.499	0.123	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
34.5	24.1	2.3	8.7	1.92	0.711	0.169	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
34.6	23.7	2.6	6.46	1.56	0.645	0.145	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
34.7	20.9	1.4	9.43	2.32	1.27	0.25	<0.0065	<0.012	0.413	0	<0.021	<0.0018	<0.0013
34.8	18.7	2.7	9.33	2.01	4.36	0.234	<0.0065	0.013	7.01	<0.010	<0.021	<0.0018	<0.0013
34.9	14.8	1.4	5.2	0.82	1.45	0.116	<0.0065	0.014	1.51	<0.010	<0.021	<0.0018	<0.0013
34.10	15.4	2.3	9.76	1.45	1.52	0.0928	<0.0065	<0.012	3.04	<0.010	<0.021	<0.0018	<0.0013
35.0	20.6	<1.3	7.03	2.89	1.7	0.543	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
35.1	36.1	<1.3	5.37	1.27	0.144	0.0922	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
35.2	39.3	<1.3	6.44	2.42	1.03	0.256	<0.0065	<0.012	<0.029	0.012	<0.021	<0.0018	<0.0013
35.3	56.9	1.3	11.6	6.95	0.31	0.14	0.0074	<0.012	<0.029	0.023	<0.021	<0.0018	<0.0014
35.4	57.4	<1.3	8.43	4.08	0.698	0.455	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0013
35.5	38.7	3.2	13	5.79	0.436	0.706	<0.0065	<0.012	0.408	<0.010	<0.021	<0.0018	<0.0014
35.6	11.4	2.1	12.4	5.66	0.101	0.778	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
35.7	14.1	2.5	11.5	4.4	0.244	0.739	<0.0065	<0.012	<0.029	<0.010	<0.021	<0.0018	<0.0014
35.8	10.9	2.7	13.9	4.48	0.579	0.811	<0.0065	<0.012	<0.029	0.017	<0.021	<0.0018	<0.0014
35.9	24.6	2.3	4.79	1.03	0.77	0.136	<0.0065	<0.012	0.99	0.02	<0.021	<0.0018	<0.0013
35.10	26.2	2.9	5.98	0.82	0.099	0.0742	<0.0065	<0.012	0.107	0.011	<0.021	<0.0018	<0.0013

TABLE D-1. November 1996 Metal Concentrations Analyzed at ManTech

0.45 μm filtered samples, all concentrations in ***mg/L***

Well	Cu	Cr	Ni	Zn	Ag	Tl	Pb	Sr	V	Ba	B	Ti
11.0	<0.0036	0.208	<0.014	0.003	<0.0068	0.036	<0.0031	0.258	<0.017	0.0273	<0.036	<0.0041
11.1	<0.0036	1.15	<0.014	0.003	<0.0068	<0.025	<0.0031	0.275	<0.017	0.0349	<0.036	<0.0041
11.2	<0.0036	1.61	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.18	<0.017	0.0274	<0.036	<0.0041
11.3	<0.0036	2.92	<0.014	<0.0013	<0.0068	0.027	<0.0032	0.186	<0.017	0.0344	<0.036	<0.0041
11.4	<0.0036	3.08	<0.014	<0.0013	<0.0068	<0.025	<0.0032	0.278	<0.017	0.0509	<0.036	<0.0041
11.5	<0.0036	0.106	<0.014	0.0019	<0.0068	<0.025	<0.0031	0.532	<0.017	0.0717	<0.036	<0.0041
11.6	<0.0036	0.1008	<0.014	0.0021	<0.0068	<0.025	<0.0031	0.533	<0.017	0.0722	<0.036	<0.0041
11.7	<0.0036	<0.0012	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.435	<0.017	0.0468	<0.036	<0.0041
11.8	<0.0036	<0.0012	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.37	<0.017	0.0285	<0.036	<0.0041
11.9	<0.0036	0.0019	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.335	<0.017	0.0244	<0.036	<0.0041
11.10	<0.0036	0.0014	<0.014	<0.0013	<0.0068	0.03	<0.0031	0.254	<0.017	0.0211	<0.036	<0.0041
12.1	<0.0047	1.89	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.156	<0.010	0.0252	<0.029	<0.016
12.2	<0.0047	3.22	<0.013	0.0083	<0.0063	<0.014	<0.021	0.143	<0.010	0.0265	<0.030	<0.016
12.3	<0.0036	2.14	<0.014	<0.0013	<0.0068	0.027	<0.0031	0.277	<0.017	0.0507	<0.036	<0.0041
12.4	<0.0047	0.894	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.347	<0.010	0.0494	<0.029	<0.016
12.5	<0.0047	0.0034	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.263	<0.010	0.0372	<0.030	<0.016
12.6	<0.0036	<0.0012	<0.014	0.002	<0.0068	<0.025	<0.0031	0.129	<0.017	0.0117	<0.036	0.0168
12.7	<0.0036	0.0088	<0.014	0.0049	<0.0068	0.006	0.0031	0.102	<0.017	0.0176	<0.036	0.113
12.8	<0.0036	0.0044	<0.014	<0.0013	<0.0068	0.028	0.0069	0.117	<0.017	0.0057	<0.036	<0.0041
12.9	<0.0036	<0.0012	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.0875	<0.017	0.0075	<0.036	0.0338
12.10	<0.0036	<0.0012	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.0575	<0.017	0.0033	<0.036	<0.0041
13.0	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.099	<0.010	0.0098	<0.029	<0.016
13.1	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0551	<0.010	0.0096	<0.029	<0.016
13.2	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0565	<0.010	0.0154	0.055	<0.016
13.3	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0502	<0.010	0.0366	0.118	<0.016
13.4	0.0105	<0.0029	<0.013	0.0162	<0.0063	<0.014	<0.021	0.0584	<0.010	0.0298	0.081	<0.016
13.5	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0537	<0.010	0.0041	0.044	<0.016
13.6	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0408	<0.010	0.0053	0.067	<0.016
13.7	<0.0036	<0.0012	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.0348	<0.017	0.0137	0.107	<0.0041
13.8	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0163	<0.010	0.0124	0.15	<0.016
13.9	<0.0036	<0.0012	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.0085	<0.017	<0.0022	0.178	<0.0041
13.10	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0158	<0.010	0.0126	0.143	<0.016
14.0	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0108	<0.010	<0.0020	0.066	<0.016
14.1	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0375	<0.010	0.0039	0.047	<0.016
14.2	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0363	<0.010	0.0032	0.066	<0.016
14.3	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0086	<0.010	<0.0020	0.134	<0.016
14.4	0.0069	<0.0029	<0.013	0.0032	<0.0063	<0.014	<0.021	0.0084	<0.010	<0.0020	0.133	<0.016
14.5	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0053	<0.010	<0.0020	0.147	<0.016
14.6	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0049	<0.010	<0.0020	0.13	<0.016
14.7	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0047	<0.010	<0.0020	0.13	<0.016
14.8	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0061	<0.010	<0.0020	0.128	<0.016
14.9	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0059	<0.010	<0.0020	0.115	<0.016
14.10	<0.0047	0.0171	<0.013	0.0103	<0.0063	<0.014	<0.021	0.0262	0.017	0.0274	0.054	0.136
15.0	<0.0047	<0.0029	0.03	0.0378	<0.0063	<0.014	0.026	0.113	<0.010	0.0138	0.057	<0.016
15.1	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0388	<0.010	0.0051	0.108	<0.016
15.2	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0359	<0.010	0.0061	<0.029	<0.016

TABLE D-1. November 1996 Metal Concentrations Analyzed at ManTech

0.45 µm filtered samples, all concentrations in ***mg/L***

Well	Na	K	Ca	Mg	Fe	Mn	Co	Mo	Al	As	Se	Cd	Be
15.3	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0363	<0.010	0.0055	<0.029	<0.016	
15.4	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0067	<0.010	<0.0020	0.133	<0.016	
15.5	<0.0047	<0.0029	<0.013	0.0102	<0.0063	<0.014	<0.021	0.0461	<0.010	0.0053	0.085	<0.016	
15.6	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.099	<0.010	0.0143	0.048	<0.016	
15.7	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.0981	<0.010	0.0133	0.06	<0.016	
15.8	<0.0047	<0.0029	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.241	<0.010	0.0267	<0.029	<0.016	
15.9	<0.0047	0.0068	<0.013	<0.0014	<0.0063	<0.014	<0.021	0.195	<0.010	0.0271	<0.029	0.062	
15.10	<0.0047	0.0363	<0.013	0.0115	<0.0063	<0.014	<0.021	0.094	0.013	0.0503	<0.030	0.147	
21.1	<0.019	<0.0031	<0.010	0.0066	<0.015	<0.030	<0.036	0.143	<0.033	0.013	<0.037	<0.021	
21.2	<0.019	1.05	<0.010	<0.0026	<0.015	<0.030	<0.036	0.118	<0.033	0.0148	<0.037	<0.021	
21.3	<0.019	1.93	<0.010	<0.0026	<0.015	<0.030	<0.036	0.105	<0.033	0.0159	<0.037	<0.021	
21.4	<0.019	2.47	<0.010	<0.0026	<0.015	<0.030	<0.036	0.241	<0.033	0.0406	<0.037	<0.021	
21.5	<0.019	5.11	<0.010	0.0048	<0.015	<0.030	<0.036	0.364	<0.033	0.085	<0.037	<0.021	
21.6	<0.019	0.464	<0.010	<0.0026	<0.015	<0.030	<0.036	0.417	<0.033	0.0533	<0.037	<0.021	
21.7	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.314	<0.033	0.0395	<0.037	<0.021	
22.1	<0.019	1.53	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0925	<0.033	0.0146	<0.037	<0.021	
22.2	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0839	<0.033	<0.0067	0.072	<0.021	
22.2a	<0.019	1.56	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0949	<0.033	0.0157	<0.037	<0.021	
22.3	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0332	<0.033	<0.0067	<0.037	<0.021	
22.4	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0209	<0.033	<0.0067	0.097	<0.021	
23.1	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0853	<0.033	<0.0067	<0.037	<0.021	
23.2	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.116	<0.033	0.0087	<0.037	<0.021	
23.3	0.001	0.0027	0.007	0.0024	<0.015	0.002	<0.036	0.0788	<0.033	<0.0067	<0.037	<0.021	
23.5	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0589	<0.033	0.0475	0.107	<0.021	
24.1	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0731	<0.033	0.0099	<0.037	<0.021	
24.2	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0437	<0.033	<0.0067	<0.037	<0.021	
24.3	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0416	<0.033	<0.0067	<0.037	<0.021	
24.4	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0203	<0.033	<0.0067	0.099	<0.021	
24.5	<0.0036	<0.0012	<0.014	<0.0013	<0.0068	<0.025	<0.0031	0.0126	<0.017	<0.0022	0.108	<0.0041	
24.6	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0105	<0.033	<0.0067	0.139	<0.021	
24.7	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0093	<0.033	<0.0067	0.13	<0.021	
25.1	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0605	<0.033	<0.0067	<0.037	<0.021	
25.2	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0705	<0.033	<0.0067	<0.037	<0.021	
25.3	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0169	<0.033	<0.0067	<0.037	<0.021	
25.4	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.006	<0.033	<0.0067	<0.037	0.035	
25.5	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.055	<0.033	0.0081	<0.037	<0.021	
25.6	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.0813	<0.033	0.012	<0.037	<0.021	
25.7	<0.019	<0.0031	<0.010	<0.0026	<0.015	<0.030	<0.036	0.067	<0.033	0.0067	<0.037	<0.021	
31.0	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.108	<0.0092	0.0092	<0.038	<0.0084	
31.1	<0.0047	0.0277	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.14	<0.0092	0.0154	<0.038	<0.0084	
31.2	<0.0047	0.0756	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.128	<0.0092	0.0176	<0.038	<0.0084	
31.3	<0.0047	0.215	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.113	<0.0092	0.0158	0.044	<0.0084	
31.4	<0.0047	0.354	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.144	<0.0092	0.0222	<0.038	<0.0084	
31.5	<0.0047	0.043	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.302	<0.0092	0.0533	<0.038	<0.0084	
31.6	<0.0047	0.0048	<0.011	0.0016	<0.0079	<0.038	<0.024	0.411	<0.0092	0.0602	<0.038	<0.0084	
31.7	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.387	<0.0092	0.0461	<0.038	<0.0084	

TABLE D-1. November 1996 Metal Concentrations Analyzed at ManTech

0.45 µm filtered samples, all concentrations in ***mg/L***

Well	Cu	Cr	Ni	Zn	Ag	Tl	Pb	Sr	V	Ba	B	Ti
31.8	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.322	<0.0092	0.0334	<0.038	<0.0084
31.9	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.312	<0.0092	0.0196	<0.038	<0.0084
31.10	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.348	<0.0092	0.0201	<0.038	<0.0084
32.0	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.12	<0.0092	0.0077	<0.038	<0.0084
32.1	<0.0047	0.0089	<0.011	0.0015	<0.0079	<0.038	<0.024	0.169	<0.0092	0.0186	<0.038	<0.0084
32.2	<0.0047	0.341	<0.011	0.0024	<0.0079	<0.038	<0.024	0.134	<0.0092	0.0213	<0.038	<0.0084
32.3	<0.0047	0.329	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.295	<0.0092	0.0541	<0.038	<0.0084
32.4	<0.0047	0.045	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.476	<0.0092	0.0798	<0.038	<0.0084
32.5	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.349	<0.0092	0.0417	<0.038	<0.0084
32.6	<0.0047	0.0034	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.217	<0.0092	0.0121	<0.038	<0.0084
32.7	<0.0047	<0.0025	<0.011	0.0067	<0.0079	<0.038	<0.024	0.242	<0.0092	0.01	<0.038	<0.0084
32.8	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.215	0.0097	0.0128	<0.038	<0.0084
32.9	<0.0047	<0.0025	<0.011	0.0005	<0.0079	<0.038	<0.024	0.101	<0.0092	0.0063	<0.038	<0.0084
32.10	<0.0047	0.017	<0.011	0.0138	<0.0079	<0.039	<0.024	0.127	0.0145	0.0385	<0.038	0.371
33.0	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0755	<0.0092	0.0033	0.045	<0.0084
33.1	<0.0047	0.0029	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.147	<0.0092	0.0063	<0.038	<0.0084
33.2	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.234	<0.0092	0.0118	<0.038	<0.0084
33.3	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.171	<0.0092	0.0072	<0.038	<0.0084
33.4	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.23	<0.0092	0.0072	<0.038	<0.0084
33.5	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.246	<0.0092	0.0041	<0.038	<0.0084
33.6	0.0053	0.0028	<0.011	0.0055	<0.0079	<0.038	<0.024	0.268	0.01	0.0022	<0.038	<0.0084
33.7	0.0108	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.2	<0.0092	0.0058	<0.038	<0.0084
33.8	<0.0047	<0.0025	<0.011	0.0026	<0.0079	<0.038	<0.024	0.24	0.0004	0.0003	<0.038	<0.0084
33.9	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.16	<0.0092	0.0031	<0.038	<0.0084
33.10	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	3.48	<0.0092	0.0189	<0.038	<0.0084
34.0	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0534	<0.0092	0.002	0.083	<0.0084
34.1	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.145	<0.0092	0.0039	<0.038	<0.0084
34.2	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.167	<0.0092	0.006	<0.038	<0.0084
34.3	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.152	<0.0092	0.0063	0.058	<0.0084
34.4	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0621	<0.0092	0.0028	0.133	<0.0084
34.5	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.07	<0.0092	0.0021	0.124	<0.0084
34.6	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0544	<0.0092	0.0021	0.108	<0.0084
34.7	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.077	<0.0092	0.0031	0.008	<0.0084
34.8	<0.0047	0.0094	<0.011	0.0106	<0.0079	<0.038	<0.024	0.0798	0.0176	0.0224	0.056	0.204
34.9	<0.0047	<0.0025	<0.011	0.003	<0.0079	<0.038	<0.024	0.0486	<0.0092	0.0053	<0.038	0.0472
34.10	<0.0047	0.0061	<0.011	0.0038	<0.0079	<0.038	<0.024	0.0815	<0.0092	0.0112	<0.038	0.0778
35.0	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0639	<0.0092	0.0029	<0.038	<0.0084
35.1	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0311	<0.0092	<0.0019	<0.038	<0.0084
35.2	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0619	<0.0092	<0.0019	<0.038	<0.0084
35.3	<0.0047	<0.0025	<0.011	0.0025	<0.0079	<0.038	<0.024	0.125	0.0121	0.0053	<0.038	<0.0084
35.4	<0.0047	<0.0025	<0.011	0.0021	<0.0079	<0.038	<0.024	0.0983	<0.0092	0.0088	<0.038	<0.0084
35.5	<0.0047	0.0035	<0.011	0.0019	<0.0079	<0.038	<0.024	0.147	<0.0092	0.0197	0.078	0.0112
35.6	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.124	<0.0092	0.0108	<0.038	<0.0084
35.7	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.109	<0.0092	0.0095	<0.038	<0.0084
35.8	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.134	<0.0092	0.0116	<0.038	<0.0084
35.9	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0519	<0.0092	0.0062	<0.038	0.0162
35.10	<0.0047	<0.0025	<0.011	<0.0014	<0.0079	<0.038	<0.024	0.0595	<0.0092	0.003	<0.038	<0.0084

TABLE D-2: February 1997 Metal Concentrations Analyzed at ManTech.

0.45 µm filtered samples, all concentrations in ***mg/L***

DESC	Na	K	Ca	Mg	Fe	Mn	Al	As	Cd	Cr	Ag	Pb	Ba
ML11-0	27.1	<1.0	16.0	9.5	0.20	0.221	<0.048	<0.011	0.0001	0.111	<0.0028	<0.0071	0.020
ML11-1	66.1	<1.0	13.9	8.3	0.01	0.127	<0.048	<0.011	<0.0012	1.66	<0.0028	<0.0071	0.029
ML11-2	64.8	<1.0	13.6	9.2	0.41	0.271	0.29	<0.011	0.0015	0.575	<0.0028	<0.0071	0.032
ML11-3	121.0	<1.0	22.2	17.3	<0.0086	0.477	<0.048	<0.011	0.0019	1.38	<0.0029	<0.0071	0.068
ML11-4	128.0	<1.0	17.7	12.3	1.31	0.369	1.23	<0.011	<0.0012	2.07	<0.0028	<0.0071	0.064
ML11-5	45.1	4.8	31.7	15.0	0.03	2.830	<0.048	<0.012	<0.0012	0.132	<0.0029	<0.0071	0.068
ML11-6	30.2	4.4	33.9	12.2	0.06	2.790	<0.048	<0.012	<0.0012	0.0476	<0.0029	<0.0071	0.052
ML11-7	15.5	2.6	22.3	7.3	0.40	1.390	<0.048	<0.011	<0.0012	<0.0047	<0.0029	<0.0071	0.019
ML11-8	15.0	2.1	21.9	6.5	0.64	0.937	0.28	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	0.015
ML11-9	14.9	2.6	23.4	5.6	0.27	0.809	<0.048	<0.011	<0.0012	<0.0047	<0.0029	<0.0071	0.015
ML11-10	15.6	3.8	17.6	6.0	0.80	0.540	0.14	<0.011	0.0002	<0.0047	<0.0028	<0.0071	0.014
ML12-1	57.6	<1.0	9.7	6.1	0.06	0.129	<0.048	<0.011	<0.0012	1.36	<0.0028	0.0079	0.021
ML12-2	114.0	<1.0	12.7	9.8	0.56	0.282	0.25	<0.011	<0.0012	2.23	<0.0028	<0.0071	0.038
ML12-3	137.0	<1.0	15.9	10.5	0.73	0.359	0.68	<0.011	<0.0012	2.29	<0.0028	<0.0071	0.059
ML12-4	100.0	2.2	23.1	11.3	0.23	1.200	0.12	<0.011	<0.0012	1.09	<0.0029	<0.0071	0.055
ML12-5	29.3	6.2	31.9	9.1	49.20	1.100	11.90	0.013	0.0017	0.0913	<0.0029	0.0175	0.210
ML12-6	10.8	2.2	6.9	2.5	11.80	0.103	3.98	<0.012	<0.0012	0.0138	<0.0028	0.0073	0.038
ML12-7	7.8	2.5	6.7	2.2	5.21	0.044	2.50	<0.011	<0.0012	0.0111	<0.0028	<0.0072	0.020
ML12-8	4.3	1.7	6.3	2.4	2.13	0.029	1.32	<0.011	<0.0012	0.0075	<0.0028	<0.0071	0.007
ML12-9	4.0	<1.0	7.0	2.7	0.87	<0.013	0.82	<0.011	<0.0012	0.0071	<0.0028	<0.0071	0.004
ML12-10	6.4	<1.0	8.9	0.6	0.09	<0.013	0.09	<0.011	<0.0012	0	<0.0028	<0.0071	<0.0015
ML13-0	59.8	<1.0	9.3	5.9	0.46	0.080	<0.048	<0.011	0.0025	<0.0047	<0.0028	<0.0071	0.013
ML13-1	94.8	<1.0	6.5	7.1	0.12	0.111	<0.048	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	0.005
ML13-2	49.0	3.6	8.9	7.2	0.03	0.078	<0.048	<0.011	<0.0012	<0.0047	<0.0028	0.0096	0.020
ML13-3	19.2	1.6	8.2	3.9	0.01	0.028	<0.048	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	0.022
ML13-4	9.3	<1.0	4.5	0.1	0.01	<0.013	<0.048	<0.011	0.0027	<0.0047	<0.0028	<0.0071	0.015
ML13-5	8.0	<1.0	5.2	0.1	0.03	<0.013	<0.048	<0.011	0.0019	0.0071	<0.0028	<0.0071	<0.0015
ML13-6	6.6	<1.0	5.4	0.2	0.02	<0.013	<0.048	<0.011	0.0014	<0.0047	<0.0028	<0.0071	0.003
ML13-7	5.4	<1.0	3.0	0.0	0.03	<0.013	<0.048	<0.011	0.0014	0.007	<0.0028	<0.0071	0.020
ML13-8	4.7	<1.0	2.7	<0.035	0.02	<0.013	<0.048	<0.011	<0.0012	0.0063	<0.0028	<0.0071	0.017
ML13-9	4.6	<1.0	3.2	<0.035	0.02	<0.013	<0.048	<0.011	<0.0012	0.0006	<0.0028	<0.0071	0.006
ML13-10	5.0	<1.0	3.7	<0.035	0.10	<0.013	<0.048	0.016	<0.0012	0.0329	<0.0028	<0.0071	<0.0015
ML14-0	47.3	<1.0	1.1	<0.035	0.02	<0.013	0.06	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	<0.0015
ML14-1	54.1	<1.0	6.5	3.8	0.01	<0.013	<0.048	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	0.004
ML14-2	14.3	2.0	6.7	0.6	0.01	<0.013	0.08	<0.011	<0.0012	0.005	<0.0028	<0.0071	0.002
ML14-3	10.7	<1.0	2.6	<0.035	<0.0086	<0.013	0.05	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	<0.0015
ML14-4	6.4	<1.0	1.4	<0.035	<0.0086	<0.013	0.05	<0.011	0.002	<0.0047	<0.0028	<0.0071	<0.0015
ML14-5	7.5	<1.0	1.3	<0.035	<0.0086	<0.013	0.08	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	<0.0015
ML14-6	7.6	<1.0	1.5	<0.035	0.02	<0.013	0.05	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	<0.0015
ML14-7	6.0	<1.0	2.5	<0.035	<0.0086	<0.013	0.05	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	<0.0015
ML14-8	7.6	<1.0	3.0	<0.035	0.00	<0.013	<0.048	<0.011	<0.0003	<0.0047	<0.0028	<0.0071	<0.0015
ML14-9	3.3	<1.0	3.4	0.3	1.47	0.017	1.74	<0.011	0.0016	0.008	<0.0028	<0.0071	0.006
ML14-10	3.0	<1.0	4.7	0.4	1.09	0.035	1.00	0.014	<0.0012	0.007	<0.0028	<0.0071	0.005
ML15-0	32.2	<1.0	11.2	6.8	0.12	0.191	<0.048	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	0.015
ML15-1	54.9	<1.0	0.8	0.4	0.36	0.068	<0.048	0.015	<0.0012	<0.0047	<0.0028	<0.0071	<0.0015
ML15-2	74.2	<1.0	7.8	3.7	0.41	0.157	<0.048	0.017	0.0022	<0.0047	<0.0028	0.0155	0.003
ML15-3	21.1	1.5	0.6	0.2	0.12	0.061	<0.048	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	<0.0015
ML15-4	8.0	<1.0	0.3	0.3	1.03	0.029	1.15	0.014	<0.0012	<0.0047	<0.0028	<0.0071	0.002
ML15-5	7.8	<1.0	1.7	0.9	1.15	0.180	1.14	<0.011	0.0003	<0.0047	<0.0028	<0.0071	0.006
ML15-6	15.9	<1.0	8.0	1.9	2.10	0.248	0.12	0.029	<0.0012	<0.0047	<0.0028	<0.0071	0.006
ML15-7	8.1	4.7	6.2	1.5	0.74	0.180	<0.048	<0.011	0.0002	<0.0047	<0.0028	0.0037	0.003
ML15-8	4.4	4.4	4.9	1.3	1.14	0.151	1.98	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	0.009
ML15-9	2.9	5.1	6.4	1.3	1.17	0.084	2.19	<0.011	<0.0012	0.0062	<0.0028	<0.0071	0.012
ML15-10	3.2	4.3	7.3	1.3	2.09	0.047	2.72	<0.011	<0.0012	0.0056	<0.0028	<0.0072	0.015

TABLE D-2: February 1997 Metal Concentrations Analyzed at ManTech.

0.45 μm filtered samples, all concentrations in ***mg/L***

DESC	Na	K	Ca	Mg	Fe	Mn	Al	As	Cd	Cr	Ag	Pb	Ba
ML21-1	19.3	1.5	10.7	6.5	0.01	0.096	<0.048	<0.011	<0.0012	<0.0047	<0.0028	<0.0071	0.029
ML21-2	31.5	2.0	8.1	4.8	<0.0086	0.092	<0.048	<0.011	<0.0012	0.872	<0.0028	<0.0071	0.040
ML21-3	30.3	1.7	5.1	3.3	0.05	0.173	<0.048	<0.011	<0.0012	0.668	<0.0028	<0.0071	0.046
ML21-4	86.8	2.4	22.8	15.9	<0.0086	0.499	<0.048	<0.011	<0.0012	0.732	<0.0029	0.0084	0.074
ML21-5	121.0	2.5	18.0	13.5	<0.0086	0.346	<0.048	<0.011	<0.0012	4.51	<0.0028	<0.0072	0.093
ML21-6	34.1	7.7	28.1	14.8	0.01	2.640	<0.048	<0.012	<0.0012	0.163	<0.0029	0.011	0.075
ML21-7	13.3	4.1	23.8	10.2	5.90	2.710	<0.027	<0.011	<0.0019	0.0037	<0.011	<0.014	0.063
ML22-2	29.8	1.5	5.8	2.9	0.01	0.005	0.09	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.030
ML22-3	92.7	1.6	4.4	9.7	0.02	0.081	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.057
ML22-4	13.4	0.8	5.9	0.4	0.02	0.006	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.059
ML23-1	42.6	1.1	5.0	5.7	<0.0066	0.044	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.048
ML23-2	63.0	0.7	6.2	6.1	<0.0066	0.023	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.048
ML23-3	83.9	1.5	5.0	8.7	0.05	0.088	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.055
ML23-4	21.8	2.6	15.9	3.5	1.23	0.375	<0.027	0.027	<0.0019	<0.0028	<0.011	<0.014	0.045
ML24-1	40.4	<0.50	3.5	3.8	<0.0066	0.018	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.058
ML24-2	42.6	0.5	3.9	2.6	<0.0066	0.016	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.053
ML24-3	97.4	1.5	4.9	8.6	<0.0066	0.032	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.033
ML24-4	13.9	0.9	5.3	0.1	<0.0066	0.008	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.082
ML24-5	13.2	<0.50	4.2	<0.035	<0.0066	<0.0028	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.086
ML24-6	9.1	<0.50	4.2	<0.035	<0.0066	<0.0028	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.059
ML24-7	10.3	<0.50	5.0	<0.035	<0.0066	0.004	<0.027	<0.010	0.0023	<0.0028	<0.011	<0.014	0.069
ML25-1	51.5	0.7	4.6	2.4	3.75	0.124	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.045
ML25-2	7.7	2.4	5.6	2.0	2.26	0.484	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.044
ML25-3	48.4	1.9	4.1	0.0	0.01	<0.0028	0.18	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.029
ML25-4	75.6	<0.50	6.0	0.4	0.01	0.012	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.045
ML25-5	83.7	1.2	5.3	0.7	0.09	0.032	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.040
ML25-6	62.5	3.8	5.2	2.6	0.67	0.395	1.15	0.013	<0.0019	<0.0028	<0.011	<0.014	0.060
ML25-7	7.8	2.2	5.8	2.1	2.30	0.511	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.039
ML31-0	16.1	<0.50	7.9	4.7	0.13	0.107	<0.027	<0.010	0.0022	0.0437	<0.011	<0.014	0.006
ML31-1	28.5	<0.51	10.0	6.0	0.01	0.091	0.03	<0.010	<0.0019	0.0664	<0.011	<0.014	0.015
ML31-2	30.6	<0.51	9.9	5.9	0.09	0.093	<0.027	<0.010	<0.0019	0.119	<0.011	<0.014	0.017
ML31-3	30.6	<0.50	9.5	5.8	<0.0066	0.131	<0.027	<0.010	<0.0019	0.0884	<0.011	<0.014	0.016
ML31-4	55.8	0.7	18.5	12.6	0.12	0.295	0.07	<0.010	<0.0019	0.142	<0.011	<0.014	0.039
ML31-5	88.8	2.3	31.4	19.5	0.01	1.240	<0.027	<0.010	<0.0019	0.0905	<0.011	<0.014	0.087
ML31-6	41.9	7.0	29.5	17.7	0.02	0.857	<0.027	<0.010	<0.0019	0.0043	<0.011	<0.014	0.065
ML31-7	27.0	5.3	30.9	13.8	<0.0066	0.864	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.042
ML31-8	12.0	3.7	16.8	7.1	0.02	0.427	<0.027	<0.010	<0.0019	0.0019	<0.011	<0.014	0.019
ML31-9	12.4	2.9	22.1	6.9	<0.0066	0.406	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.016
ML31-10	16.8	2.8	22.8	6.4	0.01	0.284	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.015
ML32-0	17.0	<0.50	8.4	5.2	1.04	0.128	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.006
ML32-1	26.0	<0.51	10.0	5.9	<0.0066	0.053	0.03	<0.010	<0.0019	0.0334	<0.011	<0.014	0.015
ML32-2	30.2	<0.50	8.3	5.1	0.01	0.117	<0.027	<0.010	<0.0019	0.219	<0.011	<0.014	0.015
ML32-3	100.0	1.2	31.2	22.4	<0.0066	0.472	<0.027	<0.010	<0.0019	0.278	<0.011	<0.014	0.094
ML32-4	65.0	4.2	39.1	16.2	0.19	2.620	<0.027	<0.011	<0.0019	0.0307	<0.011	<0.014	0.073
ML32-5	39.4	4.3	35.7	9.7	2.94	1.790	<0.027	<0.010	<0.0019	<0.0028	<0.011	<0.014	0.039
ML32-6	10.0	3.5	24.3	1.7	16.20	0.268	<0.039	0.021	<0.0021	0.0064	<0.0054	<0.015	0.011
ML32-7	10.2	3.7	25.3	1.9	12.20	0.111	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.011
ML32-8	22.2	5.3	38.3	2.3	1.38	0.013	<0.039	<0.014	<0.0021	0.0046	<0.0054	<0.015	0.020
ML32-9	7.7	10.6	24.6	2.1	<0.0067	<0.0022	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.015
ML32-10	10.7	7.8	21.7	0.5	0.04	<0.0022	0.13	<0.014	<0.0021	0.0037	<0.0054	<0.015	<0.0021

TABLE D-2: February 1997 Metal Concentrations Analyzed at ManTech.

0.45 μm filtered samples, all concentrations in ***mg/L***

DESC	Na	K	Ca	Mg	Fe	Mn	Al	As	Cd	Cr	Ag	Pb	Ba
ML33-0	23.5	2.0	5.2	1.2	0.01	0.004	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML33-1	76.9	2.6	15.3	12.1	2.61	0.158	<0.039	<0.014	<0.0021	0.0306	<0.0054	<0.015	0.015
ML33-2	65.2	3.3	22.3	8.6	10.90	0.919	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.015
ML33-3	51.3	2.8	22.4	10.8	8.10	0.815	<0.039	<0.014	<0.0021	0.0069	<0.0054	<0.015	0.011
ML33-4	13.5	2.3	21.8	1.3	<0.0067	0.010	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML33-5	27.0	2.7	35.1	2.6	0.01	0.012	<0.039	<0.014	<0.0021	0.0009	<0.0054	<0.015	<0.0021
ML33-6	12.4	3.1	35.4	3.9	0.03	0.030	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML33-7	14.4	4.3	38.0	2.9	8.02	0.299	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.015
ML33-8	10.3	2.8	43.0	1.1	0.08	0.032	0.34	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML33-9	13.4	1.6	18.1	1.7	0.01	0.026	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML33-10	21.7	6.4	83.8	0.3	1.29	0.014	4.64	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.012
ML34-0	19.8	1.9	3.9	0.3	0.01	<0.0022	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML34-1	65.6	1.5	10.0	10.2	0.02	0.024	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.007
ML34-2	65.0	2.4	13.3	8.3	0.02	0.018	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.004
ML34-3	42.6	2.6	13.1	2.2	0.03	0.025	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.003
ML34-4	45.8	4.1	8.7	4.1	0.14	0.052	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML34-5	44.3	2.1	11.1	1.7	0.13	0.045	<0.039	<0.014	<0.0021	0.0074	<0.0054	<0.015	<0.0021
ML34-6	27.5	2.2	6.8	1.1	0.01	0.011	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML34-7	29.4	2.0	7.3	2.0	0.74	0.144	<0.039	<0.014	<0.0021	0.0059	<0.0054	<0.015	<0.0021
ML34-8	19.7	<0.98	7.6	1.6	0.55	0.133	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML34-9	18.3	1.1	8.7	2.1	0.42	0.121	<0.039	<0.014	<0.0021	0.0042	<0.0054	<0.015	<0.0021
ML34-10	16.0	<0.98	7.4	1.5	0.12	0.053	<0.039	<0.014	<0.0021	0.0061	<0.0054	<0.015	<0.0021
ML35-0	15.2	<0.98	8.1	3.4	3.06	0.773	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.004
ML35-1	27.2	<0.98	5.7	1.9	0.04	0.025	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML35-2	32.5	<0.98	6.6	2.5	0.81	0.107	<0.039	0.025	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
ML35-3	55.0	0.6	18.3	11.5	0.77	0.298	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.005
ML35-4	56.4	1.7	13.3	5.8	2.48	0.613	0.16	0.016	<0.0021	<0.0036	<0.0054	<0.015	0.009
ML35-5	37.7	1.9	10.2	4.0	0.55	0.648	<0.039	<0.014	<0.0021	<0.0036	<0.0054	0.015	0.010
ML35-6	11.2	2.8	15.2	4.6	0.11	1.040	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.011
ML35-7	11.3	2.8	13.0	4.4	0.69	0.875	0.35	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.011
ML35-8	12.7	2.5	10.4	2.4	0.66	0.641	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.007
ML35-9	17.6	2.3	6.7	1.3	1.15	0.211	1.55	0.025	<0.0021	<0.0036	<0.0054	<0.015	0.009
ML35-10	18.6	1.4	3.5	0.8	0.14	0.135	0.12	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021
MW13	160.0	<0.98	17.9	12.4	<0.0067	0.048	<0.039	<0.014	<0.0021	3.26	<0.0054	<0.015	0.054
MW18	119.0	<0.98	14.1	11.6	0.65	0.656	<0.039	<0.014	<0.0021	0.0165	<0.0054	<0.015	0.054
MW35D	15.8	<0.98	14.2	5.0	6.11	0.213	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.363
MW38	19.4	1.7	12.3	5.4	0.02	0.141	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.014
MW46	11.2	<0.98	5.5	3.3	0.04	0.041	<0.039	<0.014	<0.0021	0.0044	<0.0054	<0.015	0.002
MW47	30.3	<0.98	5.1	2.6	0.08	0.180	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	0.002
MW48	54.1	<0.98	10.2	6.6	0.03	0.353	<0.039	<0.014	<0.0021	0.911	<0.0054	<0.015	0.025
MW49	56.1	<0.98	5.0	2.1	0.40	0.160	<0.039	0.025	<0.0021	<0.0036	<0.0054	<0.015	0.003
MW50	9.3	<0.98	4.3	2.6	1.02	0.051	<0.039	<0.014	<0.0021	<0.0036	<0.0054	<0.015	<0.0021

TABLE D 3. **December 1998 Dissolved Metal Concentrations Analyzed at ManTech**

0.45 µm filtered samples, all concentrations in mg/L

Sample ID	Na	K	Ca	Mg	Fe	Mn	Al	As	Cr	Ni	Zn	Pb	Sr	Ba
ML11-10	11.9	6.16	28.2	12.7	4.38	0.742	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.284	0.0197
ML11-10DUP	11.9	6.39	27.5	12.5	4.25	0.727	<0.033	<0.021	0.0037	<0.0088	<0.0012	<0.014	0.278	0.0217
ML11-9	14.8	5.12	31.1	8.98	7.53	0.986	<0.033	<0.021	<0.0023	<0.0088	0.0001	<0.014	0.302	0.0225
ML11-8	15.8	4.11	27.3	9.24	5.27	0.995	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.292	0.0216
ML11-7	15.9	4.17	28	8.45	1.45	1.6	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.291	0.0255
ML11-6	33.1	5.32	31.3	10.8	<0.0050	2.74	<0.033	<0.021	0.078	0.0121	<0.0012	<0.014	0.405	0.0472
ML11-5	36.7	5.35	25.2	11.6	<0.0050	2.41	<0.033	<0.021	0.0767	<0.0088	0.0014	<0.014	0.404	0.0548
ML11-4	102	1.29	17.6	12.9	<0.0050	0.335	<0.033	<0.021	2.13	<0.0088	0.0015	<0.014	0.314	0.0632
ML11-3	111	1.1	15.1	11.9	0.342	0.329	0.19	<0.021	2.03	<0.0088	0.0035	<0.014	0.264	0.0548
ML11-2	67.1	0.91	12.3	8.74	<0.0049	0.254	<0.033	<0.021	0.513	<0.0088	<0.0012	<0.014	0.192	0.0327
ML11-1	48.6	0.85	12	8.13	<0.0049	0.182	<0.033	<0.021	0.681	<0.0088	0.0016	<0.014	0.179	0.0256
ML11-0	38.1	1.04	18.2	11.9	<0.0049	0.166	<0.033	<0.021	0.168	0.0019	0.002	<0.014	0.25	0.0275
ML11-0DUP	37.6	1.3	18.1	11.8	<0.0049	0.161	<0.033	<0.021	0.17	<0.0088	0.002	<0.014	0.248	0.0269
ML12-10	26.6	4.73	42.6	3.66	0.0097	0.0245	<0.033	<0.021	0.0047	0.0111	0.0104	<0.014	0.335	0.0339
ML12-9DUP	29.6	6.44	49.9	5.26	2.57	0.179	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.407	0.0211
ML12-9	29.9	6.5	50.1	5.27	2.56	0.179	0.042	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.407	0.0211
ML12-8	22.6	6.25	40.4	4.89	5.04	0.0893	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.349	0.0134
ML12-7	29.6	5.35	21.2	4.61	4.74	0.0848	0.046	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.201	0.0091
ML12-6	24.7	4.91	23	5.07	11.2	0.146	<0.033	<0.021	<0.0023	0.0108	<0.0012	<0.014	0.212	0.013
ML12-5	64.1	5.74	29.1	7.11	18.7	1.09	<0.033	<0.021	<0.0024	<0.0088	<0.0013	<0.014	0.303	0.0479
ML12-4	99.8	2.28	16.9	10.7	<0.0050	0.868	<0.033	<0.021	1.13	<0.0088	<0.0012	<0.014	0.292	0.0548
ML12-3	102	1.22	14.7	11.6	<0.0049	0.335	<0.033	<0.021	1.58	<0.0088	0.0037	<0.014	0.256	0.0539
ML12-2	88.5	0.77	15.4	10.9	<0.0049	0.378	<0.033	<0.021	1.05	<0.0088	<0.0012	<0.014	0.251	0.0458
ML12-1	64.5	<0.32	13.8	8.96	<0.0049	0.247	<0.033	<0.021	0.517	<0.0088	0.0017	<0.014	0.21	0.0362
ML13-10	16.6	2.28	25.8	1.26	0.0176	0.0149	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.314	0.0076
ML13-9	5.41	1.95	9.09	0.042	0.0149	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.088	0.0233
ML13-8	4.97	2.34	5.5	<0.037	0.0116	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0546	0.0297
ML13-7DUP	5.5	2.78	4.17	0.056	0.015	<0.0035	<0.033	<0.021	<0.0023	0.0099	<0.0012	<0.014	0.0412	0.0262
ML13-7	5.42	2.74	4.12	0.056	0.0116	<0.0035	<0.033	<0.021	<0.0023	0.0088	<0.0012	<0.014	0.041	0.0255
ML13-6	7.72	3.16	4.76	0.159	0.0116	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0443	0.0172
ML13-5	8.63	2.56	6.74	0.081	0.0081	<0.0035	<0.033	<0.021	<0.0023	0.0112	<0.0012	<0.014	0.0525	0.0117
ML13-4	5.34	1.4	5.26	0.143	0.0115	0.0114	<0.033	<0.021	<0.0023	0.0115	<0.0012	<0.014	0.0351	0.0306
ML13-3	18	2.23	10.8	0.765	0.018	0.0133	<0.033	<0.021	<0.0023	0.0091	<0.0012	<0.014	0.0745	0.013
ML13-2	44.4	4.45	7.21	5.25	0.0235	0.0439	<0.033	<0.021	0.0024	<0.0088	<0.0012	<0.014	0.0691	0.0073
ML13-1	81.2	3.13	2.5	9.75	0.046	0.0603	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0211	0.0043
ML13-0	64.5	2.03	3.36	3.36	0.0174	0.0134	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.036	0.0039

TABLE D 3. **December 1998 Dissolved Metal Concentrations Analyzed at ManTech**

0.45 µm filtered samples, all concentrations in mg/L

Sample ID	Na	K	Ca	Mg	Fe	Mn	Al	As	Cr	Ni	Zn	Pb	Sr	Ba
ML14-10	10.9	1.13	14.9	1.11	3.4	0.25	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.119	0.0103
ML14-9	3.12	1.64	14.8	1.29	0.577	0.209	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.147	0.0072
ML14-8DUP	5.03	2.39	4.03	<0.037	<0.0049	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0199	<0.0011
ML14-8	5.03	2.41	4.02	<0.037	<0.0049	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0198	<0.0011
ML14-7	5.83	1.66	2.05	<0.037	0.0082	<0.0035	0.08	<0.021	<0.0023	0.0092	<0.0012	<0.014	0.0117	<0.0011
ML14-6	6.31	2.19	2.13	<0.037	<0.0049	<0.0035	<0.033	<0.021	0.0031	0.0119	<0.0012	<0.014	0.0125	<0.0011
ML14-4	6.5	2.35	3.8	<0.037	0.0033	<0.0035	<0.033	<0.021	<0.0023	0.0024	<0.0012	<0.014	0.0184	0.0001
ML14-3	10.7	1.47	4.02	0.246	0.0115	0.0094	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0365	0.0031
ML14-2	12	2.76	9.06	0.772	0.0113	<0.0035	<0.033	<0.021	<0.0023	0.0111	<0.0012	<0.014	0.087	0.026
ML14-1	60.6	2	1.19	0.276	0.0116	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.013	0.0032
ML14-0	51.3	1.56	1.29	<0.037	0.015	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.013	0.0023
ML15-10	39.6	4.77	32.1	1.89	<0.0034	0.0866	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.291	0.0057
ML15-10	40	4.54	32.5	1.87	0.0087	0.0846	<0.030	<0.017	0.0026	<0.0071	<0.0015	<0.014	0.296	0.0066
ML15-9	35	4.35	16.2	0.988	0.0599	0.0591	<0.030	<0.017	0.0026	0.0084	<0.0015	<0.014	0.153	0.0087
ML15-8	24.7	4.53	17.1	1.43	0.373	0.0951	<0.030	<0.017	<0.0016	<0.0071	<0.0015	0.016	0.149	0.0108
ML15-7	23.5	3.89	17.1	1.27	0.1	0.0851	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.152	0.0083
ML15-6DUP	12.2	3.71	10.6	2.2	2.92	0.243	<0.030	0.037	<0.0016	<0.0071	<0.0015	<0.014	0.0862	0.0082
ML15-6	12	3.92	10.5	2.2	2.85	0.241	<0.030	<0.017	0.0016	<0.0071	<0.0015	<0.014	0.0847	0.0084
ML15-5	7.36	1.73	1.88	0.846	0.312	0.193	0.085	0.019	<0.0016	<0.0071	<0.0015	<0.014	0.0197	0.0017
ML15-4	5.41	1.57	<0.011	<0.034	<0.0034	0.0038	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0004	<0.0008
ML15-3	8.94	3.14	2.36	0.126	<0.0034	0.0067	0.112	0.009	0.0003	<0.0071	<0.0015	<0.014	0.0075	<0.0008
ML15-2	44.1	2.94	3.33	2.37	0.0516	0.0237	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0288	0.0017
ML15-1	57.8	0.85	2.62	1.36	0.75	0.256	<0.033	0.035	<0.0023	<0.0088	<0.0012	<0.014	0.0283	0.0021
ML15-0	47	0.66	7.08	4.22	1.38	0.36	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0851	0.009
ML21-7DUP	21.7	5.42	26.6	9.14	6.34	3.46	<0.030	<0.017	<0.0016	0.0144	<0.0015	<0.014	0.303	0.0456
ML21-7	21.7	5.53	26.2	9	6.23	3.41	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.299	0.0454
ML21-6	39.4	5.16	25.3	11.1	3.29	2.08	<0.030	<0.017	0.002	<0.0071	0.0038	<0.014	0.358	0.0343
ML21-5	81.3	1.55	15	11.1	<0.0034	0.266	<0.030	<0.017	3.24	0.0096	<0.0015	<0.014	0.255	0.0559
ML21-4	63.9	0.74	8.21	5.59	<0.0034	0.202	<0.030	<0.017	1.37	<0.0071	<0.0015	<0.014	0.131	0.0227
ML21-3	33.1	0.6	9.12	5.86	<0.0034	0.21	<0.030	<0.017	0.276	<0.0071	<0.0015	<0.014	0.132	0.0203
ML21-2	23.3	0.4	10.2	6.12	<0.0034	0.135	<0.030	<0.019	0.365	<0.0071	<0.0015	<0.014	0.14	0.0142
ML21-1DUP	22.2	0.76	12.7	7.52	<0.0034	0.095	<0.030	<0.017	0.0019	0.0129	<0.0015	<0.014	0.164	0.017
ML21-1	22.3	0.78	12.9	7.62	<0.0034	0.099	<0.030	<0.017	0	<0.0071	<0.0015	<0.014	0.166	0.0164
ML22.5-8	10	4.3	21.9	2.69	10.9	0.321	<0.030	0.02	<0.0016	<0.0071	<0.0015	<0.014	0.244	0.0125
ML22.5-7	9.9	4.5	22.8	2.93	12.3	0.425	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.248	0.0138
ML22.5-6	10.2	4.42	23.6	3.11	12.2	0.489	<0.030	<0.017	0.0022	<0.0071	<0.0015	<0.014	0.248	0.0129
ML22.5-5	8.2	4.29	22.8	3.09	12.1	0.487	<0.030	<0.017	<0.0016	0.0085	<0.0015	<0.014	0.234	0.0102

TABLE D 3. **December 1998 Dissolved Metal Concentrations Analyzed at ManTech**

0.45 µm filtered samples, all concentrations in mg/L

Sample ID	Na	K	Ca	Mg	Fe	Mn	Al	As	Cr	Ni	Zn	Pb	Sr	Ba
ML22.5-4	28.1	3.27	23.8	5.62	10.3	0.788	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.206	0.0097
ML22.5-3	41.8	2.42	18.1	6.84	11.1	1.09	<0.030	<0.017	<0.0016	<0.0071	<0.0015	0.019	0.168	0.01
ML22.5-2	41.1	0.82	10.3	6.03	2.98	0.502	<0.030	<0.017	0.16	<0.0071	0.0016	<0.014	0.147	0.0194
ML22.5-1	30.1	0.89	9.14	5.98	0.54	0.232	<0.030	<0.017	0.212	<0.0071	<0.0015	<0.014	0.132	0.0187
ML22.5-0	38	1.19	7.3	5.57	7.79	0.15	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0872	0.0072
ML23.5-0	36.1	1.41	3.25	8.8	0.0277	0.0175	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0239	0.0052
ML23.5-8	14.4	1.23	4.72	1.52	<0.0034	0.0395	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0293	0.0019
ML23.5-7	14.1	0.91	4.25	1.43	0.0566	0.0635	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0263	0.0008
ML23.5-6	12.8	0.96	4.02	1.21	<0.0034	0.0355	0.042	<0.017	<0.0016	0.0095	<0.0015	<0.014	0.0221	<0.0008
ML23.5-5DUP	21.2	1.37	6.69	2.67	0.483	0.243	<0.030	0.029	<0.0016	<0.0071	<0.0015	<0.014	0.0453	0.002
ML23.5-5	21.2	1.09	6.78	2.69	0.49	0.243	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0461	0.002
ML23.5-4	24.6	1.74	9.02	2.79	0.736	0.261	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0714	0.0044
ML23.5-3	42.7	1.8	9.85	2.98	0.11	0.0573	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0712	0.0033
ML23.5-2	52.7	2.33	6.05	2.69	0.659	0.187	<0.030	<0.017	0.0035	<0.0071	<0.0015	<0.014	0.0591	0.0056
ML23.5-1	49.7	2.72	3.24	4.74	0.0255	0.0125	<0.030	<0.017	<0.0016	0.0052	<0.0015	<0.014	0.0462	0.004
ML24-7	7.98	1.9	3.84	0.13	0.0166	0.0356	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0412	0.0039
ML24-6	7.97	1.92	3.5	0.145	0.0705	0.0635	<0.030	<0.017	<0.0016	0.0075	<0.0015	<0.014	0.0527	0.0057
ML24-5	13.3	1.65	4.24	0.325	0.0199	0.0356	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0494	0.007
ML24-4	19.5	1.94	4.79	0.277	<0.0034	0.0116	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0578	0.0057
ML24-3	59.2	2.09	3.22	3.46	0.0259	0.0136	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0252	0.0036
ML24-2	68.8	4.56	3.25	3.37	0.0309	0.0236	<0.030	<0.017	0.0003	<0.0071	<0.0015	<0.014	0.0387	0.0085
ML24-1	58.7	3.14	2.15	3.55	0.0291	0.0435	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0243	0.0034
ML25-7	12.1	4.77	10.6	4.85	2.43	1.17	<0.030	<0.017	<0.0016	0.0123	<0.0015	<0.014	0.143	0.0141
ML25-6DUP	12.4	1.73	2.46	1.12	0.48	0.325	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0268	0.0015
ML25-6	12.3	1.8	2.44	1.14	0.467	0.323	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0268	0.0017
ML25-5	44.2	1.49	1.15	1.5	0.211	0.0227	<0.030	0.002	<0.0016	0.0002	<0.0015	<0.014	0.0128	0
ML25-4	52.7	0.95	1.57	1.07	<0.0034	0.0117	0.064	<0.017	0.0032	0.0163	<0.0015	<0.014	0.0196	<0.0008
ML25-3	62.5	2.96	1.31	0.454	0.02	0.0037	0.117	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0172	<0.0008
ML25-2	45.3	2.19	2.84	0.899	0.7	0.0416	<0.030	<0.017	<0.0016	0.0092	<0.0015	<0.014	0.0257	0.0017
ML25-1	49.6	0.75	2.47	1.34	1.85	0.129	<0.030	0.026	<0.0016	0.0079	<0.0015	<0.014	0.0294	0.0026
ML31-10	25.3	3.24	36.5	5.6	0.0234	0.435	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.429	0.0225
ML31-9DUP	23.9	4.34	34.9	7.04	<0.0034	0.501	<0.030	<0.017	0.0019	<0.0071	<0.0015	<0.014	0.417	0.0286
ML31-9	23.9	4.46	34.2	6.99	<0.0034	0.501	<0.030	<0.017	<0.0016	<0.0071	0.0032	0.014	0.408	0.0286
ML31-8	18.6	5.63	22.7	8.55	<0.0034	0.775	<0.030	<0.017	0.002	<0.0071	<0.0015	<0.014	0.213	0.0277
ML31-7	39.8	7.33	33.5	14.2	<0.0034	1.01	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.388	0.0537

TABLE D 3. **December 1998 Dissolved Metal Concentrations Analyzed at ManTech**

0.45 µm filtered samples, all concentrations in mg/L

Sample ID	Na	K	Ca	Mg	Fe	Mn	Al	As	Cr	Ni	Zn	Pb	Sr	Ba
ML31-6	51.8	7.3	29.9	17.1	<0.0034	1.03	<0.030	<0.017	<0.0016	<0.0071	0.0105	<0.014	0.445	0.0697
ML31-5	94.5	2.98	26	16.4	0.0054	0.956	<0.030	<0.017	0.0721	<0.0071	0.0042	<0.014	0.406	0.0806
ML31-4	58.7	0.83	17	11.6	<0.0034	0.292	<0.030	<0.017	0.0475	<0.0071	0.0027	<0.014	0.258	0.0385
ML31-3	28.3	<0.27	11.5	7.08	<0.0034	0.192	<0.030	<0.017	0.0102	<0.0071	0.0026	<0.014	0.159	0.019
ML31-2	28.4	0.73	11.3	7.02	<0.0034	0.19	<0.030	<0.017	0.0083	<0.0071	<0.0015	<0.014	0.156	0.0197
ML31-1	23.7	0.44	10.4	6.29	<0.0034	0.119	<0.030	<0.017	0.0451	0.009	0.0031	<0.014	0.144	0.0181
ML31-0	21.6	0.54	9.69	5.9	<0.0034	0.0612	<0.030	<0.017	0.0022	0.011	0.0037	<0.014	0.123	0.0095
ML32-10	19.7	7.77	40.4	2.93	0.0387	0.0225	<0.030	<0.017	0.0028	<0.0071	0.0017	<0.014	0.382	0.0108
ML32-10DUP	19.6	7.73	40.4	2.96	0.032	0.0224	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.388	0.0099
ML32-9	7.94	8.74	31.4	2.44	0.0088	<0.0013	<0.030	<0.017	0.0021	<0.0071	0.0016	<0.014	0.31	0.0163
ML32-8	24.5	2.55	38.7	4.47	3.62	0.104	<0.030	<0.017	<0.0016	0.0082	<0.0015	<0.014	0.514	0.0179
ML32-7	21.2	3.78	36.1	2.67	15.4	0.139	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.527	0.0172
ML32-6	23.3	4.58	37.9	3.52	22.4	0.595	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.492	0.0273
ML32-5D	48.2	5.34	44.6	9.47	0.384	2.31	<0.030	<0.017	0.0024	<0.0071	<0.0015	<0.014	0.461	0.052
ML32-5	46.2	5.57	47.2	9.74	0.252	2.45	<0.030	<0.017	<0.0016	<0.0071	0.002	<0.014	0.47	0.0538
ML32-4	70.8	3.16	24.2	11.3	<0.0034	1.57	<0.030	<0.017	0.0401	0.0023	0.0001	<0.014	0.3	0.0595
ML32-3	48	1.74	20.7	14.4	0.0078	0.354	<0.030	<0.017	0.027	<0.0071	0.0016	<0.014	0.307	0.0478
ML32-2	24	1.38	11.1	6.91	<0.0034	0.17	<0.030	<0.017	0.0403	0.0106	0.0022	<0.014	0.149	0.0194
ML32-1	23.8	0.91	10.6	6.14	0.0078	0.0851	<0.030	<0.017	0.0607	<0.0071	0.0033	<0.014	0.15	0.0194
ML32-0	20.1	0.88	9.45	5.76	0.0822	0.0652	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.119	0.0088
ML33-10	29.5	9	68.6	0.004	0.0242	<0.0040	5.17	0	<0.0024	0.0003	<0.019	<0.022	2.45	0.0104
ML33-9	21.4	4.03	29.8	2.81	0.416	0.134	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.219	0.0074
ML33-8	12.3	4.98	29.7	2.47	0.0431	0.0299	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.375	0.0064
ML33-7DUP	19.6	4.87	35.1	3.84	13.7	0.23	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.395	0.022
ML33-7D	19.5	4.78	35.6	3.89	13.3	0.248	<0.022	<0.029	<0.0024	0.0109	<0.019	<0.022	0.397	0.0238
ML33-7	20.1	4.69	35.6	3.9	13.5	0.238	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.403	0.0222
ML33-6	18.3	3.95	38.8	5.26	14.1	0.626	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.376	0.0192
ML33-5	27.8	2.9	31.4	5.8	3.44	0.577	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.286	0.0104
ML33-4	20	3.08	42.6	8.03	4.28	0.818	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.364	0.01
ML33-3	40.1	2.61	17.7	4.85	2.92	0.547	<0.022	<0.029	<0.0024	<0.0083	0.028	<0.022	0.167	0.007
ML33-2	45	3.1	35.8	10.5	7.09	1.29	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.315	0.0159
ML33-1	33.3	1.71	3.08	1.67	0.0856	0.0197	0.029	<0.028	<0.0024	<0.0083	<0.019	<0.022	0.0315	<0.0009
ML33-0	25.1	1.23	3.47	3.16	<0.0034	0.0076	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0552	0.0045
ML34-10	23.3	1.8	10.6	1.62	0.026	0.0221	<0.030	<0.020	0.0044	0.013	<0.0014	<0.014	0.0571	<0.0012
ML34-9	20.4	1.94	14	3.47	0.0956	0.0613	<0.030	<0.020	0.0023	<0.011	<0.0014	<0.014	0.0842	0.0015
ML34-8	17	1.54	12.4	3.76	0.513	0.194	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.084	0.0018

TABLE D 3. **December 1998 Dissolved Metal Concentrations Analyzed at ManTech**

0.45 µm filtered samples, all concentrations in mg/L

Sample ID	Na	K	Ca	Mg	Fe	Mn	Al	As	Cr	Ni	Zn	Pb	Sr	Ba
ML34-7DUP	17.5	2.31	22.6	8.22	3.89	0.748	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.194	0.0058
ML34-7	17.6	2.32	23	8.35	3.92	0.76	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.197	0.0057
ML34-6DUP	17.7	2.33	19.3	7.07	1.54	0.712	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.151	0.0035
ML34-6	19.4	2.2	19.3	7.15	1.27	0.684	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.15	0.0033
ML34-5	17.5	2.3	16.5	5.69	0.0956	0.0927	<0.022	<0.028	<0.0024	<0.0083	<0.019	<0.022	0.124	0.002
ML34-4	21.1	2.78	16.9	4.91	0.186	0.0524	<0.022	<0.028	<0.0024	0.0096	<0.019	<0.022	0.109	0.0028
ML34-3	34.8	3.05	17.1	3.4	0.0198	0.0122	<0.022	<0.028	<0.0024	<0.0083	<0.019	<0.022	0.138	0.0076
ML34-2	37.1	1.91	6.83	1.29	0.0106	<0.0040	0.104	<0.028	<0.0024	<0.0083	<0.019	<0.022	0.0612	0.0023
ML34-1	22.7	1.31	1.94	0.071	<0.0088	<0.0040	0.155	<0.028	<0.0024	<0.0083	<0.019	<0.022	0.0179	<0.0009
ML34-0	25.2	1.22	1.88	<0.029	0.0278	<0.0040	<0.022	<0.028	<0.0024	<0.0083	<0.019	<0.022	0.0223	0.0031
ML35-10	17.3	5.45	16.8	2.44	2.45	0.505	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.141	0.01
ML35-9	13.4	2.72	9.43	1.53	5	0.283	<0.030	0.052	<0.0019	<0.011	<0.0014	<0.014	0.0904	0.005
ML35-8	12.5	3.36	11.8	1.94	3.81	0.532	<0.030	0.038	<0.0019	<0.011	<0.0014	<0.014	0.101	0.0081
ML35-6	14.2	2.88	9.71	2.12	0.097	0.646	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.0639	0.0079
ML35-4	17.5	1.54	1.19	0.558	0.0633	0.0323	<0.030	0.024	<0.0019	0.012	<0.0014	<0.014	0.0113	<0.0012
ML35-2	29.4	0.78	2.81	1.57	0.186	0.0361	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.0313	<0.0012
ML35-0	17.1	0.41	1.9	1.01	0.561	0.116	<0.030	<0.020	0.002	<0.011	<0.0014	<0.014	0.0219	0.0013
ML35-0DUP	17.3	0.39	1.92	1.04	0.561	0.122	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.0221	0.0013
Compliance Monitoring Wells														
MW13	168	2.34	16.4	10.4	0.0124	0.0903	<0.030	<0.020	3.13	0.017	0.0052	<0.014	0.236	0.0504
MW18	135	1.79	11.4	9.83	2.27	0.723	<0.030	<0.020	0.0035	0.013	0.0086	<0.014	0.314	0.0494
MW18DUP	135	1.2	11.4	9.94	2.31	0.709	<0.030	<0.020	0.002	<0.011	0.0033	<0.014	0.32	0.0496
MW35D	17.6	1.54	15.6	5.8	6.33	0.588	<0.030	<0.020	0.0038	<0.011	0.0109	<0.014	0.13	0.0153
MW35D DUP	17.8	1.24	15.7	5.83	6.33	0.613	<0.030	<0.020	0.002	0.014	0.0115	<0.014	0.13	0.0148
MW38	17.6	2.08	9.96	4.96	0.0749	0.147	<0.030	<0.020	0.0036	<0.011	0.0757	<0.014	0.124	0.0153
MW46	24.4	1	10.2	5.84	0.0708	0.314	<0.030	<0.020	<0.0019	<0.011	0.0017	<0.014	0.125	0.0103
MW47	23.7	0.25	2.31	1.11	0.183	0.0607	0.002	<0.020	0.0023	<0.011	<0.0014	<0.014	0.0203	0.0001
MW48	59.5	1.03	10.6	7.03	0.0368	0.336	<0.030	<0.020	0.778	0.012	0.0055	<0.014	0.161	0.0291
MW49	51.5	0.86	4.66	2.45	1.35	0.311	<0.030	<0.020	<0.0019	<0.011	0.0017	<0.014	0.0456	0.0029
MW50	33.6	0.82	5.33	3.11	0.453	0.169	<0.030	<0.020	0.0033	<0.011	0.0072	<0.014	0.0636	0.0047
MW52	36.8	0.64	2.47	1.48	0.0328	0.0538	<0.030	<0.020	<0.0019	<0.011	0.0563	<0.014	0.0329	0.0038

TABLE D 3. December 1998 Dissolved Metal Concentrations Analyzed at ManTech

0.45 µm filtered samples, all concentrations in mg/L

Sample ID	Na	K	Ca	Mg	Fe	Mn	Al	As	Cr	Ni	Zn	Pb	Sr	Ba
Field Blanks														
FB 12/3	0.254	<0.23	<0.028	<0.029	0	<0.0029	<0.030	<0.020	0.0023	<0.011	<0.0014	<0.014	<0.0002	<0.0012
FB 12/4	<0.021	<0.23	<0.028	<0.029	0	<0.0029	<0.030	<0.020	0.0024	<0.011	<0.0014	<0.014	<0.0002	<0.0012
FB 12/5	<0.021	<0.23	<0.028	<0.029	0	<0.0029	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	<0.0002	<0.0012
FB 12/6	<0.021	0.28	<0.028	<0.029	0.0033	<0.0029	<0.030	<0.020	0.0024	<0.011	<0.0014	<0.014	<0.0002	<0.0012
FB 12/9	<0.021	<0.23	<0.028	<0.029	0	<0.0029	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	<0.0002	<0.0012
FB 12/10	<0.021	<0.23	<0.028	<0.029	0.0034	<0.0029	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	<0.0002	<0.0012
ML31 BLANK**	0.415	<0.23	<0.028	<0.029	0.0034	<0.0029	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	<0.0002	<0.0012
ML32 BLANK**	1.3	<0.23	<0.028	<0.029	0	<0.0029	<0.030	<0.020	0.0024	<0.011	<0.0014	<0.014	<0.0002	<0.0012
ML33 BLANK**	1.55	<0.23	<0.028	<0.029	0.0167	<0.0029	<0.030	<0.020	<0.0019	0.016	<0.0014	<0.014	<0.0002	<0.0012

Appendix E Lab Analysis Results (Anions)

TABLE E-1: Nov. 1996 Anion Concentrations Analyzed at ManTech.

(Unfiltered samples)

Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)	Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L
ML11-0	0.71	48.9	23.5	<.05	1.55	ML15-0	1.27	51	17	<.05	0.36
ML11-1	1.58	69.1	44	<.05	1.55	ML15-1	0.572	69.7	5.25	<.05	<.05
ML11-2	1.35	55.2	46.1	<.05	1.03	ML15-2	0.965	105	13.9	<.05	<.05
ML11-3	2.04	93.5	65.8	<.05	1.79	ML15-3	3.48	31.4	<.5	<.05	<.05
ML11-4	2.94	111	100	0.07	2.74	ML15-4	1.96	13.9	<.5	<.05	<.05
ML11-5	2.01	61.4	40.1	<.05	1.49	ML15-5	0.585	16.3	10.6	<.05	<.05
ML11-6	1.53	62.4	43.2	<.05	1.48	ML15-6	1.74	25.8	18.2	<.05	<.05
ML11-7	1.78	36.1	22.7	<.05	0.65	ML15-7	4.01	39.3	55.8	<.05	<.05
ML11-8	1.86	24.3	13.2	<0.05	0.07	ML15-8	3.72	26.4	37.4	<.05	<.05
ML11-9	2.47	15.7	6.02	<.05	<0.05	ML15-9	2.19	3.51	2.17	<.05	0.26
ML11-10	2.06	16.5	18.1	<.05	0.1	ML15-10	2.33	3.67	6.82	0.07	1
ML12-1	24.6	45.1	50.1	0.05	0.91	ML31-0	3.04	13.4	4.23	<.05	1.4
ML12-2	2.8	63.7	71.9	0.05	0.98	ML31-1	0.726	18.5	20.2	<.05	1.02
ML12-3	3.37	98.8	104	0.05	2.02	ML31-2	2.22	17.9	29.8	<.05	0.74
ML12-4	2.51	82.6	74.7	0.05	2.43	ML31-3	1.25	13.7	29.4	<.05	0.96
ML12-5	3.47	31.7	11.2	<.05	<.05	ML31-4	1.49	28.8	38.8	<.05	1.43
ML12-6	3.47	9.82	1.79	<.05	<.05	ML31-5	2.02	86.4	47.8	0.09	3.09
ML12-7	5.04	6.87	2.36	<.05	<.05	ML31-6	1.64	77.3	21	<.05	1.33
ML12-8	7	6.33	4.48	<.05	<.05	ML31-7	1.77	69	20.5	0.05	1.06
ML12-9	6.15	4.97	5.68	<.05	<.05	ML31-8	1.2	45.6	16.1	0.05	0.48
ML12-10	2.96	3.77	11.2	<.05	0.23	ML31-9	1.06	16	4.91	<.05	<.05
						ML31-10	0.842	17.7	15.5	<.05	0.33
ML13-0	6.27	51.5	<.5	<.05	<.05	ML32-0	2.25	18.4	7.91	<.05	1.13
ML13-1	3.89	95.7	17.1	<.05	<.05	ML32-1	1.02	24.3	27.6	<.05	1.03
ML13-2	5.01	56.9	6.25	<.05	<.05	ML32-2	1.16	29.2	32	<.05	1.13
ML13-3	6.06	13.5	2.23	<.05	<.05	ML32-3	2.13	85.2	59.4	0.07	3.84
ML13-4	6.28	10.7	<.5	<.05	<.05	ML32-4	1.95	112	62.8	0.06	2.87
ML13-5	2.91	7.34	<.5	<.05	<.05	ML32-5	2.1	67.3	40.7	<.05	1.66
ML13-6	2.48	6.38	<.5	<.05	<.05	ML32-6	1.53	8.83	9.32	<.05	<.05
ML13-7	1.93	5.8	<.5	<.05	<.05	ML32-7	1.45	8.27	8.46	<.05	<.05
ML13-8	1.07	5.29	<.5	<.05	<.05	ML32-8	1.41	7.61	9	<.05	0.2
ML13-9	0.673	3.41	2.9	<.05	<.05	ML32-9	0.512	5.3	5.1	<.05	0.36
ML13-10	2.04	5.03	<.5	<.05	<.05	ML32-10	0.23	6.88	7.52	<.05	0.42
ML14-0	6.99	59.5	9.03	<.05	<.05	ML33-0	0.795	21.6	<.5	<.05	<.05
ML14-1	6.81	56.4	<.5	<.05	<.05	ML33-1	3.04	37.4	<.5	<.05	<.05
ML14-2	6.16	24.3	<.5	<.05	<.05	ML33-2	6.44	69.1	9.73	<.05	<.05
ML14-3	5.17	15.5	<.5	<.05	<.05	ML33-3	5.28	39.9	5.76	<.05	<.05
ML14-4	3.95	12	<.5	<.05	<.05	ML33-4	3.57	59	2.92	<.05	<.05
ML14-5	4.08	8.93	<.5	<.05	<.05	ML33-5	5.07	29.9	2.37	<.05	<.05
ML14-6	3.07	7.97	1.12	<.05	<.05	ML33-6	2.6	13.1	5.28	<.05	<.05
ML14-7	3.5	7.06	<.5	<.05	<.05	ML33-7	1.32	5.21	10.5	<.05	<.16
ML14-8	3.31	5.97	<.5	<.05	<.05	ML33-8	0.497	8.28	8.57	<.05	0.26
ML14-9	2.27	4.31	<.5	0.06	0.08	ML33-9	0.743	14.8	8.88	<.05	0.28
ML14-10	1.06	3.14	2.09	0.07	0.07	ML33-10	0.933	17.3	13.5	0.07	0.3

TABLE E-1: Nov. 1996 Anion Concentrations Aanalyzed at ManTech (unfiltered)

Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)	Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L
ML34-0	3.3	18.8	1.79	<.05	<.05	ML35-0	1.73	23.9	2.96	<0.05	0.19
ML34-1	2.25	62.8	<.5	<.05	<.05	ML35-1	0.851	18.1	<.5	<0.05	<0.05
ML34-2	3.03	69.8	3.74	<.05	<.05	ML35-2	4.41	23	<.5	<0.05	<0.05
ML34-3	3.11	80.1	0.69	<.05	<.05	ML35-3	3.41	78.5	<.5	<0.05	<0.05
ML34-4	2.69	50.7	<.5	<.05	<.05	ML35-4	2.74	95.1	<.5	<0.05	<0.05
ML34-5	3.21	42.5	0.78	<.05	<.05	ML35-5	1.35	87.4	1.54	<0.05	<0.05
ML34-6	3.03	39.2	1.62	<.05	<.05	ML35-6	0.486	32.6	7.46	<.5	<0.05
ML34-7	2.41	28.7	1.42	<.05	<.05	ML35-7	0.743	19.4	8.11	<0.05	<0.05
ML34-8	1.58	22.3	1.48	<.05	<.05	ML35-8	1.62	15.5	4.91	<0.05	<0.05
ML34-9	2.48	12.3	3.9	0.07	0.11	ML35-9	1.7	8.99	11.9	0.07	<0.05
ML34-10	1.88	12.1	16	0.14	0.66	ML35-10	3.74	182	18.5	0.09	1.05
ML21-1	6.7	15	18.3	0.06	0.73	ML25-1	1.05	5.32	3.25	<.05	<.05
ML21-2	0.642	20.8	31.5	<.05	0.72	ML25-2	3.48	10.3	4.59	<.05	<.05
ML21-3	1.49	29.9	50.9	<.05	0.67	ML25-3	2.95	82.8	<.5	<.05	<.05
ML21-4	1.1	82.6	90.1	<.05	2.86	ML25-4	3.63	73.6	5.82	<.05	<.05
ML21-5	2.74	143	138	0.13	5.47	ML25-5	4.34	117	6.73	<.05	<.05
ML21-6	3.69	70.3	31.1	<.05	1.67	ML25-6	6.08	66.6	<.5	<.05	<.05
ML21-7	1.64	26.1	8.07	<.05	0.23	ML25-7	1.6	6.97	5.5	<.05	0.13
ML22-1	2.16	13.7	9.77	<.05	0.94						
ML22-2	0.745	32.6	<.5	<.05	<.05						
ML22-2A	2.34	28	18	<.05	0.58						
ML22-3	1.19	110	4.08	<.05	<.05						
ML22-4	1.86	26.7	<.5	<.05	<.05						
ML23-1	3.3	38	<.5	<.05	<.05						
ML23-2	2.07	67.6	14.6	<.05	<.05						
ML23-3	14.1	116	18.8	<.05	<.05						
ML23-5	7.66	9.86	11.9	<.05	<.05						
ML24-1	1.46	48.3	3.2	<.05	<.05						
ML24-2	1.42	66.3	<.5	<.05	<.05						
ML24-3	1.46	107	18.3	<.05	<.05						
ML24-4	3.05	29.2	<.5	<.05	<.05						
ML24-5	1.4	13.9	<.5	<.05	<.05						
ML24-6	2.07	12.2	<.5	<.05	<.05						
ML24-7	3.03	14.3	<.5	<.05	<.05						

TABLE E-2: Feb. 1997 Anion Concentrations Analyzed at ManTech (unfiltered)

Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)	Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L
ML11-0	4.57	37.2	19.3	0.05	1.14	ML15-0	<.4	47.4	14.9	0.05	0.16
ML11-1	1.66	53.0	42.5	0.05	1.19	ML15-1	0.621	54.8	0.5	0.05	0.05
ML11-2	14.8	56.5	53.9	0.05	0.78	ML15-2	3.66	57.6	0.5	0.05	0.05
ML11-3	9.94	55.4	52.4	0.05	2.25	ML15-3	2.67	28.1	0.5	0.05	0.05
ML11-4	3.59	123	93.5	0.05	2.60	ML15-4	1.82	6.66	0.5	0.05	0.05
ML11-5	1.84	58.1	47.6	0.05	1.51	ML15-5	2.8	4.36	4.98	0.05	0.05
ML11-6	2.23	32.4	22.8	0.05	0.60	ML15-6	2.71	8.44	10.1	0.05	0.05
ML11-7	2.28	1.01	1.38	0.05	0.05	ML15-7	1.09	3.96	5.75	0.05	0.05
ML11-8	2.48	8.08	12.8	0.05	0.05	ML15-8	1.02	2.48	3.60	0.05	0.09
ML11-9	1.74	7.69	12.7	0.05	0.05	ML15-9	4.44	2.28	4.32	0.05	0.25
ML11-10	1.97	6.33	18.4	0.05	0.05	ML15-10	0.929	3.25	6.66	0.05	0.55
ML12-1	22.2	33.2	35.2	0.05	0.63	ML31-0	<.4	12.4	3.38	0.05	1.31
ML12-2	3.57	93.6	96.3	0.05	1.33	ML31-1	10.1	17.6	24.2	0.05	0.89
ML12-3	30.3	117	105	0.05	2.39	ML31-2	0.928	17.8	29.2	0.05	0.72
ML12-4	6.73	99.3	79.4	0.05	1.59	ML31-3	3.78	13.8	31	0.05	0.61
ML12-5	3.50	36.2	14.7	0.05	0.05	ML31-4	1.19	82.5	33.6	0.05	5.71
ML12-6	5.96	3.70	3.61	0.05	0.05	ML31-5	1.95	151	64	0.05	8.35
ML12-7	8.78	3.29	5.47	0.05	0.08	ML31-6	12.8	92.3	28.8	0.05	2.13
ML12-8	4.18	2.89	7.33	0.05	0.09	ML31-7	2.02	62.6	20.3	0.05	1.11
ML12-9	2.32	3.56	6.94	0.05	0.33	ML31-8	1.15	18.7	14.8	0.05	0.05
ML12-10	1.17	4.07	7.19	0.05	0.55	ML31-9	0.94	14.4	8.21	0.05	0.05
						ML31-10	0.493	11.8	18.3	0.05	0.28
ML13-0	26.8	37.0	0.5	0.05	0.05	ML32-0	1.70	13.3	3.24	0.05	1.38
ML13-1	8.74	66.2	1.38	0.05	0.05	ML32-1	0.97	17.7	21.9	0.05	1.00
ML13-2	1.3	54.3	0.5	0.05	0.05	ML32-2		12.5	30.3	0.05	0.47
ML13-3	1.15	25.5	0.5	0.05	0.05	ML32-3	12.6	148	102	0.05	8.04
ML13-4	1.76	6.85	0.5	0.05	0.05	ML32-4	1.9	124	45.2	0.05	4.15
ML13-5	2.38	3.54	0.5	0.05	0.05	ML32-5	2.34	71.8	28.7	0.05	2.09
ML13-6	1.15	3.65	0.5	0.05	0.05	ML32-6	0.722	12.4	8.69	0.05	0.05
ML13-7	1.31	4.37	0.5	0.05	0.05	ML32-7	1.63	12.6	7.31	0.05	0.05
ML13-8	1.39	4.00	0.5	0.05	0.05	ML32-8	1.75	18.6	24.6	0.05	0.13
ML13-9	1.51	4.39	0.5	0.05	0.05	ML32-9	15.1	14.1	10.2	0.05	1.33
ML13-10	2.91	4.7	0.5	0.05	0.05	ML32-10	0.765	8.81	12.2	0.05	1.04
ML14-0	5.15	42.0	0.5	0.05	0.05	ML33-0	3.48	19.3	0.5	0.05	0.05
ML14-1	2.41	55.8	0.5	0.05	0.05	ML33-1	3.38	97.4	15.6	0.05	0.05
ML14-2	1.41	15.2	0.5	0.05	0.05	ML33-2	16.8	114	860*	0.05	0.05
ML14-3	1.98	12.0	0.5	0.05	0.05	ML33-3	2.93	67.9	13.7	0.05	0.05
ML14-4	1.25	3.67	0.5	0.05	0.05	ML33-4	11.5	15.1	4.86	0.05	0.05
ML14-5	2.26	3.84	0.5	0.05	0.05	ML33-5	2.11	32.7	8.73	0.05	0.05
ML14-6	3.01	3.87	0.5	0.05	0.05	ML33-6	1.26	14.8	9.23	0.05	0.05
ML14-7	3.43	3.22	0.5	0.05	0.05	ML33-7	1.46	17.2	16.6	0.05	0.05
ML14-8	5.27	3.41	0.5	0.05	0.05	ML33-8	0.998	14.1	13.7	0.05	0.05
ML14-9	2.29	3.45	0.5	0.05	0.05	ML33-9	0.96	11.3	7.09	0.05	0.21
ML14-10	2.29	2.71	1.08	0.05	0.09	ML33-10	4.66	10.1	5.88	0.05	0.10

TABLE E-2: Feb. 1997 Anion Concentrations Analyzed at ManTech (unfiltered)

Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)	Well #	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L
ML34-0	0.476	14.6	0.5	0.05	0.05	ML35-0	<.4	15.1	2.97	0.05	0.05
ML34-1	18.7	78.2	12.1	0.05	0.05	ML35-1	1.63	16.8	0.5	0.05	0.05
ML34-2	2.57	96.7	3.82	0.05	0.05	ML35-2	1.53	15.5	0.5	0.05	0.05
ML34-3	2.21	97.3	0.5	0.05	0.05	ML35-3	1.3	77.6	0.5	0.05	0.05
ML34-4	5.69	93.5	0.5	0.05	0.05	ML35-4	8.4	82.3	0.5	0.05	0.05
ML34-5	4.08	88.6	0.5	0.05	0.05	ML35-5	1.16	64.7	1.78	0.05	0.05
ML34-6	1.86	46.3	0.5	0.05	0.05	ML35-6	0.888	35.5	5.95	0.05	0.05
ML34-7	5.51	49.7	0.5	0.05	0.05	ML35-7	1.17	23.7	5.26	0.05	0.05
ML34-8	5.67	27.0	0.5	0.05	0.05	ML35-8	1.47	16.8	5.31	0.05	0.05
ML34-9	1.24	27.3	0.5	0.05	0.05	ML35-9	2.16	15.8	4.17	0.05	0.05
ML34-10	1.86	26.3	0.5	0.05	0.05	ML35-10	5.29	17.9	1.91	0.05	0.05
ML21-1	0.566	33.1	35.3	0.05	0.82	MW13	13.7				
ML21-2	11.7	20.1	30.6	0.05	0.72	MW18	3.54				
ML21-3	7.64	17.6	25.7	0.05	0.43	MW35D	15.4				
ML21-4	3.02	112	113	0.05	3.37	MW38	0.532				
ML21-5	3.9	133	131	0.05	4.31	MW46	<.4				
ML21-6	2.06	64.7	25.3	0.05	1.17	MW47	0.921				
ML21-7	36.7	19.5	3.98	0.05	0.05	MW48	1.5				
ML22-2	3.45	24.3	0.5	0.05	0.05	MW49	1.08				
ML22-3	9.82	95.1	4.36	0.05	0.05	MW50	0.970				
ML22-4	4.49	20.4	0.5	0.05	0.05						
ML23-1	3.16	29.5	0.5	0.05	0.05						
ML23-2	4.92	50.9	0.55	0.05	0.05						
ML23-3	1.99	75.4	2.35	0.05	0.05						
ML23-4	4.16	38.3	0.5	0.05	0.05						
ML24-1	5.6	20.2	0.5	0.05	0.05						
ML24-2	8.81	33.9	0.5	0.05	0.05						
ML24-3	3.25	94.5	15.9	0.05	0.05						
ML24-4	4.27	21.5	0.5	0.05	0.05						
ML24-5	4.61	17.7	0.5	0.05	0.05						
ML24-6	3.91	11.9	0.5	0.05	0.05						
ML24-7	4.39	14.6	0.5	0.05	0.05						
ML25-1	0.87	61.0	1.51	0.05	0.05						
ML25-2	4.08	4.12	9.48	0.05	0.05						
ML25-3	8.12	33.5	0.5	0.05	0.05						
ML25-4	3.03	58.0	2.47	0.05	0.05						
ML25-5	3.31	73.3	1.53	0.05	0.05						
ML25-6	1.68	84.4	0.70	0.05	0.05						
ML25-7	0.827	4.96	10.3	0.05	0.05						

TABLE E-3. December 1998 Anion Concentrations Analyzed at ManTech

Unfiltered samples, concentrations in mg/L

Piezo#	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
ML 11-10	2.50	6.73	1.93	<0.1	<0.1
ML 11-9	2.70	6.43	6.29	<0.1	<0.1
ML 11-8	2.73	8.04	13.1	<0.1	<0.1
ML 11-7	2.22	9.25	17.1	<0.1	<0.1
ML 11-6	2.22	39.8	40.9	<0.1	0.53
ML 11-5	1.64	39.2	42.35	<0.1	0.46
ML 11-4	2.60	100.0	97.4	<0.1	3.39
ML 11-3	3.80	106.0	96.1	<0.1	2.28
ML 11-2	2.34	67.2	50.7	<0.1	0.99
ML 11-1	3.08	42.1	41.4	<0.1	0.72
ML 11-0	1.29	57.1	35.3	<0.1	1.61
ML12-10	1.67	19.25	57.05	<0.1	2.65
ML12-9	2.28	29.1	45.7	<0.1	<0.1
ML12-8	3.01	18.9	17.1	<0.1	<0.1
ML12-7	3.45	5.52	2.15	<0.1	<0.1
ML12-6	2.58	4.49	7.13	<0.1	0.10
ML 12-5	2.98	69.0	58.2	<0.1	0.27
ML 12-4	2.47	95.1	93.2	<0.1	1.84
ML 12-3	2.72	95.9	95.7	<0.1	1.89
ML 12-2	12.95	90.3	76.7	<0.1	1.47
ML 12-1	1.57	63.5	50.3	<0.1	0.92
ML 13-10	1.21	14.8	13.4	<0.1	2.32
ML 13-9	0.664	16.6	<0.1	<0.1	<0.1
ML 13-8	0.794	6.36	<0.1	<0.1	<0.1
ML 13-7	0.720	6.83	<0.1	<0.1	<0.1
ML 13-6	0.881	8.93	<0.1	<0.1	<0.1
ML 13-5	1.30	6.81	<0.1	<0.1	<0.1
ML 13-4	0.950	11.0	<0.1	<0.1	<0.1
ML 13-3	1.02	33.65	<0.1	<0.1	<0.1
ML 13-2	1.59	42.9	1.69	<0.1	<0.1
ML 13-1	2.03	60.6	2.96	<0.1	<0.1
ML 13-0	1.83	48.0	<.1	<0.1	<0.1
ML 14-10	0.618	10.7	<0.1	<0.1	<0.1
ML 14-9	0.589	2.92	<0.1	<0.1	<0.1
ML 14-8	1.09	2.36	<0.1	<0.1	<0.1
ML 14-7 9:30	2.01	3.84	<0.1	<0.1	<0.1
ML 14-7 10:10		6.02	<0.1	<0.1	<0.1
ML 14-6	1.46	4.31	<0.1	<0.1	<0.1
ML 14-4	0.926	10.2	<0.1	<0.1	<0.1
ML 14-3	0.863	19.9	<0.1	<0.1	<0.1
ML 14-2	0.893	31.6	<0.1	<0.1	<0.1
ML 14-1	1.91	58.9	<0.1	<0.1	<0.1
ML 14-0	3.94	69.1	<0.1	<0.1	<0.1

Piezo#	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
ML 25-7	1.50	32.4	7.69	<0.1	<0.1
ML 25-6	0.849	15.2	1.16	<0.1	<0.1
ML 25-5	2.03	45.1	0.38	<0.1	<0.1
ML 25-4	2.75	39.3	<0.1	<0.1	<0.1
ML 25-3		48.1	<0.1	<0.1	<0.1
ML 25-2 D	2.08	43.9	0.59	<0.1	<0.1
ML 25-2	1.34	44.1	0.54	<0.1	<0.1
ML 25-1	1.17	46.6	<0.1	<0.1	<0.1
ML 24-7	2.93	13.1	<0.1	<0.1	<0.1
ML 24-6	2.12	15.0	<0.1	<0.1	<0.1
ML 24-5	2.030	24.3	<0.1	<0.1	<0.1
ML 24-4	1.70	28.2	<0.1	<0.1	<0.1
ML 24-3 D		47.7	<0.1	<0.1	<0.1
ML 24-3	2.05	47.3	<0.1	<0.1	<0.1
ML24-2	1.72	44.2	<0.1	<0.1	<0.1
ML24-1	1.86	42.6	<0.1	<0.1	<0.1
ML23.5-8	1.68	11.8	<0.1	<0.1	<0.1
ML23.5-7	2.04	10.5	<0.1	<0.1	<0.1
ML23.5-6	1.85	9.04	<0.1	<0.1	<0.1
ML23.5-5	2.08	23.6	<0.1	<0.1	<0.1
ML23.5-4	2.01	27.9	<0.1	<0.1	<0.1
ML23.5-3	2.16	33.5	<0.1	<0.1	<0.1
ML23.5-2	2.17	33.1	1.02	<0.1	<0.1
ML23.5-1	1.82	32.85	<0.1	<0.1	<0.1
ML23.5-0	1.60	27.9	<0.1	<0.1	<0.1
ML 22.5-8	1.67	33.6	7.00	<0.1	<0.1
ML 22.5-7	1.66	35.8	7.14	<0.1	<0.1
ML 22.5-6	1.75	37.3	6.91	<0.1	<0.1
ML 22.5-5	1.58	37.1	5.89	<0.1	<0.1
ML 22.5-4	1.99	36.5	10.7	<0.1	<0.1
ML 22.5-3	4.23	35.3	15.0	<0.1	<0.1
ML 22.5-2	1.40	27.7	32.6	<0.1	0.27
ML 22.5-1	1.25	20.5	29.7	<0.1	0.27
ML 22.5-0	2.10	32.0	2.1	<0.1	<0.1
ML 21-7	1.93	36.0	9.61	<0.1	0.11
ML 21-6	2.30	56.1	30.4	<0.1	0.53
ML 21-5	2.27	79.65	86.6	<0.1	2.4
ML 21-4	3.38	38.0	64.6	<0.1	0.98
ML 21-3 D		20.4	43.4	<0.1	0.35
ML 21-3	1.74	20.4	43.5	<0.1	0.33
ML 21-2	0.984	16.0	29.2	<0.1	0.46
ML 21-1	0.752	25.45	18.0	<0.1	1.59

TABLE E-3. December 1998 Anion Concentrations Analyzed at ManTech

Unfiltered samples, concentrations in mg/L

Piezo#	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
ML 15-10	0.989	6.71	39.7	<0.1	0.35
ML 15-9	1.11	6.54	15.0	<0.1	<0.1
ML 15-8	1.04	5.44	12.9	<0.1	<0.1
ML 15-7	1.81	5.19	12.5	<0.1	<0.1
ML 15-6	1.80	3.68	5.91	<0.1	<0.1
ML 15-5	1.08	4.24	1.41	<0.1	<0.1
ML 15-4	1.22	5.88	<0.1	<0.1	<0.1
ML 15-3	1.06	16.6	<0.1	<0.1	<0.1
ML 15-2	1.49	51.3	<0.1	<0.1	<0.1
ML 15-1	1.32	65.6	<0.1	<0.1	<0.1
ML 15-0	0.946	60.9	3.43	<0.1	<0.1
ML 31-10	2.63	19.9	7.53	<0.1	<0.1
ML 31-9	3.15	25.9	3.82	<0.1	<0.1
ML 31-8	1.50	27.4	16.0	<0.1	<0.1
ML 31-7	3.61	75.0	33.5	<0.1	1.46
ML 31-6	1.83	86.2	40.4	<0.1	1.97
ML 31-5	2.31	131.0	73.2	<0.1	5.31
ML 31-4	1.64	64.5	42.7	<0.1	3.72
ML 31-3D	3.61	15.7	31.2	<0.1	0.86
ML 31-3	1.79	15.9	30.5	<0.1	0.87
ML 31-1	1.49	16.2	31.4	<0.1	0.90
ML 31-0	0.812	13.6	10.6	<0.1	1.41
ML 32-10	1.44	19.9	53.1	<0.1	0.96
ML 32-9	0.903	7.24	25.2	<0.1	1.61
ML 32-8	1.82	18.4	6.58	<0.1	<0.1
ML 32-7	2.63	22.0	3.44	<0.1	<0.1
ML 32-6	2.48	43.9	12.0	<0.1	<0.1
ML 32-5	7.27	90.9	31.2	<0.1	1.64
ML 32-4	1.95	92.9	48.1	<0.1	4.45
ML 32-3	1.77	77.15	33.3	<0.1	2.34
ML 32-2	1.19	15.0	30.9	<0.1	0.61
ML 32-1	1.40	13.2	28.5	<0.1	0.45
ML 32-0	1.82	13.6	11.7	<0.1	0.75

Piezo#	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
Monitoring Wells					
MW 13	4.45	129.0	137.0	<0.1	2.96
MW 18	4.19	98.2	98.9	<0.1	<0.1
MW 18 D		110.0	111	<0.1	<0.1
MW 35D	0.906	22.0	0.51	<0.1	<0.1
MW 38	0.923	10.7	24.3	<0.1	0.83
MW 46	0.957	13.2	11.4	<0.1	<0.1
MW 46 D		13.3	11.4	<0.1	<0.1
MW 47	1.16	25.9	<.1	<0.1	<0.1
MW 48	1.82	50.0	48.8	<0.1	1.66
MW 49	1.72	56.1	0.39	<0.1	<0.1
MW 50	1.19	39.9	4.57	<0.1	<0.1
MW 52	1.04	35.9	5.44	<0.1	<0.1
Field blanks					
12-1 TRIP E	0.395	<0.1	<0.1	<0.1	<0.1
F.B. 12-3	0.430	<0.1	<0.1	<0.1	<0.1
F.B. 12-4	0.335	<0.1	<0.1	<0.1	<0.1
F.B. 12-5	0.471	<0.1	<0.1	<0.1	<0.1
F.B. 12-6	0.293	<0.1	<0.1	<0.1	<0.1
F.B. 12-9	0.291	<0.1	<0.1	<0.1	<0.1
F.B.12-10	0.235	<0.1	<0.1	<0.1	<0.1

TABLE E-3. December 1998 Anion Concentrations Analyzed at ManTech

Unfiltered samples, concentrations in mg/L

Piezo#	TOC	Cl	SO_4	NO_2(N)	NO_3(N)	Piezo#	TOC	Cl	SO_4	NO_2(N)	NO_3(N)
ML 33-10	3.31	28.8	13.0	<0.1	<0.1						
ML 33-9	1.35	23.4	16.7	<0.1	<0.1	D = Duplicate					
ML 33-8	1.21	8.22	11.6	<0.1	<0.1						
ML 33-7	1.79	15.4	11.1	<0.1	<0.1						
ML 33-6	1.83	17.3	2.28	<0.1	<0.1						
ML 33-5	2.13	38.5	0.26	<0.1	<0.1						
ML 33-4	1.78	33.0	<0.1	<0.1	<0.1						
ML 33-3	2.08	40.3	1.26	<0.1	<0.1						
ML 33-2	2.14	47.6	2.79	<0.1	<0.1						
ML 33-1	2.52	24.6	<0.1	<0.1	<0.1						
ML 33-0	1.23	13.4	<0.1	<0.1	<0.1						
ML 34-10	1.66	22.6	0.53	<0.1	<0.1						
ML 34-9	1.21	19.7	1.83	<0.1	<0.1						
ML 34-8	1.60	11.4	<0.1	<0.1	<0.1						
ML 34-7D	1.68	14.5	<0.1	<0.1	<0.1						
ML 34-7	1.81	14.2	<0.1	<0.1	<0.1						
ML 34-6	1.77	13.9	<0.1	<0.1	<0.1						
ML 34-5	3.79	19.8	<0.1	<0.1	<0.1						
ML 34-4	1.42	30.0	<0.1	<0.1	<0.1						
ML 34-3	1.75	50.6	<0.1	<0.1	<0.1						
ML 34-2	2.11	41.3	<0.1	<0.1	<0.1						
ML 34-1	1.28	16.7	<0.1	<0.1	<0.1						
ML 34-0	0.956	20.3	<0.1	<0.1	<0.1						
ML 35-10	1.32	12.0	9.77	<0.1	3.97						
ML 35-9	2.00	16.9	4.75	<0.1	1.25						
ML 35-6	1.99	23.4	5.31	<0.1	<0.1						
ML 35-4	1.29	23.2	0.48	<0.1	0.43						
ML 35-2	1.63	26.8	<0.1	<0.1	<0.1						
ML 35-1	1.11	21.95	<0.1	<0.1	<0.1						
ML 35-0 D	0.998	21.5	1.04	<0.1	<0.1						
ML 35-0	0.835	21.6	1.09	<0.1	<0.1						

Appendix F Pump Test Data

TABLE F-1. Hydraulic conductivities calculated from pump tests (UW)

Point	Date	Pump rate (mL/min)	ΔH (cm)	K (m/d)	K calculated by:
21-1	Nov-96	300	106.7 ± 0.5	1.3 - 1.4	Constant head
21-2	Feb-97	130	15.9 ± 0.5	3.8 - 4.0	Constant head
21-3	Nov-96	260	125.6 ± 0.5	1.0 - 1.0	Constant head
21-4	Feb-97	135	11.3 ± 0.5	5.5 - 6.0	Constant head
21-5 #1	**Nov-96**	**380**	**22.1 ± 0.5**	**8.1 - 8.4**	**Constant head**
21-5 #2	**Nov-96**	**207**	**11.6 ± 0.5**	**8.2 - 8.9**	**Constant head**
21-5 #3	**Sep-97**	**950**	**38 ± 0.5**	**11.8 - 12.1**	**Constant head**
21-6	Feb-97	130	25.1 ± 0.5	2.4 - 2.5	Constant head
21-7	Nov-96	225	49 ± 0.5	2.2 - 2.2	Constant head
22-1	Feb-97	132	na	0.2	Basic time lag
22-2A	Feb-97	135	6.9 ± 0.5	8.7 - 10.1	Constant head
22-3 #1	**Feb-97**	**690**	**3.3 ± 0.5**	**87.0 - 118.1**	**Constant head**
22-3 #2	**Sep-97**	**950**	**9 ± 0.5**	**47.9 - 53.6**	**Constant head**
22-4	Feb-97	130	13.1 ± 0.5	4.6 - 4.9	Constant head
22-5	Feb-97	146	na	0.0	Basic time lag
22-6	Feb-97	130	na	0.1	Basic time lag
22-7	Feb-97	146	na	0.0	Basic time lag
23-1	Nov-96	240	1.4 ± 0.5	60.6 - 127.8	Constant head
23-2	Feb-97	135	2.3 ± 0.5	23.1 - 36.0	Constant head
23-3 #1	**Nov-96**	**140**	**0.8 ± 0.5**	**51.6 - 223.7**	Constant head
23-3 #2	**Nov-96**	**690**	**2.8 ± 0.5**	**100.2 - 143.8**	Constant head
23-3 #3	**Sep-97**	**917**	**6.5 ± 0.5**	**62.8 - 73.3**	Constant head
23-5	Nov-96	825	2 ± 0.5	158.2 - 263.7	Constant head
23-6	Feb-97	1090	290 ± 0.5	1.8 - 1.8	Constant head
23-7	Nov-96	150	na	na	Basic time lag
24-1 #1	**Feb-97**	**135**	**1.4 ± 0.5**	**34.1 - 71.9**	**Constant head**
24-1 #2	**Feb-97**	**690**	**2.2 ± 0.5**	**122.5 - 194.6**	**Constant head**
24-2	Feb-97	135	0.6 ± 0.5	58.8 - 647.2	Constant head
24-3 #1	**Feb-97**	**690**	**24.3 ± 0.5**	**13.3 - 13.9**	**Constant head**
24-3 #2	**Sep-97**	**912**	**42.5 ± 0.5**	**10.2 - 10.4**	**Constant head**
24-4 #1	**Feb-97**	**135**	**14.5 ± 0.5**	**4.3 - 4.6**	**Constant head**
24-4 #2	**Feb-97**	**1090**	**89 ± 0.5**	**5.8 - 5.9**	**Constant head**
24-5	Feb-97	690	42 ± 0.5	7.8 - 8.0	Constant head
24-5				4.4	Basic time lag
24-6 #1	**Feb-97**	**135**	**5.3 ± 0.5**	**11.2 - 13.5**	**Constant head**
24-6 #2	**Feb-97**	**1090**	**24 ± 0.5**	**21.3 - 22.2**	**Constant head**
24-7 #1	Feb-97	90	6 ± 0.5	6.6 - 7.8	Constant head
24-7 #2	Feb-97	690	63.1 ± 0.5	5.2 - 5.3	Constant head
24-7 #2				2.9	Basic time lag
25-1	Nov-96	270	28.9 ± 0.5	4.4 - 4.6	Constant head
25-3 #1	Nov-96	567	17.5 ± 0.5	15.1 - 16.0	Constant head
25-3 #2	**Nov-96**	**335**	**10 ± 0.5**	**15.3 - 16.9**	**Constant head**
25-3 #3	**Sep-97**	**887**	**36 ± 0.5**	**11.6 - 12.0**	**Constant head**
25-4 #1	**Feb-97**	**110**	**8 ± 0.5**	**6.2 - 7.0**	**Constant head**
25-4 #2	**Feb-97**	**880**	**55.5 ± 0.5**	**7.5 - 7.7**	**Constant head**
25-5 #1	**Nov-96**	**292**	**23.7 ± 0.5**	**5.8 - 6.0**	**Constant head**
25-5 #2	**Nov-96**	**540**	**63.7 ± 0.5**	**4.0 - 4.1**	**Constant head**
25-6 #1	Feb-97	140			Constant head
25-6 #2	Feb-97	787	45.5 ± 0.5	8.2 - 8.4	Constant head
25-7	Nov-96	275	71.2 ± 0.5	1.8 - 1.9	Constant head
11-0	Nov-96	350	40.3 ± 0.5	4.1 - 4.2	Constant head
15-0	Nov-96	305	58.3 ± 0.5	2.5 - 2.5	Constant head
31-0	Nov-96	216	154.5 ± 0.5	0.7 - 0.7	Constant head
35-0	Nov-96	220	98 ± 0.5	1.1 - 1.1	Constant head

Range in hydraulic conductivity calculated using low and high static head difference (I.e. Low value is measured head - error, and high value is measured head+error)

Hvorslev constant head method:
(Hvorslev 1951)

$$K_h = \frac{q \ln [mL/D + (1+(mL/D)^2)^{0.5}]}{2 \pi L H_c}$$

m= 1
L= 15.24 cm
D= 1.26 cm
$H_c = \Delta H$

Hvorslev basic time lag method:
(Hvorslev 1951)

$$K = A/FT_o$$
$$K = \frac{r^2 \ln L/R}{2 L T_o}$$

T_o = Time lag
F = theoretical shape factor

Range in hydraulic conductivity calculated using low and high static head difference (I.e. Low value is measured head - error, and high value is measured head+error)

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(Hvorslev 1951)

$$K_h = \frac{q \ln [mL/D + (1+(mL/D)^2)^{0.5}]}{2 \pi L H_c}$$

m= 1
L= 15.24 cm
D= 1.26 cm
$H_c = \Delta H$

Hvorslev basic time lag method:
(Hvorslev 1951)

$$K = A/FT_o$$
$$K = \frac{r^2 \ln L/R}{2 L T_o}$$

T_o = Time lag
F = theoretical shape factor

TABLE F-2. Drawdown-Time and Time to Recovery Data from Pump Tests Conducted by the University of Waterloo.

Point 35-0		**Point 35-0**		**Point 31-0**		**Point 31-0**		**Point 25-1**		**Point 25-3 #1**		**Point 25-3 #2**	
Q=220 mL/min		**Q=0**		**Q=216 mL/min**		**Q=0**		**Q=270 mL/min**		**Q=570 mL/min**		**Q=335 mL/min**	
11/21/96		*11/21/96*		*11/21/96*		*11/21/96*		*11/21/96*		*11/21/96*		*11/21/96*	
Pumping		Recovery		Pumping		Recovery		Pump to constant head		Pump to constant head		Pump to constant head	
TIME	Depth	TIME	Depth	TIME	Depth	TIME	Depth	TIME	Depth	TIME	Depth	TIME	Depth
[s]	[cm]	[s]	[cm]	[s]	[cm]	[s]	[cm]	[s]	[cm]	[s]	[cm]	[s]	[cm]
<0	138	1500	236	<0	141.3	960	295	<0	126.9	<0	125.9	<0	125.9
3	140	1502	230	3	150	977	260	4	130	90	142.9	5	136
9	150	1507	220	8	160	983	250	9	140	120	143	6	136
14	160	1512	210	13	170	988	240	25	150	150	143.1	8	135.9
20	170	1517	200	19	180	995	230	61	155	180	143.1		
26	180	1523	190	24	190	1002	220	150	155.4	240	143.2		
34	190	1531	180	30	200	1010	210	180	155.5	360	143.2		
45	200	1542	170	37	210	1015	205	240	155.7	480	143.3		
53	205	1550	165	46	220	1020	200	300	155.8	600	143.4		
59	210	1556	160	54	230	1026	195	360	156	720	143.3		
69	215	1568	155	59	235	1030	190	420	156				
80	220	1582	150	75	250	1036	185	480	156.1				
98	225	1608	145	84	255	1044	180	540	156				
128	230	1625	143	91	260	1050	175	570	155.8				
176	233	1636	142	103	265	1059	170	600(OFF)	155.8				
206	234	1653	141	115	270	1071	165	602	150				
420	235	1676	140	132	275	1088	160	609	140				
690	235.5	1768	139	153	280	1108	155	626	130				
1043	236			184	285	1135	150	640	128				
				232	290	1164	147	660	127				
				295	294	1176	146						
				480	296.8	1225	144						
				600	295.5	1350	142						
				900	295.8	1456	141.5						

Point 25-5 #1
Q=292 mL/min
11/21/96
Pump to constant head

TIME [s]	Depth [cm]
<0	124.8
1	130
11	140
26	145
117	148
210	148.5
300	148.5
420	148.5

Point 25-5 #2
Q=540 mL/min
11/21/96
Pump to constant head

TIME [s]	Depth [cm]
<0	124.8
3	130
7	150
12	160
24	170
42	175
105	179.7
240	181.4
420	183.5
600	184.3
780	186.9
1200	187.5
1500	188.5
1560(OFF)	
1562	180
1565	170
1567	160
1571	150
1576	140
1589	130
1605	126
1635	125

Point 25-7
Q=216 mL/min
11/21/96
Pump to constant head

TIME [s]	Depth [cm]
<0	128.4
3	130
5	140
8	145
30	180
38	185
48	190
59	193
68	195
84	197
96	198
180	199.3
480	199.5
600	199.6
630(OFF)	
634	190
638	180
643	170
649	160
658	150
672	140
682	135
690	133
715	130

Point 23-1
Q=235 mL/min
11/21/96
Pump to constant head

TIME [s]	Depth [cm]
<0	132.4
60	133.6
120	133.7
180	133.8
240	133.7
300	133.8
420	133.8

Point 23-3 #1
Q=140 mL/min
11/21/96
Pump to constant head

TIME [s]	Depth [cm]
<0	133.1
60	133.7
120	133.8
240	133.9

Point 23-3 #2
Q=690 mL/min
11/21/96
Pump to constant head

TIME [s]	Depth [cm]
<0	133.2
120	136
240	136
360	136

Point 23-5
Q=825 mL/min
11/21/96
Pump to constant head

TIME [s]	Depth [cm]
<0	126.5
60	129
300	128.6
480	128.5

Point 23-7
11/22/96
pump dry-Recovery

TIME [m:s]	Depth [cm]
<0	135.5
pumped below screen	
recovery recorded	
1:47	340
2:30	330
3:16	320
4:06	310
4:59	300
5:58	290
6:58	280
8:04	270
9:15	260
10:31	250
11:58	240
13:31	230
15:16	220
17:28	210
19:52	200
22:36	190
25:59	180
30:12	170
36:11	160
46:11	150
75:40	140

Point 11-0
Q=350 mL/min
11/22/96
Pump to constant head

TIME [s]	Depth [cm]
<0	148.4
46	183.5
84	186.2
210	188.2
270	188.2
330	188.3
750	188.5
840	188.6
1140	188.7
1170(OFF)	
1173	180
1177	170
1181	160
1190	150

Point 21-1
Q=300 mL/min
11/22/96
Pump to constant head

TIME [s]	Depth [cm]
<0	152.4
90	242.2
150	247.3
210	248.5
270	249.2
330	249.9
510	251.7
570	252.9
810	256
1410	259
1800	259.1
1890(OFF)	
1892	250
1907	210
1913	200
1920	190
1928	180
1942	170
1952	165
1968	160
2008	155

Point 21-3
Q=260 mL/min
11/22/96
Pump to constant head

TIME [s]	Depth [cm]
<0	152.5
60	241
120	262.5
180	275.2
600	277.2
840	278
960	279
1380	278.7
1440	278.1
1450(OFF)	
1453	270
1456	260
1460	250
1464	240
1470	230
1474	220
1481	210
1488	200
1497	190
1509	180
1526	170
1558	160
1603	155

Point 21-5 #1
Q=207 mL/min
11/22/96
Pump to constant head

TIME [s]	Depth [cm]
<0	153.6
60	165.1
120	165.1
180	165.2
240	165.2

Point 21-5 #2
Q=380 mL/min
11/22/96
Pump to constant head

TIME [s]	Depth [cm]
<0	153.8
30	175.7
90	175.9
150	176
270	176
330	175.9

Point 21-7
Q=225 mL/min
11/22/96
Pump to constant head

TIME [s]	Depth [cm]
<0	152.7
30	189
90	200.6
150	201.6
210	201.6
270	201.1
330	201.3
390	201.7
420(OFF)	
421	200
425	190
431	180
440	170
447	165
459	160
486	155

Point 24-1 #1
Q=135 mL/min
2/28/97
pump dry-Recovery

TIME [m:s]	Depth [cm]
<0	128
54	129.4
150	129.4

Point 24-1 #2
Q=690 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	129
2	130
58	131
180	131.2
238	131.2

Point 24-3
Q=690 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	133
1	135
9	155
28	157
98	157.2
175	157.3

Point 24-5
Q=690 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	132
33	170
53	171.5
64	172
79	172.5
117	173
170	173.6
230	173.8
300	174
400	174
480(OFF)	174
485	170
487	150
490	145
494	140
501	137
508	136
514	135
521	134.5
530	134
548	133.5

Point 24-7 #1
Q=90 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	133.9
2	135
5	137
7	138
11	138.5
16	139
20	139.5
100	139.9

Point 24-7 #2
Q=690 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	133.9
2	140
7	160
15	176
18	180
26	190
31	192
35	197
225	219.5
287	221
367	224
450	226
853(OFF)	229
4	210
6	200
7	190
70	180
73	170
77	160
80	155
82	150
87	145
93	140
98	138

Point 22-3
Q=690 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	135
40	138.2
85	138.3
175	138.3
225	138.3

Point 22-1
Q=225 mL/min
2/28/97
Pump 14 mins-Recovery

TIME [s]	Depth [cm]
<0	125
595	350
840 (OFF)	357
13	340
18	335
20	330
24	325
29	320
32	315
37	310
41	305
46	300
51	295
58	290
66	280
72	285
88	260
94	255
100	250
107	245
115	240
122	235
129	230
137	225

Point 22-1
continued

TIME [s]	Depth [cm]
146	220
165	210
186	200
212	190
244	180
276	170
323	160
387	150
505	140

Point 22-5
Q=146 mL/min
2/28/97
Pumped continuously

TIME [s]	Depth [cm]
<0	135.8
5	140
11	150
20	160
28	170
36	180
44	190
52	200
61	210
66	220
76	230
85	240
93	250
102	260
111	270
119	280
128	290
136	300
146	310
154	320
164	330
174	340

Point 22-5
continued
Recovery

TIME [s]	Depth [cm]
232(OFF)	400
521	372
338	371
355	370
369	369
378	368
394	367
413	366
433	365
453	364
511	362
671	354
1058	345
1594	332
1753	328
1821	326
2679	307
3382	293
3456	291
4393	272.5
5601	252
7447	227
8341	217

Point 22-7
Q=146 mL/min
2/28/97
Pump-Recovery

TIME [m:s]	Depth [cm]
<0	134.5
8	140
14	150
21	160
28	170
35	180
41	190
55	200
1:02	210
1:09	220
1:15	230
1:22	240
2:06	250
2:14	330
2:21	340
2:30	355
2:36(OFF)	360
3:00	358
3:05	357
3:12	356
3:22	355
3:30	354
3:38	353
3:44	352

Point 22-7
continued
Recovery

TIME [s]	Depth [cm]
4:25	350
5:50	339
6:06	337
8:26	321
8:44	319
9:04	317
11:31	303
11:45	302
11:55	301
12:08	300
22:05	261.5
22:30	260
22:48	259
23:06	258
23:32	257
23:45	256
40:07	218
40:33	217
54:40	196
55:32	195
1:14:44	175
1:15:07	174.7
1:43:40	156.5
1:55:48	151

Point 21-2
Q=130 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	143
30	159
60	160
210	159
433	159
650	159
720	158.9

Point 25-2
Q=855 mL/min
2/28/97
Pump-Recovery

TIME [s]	Depth [cm]
<0	151.5
8	200
18	220
24	225
37	230
100	233
138	233
175	233.2
236	235.2
265	235.5
297	236
436	234
515	236.4
722	236.5
782	236.4
840(OFF)	
5	230
7	200
12	180
15	170
19	165
23	160
30	155
38	153

Point 25-6 #1
Q=140 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	136
5	140
18	144
171	144
239	133.9
295	133.9

Point 25-6 #2
Q=787 mL/min

TIME [s]	Depth [cm]
<0	136
20	180
114	181.2
165	181
209	181.4
284	181.5
353	181.5

Point 25-4 #1
Q=110 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	137
11	144
295	144.5
435	145

Point 25-4 #2
Q=880 mL/min

TIME [s]	Depth [cm]
<0	137
21	191.6
159	191.8
235	192
361	192.5
502	192.5

Point 21-4
Q=135 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	140.5
13	150
24	151
198	151.6
280	151.7
355	151.8

Point 21-6
Q=130 mL/min
2/28/97
Pump to constant head

TIME [m:s]	Depth [cm]
<0	142.7
22	159
34	163
44	165
60	166.5
81	167.5
113	167.7
140	167.9
305	167.6
973	167.8

Point 22-4
Q=130 mL/min
2/28/97
Pump and Recovery

TIME [s]	Depth [cm]
<0	139
10	144
24	149
31	150
51	152
108	152.5
260	152.1
300(OFF)	152.1
309	146
316	144
360	139.5

Point 22-2A
Q=135 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	136
19	142.5
50	142.5
170	142.8
308	142.9
360(OFF)	142.9
363	140
373	136.5
387	136

Point 22-6
Q=130 mL/min
2/28/97
Pump-Recovery

TIME [s]	Depth [cm]
<0	136
17	157
50	185
61	192
71	199
83	206
99	216
114	225
131	236
154	248
166	254
183	265
206	277
240(OFF)	295
246	290
250	286
254	284
266	280
274	272
282	275
305	270
332	263
368	255
390	250

Point 22-6
continued

TIME [s]	Depth [cm]
415	245
439	240
465	235
487	230
560	210
640	202
663	199
1125	169.6
1270	163.6

Point 23-2
Q=135 mL/min
2/28/97
Pump to constant head

TIME [s]	Depth [cm]
<0	141
22	143.5
40	143.6
65	143.2
175	143.3
251	143.3

Point 23-6
Q=1090 mL/min
2/28/97
Pump-Recovery

TIME [s]	Depth [cm]
<0	133
14	228
102	423
180(OFF)	423
249	408
277	402.5
305	398
351	391.5
422	370
598	354.5
845	323.5
918	316
1003	308
1369	280.5
1879	247.5
2115	236
2433	223
4005	196

Point 24-2
Q=135 mL/min
2/28/97
Pump to constant head

TIME [m:s]	Depth [cm]
<0	134.5
46	135.5
87	135.5
390	135.1

Point 24-4 #1
Q=135 mL/min
2/28/97
Pump and Recovery

TIME [s]	Depth [cm]
<0	135.5
9	140.5
37	149.5
68	150
102	150
135(OFF)	150
153	140
164	137.5
192	135.5

Point 24-4 #2
Q=1090 mL/min

TIME [s]	Depth [cm]
<0	133
8	171
34	205
86	220
112	222
150(OFF)	222
155	200
168	175
183	150
201	142
220	137
296	132

Point 24-6 #1
Q=135 mL/min
2/28/97
Pump and Recovery

TIME [s]	Depth [cm]
<0	136.2
7	141
23	141.5
135(OFF)	141.5
153	136.5
189	136.2

Point 24-6 #2
Q=1090 mL/min

TIME [s]	Depth [cm]
<0	136
9	156
28	160
49	160
90(OFF)	160
96	140
113	136

TABLE G1. **Mineral Saturation Indices Calculated with MINTEQA2.**

Based on December 1998 EPA sample analyses.

Piezometer	Ferrihydrite	Goethite	$Cr(OH)_3$ (a)	Cr(OH)3 (c)	Calcite	Dolomite	Siderite (d)	Mackinawite	Amakinite	Gypsum	Rhodochrosite	pH	Eh (mV)
ML11-10	1.387	7.097	-0.736	-3.276	-1.206	-2.462	-0.292	-53.918	-4.351	-3.579	-1.050	6.63	224
ML11-8	0.924	6.634	-1.03	-3.569	-1.594	-3.362	-0.571	-53.33	-4.858	-2.753	-1.282	6.33	244
ML11-6	-0.745	4.965	0.969	-1.57	-1.741	-3.648	-5.071	-79.792	-9.355	-2.242	-1.037	6.24	414
ML11-4	-1.142	4.568	1.779	-0.761	-2.73	-5.298	-5.846	-84.143	-10.331	-2.168	-2.668	5.79	474
ML11-2	-0.953	4.757	1.42	-1.119	-2.68	-5.212	-5.781	-84.26	-10.113	-2.531	-2.586	5.95	463
ML11-0	-1.213	4.497	0.614	-1.925	-2.763	-5.414	-5.858	-84.315	-10.384	-2.509	-3.023	5.72	477
ML12-10	0.468	6.178	-0.022	-2.562	-1.472	-3.714	-4.182	-79.391	-8.204	-1.959	-2.944	6.44	406
ML12-8	0.544	6.254	-0.87	-3.409	-1.217	-3.055	-0.389	-47.952	-4.574	-2.492	-2.131	6.49	196
ML12-6	0.322	6.032	-0.508	-3.048	-1.025	-2.41	0.391	-36.423	-3.355	-3.077	-1.491	6.92	87
ML12-4	-0.961	4.749	1.683	-0.856	-2.598	-5.098	-6.068	-86.993	-10.459	-2.194	-2.107	5.91	485
ML12-2	-1.027	4.683	1.604	-0.936	-2.717	-5.287	-5.932	-85.151	-10.313	-2.299	-2.545	5.87	475
ML13-10	-2.448	3.262	-0.505	-3.045	-1.311	-3.637	-2.715	-38.739	-6.109	-2.711	-2.782	6.92	86
ML13-8	-4.328	1.382	-0.242	-2.781	0.233	-2.975	-1.372	0.359	-0.412	-24.021	-2.380	10.19	-552
ML13-6	-4.242	1.468	-0.242	-2.782	0.235	-0.705	-1.316	0.341	-0.429	-23.267	-2.364	10.19	-539
ML13-4	-3.445	2.265	-0.149	-2.688	0.136	-0.992	-1.238	0.223	-0.899	-13.433	-1.332	9.84	-458
ML13-2	0.944	6.654	-0.088	-2.627	0.53	1.23	-1.002	-35.033	-2.051	-4.197	-0.688	9.31	-92
ML13-0	-1.161	4.549	-0.098	-2.637	0.5	1.318	-0.661	-15.862	-1.484	-6.774	-1.151	9.59	-264
ML14-10	0.602	6.312	-0.118	-2.658	-0.549	-1.929	0.545	-29.065	-1.746	-6.026	-0.627	7.96	-51
ML14-8	-2.99	2.72	-0.231	-2.771	0.178	-2.946	-2.353	-2.792	-1.537	-6.541	-2.359	10.16	-407
ML14-6	-6.078	-0.368	0.515	-2.025	-0.331	-3.691	-2.444	-0.733	-1.696	-28.325	-2.416	10.00	-561
ML14-4	-5.806	-0.096	-0.145	-2.684	-0.216	-3.713	-1.94	-0.274	-1.417	-28.32	-2.457	9.82	-551
ML14-2	0.322	6.032	-0.159	-2.698	0.087	-0.598	-2.119	-27.537	-1.399	-6.216	-2.489	9.89	-200
ML14-0	-3.741	1.969	-0.296	-2.836	-0.642	-4.099	-1.564	0.504	-0.127	-22.142	-2.468	10.32	-541
ML15-10	0.728	6.438	-0.021	-2.56	-1.112	-3.168	-5.629	-93.559	-9.458	-2.206	-1.948	6.77	475
ML15-8	-3.487	2.223	-0.85	-3.389	-1.773	-4.327	-1.68	-25.276	-5.629	-2.893	-2.264	6.50	22
ML15-6	-0.29	5.42	-0.807	-3.346	-2.107	-4.595	-0.907	-42.301	-4.634	-3.403	-1.971	6.54	148
ML15-4	-7.195	-1.485	-0.074	-2.613	-5.134	-9.97	-3.392	-1.502	-3.781	-25.216	-2.792	8.68	-439
ML15-2	1.585	7.295	-0.074	-2.613	-0.599	-1.047	-1.174	-46.107	-2.602	-6.691	-1.224	8.70	13
ML15-0	1.139	6.849	-0.776	-3.316	-2.373	-4.674	-1.321	-56.401	-4.893	-3.854	-1.888	6.58	244
ML21-7	0.322	6.032	-0.590	-3.130	-1.656	-3.480	-0.533	-47.095	-4.733	-2.434	-0.785	6.36	-0.1
ML21-6	0.273	5.983	-0.625	-3.164	-1.897	-3.855	-1.023	-50.713	-5.253	-2.041	-1.213	6.25	33.7
ML21-5	-0.964	4.746	2.228	-0.312	-2.587	-5.008	-5.686	-83.210	-10.015	-2.363	-2.557	5.96	256.0
ML21-4	-0.872	4.838	2.003	-0.536	-2.799	-5.468	-5.618	-82.080	-9.770	-2.731	-2.625	6.06	241.3
ML21-3	-1.085	4.625	1.218	-1.321	-2.699	-5.294	-5.246	-78.566	-9.586	-2.672	-2.56	5.99	222.2
ML21-2	-1.053	4.657	1.329	-1.210	-2.793	-5.511	-5.438	-79.392	-9.651	-2.615	-2.887	5.98	228.5
ML21-1	-2.222	3.488	-0.949	-3.488	-2.529	-4.991	-4.889	-65.854	-9.129	-2.888	-2.867	6.04	126.5
ML22.5-8	-0.390	5.320	-0.209	-2.748	-1.628	-3.870	-0.163	-32.879	-3.631	-3.072	-1.688	6.76	-129.1
ML22.5-7	-0.195	5.515	-0.148	-2.688	-1.448	-3.489	0.047	-32.773	-3.428	-3.056	-1.409	6.84	-134.2
ML22.5-6	0.025	5.735	0.057	-2.483	-1.368	-3.320	0.109	-33.127	-3.251	-3.057	-1.284	6.93	-137.0
ML22.5-5	0.364	6.074	-0.008	-2.548	-1.222	-3.014	0.263	-34.051	-3.017	-3.139	-1.130	7.05	-137.8

Piezometer	Ferrihydrite	Goethite	$Cr(OH)_3$ (a)	Cr(OH)3 (c)	Calcite	Dolomite	Siderite (d)	Mackinawite	Amakinite	Gypsum	Rhodochrosite	pH	Eh (mV)
ML22.5-4	0.971	6.681	0.148	-2.391	-0.689	-1.709	0.682	-34.545	-2.489	-2.896	-0.446	7.37	-151.9
ML22.5-3	-0.043	5.667	-0.102	-2.642	-1.172	-2.470	0.348	-33.458	-3.387	-2.878	-0.657	6.91	-131.8
ML22.5-2	2.145	7.855	1.659	-0.880	-1.924	-3.783	-0.750	-60.832	-4.594	-2.754	-1.471	6.60	84.0
ML22.5-1	0.454	6.164	1.228	-1.312	-2.721	-5.330	-2.190	-61.771	-6.313	-2.818	-2.534	6.08	116.0
ML22.5-0	-0.019	5.691	0.098	-2.442	-1.296	-2.412	0.468	-30.179	-2.835	-4.070	-1.255	7.25	-182.4
ML23.5-8	-2.237	3.473	0.341	-2.198	-0.479	-1.151	-1.963	-21.249	-3.354	-5.485	-1.018	8.69	-365.3
ML23.5-7	1.053	6.763	0.338	-2.202	-0.724	-1.623	-0.973	-39.534	-2.499	-5.523	-0.936	8.52	-213.5
ML23.5-6	-1.572	4.138	0.339	-2.201	-0.323	-0.868	-2.359	-26.374	-3.253	-5.545	-0.951	9.05	-353.4
ML23.5-5	-0.391	5.319	0.338	-2.201	-0.422	-0.948	0.117	-18.748	-1.464	-5.360	-0.291	8.55	-359.7
ML23.5-4	-0.081	5.629	0.338	-2.202	-0.241	-0.692	0.341	-20.295	-1.366	-5.254	-0.226	8.52	-345.6
ML23.5-3	1.982	7.692	0.338	-2.202	0.517	0.819	-4.551	-78.704	-5.896	-5.269	-0.601	9.08	5.9
ML23.5-2	2.769	8.479	0.687	-1.853	0.285	0.523	-3.216	-72.112	-4.581	-4.468	-0.092	9.06	-23.7
ML23.5-1	0.829	6.539	0.264	-2.276	0.536	1.559	-4.324	-60.395	-4.718	-5.816	-1.191	9.84	-174.2
ML23.5-0	0.869	6.579	0.266	-2.274	0.503	1.759	-2.462	-43.720	-2.831	-5.808	-1.048	9.83	-281.2
ML24-7	-3.184	2.526	0.264	-2.275	-0.921	-3.017	-1.902	1.514	-0.598	-12.845	-1.318	9.85	-648.6
ML24-6	-4.742	0.968	0.290	-2.250	-0.885	-2.857	-1.119	2.069	-0.192	-28.750	-1.001	9.70	-754.3
ML24-5	-4.607	1.103	0.260	-2.280	-0.925	-2.669	-1.876	1.594	-0.495	-25.005	-1.355	9.87	-738.7
ML24-4	-4.087	1.623	0.149	-2.390	0.189	-0.560	-2.458	0.293	-1.414	-13.099	-1.314	10.25	-677.0
ML24-3	0.685	6.395	0.229	-2.310	0.532	1.417	-1.899	-35.034	-1.994	-5.822	-1.155	9.99	-350.0
ML24-2	0.828	6.538	-0.470	-3.009	0.615	1.574	-1.931	-38.562	-2.274	-5.854	-0.909	9.92	-321.3
ML24-1	0.802	6.512	0.244	-2.295	0.359	1.258	-2.304	-40.588	-2.521	-5.996	-0.649	9.93	-309.0
ML25-7	0.095	5.805	-0.263	-2.802	-2.205	-4.453	-1.068	-43.483	-4.401	-3.309	-1.378	6.69	-51.9
ML25-6	-0.185	5.525	0.039	-2.500	-2.655	-5.343	-1.591	-41.230	-4.219	-4.682	-1.744	7.12	-103.9
ML25-5	0.522	6.232	0.330	-2.210	-1.460	-2.507	-0.480	-32.011	-2.240	-5.554	-1.504	8.33	-248.5
ML25-4	0.281	5.991	0.631	-1.908	-0.155	-0.169	-2.946	-46.814	-3.798	-6.047	-1.266	9.39	-233.5
ML25-3	0.806	6.516	0.282	-2.258	0.020	-0.104	-4.795	-64.697	-5.240	-6.172	-1.731	9.74	-139.3
ML25-2	0.691	6.401	0.231	-2.308	-1.572	-3.346	-0.433	-39.617	-3.112	-4.980	-1.673	7.62	-146.4
ML25-1	0.784	6.494	0.139	-2.401	-1.950	-3.868	-0.317	-41.729	-3.241	-5.817	-1.476	7.34	-117.2
ML31-10	0.958	6.668	-0.810	-3.350	-1.178	-2.874	-3.616	-80.368	-7.756	-2.877	-1.364	6.55	402
ML31-8	-0.620	5.090	-1.094	-3.633	-1.944	-4.016	-5.645	-85.006	-9.775	-2.726	-1.642	6.27	444
ML31-6	-1.015	4.695	-1.392	-3.931	-2.010	-3.966	-5.132	-79.277	-9.579	-2.299	-1.708	6.04	423
ML31-4	-0.989	4.721	0.338	-2.202	-2.598	-5.064	-5.845	-84.714	-10.195	-2.471	-2.583	5.91	468
ML31-0	-0.868	4.842	-1.395	-3.935	-2.619	-5.157	-5.747	-85.315	-10.071	-3.215	-3.045	6.01	462
ML32-10	1.312	7.022	0.253	-2.286	-0.938	-2.719	-2.621	-67.805	-6.035	-2.000	-2.432	7.02	295
ML32-8	0.619	6.329	-0.762	-3.302	-1.386	-3.413	-0.658	-48.101	-4.454	-2.896	-2.191	6.60	187
ML32-6	0.249	5.959	-0.832	-3.372	-1.240	-3.215	0.268	-39.274	-3.845	-2.686	-1.299	6.53	134
ML32-4	-1.001	4.709	0.293	-2.247	-2.362	-4.757	-5.611	-82.861	-9.998	-2.298	-1.774	5.94	454
ML32-2	-1.484	4.226	0.230	-2.309	-2.798	-5.505	-5.219	-75.442	-9.603	-2.721	-2.832	5.87	407
ML32-0	0.922	6.632	-1.344	-3.884	-2.647	-5.213	-3.341	-77.124	-7.567	-3.179	-3.031	6.05	418
ML33-10	-0.598	5.112	-9.142	-11.682	2.337	0.793	-13.517	-113.717	-11.813	-2.797	-2.273	11.30	271
ML33-8	-1.403	4.307	-0.304	-2.843	-0.599	-1.981	-1.709	-38.333	-5.046	-2.739	-1.878	7.28	64
ML33-6	0.373	6.083	-0.284	-2.823	-0.348	-1.268	0.925	-30.129	-2.462	-3.383	-0.445	7.33	14
ML33-4	0.952	6.662	-0.176	-2.715	-0.014	-0.456	0.689	-36.624	-2.332	-5.709	-0.073	7.66	21
ML33-2	1.573	7.283	-0.164	-2.704	-0.392	-1.020	0.649	-35.964	-1.967	-3.338	-0.111	7.71	33
ML33-0	-1.245	4.465	-0.227	-2.767	0.506	1.283	-2.386	-18.629	-1.718	-6.605	-1.368	10.29	-296

Piezometer	Ferrihydrite	Goethite	$Cr(OH)_3$ (a)	Cr(OH)3 (c)	Calcite	Dolomite	Siderite (d)	Mackinawite	Amakinite	Gypsum	Rhodochrosite	pH	Eh (mV)
ML34-10	-0.092	5.618	0.770	-1.770	0.071	-0.375	-0.938	-31.787	-2.713	-4.465	-1.175	8.61	-73
ML34-8	0.635	6.345	-0.084	-2.623	-0.074	-0.369	0.203	-31.122	-1.856	-6.125	-0.344	8.36	-66
ML34-6	0.093	5.803	-0.128	-2.667	-0.428	-0.989	0.123	-30.030	-2.316	-5.966	-0.186	7.90	-44
ML34-4	-0.617	5.093	-0.074	-2.613	0.231	0.225	-0.104	-20.065	-1.663	-6.016	-0.817	8.70	-170
ML34-2	0.565	6.275	-0.127	-2.666	0.559	0.703	-6.508	-77.898	-6.819	-6.415	-2.322	9.70	141
ML34-0	-0.180	5.530	-0.558	-3.098	0.455	-2.044	-1.443	-13.847	-0.124	-7.054	-2.289	10.79	-356
ML35-10	-0.529	5.181	-0.466	-3.006	-1.091	-2.724	-0.201	-34.370	-3.888	-3.040	-0.886	6.98	65
ML35-6	0.451	6.161	-1.014	-3.554	-2.668	-5.700	-2.934	-65.089	-6.550	-3.476	-2.057	6.33	315
ML35-4	0.217	5.927	-0.087	-2.626	-1.878	-3.787	-1.405	-34.091	-2.763	-5.377	-1.702	8.30	-34
ML35-2	0.852	6.562	-0.138	-2.678	-1.553	-3.061	-0.988	-44.356	-3.255	-6.724	-1.705	7.83	59
ML35-0	1.003	6.713	-0.704	-3.244	-3.150	-6.277	-1.913	-57.749	-5.099	-4.826	-2.575	6.65	244

(a) = amorphous
(c) = crystalline
(d)= disordered, or freshly precipitated

Appendix H List of Standard Operating Procedures

Standard Operating Procedures

1. RSKSOP-181 for the ICP determination of metal concentrations (ManTech)
2. RSKSOP-146 for analysis of TCE, cDCE, VC (automated purge and trap /GC analysis of vinyl chloride and other volatile chlorocarbons in aqueous samples containing particulates)
3. RSKSOP-152 for ground-water sampling (see Appendix I)
4. Anions by CE using Waters Capillary Electrophoresis Method N-601
5. Hexavalent chromium determination, diphenylcarbazide colorimetric method (Hach® method 8023 adapted from Standard Methods, 3500-Cr D)
6. USEPA method 353.1 for colorimetric determination of NO_2 and NO_3
7. RSKSOP-147 and RSKSOP-175 for the analysis, preparation and calculation of ethylene, methane and ethane concentrations
8. Fe(II) by the 1, 10-phenanthroline colorimetric method, (Hach® method 8146, adapted from Standard Methods, 3500-D)
9. Dissolved sulfide by colorimetric methylene blue method (Hach® method 8131 equivalent to US EPA method 376.2)
10. RSKSOP-102 for the determination of total organic carbon
11. Determination of TCE and degradation products at the University of Waterloo (Henderson et al., 1976; Glaze et al., 1981)

Glaze, W.H., Rawley, R., Burleson, J.L., Mapel, D. and Scott, D.R., 1981. Further optimization of the pentane liquid-liquid extraction method for the analysis of trace organic compounds in water. In: Advances in the identification and analysis of organic pollutants in water. Vol. 1, Keith, L.H. ed, Ann Arbor Pub. Inc., Ann Arbor, MI.

Henderson, J.E., Peyton, G.R. and Glaze, W.H., 1976. A convenient liquid-liquid extraction method for the determination of halomethanes in water at the parts-per-billion level. *In* Identification and Analysis of Organic Pollutants in Water. L.H. Keith, Ed., Ann Arbor Science Publishers Inc., Ann Arbor, MI, p. 105.

Appendix I Ground Water Sampling - Standard Operating Procedures

I. Disclaimer:

This standard operating procedure has been modified from the procedure prepared for the use of the Robert S. Kerr Environmental Research Laboratory (RSKSOP-152, Revision 4) of the U.S. Environmental Protection Agency. This procedure is suitable for University of Waterloo sampling at the U.S. Coast Guard Elizabeth City site and may not be specifically applicable to the activities of other organizations.

II. Purpose: (Scope and Application)

This document describes the procedures used to obtain the most "representative" ground-water samples currently possible from monitoring wells for the determination of ground water quality in general and specifically to determine extent of contaminant release.

III. Summary of Method:

The following ground-water sampling procedure is based on several years of experience in sampling ground waters for both metals and organic compounds (Puls and Barcelona, 1989; Puls et al., 1990; Puls et al. 1991; Puls and Powell, 1992; Paul and Puls, 1992). The primary limitations to the collection of "representative" ground-water samples are the following: disturbance of the stagnant water column above the screened interval (e.g. mixing due to insertion of the sampling device or ground water level measurement device); resuspension of settled solids at the base of the casing (e.g. high pumping rates, raising and lowering a bailer); disturbance at the well screen during purging and sampling (e.g. high pump rates, raising and lowering a bailer); introduction of atmospheric gases or degassing from the water (e.g. sample handling, transfer, vacuum from sampling device etc.).

Samples should not be taken immediately following well development. A sufficient time should elapse to allow the ground water flow regime in the vicinity of the monitoring well to stabilize and to let chemical equilibrium with the well construction materials be approached. This lag time will depend on site and installation specific parameters.

It is generally agreed that the purging of monitoring wells for the purpose of obtaining representative samples is necessary in most instances. Ground-water chemistry can be altered through contact with the atmosphere, well casing materials, screen, gravel pack and surface seal. Rather than using a general guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality indicator device be used to establish the equilibration time for several parameters (e.g. pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis and the volume required for parameter equilibration then become the accepted (documented) purge volume.

With these limitations or constraints in mind, and acknowledging that it may in fact be impossible to obtain a perfectly "representative" sample, the following general recommendations are made and incorporated into this procedure:

- the use of low flow rates (< 0.5 L/min), both during purging and sampling,
- placement of the sampling device intake at the desired sampling point,
- minimal disturbance of the stagnant water column above the screened interval (during water level measurement and sample device insertion),
- monitoring of water quality indicators during purging,
- minimization of atmospheric contact with samples,
- collection of unfiltered samples for estimating contaminant loading and transport potential in the subsurface system.

These recommendations and much of the following assume the use of portable sampling equipment, that is, non-dedicated systems. In the majority of cases, these methods will result in low turbidity samples precluding the need for filtration, resulting in less sample handling and fewer sampling artifacts. Such a method would also include the potentially mobile colloidal-associated metal contaminant fraction, which would otherwise be eliminated.

IV. References:

Puls, R.W., and M.J. Barcelona. 1989. Filtration of Ground Water Samples for Metals Analysis. Hazardous Waste and Hazardous Materials, v.6, no.4, pp. 385-393.

Puls, R.W., J.H. Eychaner, and R.M. Powell. 1990. Colloidal-Facilitated Transport of Inorganic Contaminants in Ground Water: Part I. Sampling Considerations. EPA/600/M-90/023, 12 pp.

Puls, R.W., D.A. Clark, B. Bledsoe, R.M. Powell, and C.J. Paul. 1992. Metals in GroundWater: Sampling Artifacts and Reproducibility. Hazardous Waste and Hazardous Materials. v.9, no.2, pp 149-162.

Puls, R.W. and R.M. Powell. 1992. Acquisition of Representative Ground Water Quality Samples for Metals. Ground Water Monitoring Review, v.12, no. 3.

Paul, C.J. and R.W. Puls. 1992. Comparison of Ground-Water Sampling Devices Based on Equilibration of Water Quality Indicator Parameters. Proceedings of Sampling Symposium, November, 1992, Washington D.C. pp. 21-39.

Powell, R.M. and R.W. Puls. 1993. Passive Sampling of Ground Water Monitoring Wells Without Purging: Multilevel Well Chemistry and Tracer Disappearance. Hydrology, 12(1), 51-77.

Puls, R.W. and C.J. Paul. 1995. Low-Flow Purging and Sampling of Ground-Water Monitoring Wells with Dedicated Systems. Ground Water Monitoring and Remediation, 15(1):116-123.

V. Procedure:

In advance of sampling set-up or opening of the wells, all sampling and monitoring equipment should be calibrated according to manufacturers recommendations. Calibration of pH should be performed with at least two buffers that bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

A. Water Level Measurement

Use a device that will only disturb the uppermost portion of water in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. The water level measurement should be taken from the permanent reference point, which is surveyed in relative to ground elevation. For the University of Waterloo small diameter multilevel monitoring system, the centre stock will serve as the only water level monitoring point.

B. Sampling Device Insertion and Equipment Set-up

The sampling device intake should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g. 1.5-2.5 ft below the top of a 5 ft screen). This is to minimize excessive mixing of the stagnant water above the casing with the screened interval zone water, and to minimize resuspension of solids (i.e. fines) which have collected at the bottom of the well casing. These two 'disturbance' effects have been shown to directly affect time for purging (i.e. time to reach equilibration of water quality indicator parameters). Also there appears to be a direct correlation with size of sampling device and purge time (i.e. increased time for increasing size of device). The key is to minimize disturbance of the water and solids in the well casing. The monitoring points of the multilevel samples serve as dedicated samplers, which are connected directly to a peristaltic sampling pump. These samplers will be pumped at low flow rates to minimize disturbance effects.

C. Well Purging

In most cases the water in the well casing (particularly above the screened interval) is of different chemical quality to that of the formation water due to a variety of physical, chemical and microbiological processes which can occur over time. The use of low flow (e.g. 0.1-0.5 L/min) pumps is suggested. These include bladder pumps (e.g. GeoTech small dia. bladder pump; QED Well Wizard bladder pump), submersible pumps (e.g. Grundfos Redi-Flo, 2 in. dia. pump), and peristaltic pumps. The peristaltic pump can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. All pumps have some minor limitations and these should be investigated with respect to your particular application. The use of bailers is strongly discouraged. Water level is continuously checked to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.3 ft) during purging. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, oxidation-reduction potential (redox), specific conductance, dissolved oxygen (DO) and turbidity. The most sensitive of these parameters are the last three. Once documented, the time or volume required to obtain equilibration of parameter readings, can be used as a future guide to purge time or volume for that well. Measurements should be taken at least every three minutes if the above suggested flow rates are used. Equilibration is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all 5 parameters a minimum subset would include specific conductance, DO and turbidity. In the case of the small diameter multilevel sampling wells, the minimum subset will include pH and Eh, which will be measured on-line in a sealed flow-through system. More specific equilibration guidelines are the following: three successive readings are within ±0.1/min for pH, ±10 mV/min for redox, ±3%/min for specific conductance, ±10%/min for DO, and ±10%/min for turbidity. Equilibrated trends are generally obvious and follow either an exponential decay or asymptotic trend during purging. Dissolved oxygen and turbidity usually require the longest time for equilibration. The above equilibration guidelines are provided as rough estimates based on experience. Upon parameter equilibration, sampling can be initiated. The sequence in which samples are collected is immaterial unless there will be filtration. Filtering should be done last and in-line filters should be used as discussed below.

D. Well Sampling

Upon water quality parameter equilibration, sampling should begin immediately and using the same device as was used for purging. Ideally sampling should occur in a progression from least to most contaminated well if this is known. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

E. Sample Containers & Filtration

The appropriate sample container will be prepared in advance of actual sample collection for the analyte of interest including where necessary a sample preservative. The water sample should be collected directly into this container from the pump tubing. Methods for sample handling and preservation are spelled out in Handbook for Sampling and Sample Preservation of Water and Wastewater, EPA/600/4-82.

If samples are field-filtered, an in-line high-capacity filter should be used. The filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 m).

F. Sampler & Equipment Decontamination

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. The pump (including support cable and electrical wires which are in contact with the sample) can be decontaminated by the following procedure:

1. Pump Alconox™ solution through the pump and tubing.
2. Pump water through the pump and tubing.
3. Where gross contamination by VOCs are encountered, pump methanol through the pump and tubing.
4. Pump at least one system volume (pump, tubing, etc.) of distilled water through the pump and tubing. All other equipment that comes in contact with contaminated groundwater can be decontaminated similarly. The duration of flushing with de-ionized water following the use of methanol shall be sufficiently long to ensure that all solvent has been rinsed out. This can be monitored via a conductivity meter and probe. Equipment blanks shall be collected to monitor the decontamination procedures.

G. Sample Blanks

The following blanks should always be collected:

1. field equipment/decontamination process blanks.
2. trip blank - sample bottle filled with laboratory-grade deionized water and stored and shipped with samples.

H. Dedicated Well Pumps (specific to Elizabeth City site)

If the wells have dedicated pumps (bladder, electric submersible, peristaltic tubes) installed, studies at the site have shown the need for little purging. A general guideline is 3 system volumes (pump, tubing, etc.) purged prior to sample collection. One record of parameter equilibration should be established to verify this for subsequent sampling events.

Appendix J Quality Assurance – Quality Control Narrative

A large number of samples were analyzed over the duration of the project (> 1,200 sets of samples) with a number of analyses performed (> 40 per set). The data quality was assessed using blank samples, duplicate samples, and spike recovery samples. The quality of the dataset is excellent.

Other than selected duplicate organic samples collected for UW, all groundwater samples collected at the Elizabeth City site were analyzed by the ManTech Environmental Research Services Corporation, Ada, OK using methods developed for, or recommended by, the EPA Subsurface Protection and Remediation Division (Appendix H). Once analyzed, the complete analytical results, including quality control (QC) measures such as spikes, duplicates, known standards and blanks, were reported to NRMRL-EPA. The groundwater results were organized and provided to UW by NRMRL-EPA and did not include the QC results from ManTech. During the organization of the data at NRMRL-EPA, the QC measures performed by the contract lab were examined and any unusual results were flagged in the datasets.

Duplicates

Analytical results for duplicate samples are shown in Tables J1-J4. Statistical analyses were performed on selected organic (TCE, c-DCE and VC; Table J4) and cation (Na, K, Ca, Mg and Cr; Table J2) components of interest. The replicate results are in good agreement. In general, the variability of the measurements is low and within acceptable limits (< 5 % difference). The spread of the data, as indicated by percent relative standard deviation (RSD) calculations, is < 10% and usually below 5%. As expected, larger percent differences and standard deviations were observed for measurements approaching the detection limit.

Field and Trip Blanks

Results for the field/decontamination and trip blanks analyzed are presented in Tables J5-J7. Few contamination effects were observed with the majority of the analytical results reported as ND or BLQ values. General observations and any corrective measures implemented are described below.

For the target species of interest in this project, Cr and TCE, the field and trip blanks show few false positive results. The majority of the field blanks had Cr values below the limit of quantitation with all field and trip blanks reporting < 0.006 µg/L Cr (Table J5). TCE contamination of the field and trip blanks was observed at only one sample point in June, 1997 (1.1 µg/L, Table J7) and is very close to the limit of quantitation of 1 µg/L.

Sodium was detected at quantifiable concentrations in 65% of the field blanks and in 60% of the trip blanks analyzed, but generally did not exceed 1 µg/L Na (Table J5). Because the average field blank Na values for a particular sample session represented only 0.6% to 2.3% of the average groundwater Na concentration measured for that time, Na contamination was considered a minor effect. The presence of sodium in the blanks may be attributed to a sample bottle contaminant or, for the field blanks, incomplete rinsing of Alconox® solution from the sampling lines during decontamination procedures. (Sodium is the primary cation in the Alconox® formulation.) This problem was addressed, although not completely resolved, by rinsing the sample bottles with groundwater before sample collection and ensuring more complete flushing of the sampling system with deionized water after the Alconox® rinse between sample points. Sodium is a pervasive cation in the environment. With ICP detection limits approaching better than 1 µg/L for this element, prevention of contamination is difficult.

Field blanks collected along the ML2 transect in March, 1998 contain elevated Cl and SO_4 values of < 10 µg/L (Table J6). The Cl concentrations are generally below the values measured in the piezometers previously sampled by the same equipment, whereas the blank SO_4 concentrations are higher. These effects were not observed in other sampling sessions or at other locations and are probably due to incomplete rinsing of Alconox® from the sampling equipment between sample points. Both Cl and SO_4 are present in the Alconox® cleaning solution, and at concentrations similar to the measured contamination levels, 9 ppm Cl and 12 ppm S at the recommended 1% Alconox® dilution. Corrective measures to alleviate this contamination included a more thorough rinsing of the equipment after the Alconox® flush.

c-DCE values of < 9, 8 and 3 µg/L were observed along the ML2 transect in the field blanks for March, June and December, 1998, respectively (Table J7). These measured values may be due to incomplete cleaning of sampling equipment during sampling and are not attributed to Alconox® or bottle contamination. The problem was addressed, although not completely alleviated, by ensuring more complete flushing of the sample manifold with Alconox® solution. Few manifold (i.e. organic) cross-contamination problems were observed along the ML1 and ML3 transects. All TCE, c-DCE and VC measurements on the trip blanks analyzed were below the limit of detection suggesting that the sample bottles were not a source of organic contamination.

Comparison of Organic Samples Analyzed by ManTech and UW

Groundwater in the multilevel bundle piezometers was sampled using a modified version of the Standard Operating Procedure RSKSOP-152 (Appendix I). Organic samples for analysis at UW were collected in series in the manifolds to ensure that relative comparisons could be made.

Concentrations of TCE and its degradation products were determined by headspace gas chromatography (GC) at the University of Waterloo (described in Document I), and by automated purge and trap /GC analysis at ManTech according to RSKSOP-146. The UW method requires that the partitioning of the analyte between the liquid and gas phase be at equilibrium between the two phases, as opposed to being exhaustively extracted from the water, as is the case with purge and trap techniques. Pentane extraction and headspace analytical techniques are especially suited for column treatability studies and for groundwater samples from multilevel piezometers, because they can accommodate the small sample sizes removed from ports along the column profile or from points along the piezometer bundle. At UW, a 1 mL sample volume was needed for TCE analysis via an ECD, and a 1 mL sample volume was needed for DCE and VC analyses via a PID. This is in contrast to the EPA recommended purge and trap GC method which requires a sample volume of at least 5 mL for detection with an FID detector.

Table J8 compares the TCE, c-DCE and VC results for the organic field samples analyzed via the EPA purge and trap and the UW headspace methods. Statistical analyses, including relative percent differences and standard deviations, are reported. For the statistical calculations, values reported as BLQ or ND were set to 1 µg/L, the limit of quantitation for ManTech and UW analyses.

The TCE results between the ManTech and UW labs are in good agreement. In general, the variability of the measurements is low and within acceptable limits, with relative differences < 7%. The spread of the data, as indicated by the RSD, is < 10%. Approximately 48% of the organic samples analyzed at UW are higher in TCE concentration than samples analyzed at ManTech suggesting a lack of bias between the two different analytical techniques. TCE samples measured at the low end of the calibration curve (< 10 µg/L) were reported with similar accuracy between the two labs.

In contrast to the TCE results, the c-DCE and VC measurements between the two labs agree to a lesser extent. With c-DCE and VC present as degradation products of the TCE treatment process, the majority of the groundwater samples analyzed by both labs are low in c-DCE and VC (< 10 µg/L) and approach the detection limits for each analyte. Average relative differences approach 20% for c-DCE and 24% for VC. The ManTech results for c-DCE and VC are consistently higher, in 76% and 89% of the samples, respectively. In general, samples reported by ManTech as having measurable c-DCE and VC concentrations below < 10 µg/L were reported as ND by the UW lab. The differences in reported values are probably due to the differences in analytical methods including calibration effects. For VC analysis at UW, a linear calibration curves is utilized over a longer range (1- 700 µg/L at UW *vs.* 1- 100 µg/L at ManTech), however, the majority of the samples are near the lowest standard (10 µg/L). For c-DCE, both labs run similar calibration ranges (1 - 1,000 µg/L), however, as is the case with VC, the majority of the samples are at the low end of the curve, near 10 µg/L. Because small variations in linear calibration curve setup, or differences in calibration standards, can cause large changes in results for samples measured at the low or high end of a curve, the differing results in this range are not unexpected.

Data Quality

Considering the large number of samples collected during the project and the number of analyses performed, the quality of the dataset is excellent. Sample collection and analysis sheets compiled during the project report few problems. All field analyses were performed according to EPA recommended or approved protocols. The dataset was examined for entry errors and unusual results or comments were flagged. Deviations of sample duplicates, field and trip blanks from expected results are noted above and are considered minor. Differences between c-DCE and VC analyses at ManTech and the UW labs are notable, however, both sets of analyses indicate that TCE and its degradation products are being successfully removed from the site groundwater, as is Cr(VI), using the zero valent iron reactive barrier.

List of Tables for Quality Assurance - Quality Control Narrative

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML22-2.45	Nov-96	53	2.1	6.55	0.65	0.023	<0.0051	0.679	<0.014	<0.0031	<0.010	<0.0026	<0.036	0.0839	<0.0067
ML22-2A.45		44.8	<1.6	6.65	3.95	0.014	0.117	<0.055	<0.014	1.56	<0.010	<0.0026	<0.036	0.0949	0.0157
ML31-7.45		31.1	7.7	28.4	13.1	<0.010	0.719	<0.029	<0.010	<0.0025	<0.011	<0.0014	<0.024	0.386	0.0463
ML31-7.45		32	6.4	27.9	12.9	<0.010	0.716	<0.029	<0.010	<0.0025	<0.011	<0.0014	<0.024	0.388	0.0458
ML31-10.45		14.7	4.6	26.7	7.31	<0.010	0.223	<0.029	<0.010	<0.0025	<0.011	<0.0014	<0.024	0.35	0.0196
ML31-10.45		14.7	5.3	26.5	7.26	<0.010	0.223	<0.029	0.017	<0.0025	<0.011	<0.0014	<0.024	0.345	0.0207
no data	Feb-97														
ML11-9 DUP	Jun-97	13.7	4.23	18	3.96	0.617	0.556	<0.026	<0.015	<0.0044	<0.011	<0.0015	<0.0092	0.18	0.0136
ML11-9		13.5	3.68	17.9	3.87	0.611	0.553	0.027	<0.015	<0.0044	<0.011	<0.0015	<0.0092	0.178	0.0128
ML11-4		113	1.47	19.6	13.4	<0.0063	0.362	<0.026	<0.015	1.64	<0.011	0.0017	<0.0092	0.339	0.0619
ML11-4 DUP		108	2.16	18.4	12.7	<0.0071	0.331	<0.027	<0.012	1.59	<0.0098	0.0027	<0.0085	0.314	0.0582
ML11-4 DUP		107	2.08	18.3	12.6	<0.0071	0.331	<0.027	0.013	1.57	<0.0098	0.0024	<0.0085	0.312	0.0576
ML11-2 DUP		81.1	1.1	14.4	9.64	<0.0063	0.295	0.027	<0.015	0.942	<0.011	0.0006	<0.0092	0.219	0.0364
ML11-2		81.8	0.88	14.9	9.81	<0.0063	0.3	<0.026	<0.015	0.952	<0.011	0.0072	<0.0092	0.225	0.0363
ML12-6 DUP		6.9	3.62	7.15	2.85	9.46	0.0942	4.49	<0.015	0.0104	<0.011	0.0152	<0.0094	0.07	0.0373
ML12-6		6.88	3.3	6.86	2.43	6.76	0.0823	2.98	<0.015	<0.0044	<0.011	0.0108	<0.0093	0.065	0.0222
ML12-2 DUP+A16		60	1.32	9.92	7.33	<0.0071	0.237	<0.027	<0.012	0.852	<0.0098	0.0005	<0.0085	0.154	0.0247
ML12-2 DUP		60.6	1.45	9.9	7.39	<0.0071	0.239	<0.027	<0.012	0.857	<0.0098	0.0021	<0.0085	0.154	0.0249
ML13-8 DUP		3.49	2.16	6.63	<0.071	<0.0071	<0.0040	<0.027	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.0525	0.0293
ML13-8 DUP		3.44	2.17	6.63	0.09	<0.0071	<0.0040	<0.027	0.018	<0.0020	<0.0098	<0.0010	<0.0085	0.0528	0.0295
ML13-3 DUP		14.8	1.12	4.94	1.05	0.017	0.015	<0.026	<0.015	<0.0044	<0.011	0.0021	<0.0092	0.0475	0.0095
ML13-3		15	1.26	4.85	1.03	0.0201	0.0167	0.029	<0.015	<0.0044	<0.011	<0.0015	<0.0092	0.0471	0.0093
ML14-10		2.62	1.32	5.2	0.187	0.12	0.0063	0.21	<0.015	<0.0044	<0.011	<0.0015	<0.0092	0.0173	<0.0033
ML14-10 DU		2.62	1.55	5.23	0.194	0.157	0.008	0.281	<0.015	<0.0044	<0.011	<0.0015	<0.0092	0.0176	<0.0033
ML14-6		5.54	1.5	2.34	<0.073	<0.0063	<0.0036	<0.026	<0.015	<0.0044	<0.011	<0.0015	<0.0092	0.007	<0.0033
ML14-6 DUP+A19		4.63	1.66	2.41	0.073	<0.0071	<0.0040	<0.027	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.0071	<0.0025
ML14-6 DUP		4.6	1.8	2.42	<0.071	<0.0071	<0.0040	0.059	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.0074	<0.0025
ML15-10		2.33	4.69	11.9	1.08	0.0777	0.0147	0.189	<0.015	0.0069	<0.011	<0.0015	<0.0092	0.123	0.0056
ML15-10 DUP+A19		2.28	4.14	11.6	1.03	0.047	0.0167	0.106	<0.016	0.0014	<0.0072	0.0032	<0.011	0.119	0.0057
ML15-1 DUP		58.6	<0.58	1.29	0.694	0.489	0.093	<0.026	<0.015	<0.0044	<0.011	0.0008	<0.0092	0.0164	<0.0033
ML15-1		58	<0.58	1.23	0.716	0.479	0.093	<0.026	<0.015	<0.0044	<0.011	<0.0015	<0.0092	0.0157	<0.0033
ML15-0		31.6	1.63	7.25	4.48	0.192	0.1187	<0.027	<0.012	<0.0020	<0.0098	0.001	<0.0085	0.0885	0.0096
ML15-0 DUP		31.7	1.73	7.35	4.48	0.189	0.1187	<0.027	<0.012	<0.0020	<0.0098	0.003	<0.0085	0.0889	0.0092
ML31-2		26.7	0.55	9.45	5.72	0.358	0.0984	0.233	<0.016	0.0498	<0.0072	0.004	<0.011	0.129	0.0169
ML31-2 DUP		26.7	1.4	9.44	5.67	<0.0071	0.0888	<0.027	<0.012	0.0434	<0.0098	<0.0010	<0.0085	0.128	0.0156
ML31-2 DUP		27.2	1.5	9.46	5.68	<0.0071	0.0888	<0.027	<0.012	0.0458	<0.0098	0.0019	<0.0085	0.128	0.016
ML32-6		13.1	4.6	27.3	2.07	12.3	0.244	<0.027	0.02	<0.0020	<0.0098	0.0004	<0.0085	0.335	0.0177
ML32-6 DUP		13.2	4.3	27.8	2.09	12.2	0.244	<0.027	0.02	<0.0020	<0.0098	<0.0010	<0.0085	0.341	0.0184
ML32-2 DUP		26.1	0.85	9.26	5.75	<0.012	0.136	<0.030	<0.016	0.12	0.0073	<0.0009	<0.011	0.123	0.0155
ML32-2		26.7	1.03	9.3	5.81	<0.012	0.137	<0.030	<0.016	0.121	<0.0072	0.0011	<0.011	0.124	0.0159
ML33-10 DUP		24.4	7.23	71.7	0.045	0.073	0.004	4.45	<0.016	<0.0037	<0.0072	<0.0009	<0.011	2.52	0.0084
ML33-10		23.8	7.49	71.1	0.067	<0.012	<0.0032	4.44	0.02	<0.0037	<0.0072	0.0465	<0.011	2.51	0.0086
ML33-4		21	2.95	26	5.4	0.429	0.191	<0.030	<0.016	<0.0037	<0.0072	0.171	<0.011	0.261	0.0039
ML33-4		26.2	2.67	20.4	4.79	0.961	0.255	<0.027	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.2	0.003
ML33-4 DUP		26.5	2.97	20.3	4.77	0.99	0.267	<0.027	0.014	<0.0020	<0.0098	<0.0010	<0.0085	0.199	0.0034
ML33-3 DUP		37.7	2.53	19.1	5.9	5.84	0.636	<0.030	<0.016	<0.0037	0.0009	0.0029	<0.011	0.165	0.0064
ML33-3		38.2	2.72	19.9	6.2	6.06	0.659	<0.030	<0.016	<0.0037	<0.0072	<0.0009	<0.011	0.172	0.0063

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML34-9 DUP		15.2	1.57	6.27	1.57	0.0952	0.0345	0.127	<0.012	<0.0020	<0.0098	0.0016	<0.0085	0.0366	<0.0025
ML34-9		15.2	1.18	6.36	1.59	0.153	0.0344	0.206	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.0374	<0.0025
ML34-2		36	0.84	5.51	2.76	0.0571	0.0064	0.028	<0.012	<0.0020	<0.0098	0.0032	<0.0085	0.054	<0.0025
ML34-2		36.3	1.7	4.23	2.21	<0.0071	<0.0040	<0.027	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.0424	<0.0025
ML34-2 DUP		36.2	2.55	4.22	2.23	<0.0071	<0.0040	0.048	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.0418	<0.0025
ML35-1 DUP		27.1	0.98	6.72	2.65	0.0281	0.008	<0.027	<0.012	<0.0020	<0.0098	<0.0010	<0.0085	0.07	<0.0025
ML35-1		27.1	0.85	6.71	2.61	0.0252	0.0096	0.028	0.022	<0.0020	<0.0098	<0.0010	<0.0085	0.0701	<0.0025
ML11-10DUP	Sep-97	7.84	5.9	11.1	5.05	2.45	0.35	0.571	<0.014	<0.0044	<0.018	0.0049	<0.010	0.128	0.0153
ML11-10		7.63	6.26	10.8	4.89	2.27	0.336	0.398	<0.014	<0.0044	<0.018	0.0036	<0.010	0.125	0.0135
ML11-9DUP		10.8	3.73	15.2	3.32	1.06	0.51	<0.039	0.017	<0.0044	<0.018	<0.0013	<0.010	0.15	0.0122
ML11-9		10.4	4.69	14.6	3.21	1	0.486	<0.039	0.015	<0.0044	<0.018	<0.0013	<0.010	0.143	0.0109
ML11-8DUP		11.8	6.53	16.5	4.44	0.748	0.647	<0.039	<0.014	<0.0044	<0.018	0.0033	<0.010	0.166	0.0131
ML11-8		12.4	4.75	16.7	4.39	0.757	0.659	<0.039	<0.014	<0.0044	<0.018	0.0166	<0.010	0.171	0.0136
ML11-7DUP		12.9	5.16	17.2	5.29	0.308	1.01	<0.039	<0.014	<0.0044	<0.018	0.0051	<0.010	0.183	0.0191
ML11-7		13.5	4.29	17.8	5.42	0.308	1.05	<0.039	<0.014	<0.0044	<0.018	<0.0013	<0.010	0.19	0.0193
ML11-6DUP		15.5	5.8	20.1	7.27	<0.0069	1.62	<0.039	<0.015	<0.0044	<0.018	0.002	<0.010	0.247	0.0273
ML11-6		15.8	4.82	20.7	7.44	0.0134	1.68	<0.039	<0.015	<0.0044	<0.018	0.0069	<0.010	0.256	0.028
ML11-5DUP		33.5	6.59	23.1	10.8	<0.0069	2.03	<0.039	<0.015	0.0832	<0.018	0.0045	<0.010	0.356	0.0491
ML11-5		35	6.53	23.5	11.2	<0.0069	2.12	<0.039	<0.015	0.0839	<0.018	0.0128	<0.010	0.371	0.0516
ML11-4DUP		86.8	2.24	14.3	9.85	<0.0069	0.269	<0.039	<0.014	1.6	<0.018	0.0109	<0.010	0.245	0.0441
ML11-4		86.1	1.77	13.9	9.59	<0.0069	0.261	<0.039	0	1.56	<0.018	0.0087	<0.010	0.24	0.0453
ML11-3DUP		67.1	0.883	4.92	3.91	<0.0069	0.105	<0.039	<0.014	1.61	<0.018	<0.0013	<0.010	0.0845	0.0173
ML11-3		66.1	1.177	4.92	3.96	<0.0069	0.105	<0.039	<0.014	1.6	<0.018	<0.0013	<0.010	0.0845	0.0171
ML11-2DUP		68.6	1.143	9.03	6.15	<0.0069	0.185	<0.039	<0.014	1.17	<0.018	0.0022	<0.010	0.138	0.0242
ML11-2DUP		68	1.53	9.14	6.13	<0.0069	0.183	<0.039	<0.014	1.17	<0.018	0.0024	<0.010	0.137	0.0244
ML11-2DUP		73.8	1.59	9.63	6.56	0.007	0.197	<0.039	<0.014	1.24	<0.018	0.0127	<0.010	0.147	0.0269
ML11-2		72	1.45	9.45	6.45	<0.0069	0.195	<0.039	<0.014	1.22	<0.018	0.0022	<0.010	0.145	0.0262
ML11-1DUP		49.1	1.008	8.18	5.24	<0.0069	0.117	<0.039	<0.014	0.873	<0.018	0.009	<0.010	0.12	0.0198
ML11-1		48.2	1.48	8.05	5.17	<0.0069	0.117	<0.039	<0.014	0.856	<0.018	0.0035	<0.010	0.117	0.0198
ML11-0DUP		42.5	2.31	25.4	15.3	<0.0069	0.193	<0.039	<0.014	0.25	<0.018	0.0063	<0.010	0.341	0.0398
ML11-0		43.7	2.03	25.9	15.6	<0.0069	0.199	<0.039	<0.014	0.254	<0.018	0.007	<0.010	0.348	0.0408
ML12-10DUP		3.33	2.47	12.3	0.745	0.376	0.0326	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.101	0.0059
ML12-10		3.31	2.74	12.1	0.736	0.383	0.0306	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.1	0.0063
ML12-9DUP		4.11	3.18	13.4	2.64	1.26	0.0425	0.054	<0.017	0.003	<0.012	0.0085	<0.015	0.0978	0.0037
ML12-9		4.11	2.98	13.5	2.64	1.29	0.0424	0.168	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0983	0.0048
ML12-8DUP		4.63	4.26	9.75	3.51	2.92	0.0424	1.08	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.082	0.0055
ML12-8		4.53	4.06	9.6	3.43	2.9	0.0425	0.94	<0.017	0.0041	<0.012	0.0389	<0.015	0.0808	0.0047
ML12-5DUP		22	5.64	20.2	3.84	12.7	0.562	0.2	0.024	<0.0028	<0.012	<0.0028	<0.015	0.168	0.0203
ML12-5		22.3	5.37	20.6	3.83	13	0.565	<0.038	0.008	<0.0028	<0.012	<0.0028	<0.015	0.172	0.0199
ML12-4DUP		77	5.34	20.1	9.59	0.0991	1.18	<0.038	<0.017	0.331	<0.012	<0.0028	<0.015	0.312	0.0473
ML12-4		76.6	5.5	20.4	9.63	0.093	1.19	<0.038	<0.017	0.305	<0.012	0.0023	<0.015	0.314	0.0482
ML12-3DUP		98.7	2.71	14.2	9.9	0.0096	0.329	<0.038	<0.017	1.52	<0.003	<0.0028	<0.015	0.247	0.0453
ML12-3		101	1.96	14.6	10	<0.0003	0.337	<0.038	<0.017	1.56	<0.012	<0.0028	<0.015	0.254	0.0469
ML12-2TRIP		86.4	1.87	12.3	9.15	<0.0003	0.299	<0.038	<0.017	1.35	<0.012	<0.0028	<0.015	0.2	0.037
ML12-2DUP		87	2.21	12.3	9.19	<0.0005	0.299	<0.038	<0.017	1.35	<0.012	<0.0028	<0.015	0.2	0.0365
ML12-2		89.6	1.82	12.7	9.44	0.0099	0.309	<0.038	<0.017	1.38	0.019	<0.0028	<0.015	0.207	0.0374
ML12-1DUP		68.7	1.97	14.6	9.53	0.0031	0.228	<0.038	0.021	0.845	<0.012	<0.0028	<0.015	0.217	0.035
ML12-1		69.7	1.56	14.9	9.67	0.0013	0.236	<0.038	<0.017	0.86	<0.012	<0.0028	<0.015	0.222	0.0357
ML13-10DUP		5.35	6.1	7.68	0.279	0.0068	<0.0042	0.294	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.171	<0.0020
ML13-10		5.46	5.35	8.08	0.213	0.0033	<0.0042	0.328	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.188	0.0021

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML13-9DUP		4.43	5.36	6.91	0.204	0.0033	<0.0042	<0.038	0.018	<0.0028	<0.012	<0.0028	<0.015	0.0602	0.0158
ML13-9		4.43	4.84	6.98	0.179	0	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0607	0.0158
ML13-8DUP		4.08	3.91	5.87	0.095	0.0175	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0711	0.0373
ML13-8		4.02	3.91	5.86	0.137	0.0069	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.071	0.0368
ML13-7DUP		3.89	4.55	4.54	0.198	0.0104	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.037	0.0265
ML13-7		3.89	3.3	4.57	0.119	0.021	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0379	0.0271
ML13-6TRIP		3.99	3.15	7.73	0.137	0.0033	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0728	0.0106
ML13-6DUP		4.04	3.19	7.85	0.162	0.0068	0.005	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0727	0.0111
ML13-6		26.2	9	19.9	11.5	<0.0004	0.513	<0.038	<0.017	<0.0028	<0.012	0.0022	<0.015	0.283	0.0404
ML13-5DUP		3.66	2.83	8.5	0.146	0.0068	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0763	0.0084
ML13-5		3.69	2.74	8.48	0.171	0.0032	<0.0042	<0.038	<0.017	<0.0028	<0.012	0.0127	<0.015	0.0763	0.0091
ML13-4DUP		4.28	2.01	5.99	0.095	0.0033	0.005	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0383	0.0256
ML13-4		4.29	2.54	5.99	0.145	0.0033	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0381	0.0256
ML13-3DUP		9.31	1.79	5.02	0.518	0.0102	0.007	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0341	0.0111
ML13-3		9.03	2.58	4.87	0.535	0.0226	0.0024	<0.038	0.001	<0.0028	0	0.0175	0.001	0.0326	0.0101
ML13-2DUP	Sep-97	25.1	2.48	2.9	0.425	0.0209	0.013	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0257	0.0042
ML13-2		24.1	3.24	3.67	0.467	0.0244	0.009	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0265	0.0039
ML13-1DUP		61.3	4	1.29	0.541	0.0033	<0.0042	<0.038	<0.017	<0.0028	<0.012	<0.0028	<0.015	0.0121	<0.0020
ML13-1		65.4	3.47	1.88	0.781	0.0102	0.0309	<0.038	<0.017	0.0074	<0.012	<0.0028	<0.015	0.0204	<0.0020
ML14-10		2.33	1.63	4.65	0.27	0.001	0.0092	<0.027	<0.027	<0.0033	<0.014	0.0009	<0.020	0.0247	0.0028
ML14-10DUP		2.38	1.06	4.96	0.227	0.013	0.0092	0.032	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.026	0.0023
ML14-9DUP		2.57	2.46	5.26	0.079	<0.011	<0.0076	0.097	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.018	<0.0021
ML14-9		2.65	1.88	5.62	<0.049	<0.011	<0.0076	0.13	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0194	<0.0021
ML14-8DUP		6.16	1.91	3.05	<0.049	<0.011	<0.0076	0.033	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0124	<0.0021
ML14-8		6.09	1.94	3.04	<0.049	<0.011	<0.0076	0.054	<0.027	0.0035	<0.014	<0.0010	<0.020	0.0125	<0.0021
ML14-7DUP		6.5	2.23	3.22	<0.049	<0.011	<0.0076	0.054	<0.027	<0.0033	<0.014	0.0012	<0.020	0.0115	<0.0021
ML14-7		6.34	2.44	3.12	<0.049	<0.011	<0.0076	0.065	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0112	<0.0021
ML14-6DUP		6.15	2.69	2.77	<0.049	0.013	<0.0076	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.01	<0.0021
ML14-6		6.38	2.12	2.89	<0.049	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0103	<0.0021
ML14-5DUP		7.27	2.25	2.28	0.086	<0.011	<0.0076	0.033	<0.027	<0.0033	<0.014	0.021	<0.020	0.0077	<0.0021
ML14-5		7.28	2.05	2.34	<0.049	<0.011	<0.0076	0.049	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0077	<0.0021
ML14-4DUP		5.71	2.56	3.19	<0.049	<0.011	<0.0076	<0.027	<0.027	0.0051	<0.014	<0.0010	<0.020	0.0093	0.0047
ML14-4		5.81	2.41	3.19	0.071	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	0.0247	<0.020	0.0093	<0.0021
ML14-3DUP		9.42	2.23	3.98	<0.049	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.02	<0.0021
ML14-3		9.42	2.43	4.01	<0.049	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0198	<0.0021
ML14-2DUP		12.4	2.51	4.09	0.188	<0.011	<0.0076	0.054	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0326	0.003
ML14-2		12.1	2.77	4.03	0.157	<0.011	<0.0076	0.032	<0.027	<0.0033	<0.014	0.0012	<0.020	0.0319	0.0028
ML14-1DUP		59.1	2.18	2.58	0.21	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0231	0.0022
ML14-1		59.5	2.46	2.55	0.21	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0228	<0.0021
ML14-0DUP		47.8	1.8	3.18	0.11	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	0.0073	<0.020	0.0248	0.0064
ML14-0		46.4	2.11	3.18	0.129	<0.011	<0.0076	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0246	0.007
ML15-10		4.78	7.94	26.9	2.23	<0.011	0.0578	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.251	0.0132
ML15-10DUP		4.69	8.14	26.1	2.19	<0.011	0.056	<0.027	<0.027	<0.0033	<0.014	0.0014	<0.020	0.244	0.0119
ML15-9DUP		5.58	6.9	19.6	1.48	<0.011	0.0599	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.171	0.0109
ML15-9		5.58	7.42	19.4	1.48	<0.011	0.0544	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.169	0.0105
ML15-8DUP		8.69	5.77	13.7	1.74	0.192	0.191	<0.027	<0.027	<0.0033	<0.014	0.0079	<0.020	0.121	0.0089
ML15-8		8.87	5.88	14	1.8	0.198	0.202	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.123	0.0091
ML15-7DUP		8.57	5.39	12.9	2.16	0.365	0.242	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.117	0.0091
ML15-7		8.59	5.69	12.9	2.21	0.375	0.242	<0.027	<0.027	<0.0033	<0.014	0.0047	<0.020	0.116	0.0089

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML15-6DUP		11.5	4.06	8.09	1.89	1.93	0.233	0.064	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0655	0.0076
ML15-6		11.5	3.86	8.11	1.9	1.9	0.233	0.064	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0656	0.0072
ML15-5DUP		7.8	1.81	1.62	0.877	0.899	0.168	0.915	<0.027	0.0042	<0.014	<0.0010	<0.020	0.0183	0.0049
ML15-5		7.91	2.18	1.73	1.02	1.48	0.177	1.65	<0.027	<0.0033	<0.014	0.0041	<0.020	0.0197	0.0178
ML15-4DUP		7.58	0.91	0.076	0.145	0.464	0.0093	0.629	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0015	0.0022
ML15-4		7.75	0.01	0.082	0.18	0.806	0.0174	1.06	<0.027	0.0038	<0.014	0.0001	<0.020	0.0017	0.0033
ML15-3DUP		7.42	3.19	0.33	0.316	0.964	0.0219	1.49	<0.027	0.0048	<0.014	0.0029	<0.020	0.0032	0.0057
ML15-3		7.42	3.02	0.318	0.254	0.798	0.0165	1.2	<0.027	<0.0033	<0.014	0.0011	<0.020	0.003	0.0041
ML15-2DUP		32.2	2.5	2.23	1.61	0.078	0.0294	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0166	<0.0021
ML15-2		32.6	2.4	2.25	1.57	0.088	0.0348	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0167	0.0022
ML15-1DUP		35.4	1.89	5.93	3.58	0.283	0.131	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0726	0.0086
ML15-1		34.9	2.07	5.83	3.52	0.29	0.131	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.0715	0.0082
ML15-0DUP		35.9	2.11	5.22	3.12	0.542	0.133	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.065	0.0077
ML15-0		36.8	1.81	5.44	3.25	0.512	0.133	<0.027	<0.027	<0.0033	<0.014	0.0015	<0.020	0.068	0.0078
ML31-10		20.1	5.28	35.2	7.09	0.019	0.453	<0.027	<0.027	<0.0033	<0.014	0.0419	<0.020	0.391	0.0249
ML31-10DUP		19.9	5.27	34.9	7.15	0.016	0.455	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.389	0.0251
ML31-9DUP		26	5.59	48.3	5.17	<0.011	0.449	<0.027	<0.027	<0.0033	<0.014	0.0071	<0.020	0.618	0.0339
ML31-9		25.7	5.71	47.8	5.16	<0.011	0.445	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.612	0.0342
ML31-8DUP		15.3	6	21.6	9.05	<0.011	0.506	<0.027	<0.027	<0.0033	<0.014	0.0048	<0.020	0.23	0.0245
ML31-8		15.2	5.37	21.4	8.94	<0.011	0.503	0.029	<0.027	<0.0033	<0.014	0.0042	<0.020	0.228	0.0243
ML31-7DUP		25.2	7.37	28.8	10.8	<0.011	0.725	<0.027	<0.027	<0.0033	<0.014	0.0206	<0.020	0.295	0.0376
ML31-7		25.3	7.53	29.3	10.9	<0.011	0.747	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.299	0.0441
ML31-5BDUP	Sep-97	84.1	3.81	26.8	16.5	<0.011	1.04	<0.027	<0.027	0.0642	<0.014	0.0013	<0.020	0.392	0.0728
ML31-5B		82.6	4.07	26.4	16.1	<0.011	1.02	<0.027	<0.027	0.0608	<0.014	<0.0010	<0.020	0.385	0.0709
ML31-5DUP		85.1	3.87	27.2	16.6	<0.011	1.08	<0.027	<0.027	0.0621	<0.014	0.0039	<0.020	0.397	0.0728
ML31-5		84.4	4.08	27.1	16.6	<0.011	1.08	<0.027	<0.027	0.0615	<0.014	0.0018	<0.020	0.396	0.0722
ML31-4DUP		90.7	2.84	27	18.2	<0.011	0.458	<0.027	<0.027	0.0793	<0.014	0.0064	<0.020	0.396	0.0662
ML31-4		91.8	2.78	27.4	18.5	<0.011	0.464	<0.027	<0.027	0.0784	<0.014	0.0031	<0.020	0.403	0.0666
ML31-3DUP		46.7	1.91	16.4	10	<0.011	0.238	<0.027	<0.027	0.0452	<0.014	<0.0010	<0.020	0.218	0.0288
ML31-3		46.4	2.19	16.3	9.94	<0.011	0.236	<0.027	<0.027	0.0408	<0.014	0.0004	<0.020	0.216	0.0289
ML31-2DUP		27.6	1.52	10.2	6.07	<0.011	0.1	<0.027	<0.027	0.0472	<0.014	0.0015	<0.020	0.135	0.0177
ML31-2		27.5	1.75	10	5.99	<0.011	0.096	<0.027	<0.027	0.0467	<0.014	0.0011	<0.020	0.133	0.0167
ML31-1DUP		27.1	1.57	9.82	5.82	<0.011	0.096	<0.027	<0.027	0.0451	<0.014	<0.0010	<0.020	0.13	0.0163
ML31-1		27.1	1.35	9.97	5.89	<0.011	0.096	<0.027	<0.027	0.0407	<0.014	<0.0010	<0.020	0.131	0.0154
ML31-0DUP		21.8	1.29	10.2	6.15	<0.011	0.0564	<0.027	<0.027	<0.0033	<0.014	<0.0010	<0.020	0.123	0.0104
ML31-0		21.5	1.53	10.1	6.1	<0.011	0.0655	<0.027	<0.027	<0.0033	<0.014	0.0031	<0.020	0.122	0.0144
ML32-9DUP		8.86	15.4	21.6	1.77	<0.0067	0.0013	<0.023	<0.012	<0.0042	0.0097	0.0101	<0.015	0.19	0.0169
ML32-9		8.87	15.2	21.5	1.76	<0.0067	<0.0013	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.19	0.0167
ML32-8DUP		13.1	5.4	34.6	2.47	2.75	0.0337	<0.023	<0.012	<0.0042	<0.0076	0.0051	<0.015	0.288	0.0145
ML32-8		13.1	4.7	35.1	2.44	2.81	0.03	<0.023	<0.012	<0.0042	<0.0076	0.0019	<0.015	0.292	0.0147
ML32-7DUP		12.8	5.19	28.8	2.03	13.3	0.108	<0.023	0.015	<0.0042	<0.0076	<0.0013	<0.015	0.368	0.0132
ML32-7		12.8	4.94	29.1	2.03	13.4	0.108	<0.023	<0.012	<0.0042	<0.0076	0.0058	<0.015	0.373	0.0127
ML32-6DUP		11.5	4.75	26	1.67	16.1	0.201	<0.023	0.021	<0.0042	<0.0076	<0.0013	<0.015	0.321	0.0138
ML32-6		11.6	4.55	26.3	1.67	16.3	0.207	<0.023	0.028	<0.0042	<0.0076	<0.0013	<0.015	0.324	0.0151
ML32-5DUP		31.8	5.18	27.6	5.69	2.34	1.31	<0.023	<0.012	<0.0042	<0.0076	0.063	<0.015	0.254	0.0254
ML32-5		31.5	5.32	27.2	5.68	2.37	1.3	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.251	0.0246
ML32-4DUP		45.7	4.89	23.2	9.12	0.0162	1.45	<0.023	<0.012	0.0569	<0.0076	0.0192	<0.015	0.243	0.0412
ML32-4		45.1	4.68	22.4	8.76	<0.0067	1.41	<0.023	<0.012	0.0554	<0.0076	0.0935	<0.015	0.234	0.0399

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML32-3DUP		39.8	1.47	9.19	6.48	<0.0067	0.14	<0.023	<0.012	0.109	<0.0076	<0.0013	<0.015	0.14	0.0231
ML32-3		40.5	1.43	9.3	6.6	<0.0067	0.142	0.028	<0.012	0.109	<0.0076	0.0164	<0.015	0.142	0.0234
ML32-2DUP		27.2	<0.90	9.25	5.66	<0.0074	0.137	<0.028	<0.020	0.102	<0.014	<0.0022	<0.017	0.126	0.0164
ML32-2		26.7	<0.90	9.06	5.55	<0.0074	0.135	<0.028	<0.020	0.1	<0.014	<0.0022	<0.017	0.123	0.0162
ML32-1DUP		26.5	1.1	9.59	5.5	<0.0067	0.0558	<0.023	<0.012	0.0385	<0.0076	0.0103	<0.015	0.129	0.0143
ML32-1		26.3	1.69	9.48	5.46	<0.0067	0.0558	<0.023	<0.012	0.0402	<0.0076	0.0156	<0.015	0.127	0.0143
ML32-0DUP		17.8	0.68	8.46	5.18	0.335	0.0847	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.102	0.0067
ML32-0		17.6	0.84	8.43	5.19	0.43	0.0955	0.007	<0.012	<0.0042	<0.0076	0.0105	<0.015	0.101	0.0076
ML33-10		24.7	12.8	103	0.014	<0.0067	<0.0013	8.7	<0.013	<0.0042	0.0125	<0.0013	<0.016	6.07	0.0287
ML33-10DUP		23.7	13	98.6	0.072	<0.0067	<0.0013	8.2	<0.013	<0.0042	0.0134	<0.0013	<0.016	5.77	0.0265
ML33-9DUP		15.9	3.4	14.3	1.31	0.0485	0.0413	0.027	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.1	<0.0024
ML33-9		15.3	3.88	13.9	1.29	0.055	0.0413	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0964	<0.0024
ML33-8DUP		10.9	5.34	32.4	0.235	<0.0067	<0.0013	0.245	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.248	<0.0024
ML33-8		10.9	5.48	32.1	0.312	<0.0067	<0.0013	0.235	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.252	<0.0024
ML33-7DUP		12.8	6.57	27.7	2.52	6.23	0.285	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.288	0.0131
ML33-7		12.9	6.47	28.2	2.53	6.37	0.288	<0.023	<0.012	<0.0042	<0.0076	0.0028	<0.015	0.293	0.0139
ML33-6DUP		13.4	4.78	25.3	2.95	0.241	0.105	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.235	0.0037
ML33-6		13.5	4.85	25.1	2.93	0.241	0.107	<0.023	<0.012	<0.0042	<0.0076	0.0028	<0.015	0.233	0.0033
ML33-5DUP		17.3	4.28	17.8	2.71	0.0706	0.0736	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.201	<0.0024
ML33-5		17.6	4.02	18.2	2.76	0.0754	0.0808	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.206	<0.0024
ML33-4DUP		16.7	3.6	21.8	4.19	0.338	0.136	<0.023	<0.012	<0.0042	<0.0076	0.0036	<0.015	0.191	<0.0024
ML33-4		16.4	3.73	21.2	4.05	0.302	0.129	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.186	0.003
ML33-3DUP		30.4	2.48	8.44	2.88	2.46	0.314	0.028	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0761	0.0028
ML33-3		30.6	2.14	8.63	2.91	2.57	0.323	0.059	<0.012	<0.0042	<0.0076	0.0027	<0.015	0.0784	0.0028
ML33-2ADUP		33.9	1.93	6.93	2.41	1.61	0.238	<0.023	0.015	<0.0042	<0.0076	<0.0013	<0.015	0.0608	<0.0024
ML33-2A		34.6	2.04	7.08	2.46	1.63	0.238	<0.023	<0.012	<0.0042	<0.0076	0.0126	<0.015	0.062	<0.0024
ML33-2DUP		33.8	2.26	12.8	4.6	4.9	0.503	<0.023	<0.012	<0.0042	0.0252	0.0087	<0.015	0.112	0.0045
ML33-2		34	2.5	13.1	4.76	5.09	0.518	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.115	0.0049
ML33-1DUP		29.2	1.72	2.22	0.342	<0.0067	<0.0013	0.05	<0.012	<0.0042	0.0097	<0.0013	<0.015	0.0216	<0.0024
ML33-1		28.6	2.23	2.25	0.349	<0.0067	0.0003	0.045	0.002	<0.0042	<0.0076	0.0004	<0.015	0.0214	<0.0024
ML33-0DUP	Sep-97	18.2	1.67	4.1	0.158	<0.0067	<0.0013	0.04	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0551	<0.0024
ML33-0		18	2.06	4.04	0.174	<0.0067	<0.0013	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0541	<0.0024
ML34-6DUP		14.2	1.71	3.02	0.578	1.01	0.016	1.67	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0163	0.0048
ML34-6		14.2	1.43	2.96	0.486	0.695	0.0107	1.26	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0156	0.0032
ML34-5DUP		19	1.46	3.22	0.288	<0.0067	<0.0013	0.071	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0166	<0.0024
ML34-5		18.8	1.48	3.18	0.288	0.0232	0.0037	0.145	0.018	<0.0042	<0.0076	0.0063	<0.015	0.0166	<0.0024
ML34-4DDUP		22.7	2.09	1.99	0.748	0.007	0.011	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0138	<0.0024
ML34-4D		22.7	2.09	1.98	0.748	0.0102	0.011	0.04	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0139	<0.0024
ML34-4DUP		24.1	1.98	1.63	0.602	<0.0067	0.0056	0.04	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0119	<0.0024
ML34-4		25	2.07	1.64	0.659	0.318	0.0109	0.627	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0126	<0.0024
ML34-3DUP		28.6	3.35	8.24	1.17	0.0487	0.0324	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0634	0.0028
ML34-3		29	3.65	8.33	1.21	0.0261	0.0324	<0.023	<0.012	<0.0042	0.009	<0.0013	<0.015	0.0638	0.0036
ML34-2DUP		31.7	2.67	3.9	0.642	<0.0067	<0.0013	0.134	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0311	<0.0024
ML34-2		31.5	2.57	3.76	0.558	<0.0067	<0.0013	0.103	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0307	<0.0024
ML34-1DUP		26.2	2.54	1.25	0.187	<0.0067	<0.0013	0.145	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0134	<0.0024
ML34-1		26.1	2.7	1.23	0.21	<0.0067	<0.0013	0.166	0.015	<0.0042	<0.0076	0.0014	0.018	0.0133	<0.0024
ML34-0DUP		22.3	2.28	2.8	0.111	<0.0067	<0.0013	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0382	0.0038
ML34-0		21.8	2.69	2.77	0.096	0.0072	<0.0013	0.029	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0396	0.0036

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML35-10		32.8	6.24	18.8	3.27	0.893	0.551	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.159	0.0116
ML35-10DUP		32.8	6.06	18.7	3.28	0.893	0.56	<0.023	<0.012	<0.0042	<0.0076	0.0112	<0.015	0.159	0.0122
ML35-9DUP		22.7	5.2	14.4	2.28	1.48	0.382	<0.023	0.052	<0.0042	<0.0076	0.0028	<0.015	0.131	0.0105
ML35-9		22.8	5.39	13.3	2.23	1.47	0.377	<0.023	0.045	<0.0042	<0.0076	<0.0013	<0.015	0.128	0.0097
ML35-8DUP		17.4	4.94	11.4	2.56	1.2	0.618	<0.023	0.043	<0.0042	<0.0076	0.0024	<0.015	0.1	0.0103
ML35-8		17.3	4.94	11.4	2.54	1.18	0.614	<0.023	0.039	<0.0042	<0.0076	0.0006	<0.015	0.099	0.0106
ML35-7DUP		14.4	4.88	12.9	3.47	0.365	0.846	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.099	0.0102
ML35-7		14.6	5.01	13	3.51	0.365	0.847	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.1	0.0108
ML35-6DUP		14.5	4.11	14.4	3.62	0.0776	0.93	0.037	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0989	0.0123
ML35-6		14.2	4.51	14.1	3.59	0.0745	0.914	<0.023	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0967	0.0112
ML35-5DUP		30.2	2.93	4.81	1.94	0.442	0.333	<0.023	0.019	<0.0042	<0.0076	<0.0013	<0.015	0.0457	0.0049
ML35-5		30	3.26	4.77	1.96	0.427	0.33	<0.023	0.007	<0.0042	<0.0076	<0.0013	<0.015	0.0453	0.0048
ML35-4DUP		25.8	1.95	2.9	1.32	0.439	0.0958	<0.023	0.021	<0.0042	<0.0076	0.0055	<0.015	0.0228	<0.0024
ML35-4		25.3	1.92	2.82	1.29	0.43	0.0922	<0.023	0.032	<0.0042	<0.0076	<0.0013	<0.015	0.0224	<0.0024
ML35-3DUP		42.4	2.28	5	3.26	0.361	0.0578	<0.023	0.021	<0.0042	<0.0076	<0.0013	<0.015	0.0712	<0.0024
ML35-3		42	2.27	5.05	3.24	0.371	0.0578	<0.023	0.019	<0.0042	<0.0076	<0.0013	<0.015	0.0712	<0.0024
ML35-2DUP		39.4	1.13	6.09	2.75	0.549	0.0939	<0.023	0.026	<0.0042	<0.0076	<0.0013	<0.015	0.0564	<0.0024
ML35-2		38.8	1.28	6.02	2.7	0.545	0.0903	<0.023	0.018	<0.0042	<0.0076	<0.0013	<0.015	0.0555	<0.0024
ML35-1DUP		26.6	1.23	2.41	0.94	0.0942	0.0091	0.155	<0.012	<0.0042	<0.0076	<0.0013	<0.015	0.0267	<0.0024
ML35-1		26.5	1.28	2.41	0.925	0.207	0.0109	0.239	0.015	<0.0042	<0.0076	<0.0013	<0.015	0.0268	<0.0024
ML35-0DUP		19	0.81	2.52	1.23	0.846	0.214	<0.023	0.022	<0.0042	<0.0076	0.0278	<0.015	0.0272	<0.0024
ML35-0		18.4	1.56	2.5	1.22	0.822	0.211	<0.023	0.002	<0.0042	<0.0076	<0.0013	<0.015	0.0264	<0.0024
ML11-10B	Mar-98	14.1	7.37	22.1	10.7	3.34	0.726	<0.036	<0.020	<0.0025	<0.015	<0.016	0.0062	0.249	0.0184
ML11-10A		13.4	6.82	21.3	10.3	3.35	0.707	<0.036	<0.020	<0.0025	<0.015	<0.016	<0.0060	0.24	0.0188
ML11-9B		12.1	4.72	25.5	6.92	5.72	1	<0.036	<0.020	<0.0025	<0.015	<0.016	<0.0060	0.256	0.0156
ML11-9A		12	5.08	25.2	6.86	5.68	0.993	<0.036	<0.020	<0.0025	<0.015	<0.016	<0.0060	0.252	0.0156
ML11-8B		11.4	4.2	24.6	7.07	2.52	1.06	<0.036	<0.020	<0.0025	<0.015	<0.016	<0.0060	0.248	0.0145
ML11-8A		11.6	3.87	24.7	7.12	2.54	1.06	<0.036	<0.020	<0.0025	<0.015	<0.016	0.0061	0.25	0.0145
ML11-7B		12.6	3.9	25.9	7.47	1.04	1.57	<0.036	<0.020	<0.0025	<0.015	<0.016	<0.0060	0.27	0.0201
ML11-7A		12.6	4.1	25.7	7.45	1.02	1.56	<0.036	<0.020	<0.0025	<0.015	<0.016	<0.0060	0.268	0.0206
ML11-6B		49.5	6.07	34	13.2	<0.0063	3.63	<0.036	<0.021	0.149	<0.015	<0.016	<0.0060	0.502	0.0589
ML11-6A		49.7	6.36	34.3	13.3	0.0003	3.66	<0.036	<0.021	0.146	<0.015	<0.016	<0.0060	0.504	0.0599
ML11-5B		52.3	5.77	34.1	15.2	<0.0063	3.31	<0.036	<0.020	0.121	<0.015	<0.016	<0.0060	0.545	0.0754
ML11-5A		52.2	6.3	33.5	15	<0.0063	3.25	<0.036	<0.020	0.122	<0.015	<0.016	<0.0060	0.534	0.0742
ML11-4C		72	1.22	8.17	5.76	<0.0062	0.159	<0.036	<0.020	1.2	<0.015	<0.016	<0.0060	0.144	0.0277
ML11-4B		73	1.17	8.19	5.82	0.0118	0.156	<0.036	<0.020	1.21	<0.015	<0.016	<0.0060	0.145	0.0274
ML11-4A		73.5	<0.86	8.29	5.82	<0.0062	0.16	<0.036	<0.020	1.21	<0.015	<0.016	<0.0060	0.148	0.0279
ML12-4B	Mar-98	69	2.67	15.4	9.15	<0.0062	0.764	<0.036	<0.020	0.7	<0.015	<0.016	0.008	0.258	0.0413
ML12-4A		68.2	2.36	15.5	9.24	<0.0062	0.77	<0.036	<0.020	0.691	<0.015	<0.016	<0.0060	0.26	0.0416
ML13-4B		4.74	1.54	4.92	0.16	0.0142	0.012	<0.036	<0.020	0.0026	<0.015	<0.016	0.006	0.0386	0.016
ML13-4A		4.64	1.43	4.89	0.152	0.0106	0.012	<0.036	<0.020	<0.0025	<0.015	<0.016	0.0134	0.0382	0.0162
ML14-4B		3.86	1.9	3.06	<0.050	<0.034	0	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0101	<0.0036
ML14-4A		3.81	1.5	3.02	<0.050	<0.034	0	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0101	<0.0036
ML15-4B		10.2	1.17	0.3	0.117	0.042	0.0292	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0047	<0.0036
ML15-4A		9.9	1.35	0.3	0.157	0.035	0.0331	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0044	<0.0036
ML15-3B		12.7	1.3	0.93	<0.050	<0.034	0	0.231	<0.025	<0.0024	<0.0080	<0.0017	0.0019	0.0037	<0.0036
ML15-3A		12.6	1.53	0.923	<0.050	<0.034	0	0.231	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0035	<0.0036
ML15-2DUP		44.3	3.38	4.74	3.36	<0.034	0.0329	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0393	<0.0036
ML15-2B		43.1	2.96	4.81	3.42	<0.034	0.0329	<0.031	<0.025	0.0027	<0.0080	<0.0017	<0.0091	0.0399	<0.0036
ML15-2A		43.3	3.54	4.66	3.33	<0.034	0.029	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0383	<0.0036

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML15-1B		56.7	<0.88	1.46	0.818	0.51	0.0876	0.283	<0.025	<0.0024	<0.0080	0.0086	<0.0091	0.0179	<0.0036
ML15-1A		55.2	0.5	1.39	0.791	0.505	0.0877	0.402	0.036	<0.0053	0.0072	0.0019	<0.0078	0.0168	0.0035
ML15-0B		33.5	<0.88	6.68	4.03	0.55	0.196	<0.031	<0.025	<0.0024	<0.0080	0.0031	0.0104	0.0852	0.0079
ML15-0A		33.8	<0.88	6.67	4.06	0.536	0.198	<0.031	<0.025	<0.0024	<0.0080	0.0027	<0.0091	0.0855	0.0077
ML31-10B		22.1	2.9	39	7.11	0.0113	0.537	0.04	<0.024	<0.0041	0.0107	0.0068	<0.020	0.504	0.0258
ML31-10A		21.5	3.3	38.4	7.1	0.0077	0.531	<0.027	<0.024	<0.0041	<0.0088	0.0084	<0.020	0.494	0.0246
ML31-9B		22.8	4.3	30.4	10.01	<0.0036	0.66	<0.027	<0.024	<0.0041	<0.0088	0.0062	<0.020	0.387	0.0298
ML31-9A		22.8	4.1	30	9.96	<0.0036	0.652	0.03	<0.024	<0.0041	<0.0088	0.006	<0.020	0.383	0.0305
ML31-8B		31.8	5.8	32.6	11.8	<0.0036	1.07	<0.027	0.033	<0.0041	0.0126	0.006	<0.020	0.352	0.042
ML31-8A		32.9	5.5	33.5	12.1	0.0047	1.09	<0.027	<0.024	<0.0041	<0.0088	0.0068	<0.020	0.362	0.0433
ML31-7B		47.8	6.3	36.1	17.5	<0.0036	1.14	<0.027	<0.024	<0.0041	<0.0088	0.0069	<0.020	0.488	0.059
ML31-7A		46	6.9	35	17	<0.0036	1.11	<0.027	<0.024	<0.0041	<0.0088	0.007	<0.020	0.471	0.0567
ML31-6D-A		55.4	7.14	34.5	20.1	<0.034	1.03	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.53	0.0791
ML31-6C		54	7.52	33.9	19.8	<0.034	1.01	<0.031	<0.025	0.0036	<0.0080	0.003	<0.0091	0.52	0.0782
ML31-6B		56.3	6.9	34.8	20.2	<0.034	1.05	<0.031	<0.025	0.0028	<0.0080	0.0024	<0.0091	0.536	0.0805
ML31-6A		54.5	7.03	34.3	20	<0.034	1.02	<0.031	<0.025	0.0044	<0.0080	<0.0017	<0.0091	0.528	0.0787
ML31-5B		66.7	1.92	20.3	12.6	<0.034	0.792	<0.031	<0.025	0.0707	<0.0080	0.0037	<0.0091	0.319	0.0548
ML31-5A		68.7	1.56	20.7	12.8	<0.034	0.809	<0.031	<0.025	0.0738	<0.0080	0.0037	<0.0091	0.326	0.0562
ML31-4B-B		0.24	<0.88	<0.042	<0.050	<0.034	0	<0.031	<0.025	<0.0024	<0.0080	0.0052	<0.0091	0.0002	<0.0036
ML31-4B-A		0.29	<0.88	<0.042	<0.050	<0.034	0	<0.031	<0.025	<0.0024	<0.0080	<0.0017	<0.0091	0.0002	<0.0036
ML31-4B		38.9	1.12	14.5	9.9	<0.034	0.244	<0.031	<0.025	0.0391	<0.0080	0.0022	<0.0091	0.218	0.0275
ML31-4A		40.2	<0.88	14.9	10.2	<0.034	0.256	<0.031	<0.025	0.0382	<0.0080	0.0018	<0.0091	0.227	0.0296
ML31-3B		25.9	1.1	12.5	7.63	<0.57	0.191	<0.10	<0.0095	0.0196	<0.0094	0.0073	<0.019	0.174	0.0186
ML31-3A		25.7	1.01	12.8	7.83	<0.034	0.192	<0.031	<0.025	0.0181	<0.0080	0.0031	<0.0091	0.177	0.0199
ML31-2B		22.4	1.03	10.8	6.55	<0.034	0.117	<0.031	<0.025	0.077	<0.0080	0.0041	<0.0091	0.152	0.0191
ML31-2A		23.3	<0.88	11.2	6.75	<0.034	0.12	<0.031	<0.025	0.0791	<0.0080	0.004	<0.0091	0.158	0.0176
ML31-1B(3/12/98)		22.3	1.14	10.8	6.55	<0.034	0.114	<0.031	<0.025	0.0786	<0.0080	<0.0017	<0.0091	0.152	0.0172
ML31-1A(3/12/98)		22.5	<0.88	10.9	6.63	<0.034	0.114	<0.031	<0.025	0.08	<0.0080	<0.0017	<0.0091	0.155	0.0172
ML31-0B		18.7	<0.88	9.12	5.46	<0.034	0.0814	<0.031	<0.025	<0.0024	<0.0080	0.0034	0.0209	0.116	0.0071
ML31-0A		18.3	<0.88	8.98	5.43	<0.034	0.0795	<0.031	<0.025	<0.0024	<0.0080	0.0046	<0.0091	0.115	0.0069
ML32-10B		13.6	6.9	35.2	2.2	<0.0036	<0.0015	0.041	0.03	<0.0041	<0.0088	0.0035	<0.020	0.329	0.0076
ML32-10A		13.8	6.6	36	2.21	<0.0036	<0.0015	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.339	0.0076
ML32-9B		8.13	10.1	29.7	2.14	<0.0036	<0.0015	<0.027	<0.024	<0.0041	<0.0088	0.0034	<0.020	0.303	0.018
ML32-9A		8.01	9.9	29.4	2.11	<0.0036	<0.0015	<0.027	<0.024	<0.0041	<0.0088	0.0041	<0.020	0.3	0.0169
ML32-8B		23.2	2.7	44.3	5.4	2.72	0.0475	0.028	<0.024	<0.0041	0.0089	0.0028	<0.020	0.623	0.0193
ML32-8A		22.6	2.8	42.9	5.26	2.65	0.0476	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.605	0.0184
ML32-7B		15.8	3.7	35.8	2.6	17.4	0.161	0.04	<0.024	<0.0041	<0.0088	0.004	<0.020	0.509	0.0153
ML32-7A		16	2.9	36.4	2.63	17.8	0.165	<0.027	<0.024	<0.0041	0.013	0.0043	<0.020	0.52	0.0153
ML32-6B-B		0.122	<1.6	<0.035	<0.10	0.0157	<0.0015	0.035	<0.024	<0.0041	<0.0088	0.0096	<0.020	0.0013	<0.0030
ML32-6B-A		0.15	<1.6	<0.035	<0.10	0.0268	<0.0015	<0.027	<0.024	<0.0041	<0.0088	0.0074	<0.020	0.0017	<0.0030
ML32-6B		17.7	3.8	32.7	3.56	18.4	0.651	0.029	0.032	<0.0041	<0.0088	0.0041	<0.020	0.425	0.0214
ML32-6A		17.6	3.1	32.7	3.59	18.6	0.655	0.04	0.047	<0.0041	<0.0088	<0.0023	<0.020	0.428	0.0221
ML32-5B		43.8	4.3	35.1	8.93	1.29	1.99	<0.027	<0.024	0.0182	<0.0088	0.0042	<0.020	0.373	0.0422
ML32-5A		44.5	4	35.2	8.98	1.36	1.99	0.039	<0.024	0.0246	<0.0088	0.0043	<0.020	0.374	0.042
ML32-4B	Mar-98	70.8	2.5	24.4	12.2	0.0146	1.53	0.03	<0.024	0.0826	<0.0088	0.0077	<0.020	0.327	0.0584
ML32-4A		70.9	2.6	24.5	12.3	0.011	1.52	0.03	<0.024	0.0829	<0.0088	0.0065	<0.020	0.327	0.0582
ML32-3D-B		55.3	<1.6	18.1	12.6	<0.0036	0.307	<0.027	<0.024	0.0993	<0.0088	0.006	<0.020	0.295	0.0457
ML32-3D-A		54.6	<1.6	18.1	12.7	<0.0036	0.309	<0.027	<0.024	0.102	0.0093	0.007	<0.020	0.295	0.0455
ML32-3B		54	<1.6	17.7	12.5	<0.0036	0.307	<0.027	<0.024	0.0992	<0.0088	0.008	<0.020	0.288	0.045
ML32-3A		55.5	<1.6	18.2	12.8	<0.0036	0.313	<0.027	<0.024	0.103	<0.0088	0.006	<0.020	0.296	0.0464

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML32-2B		22.6	<1.6	11.3	6.96	<0.0036	0.166	0.056	<0.024	0.0696	<0.0088	0.0048	<0.020	0.161	0.0197
ML32-2A		22.3	<1.6	11.1	6.89	<0.0036	0.164	<0.027	<0.024	0.0641	<0.0088	0.0044	<0.020	0.157	0.0197
ML32-1B		23.7	<1.6	10.1	5.8	<0.0036	0.0728	<0.027	<0.024	0.0531	0.0021	0.0077	<0.020	0.147	0.0174
ML32-1A		24.4	<1.6	10.3	5.85	<0.0036	0.0728	<0.027	<0.024	0.0579	<0.0088	0.007	<0.020	0.152	0.0161
ML33-10B		26.7	7.5	74.5	<0.10	0.0064	<0.0016	4.55	0.045	<0.0041	<0.0088	<0.0023	<0.020	2.73	0.0185
ML33-10A		26.9	10.3	81.4	<0.10	0.01	<0.0016	4.48	<0.024	<0.0041	<0.0088	<0.0023	<0.020	2.75	0.026
ML33-9B		15.3	2.8	32.6	2.86	0.505	0.145	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.253	0.0077
ML33-9A		15.6	2.6	32.9	2.9	0.535	0.153	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.258	0.0077
ML33-8B		17.8	4.3	39.7	3.26	15.2	0.251	<0.027	<0.024	<0.0041	<0.0088	0.0026	0	0.403	0.0237
ML33-8A		14.2	5.5	37.4	2.87	7.06	0.299	0.04	<0.024	<0.0041	<0.0088	0.0032	<0.020	0.499	0.0109
ML33-7D-B		14.1	5.3	37.3	2.84	7.04	0.285	0.074	<0.024	<0.0041	0.0138	<0.0023	<0.020	0.495	0.0112
ML33-7D-A		17.8	4.4	39.6	3.25	15.1	0.244	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.401	0.0236
ML33-7B		18.2	4.4	41.9	3.42	17.2	0.294	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.428	0.024
ML33-7A		18.4	4.2	42.1	3.35	17.3	0.296	<0.027	<0.024	<0.0041	0.0139	<0.0023	<0.020	0.432	0.0249
ML33-6B		15.5	3.8	43.5	4.93	14.5	0.81	<0.027	<0.024	<0.0041	0.0122	<0.0023	<0.020	0.458	0.0167
ML33-6A		15.8	3.9	44.3	5.06	14.6	0.822	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.464	0.0161
ML33-5B		16.6	2.4	48.5	7.2	4.17	0.984	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.549	0.01
ML33-5A		16.1	3	46.6	6.93	3.97	0.943	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.525	0.01
ML33-4B		29.1	2.6	49.8	10.7	3.06	0.864	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.52	0.011
ML33-4A		30.1	2.1	50.5	10.9	3.16	0.892	<0.027	0.028	<0.0041	<0.0088	<0.0023	<0.020	0.529	0.0119
ML33-3B-B		1.12	<1.6	0.003	<0.10	0.0175	<0.0015	0.035	<0.024	<0.0041	0.0036	0.0056	<0.020	0.0001	<0.0030
ML33-3B-A		1.15	<1.6	<0.035	<0.10	0.0194	<0.0015	0.046	<0.024	<0.0041	<0.0088	0.0078	<0.020	<0.0010	<0.0030
ML33-3B		44.8	2	37.3	11.8	8.84	1.18	0.039	<0.024	<0.0041	0.0118	<0.0023	<0.020	0.355	0.0145
ML33-3A		43.7	2.7	35.2	11.2	8.29	1.11	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.333	0.0138
ML34-10B		14.2	<1.6	8.65	1.59	0.059	0.028	<0.027	<0.024	<0.0041	<0.0088	<0.0023	0.024	0.0435	<0.0030
ML34-10A		13.9	<1.6	8.55	1.6	0.0664	0.0301	0.034	<0.024	<0.0041	<0.0088	0.0141	0.023	0.0425	<0.0030
ML34-8B		17.8	<1.6	16	4.86	1.56	0.483	<0.027	<0.024	<0.0041	<0.0088	0.0055	<0.020	0.125	<0.0030
ML34-8A		17.3	<1.6	15.5	4.69	1.48	0.462	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.12	<0.0030
ML34-7B		16.2	<1.6	17.2	6.59	3.32	0.673	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.141	0.0035
ML34-7A		16.1	<1.6	17.2	6.62	3.27	0.673	0.043	0.043	<0.0041	0.0157	0.0054	<0.020	0.142	0.004
ML34-6B		24.2	<1.6	11.2	2.61	0.0367	0.0279	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0718	<0.0030
ML34-6A		24.6	<1.6	11.5	2.66	0.0293	0.0299	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0732	<0.0030
ML34-5B		32.7	<1.6	10.6	1.77	0.0369	0.0239	0.056	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0673	0.0034
ML34-5A		31.9	<1.6	10.4	1.75	0.0314	0.0239	0.045	0.003	<0.0041	<0.0088	<0.0023	<0.020	0.0665	0.0004
ML34-4B		44.1	3.3	9.66	2.71	0.0587	0.0259	0.033	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0671	<0.0030
ML34-4A		45.1	2.5	9.81	2.73	0.0587	0.0239	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0687	<0.0030
ML34-3B-B		1.1	<1.6	<0.035	<0.10	<0.0036	<0.0015	<0.027	<0.024	<0.0041	<0.0088	0.0032	<0.020	0.0011	<0.0030
ML34-3B-A		1.09	<1.6	<0.035	<0.10	0.012	<0.0015	<0.027	<0.024	<0.0041	<0.0088	0.0037	<0.020	<0.0010	<0.0030
ML34-3B		38.8	1.9	10.1	1.32	0.0408	0.0116	0.045	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0779	0.0045
ML34-3A		38.5	<1.6	10.2	1.29	0.0371	0.0075	0.045	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.079	0.0047
ML34-2B		44.5	<1.6	9.09	4.42	0.0105	0.0116	0.067	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0944	0.0037
ML34-2A		45	<1.6	9.21	4.49	0.0178	0.0116	0.033	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0953	0.0035
ML34-1D-B		29.9	<1.6	11.3	9.61	0.0822	0.0645	0.055	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.15	0.012
ML34-1D-A		28.7	<1.6	11	9.35	0.0768	0.0605	<0.027	<0.024	<0.0041	0.0019	<0.0023	<0.020	0.145	0.0108
ML34-1B		29.9	<1.6	11.3	9.58	0.0896	0.0686	<0.027	0.029	<0.0041	<0.0088	<0.0023	<0.020	0.15	0.0111
ML34-1A		29.5	<1.6	11.1	9.48	0.0933	0.0604	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.148	0.0109
ML34-0B		23.4	<1.6	3.42	<0.10	0.0156	<0.0015	0.035	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.0449	0.006
ML34-0A		23.9	<1.6	3.52	<0.10	0.0119	<0.0015	<0.027	<0.024	<0.0041	<0.0088	<0.0023	<0.020	0.047	0.0056

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML35-10B		10.1	2.06	3.91	0.692	0.359	0.146	<0.036	<0.024	<0.0020	<0.010	0.0036	<0.018	0.0333	<0.0057
ML35-10A		9.88	2.2	3.86	0.699	0.348	0.146	<0.036	<0.024	<0.0020	<0.010	<0.0010	<0.018	0.0328	<0.0057
ML35-9B	Mar-98	12.2	2.83	7.09	1.16	1.68	0.205	<0.036	0.025	0.0032	<0.010	0.0029	<0.018	0.0703	<0.0057
ML35-9A		12.1	2.44	7.1	1.11	1.67	0.207	<0.036	0.033	<0.0020	<0.010	0.0033	<0.018	0.071	<0.0057
ML35-8B		14.4	3.67	13.3	2.36	1.95	0.662	<0.036	<0.024	<0.0020	<0.010	<0.0010	<0.018	0.121	0.0093
ML35-8A		14.6	3.81	13.4	2.38	1.95	0.667	<0.036	<0.024	<0.0020	<0.010	0.0038	<0.018	0.122	0.0098
ML35-7B		15.9	2.77	15.2	3.34	0.414	0.955	<0.036	<0.024	<0.0020	<0.010	0.0034	<0.018	0.117	0.0096
ML35-7A		15.5	3.27	14.9	3.29	0.415	0.94	<0.036	<0.024	<0.0020	<0.010	0.003	<0.018	0.115	0.0102
ML35-6B		16.1	2.68	12.4	2.82	0.077	0.837	<0.036	<0.024	0.0036	<0.010	<0.0010	<0.018	0.0899	0.0091
ML35-6A		16.2	2.38	12.5	2.86	0.085	0.841	<0.036	<0.024	<0.0020	<0.010	0.003	<0.018	0.091	0.0096
ML35-5B		34.6	2.38	4.6	1.9	0.74	0.31	<0.036	<0.024	<0.0020	<0.010	0.0018	<0.018	0.0462	<0.0057
ML35-5A		34.5	2.33	4.6	1.89	0.758	0.31	<0.036	<0.024	<0.0020	<0.010	0.0041	<0.018	0.0462	<0.0057
ML35-4B		50.2	3.49	9.18	4.21	1.04	0.226	0.037	<0.024	0.0025	<0.010	<0.0010	<0.018	0.089	0.0059
ML35-4A		49.2	3.28	9.05	4.18	1.03	0.224	<0.036	<0.024	<0.0020	<0.010	<0.0010	<0.018	0.0878	<0.0057
ML35-3B		40.5	2.26	10.1	7.55	0.207	0.0325	0.047	<0.024	<0.0020	<0.010	<0.0010	<0.018	0.122	<0.0057
ML35-3A		41.7	1.56	10.6	7.88	0.208	0.0325	0.036	<0.024	<0.0020	<0.010	0.0034	<0.018	0.129	<0.0057
ML35-2D-B		24.1	0.91	6.47	3.51	0.696	0.0559	0.299	<0.024	<0.0020	<0.010	0.0015	<0.018	0.0623	<0.0057
ML35-2D-A		23.5	1.17	6.31	3.38	0.23	0.0475	<0.036	<0.024	0.0028	<0.010	0.0015	<0.018	0.0602	<0.0057
ML35-2B		23.8	1.19	6.3	3.36	0.256	0.0454	<0.036	<0.024	<0.0020	<0.010	<0.0010	<0.018	0.0597	<0.0057
ML35-2A		24.2	0.9	6.34	3.39	0.259	0.0454	<0.036	<0.024	0.0032	<0.010	<0.0010	<0.018	0.0605	<0.0057
ML35-1B-B		1.05	<0.78	<0.035	<0.074	<0.012	<0.0079	<0.036	<0.024	<0.0020	<0.010	0.0042	<0.018	0.0003	<0.0057
ML35-1B-A		1.07	<0.78	<0.035	<0.074	<0.012	<0.0079	<0.036	<0.024	<0.0020	<0.010	0.0026	<0.018	0.0003	<0.0057
ML35-1B		20.9	0.89	0.708	0.306	0.033	<0.0079	0.267	0.031	0.0046	<0.010	<0.0010	<0.018	0.0106	<0.0057
ML35-1A		20.4	0.93	0.748	0.306	0.055	<0.0079	0.256	<0.024	<0.0020	<0.010	<0.0010	<0.018	0.0104	<0.0057
ML35-0B		14.4	0.96	4.39	2.15	1.25	0.351	<0.036	<0.024	0.0022	<0.010	<0.0010	<0.018	0.0484	<0.0057
ML35-0A		14.6	<0.78	4.39	2.18	1.27	0.363	<0.036	<0.024	0.0024	<0.010	0.0006	<0.018	0.0498	<0.0057
ML24-6DUP		9.95	1.47	3.08	0.141	<0.57	0.0272	<0.10	<0.0095	<0.0037	<0.0094	<0.0022	<0.019	0.0369	<0.0033
ML21-6		53.1	6.15	31	15.9	<0.57	3.08	<0.10	<0.0097	0.716	<0.0094	0.0079	<0.019	0.508	0.0661
ML21-1DUP		20	1.49	12.1	6.89	<0.012	0.0957	<0.036	<0.024	<0.0020	<0.010	0.0043	<0.018	0.156	0.0146
ML21-1		20.6	1.02	12.4	7.03	<0.012	0.0957	<0.036	<0.024	<0.0020	<0.010	0.0051	<0.018	0.16	0.0153
ML23-2DUP		44.4	1.23	4.39	6.64	0.033	0.025	0.033	<0.019	<0.0034	<0.013	<0.0025	<0.020	0.0481	0.0081
ML23-2		46.2	<0.79	4.46	6.73	0.058	0.023	<0.033	<0.019	<0.0034	<0.013	<0.0025	<0.020	0.0497	0.0079
ML23.5-0DU		31	1.85	9.32	6.56	0.066	0.074	<0.033	<0.019	<0.0034	<0.013	0.0027	<0.020	0.0911	<0.0050
ML23.5-0		31.4	1.77	9.35	6.68	0.055	0.078	<0.033	<0.019	<0.0034	<0.013	<0.0025	<0.020	0.0917	<0.0050
ML25-2DUP		42.7	<0.79	2.89	1.41	3.65	0.171	0.066	<0.019	<0.0034	<0.013	0.0089	<0.020	0.039	<0.0050
ML25-2		42.6	0.08	2.92	1.44	3.69	0.17	0.044	0.005	<0.0034	<0.013	0.0042	<0.020	0.0395	<0.0050
ML11-5FDUP	Jun-98	48.7	7.03	29.1	13.5	<0.0093	2.89	<0.034	<0.022	0.156	<0.011	<0.0007	<0.010	0.477	0.064
ML11-5		50.3	6.84	29.6	13.8	<0.0093	2.94	<0.034	<0.022	0.178	<0.011	<0.0007	<0.010	0.489	0.0662
ML12-5FDUP		56	5.8	28.8	6.51	17	1.02	<0.034	<0.022	<0.0023	<0.011	<0.0007	<0.010	0.289	0.0406
ML12-5		55.2	6.09	28.6	6.47	17	1.01	<0.034	<0.022	<0.0023	<0.011	<0.0007	<0.010	0.288	0.0402
ML13-9FDUP		5.3	2.92	18.4	1.83	0.342	0.0337	<0.023	<0.020	<0.0031	<0.0043	<0.0014	<0.011	0.143	0.0051
ML13-9		2.91	0.96	4.78	<0.034	<0.0026	<0.0040	<0.023	<0.020	<0.0031	<0.0043	<0.0014	<0.011	0.0364	0.0069
ML14-6FDUP		4.69	1.96	2.42	<0.034	0.008	<0.0040	<0.023	<0.020	<0.0031	<0.0043	<0.0014	<0.011	0.0103	<0.0013
ML14-6		5.2	2.06	2.77	<0.034	0.008	<0.0040	<0.023	<0.020	<0.0031	0.0094	<0.0014	<0.011	0.0118	<0.0013
ML15-5FDUP		6.64	1.03	1.04	0.636	0.985	0.118	1.43	<0.020	0.005	<0.0043	<0.0014	<0.011	0.012	0.0039
ML15-5		7.5	1.2	1.45	0.732	0.811	0.144	0.881	0.03	<0.0031	<0.0043	<0.0014	<0.011	0.0162	0.002
ML15-3		9.09	2.33	1.11	0.074	0.0119	<0.0040	0.238	<0.020	<0.0031	<0.0043	<0.0014	<0.011	0.0037	<0.0013
ML15-3		7.22	0.92	<0.026	<0.034	0.0196	0.0053	0.04	<0.020	<0.0031	<0.0043	<0.0014	<0.011	0.0009	<0.0013

Table J1 **Summary of Cation Results for Duplicates**

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML31-10		27.5	4.8	31.9	5.61	<0.010	0.386	<0.042	<0.0080	<0.0036	0.015	<0.0014	<0.011	0.393	0.0189
ML31-10FDU		27.5	4.5	32.1	5.6	<0.010	0.393	<0.042	<0.0080	<0.0036	<0.011	<0.0014	<0.011	0.397	0.0189
ML32-9FDUP		6.66	9.4	26	1.8	<0.010	<0.0025	<0.042	<0.0080	<0.0036	0.013	<0.0014	0.015	0.264	0.0036
ML32-9		6.78	9.4	26.3	1.79	<0.010	<0.0025	<0.042	<0.0080	<0.0036	<0.011	<0.0014	<0.011	0.265	0.0134
ML33-8FDUP		13.2	5.1	31.3	2.28	3.69	0.238	0.046	<0.0080	<0.0036	<0.011	<0.0014	<0.011	0.391	<0.0009
ML33-8		13.5	5.2	31.6	2.28	4.09	0.238	0.046	<0.0080	0.0043	<0.011	<0.0014	<0.011	0.394	0.0012
ML34-10		14.3	2	6.35	1.2	0.0218	0.0133	<0.034	0.024	<0.0023	<0.011	<0.0007	<0.010	0.0334	<0.0008
ML34-10		14.9	2.01	6.46	1.21	0.0256	0.018	<0.034	<0.022	<0.0023	<0.011	<0.0007	<0.010	0.034	0.0036
ML34-7FDUP		16.8	2.61	18.4	7.57	5.43	0.907	<0.034	<0.022	<0.0023	<0.011	<0.0007	<0.010	0.153	0.0024
ML34-7		16.6	2.8	18.2	7.52	5.28	0.888	<0.034	<0.022	<0.0023	<0.011	<0.0007	<0.010	0.151	0.0021
ML35-7	Jun-98	13.2	3.79	12	2.6	0.408	0.722	<0.034	<0.022	<0.0023	<0.011	<0.0007	<0.010	0.0893	0.0068
ML35-7		13.1	3.82	11.9	2.62	0.412	0.717	<0.034	0.028	<0.0023	<0.011	<0.0007	<0.010	0.0891	0.007
ML21-6DUP		52.5	6.31	29.4	14.2	0.0223	2.77	<0.031	<0.025	0.849	<0.010	<0.0012	<0.019	0.466	0.0187
ML21-6		52.5	6.64	29.1	14	0.0582	2.72	<0.031	<0.025	0.84	<0.010	<0.0012	<0.019	0.458	0.0179
ML22.5-5DU		22.8	4.43	30.3	4.38	15.5	0.676	<0.031	<0.024	<0.0016	<0.010	0	<0.019	0.335	0.0201
ML22.5-5		22.8	5	30.9	4.48	15.7	0.688	<0.031	<0.024	<0.0016	<0.010	0.0016	<0.019	0.335	0.0196
ML22.5-1DU		28.3	1.75	9.14	5.69	0.543	0.184	<0.031	<0.024	0.215	0.013	<0.0012	<0.019	0.13	0.0177
ML22.5-1		28.6	1.81	9.14	5.67	0.543	0.18	<0.031	<0.024	0.211	<0.010	0.0012	<0.019	0.13	0.0175
ML24-7DUP		7.41	2.01	1.89	0.108	<0.0028	0.005	0.049	0.029	0.002	<0.010	<0.0012	<0.019	0.0143	0.0129
ML24-7		7.43	2.1	1.91	0.095	0.0055	0.005	0.049	<0.024	<0.0016	<0.010	<0.0012	<0.019	0.0145	0.0039
ML11-10	Dec-98	11.9	6.16	28.2	12.7	4.38	0.742	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.284	0.0197
ML11-10DUP		11.9	6.39	27.5	12.5	4.25	0.727	<0.033	<0.021	0.0037	<0.0088	<0.0012	<0.014	0.278	0.0217
ML11-0		38.1	1.04	18.2	11.9	<0.0049	0.166	<0.033	<0.021	0.168	0.0019	0.002	<0.014	0.25	0.0275
ML11-0DUP		37.6	1.3	18.1	11.8	<0.0049	0.161	<0.033	<0.021	0.17	<0.0088	0.002	<0.014	0.248	0.0269
ML12-9DUP		29.6	6.44	49.9	5.26	2.57	0.179	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.407	0.0211
ML12-9		29.9	6.5	50.1	5.27	2.56	0.179	0.042	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.407	0.0211
ML13-7DUP		5.5	2.78	4.17	0.056	0.015	<0.0035	<0.033	<0.021	<0.0023	0.0099	<0.0012	<0.014	0.0412	0.0262
ML13-7		5.42	2.74	4.12	0.056	0.0116	<0.0035	<0.033	<0.021	<0.0023	0.0088	<0.0012	<0.014	0.041	0.0255
ML14-8DUP		5.03	2.39	4.03	<0.037	<0.0049	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0199	<0.0011
ML14-8		5.03	2.41	4.02	<0.037	<0.0049	<0.0035	<0.033	<0.021	<0.0023	<0.0088	<0.0012	<0.014	0.0198	<0.0011
ML15-10		39.6	4.77	32.1	1.89	<0.0034	0.0866	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.291	0.0057
ML15-10		40	4.54	32.5	1.87	0.0087	0.0846	<0.030	<0.017	0.0026	<0.0071	<0.0015	<0.014	0.296	0.0066
ML15-6DUP		12.2	3.71	10.6	2.2	2.92	0.243	<0.030	0.037	<0.0016	<0.0071	<0.0015	<0.014	0.0862	0.0082
ML15-6		12	3.92	10.5	2.2	2.85	0.241	<0.030	<0.017	0.0016	<0.0071	<0.0015	<0.014	0.0847	0.0084
ML21-7DUP		21.7	5.42	26.6	9.14	6.34	3.46	<0.030	<0.017	<0.0016	0.0144	<0.0015	<0.014	0.303	0.0456
ML21-7		21.7	5.53	26.2	9	6.23	3.41	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.299	0.0454
ML21-1DUP		22.2	0.76	12.7	7.52	<0.0034	0.095	<0.030	<0.017	0.0019	0.0129	<0.0015	<0.014	0.164	0.017
ML21-1		22.3	0.78	12.9	7.62	<0.0034	0.099	<0.030	<0.017	0	<0.0071	<0.0015	<0.014	0.166	0.0164
ML23.5-5DUP		21.2	1.37	6.69	2.67	0.483	0.243	<0.030	0.029	<0.0016	<0.0071	<0.0015	<0.014	0.0453	0.002
ML23.5-5		21.2	1.09	6.78	2.69	0.49	0.243	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0461	0.002
ML25-6DUP		12.4	1.73	2.46	1.12	0.48	0.325	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0268	0.0015
ML25-6		12.3	1.8	2.44	1.14	0.467	0.323	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.0268	0.0017
ML31-9DUP		23.9	4.34	34.9	7.04	<0.0034	0.501	<0.030	<0.017	0.0019	<0.0071	<0.0015	<0.014	0.417	0.0286
ML31-9		23.9	4.46	34.2	6.99	<0.0034	0.501	<0.030	<0.017	<0.0016	<0.0071	0.0032	0.014	0.408	0.0286
ML32-10		19.7	7.77	40.4	2.93	0.0387	0.0225	<0.030	<0.017	0.0028	<0.0071	0.0017	<0.014	0.382	0.0108
ML32-10DUP		19.6	7.73	40.4	2.96	0.032	0.0224	<0.030	<0.017	<0.0016	<0.0071	<0.0015	<0.014	0.388	0.0099
ML32-5D		48.2	5.34	44.6	9.47	0.384	2.31	<0.030	<0.017	0.0024	<0.0071	<0.0015	<0.014	0.461	0.052
ML32-5		46.2	5.57	47.2	9.74	0.252	2.45	<0.030	<0.017	<0.0016	<0.0071	0.002	<0.014	0.47	0.0538

Table J1 Summary of Cation Results for Duplicates

Sample	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	As (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)	Pb (mg/L)	Sr (mg/L)	Ba (mg/L)
ML33-7DUP		19.6	4.87	35.1	3.84	13.7	0.23	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.395	0.022
ML33-7D		19.5	4.78	35.6	3.89	13.3	0.248	<0.022	<0.029	<0.0024	0.0109	<0.019	<0.022	0.397	0.0238
ML33-7		20.1	4.69	35.6	3.9	13.5	0.238	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.403	0.0222
ML34-7DUP		17.5	2.31	22.6	8.22	3.89	0.748	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.194	0.0058
ML34-7		17.6	2.32	23	8.35	3.92	0.76	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.197	0.0057
ML34-6DUP		17.7	2.33	19.3	7.07	1.54	0.712	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.151	0.0035
ML34-6		19.4	2.2	19.3	7.15	1.27	0.684	<0.022	<0.029	<0.0024	<0.0083	<0.019	<0.022	0.15	0.0033
ML35-0		17.1	0.41	1.9	1.01	0.561	0.116	<0.030	<0.020	0.002	<0.011	<0.0014	<0.014	0.0219	0.0013
ML35-0DUP		17.3	0.39	1.92	1.04	0.561	0.122	<0.030	<0.020	<0.0019	<0.011	<0.0014	<0.014	0.0221	0.0013

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Table J2 Statistical Results for Selected Cation Duplicates

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML22-2.45	Nov-96	53	48.90	8.38	5.80	**11.86**	2.1	1.85	13.51	0.35	**19.11**
ML22-2A.45		44.8					1.6				
ML31-7.45		31.1	31.55	-1.43	0.64	**2.02**	7.7	7.05	9.22	0.92	**13.04**
ML31-7.45		32					6.4				
ML31-10.45		14.7	14.70	0.00	0.00	**0.00**	4.6	4.95	-7.07	0.49	**10.00**
ML31-10.45		14.7					5.3				
no data	Feb-97										
ML11-9 DUP	Jun-97	13.7	13.60	0.74	0.14	**1.04**	4.23	3.96	6.95	0.39	**9.83**
ML11-9		13.5					3.68				
ML11-4		113	109.33	3.35	3.21	**2.94**	1.47	1.90	-22.77	0.38	**19.83**
ML11-4 DUP		108		-1.22			2.16		13.49		
ML11-4 DUP		107		-2.13			2.08		9.28		
ML11-2 DUP		81.1	81.45	-0.43	0.49	**0.61**	1.1	0.99	11.11	0.16	**15.71**
ML11-2		81.8					0.88				
ML12-6 DUP		6.9	6.89	0.15	0.01	**0.21**	3.62	3.46	4.62	0.23	**6.54**
ML12-6		6.88					3.3				
ML12-2 DUP+A16		60	60.30	-0.50	0.42	**0.70**	1.32	1.39	-4.69	0.09	**6.64**
ML12-2 DUP		60.6					1.45				
ML13-8 DUP		3.49	3.47	0.72	0.04	**1.02**	2.16	2.17	-0.23	0.01	**0.33**
ML13-8 DUP		3.44					2.17				
ML13-3 DUP		14.8	14.90	-0.67	0.14	**0.95**	1.12	1.19	-5.88	0.10	**8.32**
ML13-3		15					1.26				
ML14-10		2.62	2.62	0.00	0.00	**0.00**	1.32	1.44	-8.01	0.16	**11.33**
ML14-10 DU		2.62					1.55				
ML14-6		5.54	4.92	12.53	0.53	**10.85**	1.5	1.65	-9.27	0.15	**9.08**
ML14-6 DUP+A19		4.63		-5.96			1.66		0.40		
ML14-6 DUP		4.6		-6.57			1.8		8.87		
ML15-10		2.33	2.31	1.08	0.04	**1.53**	4.69	4.42	6.23	0.39	**8.81**
ML15-10 DUP+A19		2.28					4.14				
ML15-1 DUP		58.6	58.30	0.51	0.42	**0.73**	0.58	0.58	0.00	0.00	**0.00**
ML15-1		58					0.58				
ML15-0		31.6	31.65	-0.16	0.07	**0.22**	1.63	1.68	-2.98	0.07	**4.21**
ML15-0 DUP		31.7					1.73				
ML31-2		26.7	26.87	-0.62	0.29	**1.07**	0.55	1.15	-52.17	0.52	**45.39**
ML31-2 DUP		26.7		-0.62			1.4		21.74		
ML31-2 DUP		27.2		1.24			1.5		30.43		
ML32-6		13.1	13.15	-0.38	0.07	**0.54**	4.6	4.45	3.37	0.21	**4.77**
ML32-6 DUP		13.2					4.3				
ML32-2 DUP		26.1	26.40	-1.14	0.42	**1.61**	0.85	0.94	-9.57	0.13	**13.54**
ML32-2		26.7					1.03				
ML33-10 DUP	Jun-97	24.4	24.10	1.24	0.42	**1.76**	7.23	7.36	-1.77	0.18	**2.50**
ML33-10		23.8					7.49				
ML33-4		21	24.57	-14.52	3.09	**12.59**	2.95	2.86	3.03	0.17	**5.86**
ML33-4		26.2		6.65			2.67		-6.75		
ML33-4 DUP		26.5		7.87			2.97		3.73		
ML33-3 DUP		37.7	37.95	-0.66	0.35	**0.93**	2.53	2.63	-3.62	0.13	**5.12**
ML33-3		38.2					2.72				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
6.55 6.65	6.60	-0.76	0.07	**1.07**	0.65 3.95	2.30	-71.74	2.33	**101.45**	0.0031 1.56	0.78	-99.60	1.10	**140.86**
28.4 27.9	28.15	0.89	0.35	**1.26**	13.1 12.9	13.00	0.77	0.14	**1.09**	0.0025 0.0025	0.00	0.00	0.00	**0.00**
26.7 26.5	26.60	0.38	0.14	**0.53**	7.31 7.26	7.29	0.34	0.04	**0.49**	0.0025 0.0025	0.00	0.00	0.00	**0.00**
18 17.9	17.95	0.28	0.07	**0.39**	3.96 3.87	3.92	1.15	0.06	**1.63**	0.0044 0.0044	0.00	0.00	0.00	**0.00**
19.6 18.4 18.3	18.77	4.44 -1.95 -2.49	0.72	**3.85**	13.4 12.7 12.6	12.90	3.88 -1.55 -2.33	0.44	**3.38**	1.64 1.59 1.57	1.60	2.50 -0.62 -1.87	0.04	**2.25**
14.4 14.9	14.65	-1.71	0.35	**2.41**	9.64 9.81	9.73	-0.87	0.12	**1.24**	0.942 0.952	0.95	-0.53	0.01	**0.75**
7.15 6.86	7.01	2.07	0.21	**2.93**	2.85 2.43	2.64	7.95	0.30	**11.25**	0.0104 0.0044	0.01	40.54	0.00	**57.33**
9.92 9.9	9.91	0.10	0.01	**0.14**	7.33 7.39	7.36	-0.41	0.04	**0.58**	0.852 0.857	0.85	-0.29	0.00	**0.41**
6.63 6.63	6.63	0.00	0.00	**0.00**	0.071 0.09	0.08	-11.80	0.01	**16.69**	0.002 0.002	0.00	0.00	0.00	**0.00**
4.94 4.85	4.90	0.92	0.06	**1.30**	1.05 1.03	1.04	0.96	0.01	**1.36**	0.0044 0.0044	0.00	0.00	0.00	**0.00**
5.2 5.23	5.22	-0.29	0.02	**0.41**	0.187 0.194	0.19	-1.84	0.00	**2.60**	0.0044 0.0044	0.00	0.00	0.00	**0.00**
2.34 2.41 2.42	2.39	-2.09 0.84 1.26	0.04	**1.82**	0.073 0.073 0.071	0.07	0.92 0.92 -1.84	0.00	**1.60**	0.0044 0.002 0.002	0.00	57.14 -28.57 -28.57	0.00	**49.49**
11.9 11.6	11.75	1.28	0.21	**1.81**	1.08 1.03	1.06	2.37	0.04	**3.35**	0.0069 0.0014	0.00	66.27	0.00	**93.71**
1.29 1.23	1.26	2.38	0.04	**3.37**	0.694 0.716	0.71	-1.56	0.02	**2.21**	0.0044 0.0044	0.00	0.00	0.00	**0.00**
7.25 7.35	7.30	-0.68	0.07	**0.97**	4.48 4.48	4.48	0.00	0.00	**0.00**	0.002 0.002	0.00	0.00	0.00	**0.00**
9.45 9.44 9.46	9.45	0.00 -0.11 0.11	0.01	**0.11**	5.72 5.67 5.68	5.69	0.53 -0.35 -0.18	0.03	**0.46**	0.0498 0.0434 0.0458	0.05	7.48 -6.33 -1.15	0.00	**6.98**
27.3 27.8	27.55	-0.91	0.35	**1.28**	2.07 2.09	2.08	-0.48	0.01	**0.68**	0.002 0.002	0.00	0.00	0.00	**0.00**
9.26 9.3	9.28	-0.22	0.03	**0.30**	5.75 5.81	5.78	-0.52	0.04	**0.73**	0.12 0.121	0.12	-0.41	0.00	**0.59**
71.7 71.1	71.40	0.42	0.42	**0.59**	0.045 0.067	0.06	-19.64	0.02	**27.78**	0.0037 0.0037	0.00	0.00	0.00	**0.00**
26 20.4 20.3	22.23	16.94 -8.25 -8.70	3.26	**14.67**	5.4 4.79 4.77	4.99	8.29 -3.94 -4.34	0.36	**7.18**	0.0037 0.002 0.002	0.00	44.16 -22.08 -22.08	0.00	**38.24**
19.1 19.9	19.50	-2.05	0.57	**2.90**	5.9 6.2	6.05	-2.48	0.21	**3.51**	0.0037 0.0037	0.00	0.00	0.00	**0.00**

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML11-8DUP		11.8	12.10	-2.48	0.42	**3.51**	6.53	5.64	15.78	1.26	**22.32**
ML11-8		12.4					4.75				
ML11-7DUP		12.9	13.20	-2.27	0.42	**3.21**	5.16	4.73	9.21	0.62	**13.02**
ML11-7		13.5					4.29				
ML11-6DUP		15.5	15.65	-0.96	0.21	**1.36**	5.8	5.31	9.23	0.69	**13.05**
ML11-6		15.8					4.82				
ML11-5DUP		33.5	34.25	-2.19	1.06	**3.10**	6.59	6.56	0.46	0.04	**0.65**
ML11-5		35					6.53				
ML11-4DUP		86.8	86.45	0.40	0.49	**0.57**	2.24	2.01	11.72	0.33	**16.58**
ML11-4		86.1					1.77				
ML11-3DUP		67.1	66.60	0.75	0.71	**1.06**	0.883	1.03	-14.27	0.21	**20.18**
ML11-3		66.1					1.177				
ML11-2DUP		68.6	70.60	-2.83	2.77	**3.92**	1.143	1.43	-19.97	0.20	**13.91**
ML11-2DUP		68		-3.68			1.53		7.12		
ML11-2DUP		73.8		4.53			1.59		11.33		
ML11-2		72		1.98			1.45		1.52		
ML11-1DUP		49.1	48.65	0.92	0.64	**1.31**	1.008	1.24	-18.97	0.33	**26.83**
ML11-1		48.2					1.48				
ML11-0DUP		42.5	43.10	-1.39	0.85	**1.97**	2.31	2.17	6.45	0.20	**9.12**
ML11-0		43.7					2.03				
ML12-10DUP		3.33	3.32	0.30	0.01	**0.43**	2.47	2.61	-5.18	0.19	**7.33**
ML12-10		3.31					2.74				
ML12-9DUP	Sep-97	4.11	4.11	0.00	0.00	**0.00**	3.18	3.08	3.25	0.14	**4.59**
ML12-9		4.11					2.98				
ML12-8DUP		4.63	4.58	1.09	0.07	**1.54**	4.26	4.16	2.40	0.14	**3.40**
ML12-8		4.53					4.06				
ML12-5DUP		22	22.15	-0.68	0.21	**0.96**	5.64	5.51	2.45	0.19	**3.47**
ML12-5		22.3					5.37				
ML12-4DUP		77	76.80	0.26	0.28	**0.37**	5.34	5.42	-1.48	0.11	**2.09**
ML12-4		76.6					5.5				
ML12-3DUP		98.7	99.85	-1.15	1.63	**1.63**	2.71	2.34	16.06	0.53	**22.71**
ML12-3		101					1.96				
ML12-2DUP		87	88.30	-1.47	1.84	**2.08**	2.21	2.02	9.68	0.28	**13.69**
ML12-2		89.6					1.82				
ML12-1DUP		68.7	69.20	-0.72	0.71	**1.02**	1.97	1.77	11.61	0.29	**16.43**
ML12-1		69.7					1.56				
ML13-10DUP		5.35	5.41	-1.02	0.08	**1.44**	6.1	5.73	6.55	0.53	**9.26**
ML13-10		5.46					5.35				
ML13-9DUP		4.43	4.43	0.00	0.00	**0.00**	5.36	5.10	5.10	0.37	**7.21**
ML13-9		4.43					4.84				
ML13-8DUP		4.08	4.05	0.74	0.04	**1.05**	3.91	3.91	0.00	0.00	**0.00**
ML13-8		4.02					3.91				
ML13-7DUP		3.89	3.89	0.00	0.00	**0.00**	4.55	3.93	15.92	0.88	**22.52**
ML13-7		3.89					3.3				
ML13-6TRIP		3.99	4.02	-0.62	0.04	**0.88**	3.15	3.17	-0.63	0.03	**0.89**
ML13-6DUP		4.04					3.19				
ML13-5DUP		3.66	3.68	-0.41	0.02	**0.58**	2.83	2.79	1.62	0.06	**2.29**
ML13-5		3.69					2.74				
ML13-4DUP		4.28	4.29	-0.12	0.01	**0.17**	2.01	2.28	-11.65	0.37	**16.47**
ML13-4		4.29					2.54				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
16.5	16.60	-0.60	0.14	**0.85**	4.44	4.42	0.57	0.04	**0.80**	0.0044	0.00	0.00	0.00	**0.00**
16.7					4.39					0.0044				
17.2	17.50	-1.71	0.42	**2.42**	5.29	5.36	-1.21	0.09	**1.72**	0.0044	0.00	0.00	0.00	**0.00**
17.8					5.42					0.0044				
20.1	20.40	-1.47	0.42	**2.08**	7.27	7.36	-1.16	0.12	**1.63**	0.0044	0.00	0.00	0.00	**0.00**
20.7					7.44					0.0044				
23.1	23.30	-0.86	0.28	**1.21**	10.8	11.00	-1.82	0.28	**2.57**	0.0832	0.08	-0.42	0.00	**0.59**
23.5					11.2					0.0839				
14.3	14.10	1.42	0.28	**2.01**	9.85	9.72	1.34	0.18	**1.89**	1.6	1.58	1.27	0.03	**1.79**
13.9					9.59					1.56				
4.92	4.92	0.00	0.00	**0.00**	3.91	3.94	-0.64	0.04	**0.90**	1.61	1.61	0.31	0.01	**0.44**
4.92					3.96					1.6				
9.03	9.31	-3.03	0.28	**2.97**	6.15	6.32	-2.73	0.22	**3.41**	1.17	1.20	-2.50	0.04	**2.97**
9.14		-1.85			6.13		-3.04			1.17		-2.50		
9.63		3.41			6.56		3.76			1.24		3.33		
9.45		1.48			6.45		2.02			1.22		1.67		
8.18	8.12	0.80	0.09	**1.13**	5.24	5.21	0.67	0.05	**0.95**	0.873	0.86	0.98	0.01	**1.39**
8.05					5.17					0.856				
25.4	25.65	-0.97	0.35	**1.38**	15.3	15.45	-0.97	0.21	**1.37**	0.25	0.25	-0.79	0.00	**1.12**
25.9					15.6					0.254				
12.3	12.20	0.82	0.14	**1.16**	0.745	0.74	0.61	0.01	**0.86**	0.0028	0.00	0.00	0.00	**0.00**
12.1					0.736					0.0028				
13.4	13.45	-0.37	0.07	**0.53**	2.64	2.64	0.00	0.00	**0.00**	0.003	0.00	3.45	0.00	**4.88**
13.5					2.64					0.0028				
9.75	9.68	0.78	0.11	**1.10**	3.51	3.47	1.15	0.06	**1.63**	0.0028	0.00	-18.84	0.00	**26.64**
9.6					3.43					0.0041				
20.2	20.40	-0.98	0.28	**1.39**	3.84	3.84	0.13	0.01	**0.18**	0.0028	0.00	0.00	0.00	**0.00**
20.6					3.83					0.0028				
20.1	20.25	-0.74	0.21	**1.05**	9.59	9.61	-0.21	0.03	**0.29**	0.331	0.32	4.09	0.02	**5.78**
20.4					9.63					0.305				
14.2	14.40	-1.39	0.28	**1.96**	9.9	9.95	-0.50	0.07	**0.71**	1.52	1.54	-1.30	0.03	**1.84**
14.6					10					1.56				
12.3	12.50	-1.60	0.28	**2.26**	9.19	9.32	-1.34	0.18	**1.90**	1.35	1.37	-1.10	0.02	**1.55**
12.7					9.44					1.38				
14.6	14.75	-1.02	0.21	**1.44**	9.53	9.60	-0.73	0.10	**1.03**	0.845	0.85	-0.88	0.01	**1.24**
14.9					9.67					0.86				
7.68	7.88	-2.54	0.28	**3.59**	0.279	0.25	13.41	0.05	**18.97**	0.0028	0.00	0.00	0.00	**0.00**
8.08					0.213					0.0028				
6.91	6.95	-0.50	0.05	**0.71**	0.204	0.19	6.53	0.02	**9.23**	0.0028	0.00	0.00	0.00	**0.00**
6.98					0.179					0.0028				
5.87	5.87	0.09	0.01	**0.12**	0.095	0.12	-18.10	0.03	**25.60**	0.0028	0.00	0.00	0.00	**0.00**
5.86					0.137					0.0028				
4.54	4.56	-0.33	0.02	**0.47**	0.198	0.16	24.92	0.06	**35.24**	0.0028	0.00	0.00	0.00	**0.00**
4.57					0.119					0.0028				
7.73	7.79	-0.77	0.08	**1.09**	0.137	0.15	-8.36	0.02	**11.82**	0.0028	0.00	0.00	0.00	**0.00**
7.85					0.162					0.0028				
8.5	8.49	0.12	0.01	**0.17**	0.146	0.16	-7.89	0.02	**11.15**	0.0028	0.00	0.00	0.00	**0.00**
8.48					0.171					0.0028				
5.99	5.99	0.00	0.00	**0.00**	0.095	0.12	-20.83	0.04	**29.46**	0.0028	0.00	0.00	0.00	**0.00**
5.99					0.145					0.0028				

Table J2 Statistical Results for Selected Cation Duplicates

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML13-3DUP		9.31	9.17	1.53	0.20	**2.16**	1.79	2.19	-18.08	0.56	**25.57**
ML13-3		9.03					2.58				
ML13-2DUP		25.1	24.60	2.03	0.71	**2.87**	2.48	2.86	-13.29	0.54	**18.79**
ML13-2		24.1					3.24				
ML13-1DUP		61.3	63.35	-3.24	2.90	**4.58**	4	3.74	7.10	0.37	**10.03**
ML13-1		65.4					3.47				
ML14-10		2.33	2.36	-1.06	0.04	**1.50**	1.63	1.35	21.19	0.40	**29.97**
ML14-10DUP		2.38					1.06				
ML14-9DUP		2.57	2.61	-1.53	0.06	**2.17**	2.46	2.17	13.36	0.41	**18.90**
ML14-9		2.65					1.88				
ML14-8DUP		6.16	6.13	0.57	0.05	**0.81**	1.91	1.93	-0.78	0.02	**1.10**
ML14-8		6.09					1.94				
ML14-7DUP	Sep-97	6.5	6.42	1.25	0.11	**1.76**	2.23	2.34	-4.50	0.15	**6.36**
ML14-7		6.34					2.44				
ML14-6DUP		6.15	6.27	-1.84	0.16	**2.60**	2.69	2.41	11.85	0.40	**16.76**
ML14-6		6.38					2.12				
ML14-5DUP		7.27	7.28	-0.07	0.01	**0.10**	2.25	2.15	4.65	0.14	**6.58**
ML14-5		7.28					2.05				
ML14-4DUP		5.71	5.76	-0.87	0.07	**1.23**	2.56	2.49	3.02	0.11	**4.27**
ML14-4		5.81					2.41				
ML14-3DUP		9.42	9.42	0.00	0.00	**0.00**	2.23	2.33	-4.29	0.14	**6.07**
ML14-3		9.42					2.43				
ML14-2DUP		12.4	12.25	1.22	0.21	**1.73**	2.51	2.64	-4.92	0.18	**6.96**
ML14-2		12.1					2.77				
ML14-1DUP		59.1	59.30	-0.34	0.28	**0.48**	2.18	2.32	-6.03	0.20	**8.53**
ML14-1		59.5					2.46				
ML14-0DUP		47.8	47.10	1.49	0.99	**2.10**	1.8	1.96	-7.93	0.22	**11.21**
ML14-0		46.4					2.11				
ML15-10		4.78	4.74	0.95	0.06	**1.34**	7.94	8.04	-1.24	0.14	**1.76**
ML15-10DUP		4.69					8.14				
ML15-9DUP		5.58	5.58	0.00	0.00	**0.00**	6.9	7.16	-3.63	0.37	**5.14**
ML15-9		5.58					7.42				
ML15-8DUP		8.69	8.78	-1.03	0.13	**1.45**	5.77	5.83	-0.94	0.08	**1.34**
ML15-8		8.87					5.88				
ML15-7DUP		8.57	8.58	-0.12	0.01	**0.16**	5.39	5.54	-2.71	0.21	**3.83**
ML15-7		8.59					5.69				
ML15-6DUP		11.5	11.50	0.00	0.00	**0.00**	4.06	3.96	2.53	0.14	**3.57**
ML15-6		11.5					3.86				
ML15-5DUP		7.8	7.86	-0.70	0.08	**0.99**	1.81	2.00	-9.27	0.26	**13.11**
ML15-5		7.91					2.18				
ML15-4DUP		7.58	7.67	-1.11	0.12	**1.57**	0.91	0.46	97.83	0.64	**138.35**
ML15-4		7.75					0.01				
ML15-3DUP		7.42	7.42	0.00	0.00	**0.00**	3.19	3.11	2.74	0.12	**3.87**
ML15-3		7.42					3.02				
ML15-2DUP		32.2	32.40	-0.62	0.28	**0.87**	2.5	2.45	2.04	0.07	**2.89**
ML15-2		32.6					2.4				
ML15-1DUP		35.4	35.15	0.71	0.35	**1.01**	1.89	1.98	-4.55	0.13	**6.43**
ML15-1		34.9					2.07				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
5.02	4.95	1.52	0.11	**2.14**	0.518	0.53	-1.61	0.01	**2.28**	0.0028	0.00	0.00	0.00	**0.00**
4.87					0.535					0.0028				
2.9	3.29	-11.72	0.54	**16.57**	0.425	0.45	-4.71	0.03	**6.66**	0.0028	0.00	0.00	0.00	**0.00**
3.67					0.467					0.0028				
1.29	1.59	-18.61	0.42	**26.32**	0.541	0.66	-18.15	0.17	**25.67**	0.0028	0.01	-45.10	0.00	**63.78**
1.88					0.781					0.0074				
4.65	4.81	-3.23	0.22	**4.56**	0.27	0.25	8.65	0.03	**12.24**	0.0033	0.00	0.00	0.00	**0.00**
4.96					0.227					0.0033				
5.26	5.44	-3.31	0.25	**4.68**	0.079	0.06	23.44	0.02	**33.15**	0.0033	0.00	0.00	0.00	**0.00**
5.62					0.049					0.0033				
3.05	3.05	0.16	0.01	**0.23**	0.049	0.05	0.00	0.00	**0.00**	0.0033	0.00	-2.94	0.00	**4.16**
3.04					0.049					0.0035				
3.22	3.17	1.58	0.07	**2.23**	0.049	0.05	0.00	0.00	**0.00**	0.0033	0.00	0.00	0.00	**0.00**
3.12					0.049					0.0033				
2.77	2.83	-2.12	0.08	**3.00**	0.049	0.05	0.00	0.00	**0.00**	0.0033	0.00	0.00	0.00	**0.00**
2.89					0.049					0.0033				
2.28	2.31	-1.30	0.04	**1.84**	0.086	0.07	27.41	0.03	**38.76**	0.0033	0.00	0.00	0.00	**0.00**
2.34					0.049					0.0033				
3.19	3.19	0.00	0.00	**0.00**	0.049	0.06	-18.33	0.02	**25.93**	0.0051	0.00	21.43	0.00	**30.30**
3.19					0.071					0.0033				
3.98	4.00	-0.38	0.02	**0.53**	0.049	0.05	0.00	0.00	**0.00**	0.0033	0.00	0.00	0.00	**0.00**
4.01					0.049					0.0033				
4.09	4.06	0.74	0.04	**1.04**	0.188	0.17	8.99	0.02	**12.71**	0.0033	0.00	0.00	0.00	**0.00**
4.03					0.157					0.0033				
2.58	2.57	0.58	0.02	**0.83**	0.21	0.21	0.00	0.00	**0.00**	0.0033	0.00	0.00	0.00	**0.00**
2.55					0.21					0.0033				
3.18	3.18	0.00	0.00	**0.00**	0.11	0.12	-7.95	0.01	**11.24**	0.0033	0.00	0.00	0.00	**0.00**
3.18					0.129					0.0033				
26.9	26.50	1.51	0.57	**2.13**	2.23	2.21	0.90	0.03	**1.28**	0.0033	0.00	0.00	0.00	**0.00**
26.1					2.19					0.0033				
19.6	19.50	0.51	0.14	**0.73**	1.48	1.48	0.00	0.00	**0.00**	0.0033	0.00	0.00	0.00	**0.00**
19.4					1.48					0.0033				
13.7	13.85	-1.08	0.21	**1.53**	1.74	1.77	-1.69	0.04	**2.40**	0.0033	0.00	0.00	0.00	**0.00**
14					1.8					0.0033				
12.9	12.90	0.00	0.00	**0.00**	2.16	2.19	-1.14	0.04	**1.62**	0.0033	0.00	0.00	0.00	**0.00**
12.9					2.21					0.0033				
8.09	8.10	-0.12	0.01	**0.17**	1.89	1.90	-0.26	0.01	**0.37**	0.0033	0.00	0.00	0.00	**0.00**
8.11					1.9					0.0033				
1.62	1.68	-3.28	0.08	**4.64**	0.877	0.95	-7.54	0.10	**10.66**	0.0042	0.00	12.00	0.00	**16.97**
1.73					1.02					0.0033				
0.076	0.08	-3.80	0.00	**5.37**	0.145	0.16	-10.77	0.02	**15.23**	0.0033	0.00	-7.04	0.00	**9.96**
0.082					0.18					0.0038				
0.33	0.32	1.85	0.01	**2.62**	0.316	0.29	10.88	0.04	**15.38**	0.0048	0.00	18.52	0.00	**26.19**
0.318					0.254					0.0033				
2.23	2.24	-0.45	0.01	**0.63**	1.61	1.59	1.26	0.03	**1.78**	0.0033	0.00	0.00	0.00	**0.00**
2.25					1.57					0.0033				
5.93	5.88	0.85	0.07	**1.20**	3.58	3.55	0.85	0.04	**1.20**	0.0033	0.00	0.00	0.00	**0.00**
5.83					3.52					0.0033				

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML15-0DUP		35.9	36.35	-1.24	0.64	**1.75**	2.11	1.96	7.65	0.21	**10.82**
ML15-0		36.8					1.81				
ML31-10		20.1	20.00	0.50	0.14	**0.71**	5.28	5.28	0.09	0.01	**0.13**
ML31-10DUP		19.9					5.27				
ML31-9DUP	Sep-97	26	25.85	0.58	0.21	**0.82**	5.59	5.65	-1.06	0.08	**1.50**
ML31-9		25.7					5.71				
ML31-8DUP		15.3	15.25	0.33	0.07	**0.46**	6	5.69	5.54	0.45	**7.84**
ML31-8		15.2					5.37				
ML31-7DUP		25.2	25.25	-0.20	0.07	**0.28**	7.37	7.45	-1.07	0.11	**1.52**
ML31-7		25.3					7.53				
ML31-5BDUP		84.1	83.35	0.90	1.06	**1.27**	3.81	3.94	-3.30	0.18	**4.67**
ML31-5B		82.6					4.07				
ML31-5DUP		85.1	84.75	0.41	0.49	**0.58**	3.87	3.98	-2.64	0.15	**3.74**
ML31-5		84.4					4.08				
ML31-4DUP		90.7	91.25	-0.60	0.78	**0.85**	2.84	2.81	1.07	0.04	**1.51**
ML31-4		91.8					2.78				
ML31-3DUP		46.7	46.55	0.32	0.21	**0.46**	1.91	2.05	-6.83	0.20	**9.66**
ML31-3		46.4					2.19				
ML31-2DUP		27.6	27.55	0.18	0.07	**0.26**	1.52	1.64	-7.03	0.16	**9.95**
ML31-2		27.5					1.75				
ML31-1DUP		27.1	27.10	0.00	0.00	**0.00**	1.57	1.46	7.53	0.16	**10.66**
ML31-1		27.1					1.35				
ML31-0DUP		21.8	21.65	0.69	0.21	**0.98**	1.29	1.41	-8.51	0.17	**12.04**
ML31-0		21.5					1.53				
ML32-9DUP		8.86	8.87	-0.06	0.01	**0.08**	15.4	15.30	0.65	0.14	**0.92**
ML32-9		8.87					15.2				
ML32-8DUP		13.1	13.10	0.00	0.00	**0.00**	5.4	5.05	6.93	0.49	**9.80**
ML32-8		13.1					4.7				
ML32-7DUP		12.8	12.80	0.00	0.00	**0.00**	5.19	5.07	2.47	0.18	**3.49**
ML32-7		12.8					4.94				
ML32-6DUP		11.5	11.55	-0.43	0.07	**0.61**	4.75	4.65	2.15	0.14	**3.04**
ML32-6		11.6					4.55				
ML32-5DUP		31.8	31.65	0.47	0.21	**0.67**	5.18	5.25	-1.33	0.10	**1.89**
ML32-5		31.5					5.32				
ML32-4DUP		45.7	45.40	0.66	0.42	**0.93**	4.89	4.79	2.19	0.15	**3.10**
ML32-4		45.1					4.68				
ML32-3DUP		39.8	40.15	-0.87	0.49	**1.23**	1.47	1.45	1.38	0.03	**1.95**
ML32-3		40.5					1.43				
ML32-2DUP		27.2	26.95	0.93	0.35	**1.31**	0.9	0.90	0.00	0.00	**0.00**
ML32-2		26.7					0.9				
ML32-1DUP		26.5	26.40	0.38	0.14	**0.54**	1.1	1.40	-21.15	0.42	**29.91**
ML32-1		26.3					1.69				
ML32-0DUP		17.8	17.70	0.56	0.14	**0.80**	0.68	0.76	-10.53	0.11	**14.89**
ML32-0		17.6					0.84				
ML33-10	Sep-97	24.7	24.20	2.07	0.71	**2.92**	12.8	12.90	-0.78	0.14	**1.10**
ML33-10DUP		23.7					13				
ML33-9DUP		15.9	15.60	1.92	0.42	**2.72**	3.4	3.64	-6.59	0.34	**9.32**
ML33-9		15.3					3.88				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
5.22 5.44	5.33	-2.06	0.16	**2.92**	3.12 3.25	3.19	-2.04	0.09	**2.89**	0.0033 0.0033	0.00	0.00	0.00	**0.00**
35.2 34.9	35.05	0.43	0.21	**0.61**	7.09 7.15	7.12	-0.42	0.04	**0.60**	0.0033 0.0033	0.00	0.00	0.00	**0.00**
48.3 47.8	48.05	0.52	0.35	**0.74**	5.17 5.16	5.17	0.10	0.01	**0.14**	0.0033 0.0033	0.00	0.00	0.00	**0.00**
21.6 21.4	21.50	0.47	0.14	**0.66**	9.05 8.94	9.00	0.61	0.08	**0.86**	0.0033 0.0033	0.00	0.00	0.00	**0.00**
28.8 29.3	29.05	-0.86	0.35	**1.22**	10.8 10.9	10.85	-0.46	0.07	**0.65**	0.0033 0.0033	0.00	0.00	0.00	**0.00**
26.8 26.4	26.60	0.75	0.28	**1.06**	16.5 16.1	16.30	1.23	0.28	**1.74**	0.0642 0.0608	0.06	2.72	0.00	**3.85**
27.2 27.1	27.15	0.18	0.07	**0.26**	16.6 16.6	16.60	0.00	0.00	**0.00**	0.0621 0.0615	0.06	0.49	0.00	**0.69**
27 27.4	27.20	-0.74	0.28	**1.04**	18.2 18.5	18.35	-0.82	0.21	**1.16**	0.0793 0.0784	0.08	0.57	0.00	**0.81**
16.4 16.3	16.35	0.31	0.07	**0.43**	10 9.94	9.97	0.30	0.04	**0.43**	0.0452 0.0408	0.04	5.12	0.00	**7.24**
10.2 10	10.10	0.99	0.14	**1.40**	6.07 5.99	6.03	0.66	0.06	**0.94**	0.0472 0.0467	0.05	0.53	0.00	**0.75**
9.82 9.97	9.90	-0.76	0.11	**1.07**	5.82 5.89	5.86	-0.60	0.05	**0.85**	0.0451 0.0407	0.04	5.13	0.00	**7.25**
10.2 10.1	10.15	0.49	0.07	**0.70**	6.15 6.1	6.13	0.41	0.04	**0.58**	0.0033 0.0033	0.00	0.00	0.00	**0.00**
21.6 21.5	21.55	0.23	0.07	**0.33**	1.77 1.76	1.77	0.28	0.01	**0.40**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
34.6 35.1	34.85	-0.72	0.35	**1.01**	2.47 2.44	2.46	0.61	0.02	**0.86**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
28.8 29.1	28.95	-0.52	0.21	**0.73**	2.03 2.03	2.03	0.00	0.00	**0.00**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
26 26.3	26.15	-0.57	0.21	**0.81**	1.67 1.67	1.67	0.00	0.00	**0.00**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
27.6 27.2	27.40	0.73	0.28	**1.03**	5.69 5.68	5.69	0.09	0.01	**0.12**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
23.2 22.4	22.80	1.75	0.57	**2.48**	9.12 8.76	8.94	2.01	0.25	**2.85**	0.0569 0.0554	0.06	1.34	0.00	**1.89**
9.19 9.3	9.25	-0.59	0.08	**0.84**	6.48 6.6	6.54	-0.92	0.08	**1.30**	0.109 0.109	0.11	0.00	0.00	**0.00**
9.25 9.06	9.16	1.04	0.13	**1.47**	5.66 5.55	5.61	0.98	0.08	**1.39**	0.102 0.1	0.10	0.99	0.00	**1.40**
9.59 9.48	9.54	0.58	0.08	**0.82**	5.5 5.46	5.48	0.36	0.03	**0.52**	0.0385 0.0402	0.04	-2.16	0.00	**3.05**
8.46 8.43	8.45	0.18	0.02	**0.25**	5.18 5.19	5.19	-0.10	0.01	**0.14**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
103 98.6	100.80	2.18	3.11	**3.09**	0.014 0.072	0.04	-67.44	0.04	**95.38**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
14.3 13.9	14.10	1.42	0.28	**2.01**	1.31 1.29	1.30	0.77	0.01	**1.09**	0.0042 0.0042	0.00	0.00	0.00	**0.00**

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML33-8DUP		10.9	10.90	0.00	0.00	**0.00**	5.34	5.41	-1.29	0.10	**1.83**
ML33-8		10.9					5.48				
ML33-7DUP		12.8	12.85	-0.39	0.07	**0.55**	6.57	6.52	0.77	0.07	**1.08**
ML33-7		12.9					6.47				
ML33-6DUP		13.4	13.45	-0.37	0.07	**0.53**	4.78	4.82	-0.73	0.05	**1.03**
ML33-6		13.5					4.85				
ML33-5DUP		17.3	17.45	-0.86	0.21	**1.22**	4.28	4.15	3.13	0.18	**4.43**
ML33-5		17.6					4.02				
ML33-4DUP		16.7	16.55	0.91	0.21	**1.28**	3.6	3.67	-1.77	0.09	**2.51**
ML33-4		16.4					3.73				
ML33-3DUP		30.4	30.50	-0.33	0.14	**0.46**	2.48	2.31	7.36	0.24	**10.41**
ML33-3		30.6					2.14				
ML33-2ADUP		33.9	34.25	-1.02	0.49	**1.45**	1.93	1.99	-2.77	0.08	**3.92**
ML33-2A		34.6					2.04				
ML33-2DUP		33.8	33.90	-0.29	0.14	**0.42**	2.26	2.38	-5.04	0.17	**7.13**
ML33-2		34					2.5				
ML33-1DUP		29.2	28.90	1.04	0.42	**1.47**	1.72	1.98	-12.91	0.36	**18.26**
ML33-1		28.6					2.23				
ML33-0DUP		18.2	18.10	0.55	0.14	**0.78**	1.67	1.87	-10.46	0.28	**14.79**
ML33-0		18					2.06				
ML34-6DUP		14.2	14.20	0.00	0.00	**0.00**	1.71	1.57	8.92	0.20	**12.61**
ML34-6		14.2					1.43				
ML34-5DUP		19	18.90	0.53	0.14	**0.75**	1.46	1.47	-0.68	0.01	**0.96**
ML34-5		18.8					1.48				
ML34-4DDUP		22.7	22.70	0.00	0.00	**0.00**	2.09	2.09	0.00	0.00	**0.00**
ML34-4D		22.7					2.09				
ML34-4DUP		24.1	24.55	-1.83	0.64	**2.59**	1.98	2.03	-2.22	0.06	**3.14**
ML34-4		25					2.07				
ML34-3DUP		28.6	28.80	-0.69	0.28	**0.98**	3.35	3.50	-4.29	0.21	**6.06**
ML34-3		29					3.65				
ML34-2DUP		31.7	31.60	0.32	0.14	**0.45**	2.67	2.62	1.91	0.07	**2.70**
ML34-2		31.5					2.57				
ML34-1DUP		26.2	26.15	0.19	0.07	**0.27**	2.54	2.62	-3.05	0.11	**4.32**
ML34-1		26.1					2.7				
ML34-0DUP		22.3	22.05	1.13	0.35	**1.60**	2.28	2.49	-8.25	0.29	**11.67**
ML34-0		21.8					2.69				
ML35-10	Sep-97	32.8	32.80	0.00	0.00	**0.00**	6.24	6.15	1.46	0.13	**2.07**
ML35-10DUP		32.8					6.06				
ML35-9DUP		22.7	22.75	-0.22	0.07	**0.31**	5.2	5.30	-1.79	0.13	**2.54**
ML35-9		22.8					5.39				
ML35-8DUP		17.4	17.35	0.29	0.07	**0.41**	4.94	4.94	0.00	0.00	**0.00**
ML35-8		17.3					4.94				
ML35-7DUP		14.4	14.50	-0.69	0.14	**0.98**	4.88	4.95	-1.31	0.09	**1.86**
ML35-7		14.6					5.01				
ML35-6DUP		14.5	14.35	1.05	0.21	**1.48**	4.11	4.31	-4.64	0.28	**6.56**
ML35-6		14.2					4.51				
ML35-5DUP		30.2	30.10	0.33	0.14	**0.47**	2.93	3.10	-5.33	0.23	**7.54**
ML35-5		30					3.26				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
32.4	32.25	0.47	0.21	**0.66**	0.235	0.27	-14.08	0.05	**19.91**	0.0042	0.00	0.00	0.00	**0.00**
32.1					0.312					0.0042				
27.7	27.95	-0.89	0.35	**1.26**	2.52	2.53	-0.20	0.01	**0.28**	0.0042	0.00	0.00	0.00	**0.00**
28.2					2.53					0.0042				
25.3	25.20	0.40	0.14	**0.56**	2.95	2.94	0.34	0.01	**0.48**	0.0042	0.00	0.00	0.00	**0.00**
25.1					2.93					0.0042				
17.8	18.00	-1.11	0.28	**1.57**	2.71	2.74	-0.91	0.04	**1.29**	0.0042	0.00	0.00	0.00	**0.00**
18.2					2.76					0.0042				
21.8	21.50	1.40	0.42	**1.97**	4.19	4.12	1.70	0.10	**2.40**	0.0042	0.00	0.00	0.00	**0.00**
21.2					4.05					0.0042				
8.44	8.54	-1.11	0.13	**1.57**	2.88	2.90	-0.52	0.02	**0.73**	0.0042	0.00	0.00	0.00	**0.00**
8.63					2.91					0.0042				
6.93	7.01	-1.07	0.11	**1.51**	2.41	2.44	-1.03	0.04	**1.45**	0.0042	0.00	0.00	0.00	**0.00**
7.08					2.46					0.0042				
12.8	12.95	-1.16	0.21	**1.64**	4.6	4.68	-1.71	0.11	**2.42**	0.0042	0.00	0.00	0.00	**0.00**
13.1					4.76					0.0042				
2.22	2.24	-0.67	0.02	**0.95**	0.342	0.35	-1.01	0.00	**1.43**	0.0042	0.00	0.00	0.00	**0.00**
2.25					0.349					0.0042				
4.1	4.07	0.74	0.04	**1.04**	0.158	0.17	-4.82	0.01	**6.82**	0.0042	0.00	0.00	0.00	**0.00**
4.04					0.174					0.0042				
3.02	2.99	1.00	0.04	**1.42**	0.578	0.53	8.65	0.07	**12.23**	0.0042	0.00	0.00	0.00	**0.00**
2.96					0.486					0.0042				
3.22	3.20	0.63	0.03	**0.88**	0.288	0.29	0.00	0.00	**0.00**	0.0042	0.00	0.00	0.00	**0.00**
3.18					0.288					0.0042				
1.99	1.99	0.25	0.01	**0.36**	0.748	0.75	0.00	0.00	**0.00**	0.0042	0.00	0.00	0.00	**0.00**
1.98					0.748					0.0042				
1.63	1.64	-0.31	0.01	**0.43**	0.602	0.63	-4.52	0.04	**6.39**	0.0042	0.00	0.00	0.00	**0.00**
1.64					0.659					0.0042				
8.24	8.29	-0.54	0.06	**0.77**	1.17	1.19	-1.68	0.03	**2.38**	0.0042	0.00	0.00	0.00	**0.00**
8.33					1.21					0.0042				
3.9	3.83	1.83	0.10	**2.58**	0.642	0.60	7.00	0.06	**9.90**	0.0042	0.00	0.00	0.00	**0.00**
3.76					0.558					0.0042				
1.25	1.24	0.81	0.01	**1.14**	0.187	0.20	-5.79	0.02	**8.19**	0.0042	0.00	0.00	0.00	**0.00**
1.23					0.21					0.0042				
2.8	2.79	0.54	0.02	**0.76**	0.111	0.10	7.25	0.01	**10.25**	0.0042	0.00	0.00	0.00	**0.00**
2.77					0.096					0.0042				
18.8	18.75	0.27	0.07	**0.38**	3.27	3.28	-0.15	0.01	**0.22**	0.0042	0.00	0.00	0.00	**0.00**
18.7					3.28					0.0042				
14.4	13.85	3.97	0.78	**5.62**	2.28	2.26	1.11	0.04	**1.57**	0.0042	0.00	0.00	0.00	**0.00**
13.3					2.23					0.0042				
11.4	11.40	0.00	0.00	**0.00**	2.56	2.55	0.39	0.01	**0.55**	0.0042	0.00	0.00	0.00	**0.00**
11.4					2.54					0.0042				
12.9	12.95	-0.39	0.07	**0.55**	3.47	3.49	-0.57	0.03	**0.81**	0.0042	0.00	0.00	0.00	**0.00**
13					3.51					0.0042				
14.4	14.25	1.05	0.21	**1.49**	3.62	3.61	0.42	0.02	**0.59**	0.0042	0.00	0.00	0.00	**0.00**
14.1					3.59					0.0042				
4.81	4.79	0.42	0.03	**0.59**	1.94	1.95	-0.51	0.01	**0.73**	0.0042	0.00	0.00	0.00	**0.00**
4.77					1.96					0.0042				

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML35-4DUP		25.8	25.55	0.98	0.35	**1.38**	1.95	1.94	0.78	0.02	**1.10**
ML35-4		25.3					1.92				
ML35-3DUP		42.4	42.20	0.47	0.28	**0.67**	2.28	2.28	0.22	0.01	**0.31**
ML35-3		42					2.27				
ML35-2DUP		39.4	39.10	0.77	0.42	**1.09**	1.13	1.21	-6.22	0.11	**8.80**
ML35-2		38.8					1.28				
ML35-1DUP		26.6	26.55	0.19	0.07	**0.27**	1.23	1.26	-1.99	0.04	**2.82**
ML35-1		26.5					1.28				
ML35-0DUP		19	18.70	1.60	0.42	**2.27**	0.81	1.19	-31.65	0.53	**44.75**
ML35-0		18.4					1.56				
ML11-10B	Mar-98	14.1	13.75	2.55	0.49	**3.60**	7.37	7.10	3.88	0.39	**5.48**
ML11-10A		13.4					6.82				
ML11-9B		12.1	12.05	0.41	0.07	**0.59**	4.72	4.90	-3.67	0.25	**5.20**
ML11-9A		12					5.08				
ML11-8B		11.4	11.50	-0.87	0.14	**1.23**	4.2	4.04	4.09	0.23	**5.78**
ML11-8A		11.6					3.87				
ML11-7B		12.6	12.60	0.00	0.00	**0.00**	3.9	4.00	-2.50	0.14	**3.54**
ML11-7A		12.6					4.1				
ML11-6B		49.5	49.60	-0.20	0.14	**0.29**	6.07	6.22	-2.33	0.21	**3.30**
ML11-6A		49.7					6.36				
ML11-5B		52.3	52.25	0.10	0.07	**0.14**	5.77	6.04	-4.39	0.37	**6.21**
ML11-5A		52.2					6.3				
ML11-4C		72	72.83	-1.14	0.76	**1.05**	1.22	1.08	12.62	0.20	**18.00**
ML11-4B		73		0.23			1.17		8.00		
ML11-4A		73.5		0.92			0.86		-20.62		
ML12-4B		69	68.60	0.58	0.57	**0.82**	2.67	2.52	6.16	0.22	**8.72**
ML12-4A		68.2					2.36				
ML13-4B		4.74	4.69	1.07	0.07	**1.51**	1.54	1.49	3.70	0.08	**5.24**
ML13-4A		4.64					1.43				
ML14-4B	Mar-98	3.86	3.84	0.65	0.04	**0.92**	1.9	1.70	11.76	0.28	**16.64**
ML14-4A		3.81					1.5				
ML15-4B		10.2	10.05	1.49	0.21	**2.11**	1.17	1.26	-7.14	0.13	**10.10**
ML15-4A		9.9					1.35				
ML15-3B		12.7	12.65	0.40	0.07	**0.56**	1.3	1.42	-8.13	0.16	**11.49**
ML15-3A		12.6					1.53				
ML15-2DUP		44.3	43.57	1.68	0.64	**1.48**	3.38	3.29	2.63	0.30	**9.10**
ML15-2B		43.1		-1.07			2.96		-10.12		
ML15-2A		43.3		-0.61			3.54		7.49		
ML15-1B		56.7	55.95	1.34	1.06	**1.90**	0.88	0.69	27.54	0.27	**38.94**
ML15-1A		55.2					0.5				
ML15-0B		33.5	33.65	-0.45	0.21	**0.63**	0.88	0.88	0.00	0.00	**0.00**
ML15-0A		33.8					0.88				
ML31-10B		22.1	21.80	1.38	0.42	**1.95**	2.9	3.10	-6.45	0.28	**9.12**
ML31-10A		21.5					3.3				
ML31-9B		22.8	22.80	0.00	0.00	**0.00**	4.3	4.20	2.38	0.14	**3.37**
ML31-9A		22.8					4.1				
ML31-8B		31.8	32.35	-1.70	0.78	**2.40**	5.8	5.65	2.65	0.21	**3.75**
ML31-8A		32.9					5.5				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
2.9 2.82	2.86	1.40	0.06	**1.98**	1.32 1.29	1.31	1.15	0.02	**1.63**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
5 5.05	5.03	-0.50	0.04	**0.70**	3.26 3.24	3.25	0.31	0.01	**0.44**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
6.09 6.02	6.06	0.58	0.05	**0.82**	2.75 2.7	2.73	0.92	0.04	**1.30**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
2.41 2.41	2.41	0.00	0.00	**0.00**	0.94 0.925	0.93	0.80	0.01	**1.14**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
2.52 2.5	2.51	0.40	0.01	**0.56**	1.23 1.22	1.23	0.41	0.01	**0.58**	0.0042 0.0042	0.00	0.00	0.00	**0.00**
22.1 21.3	21.70	1.84	0.57	**2.61**	10.7 10.3	10.50	1.90	0.28	**2.69**	0.0025 0.0025	0.00	0.00	0.00	**0.00**
25.5 25.2	25.35	0.59	0.21	**0.84**	6.92 6.86	6.89	0.44	0.04	**0.62**	0.0025 0.0025	0.00	0.00	0.00	**0.00**
24.6 24.7	24.65	-0.20	0.07	**0.29**	7.07 7.12	7.10	-0.35	0.04	**0.50**	0.0025 0.0025	0.00	0.00	0.00	**0.00**
25.9 25.7	25.80	0.39	0.14	**0.55**	7.47 7.45	7.46	0.13	0.01	**0.19**	0.0025 0.0025	0.00	0.00	0.00	**0.00**
34 34.3	34.15	-0.44	0.21	**0.62**	13.2 13.3	13.25	-0.38	0.07	**0.53**	0.149 0.146	0.15	1.02	0.00	**1.44**
34.1 33.5	33.80	0.89	0.42	**1.26**	15.2 15	15.10	0.66	0.14	**0.94**	0.121 0.122	0.12	-0.41	0.00	**0.58**
8.17 8.19 8.29	8.22	-0.57 -0.32 0.89	0.06	**0.78**	5.76 5.82 5.82	5.80	-0.69 0.34 0.34	0.03	**0.60**	1.2 1.21 1.21	1.21	-0.55 0.28 0.28	0.01	**0.48**
15.4 15.5	15.45	-0.32	0.07	**0.46**	9.15 9.24	9.20	-0.49	0.06	**0.69**	0.7 0.691	0.70	0.65	0.01	**0.92**
4.92 4.89	4.91	0.31	0.02	**0.43**	0.16 0.152	0.16	2.56	0.01	**3.63**	0.0026 0.0025	0.00	1.96	0.00	**2.77**
3.06 3.02	3.04	0.66	0.03	**0.93**	0.05 0.05	0.05	0.00	0.00	**0.00**	0.0024 0.0024	0.00	0.00	0.00	**0.00**
0.3 0.3	0.30	0.00	0.00	**0.00**	0.117 0.157	0.14	-14.60	0.03	**20.65**	0.0024 0.0024	0.00	0.00	0.00	**0.00**
0.93 0.923	0.93	0.38	0.00	**0.53**	0.05 0.05	0.05	0.00	0.00	**0.00**	0.0024 0.0024	0.00	0.00	0.00	**0.00**
4.74 4.81 4.66	4.74	0.07 1.55 -1.62	0.08	**1.58**	3.36 3.42 3.33	3.37	-0.30 1.48 -1.19	0.05	**1.36**	0.0024 0.0027 0.0024	0.00	-4.00 8.00 -4.00	0.00	**6.93**
1.46 1.39	1.43	2.46	0.05	**3.47**	0.818 0.791	0.80	1.68	0.02	**2.37**	0.0024 0.0053	0.00	-37.66	0.00	**53.26**
6.68 6.67	6.68	0.07	0.01	**0.11**	4.03 4.06	4.05	-0.37	0.02	**0.52**	0.0024 0.0024	0.00	0.00	0.00	**0.00**
39 38.4	38.70	0.78	0.42	**1.10**	7.11 7.1	7.11	0.07	0.01	**0.10**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
30.4 30	30.20	0.66	0.28	**0.94**	10.01 9.96	9.99	0.25	0.04	**0.35**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
32.6 33.5	33.05	-1.36	0.64	**1.93**	11.8 12.1	11.95	-1.26	0.21	**1.78**	0.0041 0.0041	0.00	0.00	0.00	**0.00**

Table J2 Statistical Results for Selected Cation Duplicates

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML31-7B		47.8	46.90	1.92	1.27	**2.71**	6.3	6.60	-4.55	0.42	**6.43**
ML31-7A		46					6.9				
ML31-6D-A		55.4	55.05	0.64	1.01	**1.84**	7.14	7.15	-0.10	0.27	**3.74**
ML31-6C		54		-1.91			7.52		5.21		
ML31-6B		56.3		2.27			6.9		-3.46		
ML31-6A		54.5		-1.00			7.03		-1.64		
ML31-5B		66.7	67.70	-1.48	1.41	**2.09**	1.92	1.74	10.34	0.25	**14.63**
ML31-5A		68.7					1.56				
ML31-4B-B		0.24	0.27	-9.43	0.04	**13.34**	0.88	0.88	0.00	0.00	**0.00**
ML31-4B-A		0.29					0.88				
ML31-4B		38.9	39.55	-1.64	0.92	**2.32**	1.12	1.00	12.00	0.17	**16.97**
ML31-4A		40.2					0.88				
ML31-3B		25.9	25.80	0.39	0.14	**0.55**	1.1	1.06	4.27	0.06	**6.03**
ML31-3A		25.7					1.01				
ML31-2B		22.4	22.85	-1.97	0.64	**2.79**	1.03	0.96	7.85	0.11	**11.11**
ML31-2A		23.3					0.88				
ML31-1B(3/12/98)		22.3	22.40	-0.45	0.14	**0.63**	1.14	1.01	12.87	0.18	**18.20**
ML31-1A(3/12/98)		22.5					0.88				
ML31-0B		18.7	18.50	1.08	0.28	**1.53**	0.88	0.88	0.00	0.00	**0.00**
ML31-0A		18.3					0.88				
ML32-10B		13.6	13.70	-0.73	0.14	**1.03**	6.9	6.75	2.22	0.21	**3.14**
ML32-10A		13.8					6.6				
ML32-9B	Mar-98	8.13	8.07	0.74	0.08	**1.05**	10.1	10.00	1.00	0.14	**1.41**
ML32-9A		8.01					9.9				
ML32-8B		23.2	22.90	1.31	0.42	**1.85**	2.7	2.75	-1.82	0.07	**2.57**
ML32-8A		22.6					2.8				
ML32-7B		15.8	15.90	-0.63	0.14	**0.89**	3.7	3.30	12.12	0.57	**17.14**
ML32-7A		16					2.9				
ML32-6B-B		0.122	0.14	-10.29	0.02	**14.56**	1.6	1.60	0.00	0.00	**0.00**
ML32-6B-A		0.15					1.6				
ML32-6B		17.7	17.65	0.28	0.07	**0.40**	3.8	3.45	10.14	0.49	**14.35**
ML32-6A		17.6					3.1				
ML32-5B		43.8	44.15	-0.79	0.49	**1.12**	4.3	4.15	3.61	0.21	**5.11**
ML32-5A		44.5					4				
ML32-4B		70.8	70.85	-0.07	0.07	**0.10**	2.5	2.55	-1.96	0.07	**2.77**
ML32-4A		70.9					2.6				
ML32-3D-B		55.3	54.95	0.64	0.49	**0.90**	1.6	1.60	0.00	0.00	**0.00**
ML32-3D-A		54.6					1.6				
ML32-3B		54	54.75	-1.37	1.06	**1.94**	1.6	1.60	0.00	0.00	**0.00**
ML32-3A		55.5					1.6				
ML32-2B		22.6	22.45	0.67	0.21	**0.94**	1.6	1.60	0.00	0.00	**0.00**
ML32-2A		22.3					1.6				
ML32-1B		23.7	24.05	-1.46	0.49	**2.06**	1.6	1.60	0.00	0.00	**0.00**
ML32-1A		24.4					1.6				
ML33-10B		26.7	26.80	-0.37	0.14	**0.53**	7.5	8.90	-15.73	1.98	**22.25**
ML33-10A		26.9					10.3				
ML33-9B		15.3	15.45	-0.97	0.21	**1.37**	2.8	2.70	3.70	0.14	**5.24**
ML33-9A		15.6					2.6				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
36.1 35	35.55	1.55	0.78	**2.19**	17.5 17	17.25	1.45	0.35	**2.05**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
34.5 33.9 34.8 34.3	34.38	0.36 -1.38 1.24 -0.22	0.38	**1.10**	20.1 19.8 20.2 20	20.03	0.37 -1.12 0.87 -0.12	0.17	**0.85**	0.0024 0.0036 0.0028 0.0044	0.00	-27.27 9.09 -15.15 33.33	0.00	**26.88**
20.3 20.7	20.50	-0.98	0.28	**1.38**	12.6 12.8	12.70	-0.79	0.14	**1.11**	0.0707 0.0738	0.07	-2.15	0.00	**3.03**
0.042 0.042	0.04	0.00	0.00	**0.00**	0.05 0.05	0.05	0.00	0.00	**0.00**	0.0024 0.0024	0.00	0.00	0.00	**0.00**
14.5 14.9	14.70	-1.36	0.28	**1.92**	9.9 10.2	10.05	-1.49	0.21	**2.11**	0.0391 0.0382	0.04	1.16	0.00	**1.65**
12.5 12.8	12.65	-1.19	0.21	**1.68**	7.63 7.83	7.73	-1.29	0.14	**1.83**	0.0196 0.0181	0.02	3.98	0.00	**5.63**
10.8 11.2	11.00	-1.82	0.28	**2.57**	6.55 6.75	6.65	-1.50	0.14	**2.13**	0.077 0.0791	0.08	-1.35	0.00	**1.90**
10.8 10.9	10.85	-0.46	0.07	**0.65**	6.55 6.63	6.59	-0.61	0.06	**0.86**	0.0786 0.08	0.08	-0.88	0.00	**1.25**
9.12 8.98	9.05	0.77	0.10	**1.09**	5.46 5.43	5.45	0.28	0.02	**0.39**	0.0024 0.0024	0.00	0.00	0.00	**0.00**
35.2 36	35.60	-1.12	0.57	**1.59**	2.2 2.21	2.21	-0.23	0.01	**0.32**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
29.7 29.4	29.55	0.51	0.21	**0.72**	2.14 2.11	2.13	0.71	0.02	**1.00**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
44.3 42.9	43.60	1.61	0.99	**2.27**	5.4 5.26	5.33	1.31	0.10	**1.86**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
35.8 36.4	36.10	-0.83	0.42	**1.18**	2.6 2.63	2.62	-0.57	0.02	**0.81**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
0.035 0.035	0.04	0.00	0.00	**0.00**	0.1 0.1	0.10	0.00	0.00	**0.00**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
32.7 32.7	32.70	0.00	0.00	**0.00**	3.56 3.59	3.58	-0.42	0.02	**0.59**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
35.1 35.2	35.15	-0.14	0.07	**0.20**	8.93 8.98	8.96	-0.28	0.04	**0.39**	0.0182 0.0246	0.02	-14.95	0.00	**21.15**
24.4 24.5	24.45	-0.20	0.07	**0.29**	12.2 12.3	12.25	-0.41	0.07	**0.58**	0.0826 0.0829	0.08	-0.18	0.00	**0.26**
18.1 18.1	18.10	0.00	0.00	**0.00**	12.6 12.7	12.65	-0.40	0.07	**0.56**	0.0993 0.102	0.10	-1.34	0.00	**1.90**
17.7 18.2	17.95	-1.39	0.35	**1.97**	12.5 12.8	12.65	-1.19	0.21	**1.68**	0.0992 0.103	0.10	-1.88	0.00	**2.66**
11.3 11.1	11.20	0.89	0.14	**1.26**	6.96 6.89	6.93	0.51	0.05	**0.71**	0.0696 0.0641	0.07	4.11	0.00	**5.82**
10.1 10.3	10.20	-0.98	0.14	**1.39**	5.8 5.85	5.83	-0.43	0.04	**0.61**	0.0531 0.0579	0.06	-4.32	0.00	**6.12**
74.5 81.4	77.95	-4.43	4.88	**6.26**	0.1 0.1	0.10	0.00	0.00	**0.00**	0.0041 0.0041	0.00	0.00	0.00	**0.00**
32.6 32.9	32.75	-0.46	0.21	**0.65**	2.86 2.9	2.88	-0.69	0.03	**0.98**	0.0041 0.0041	0.00	0.00	0.00	**0.00**

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML33-8B		17.8	16.00	11.25	2.55	**15.91**	4.3	4.90	-12.24	0.85	**17.32**
ML33-8A		14.2					5.5				
ML33-7D-B		14.1	15.95	-11.60	2.62	**16.40**	5.3	4.85	9.28	0.64	**13.12**
ML33-7D-A		17.8					4.4				
ML33-7B		18.2	18.30	-0.55	0.14	**0.77**	4.4	4.30	2.33	0.14	**3.29**
ML33-7A		18.4					4.2				
ML33-6B		15.5	15.65	-0.96	0.21	**1.36**	3.8	3.85	-1.30	0.07	**1.84**
ML33-6A		15.8					3.9				
ML33-5B		16.6	16.35	1.53	0.35	**2.16**	2.4	2.70	-11.11	0.42	**15.71**
ML33-5A		16.1					3				
ML33-4B		29.1	29.60	-1.69	0.71	**2.39**	2.6	2.35	10.64	0.35	**15.04**
ML33-4A		30.1					2.1				
ML33-3B-B		1.12	1.14	-1.32	0.02	**1.87**	1.6	1.60	0.00	0.00	**0.00**
ML33-3B-A		1.15					1.6				
ML33-3B	Mar-98	44.8	44.25	1.24	0.78	**1.76**	2	2.35	-14.89	0.49	**21.06**
ML33-3A		43.7					2.7				
ML34-10B		14.2	14.05	1.07	0.21	**1.51**	1.6	1.60	0.00	0.00	**0.00**
ML34-10A		13.9					1.6				
ML34-8B		17.8	17.55	1.42	0.35	**2.01**	1.6	1.60	0.00	0.00	**0.00**
ML34-8A		17.3					1.6				
ML34-7B		16.2	16.15	0.31	0.07	**0.44**	1.6	1.60	0.00	0.00	**0.00**
ML34-7A		16.1					1.6				
ML34-6B		24.2	24.40	-0.82	0.28	**1.16**	1.6	1.60	0.00	0.00	**0.00**
ML34-6A		24.6					1.6				
ML34-5B		32.7	32.30	1.24	0.57	**1.75**	1.6	1.60	0.00	0.00	**0.00**
ML34-5A		31.9					1.6				
ML34-4B		44.1	44.60	-1.12	0.71	**1.59**	3.3	2.90	13.79	0.57	**19.51**
ML34-4A		45.1					2.5				
ML34-3B-B		1.1	1.10	0.46	0.01	**0.65**	1.6	1.60	0.00	0.00	**0.00**
ML34-3B-A		1.09					1.6				
ML34-3B		38.8	38.65	0.39	0.21	**0.55**	1.9	1.75	8.57	0.21	**12.12**
ML34-3A		38.5					1.6				
ML34-2B		44.5	44.75	-0.56	0.35	**0.79**	1.6	1.60	0.00	0.00	**0.00**
ML34-2A		45					1.6				
ML34-1D-B		29.9	29.30	2.05	0.85	**2.90**	1.6	1.60	0.00	0.00	**0.00**
ML34-1D-A		28.7					1.6				
ML34-1B		29.9	29.70	0.67	0.28	**0.95**	1.6	1.60	0.00	0.00	**0.00**
ML34-1A		29.5					1.6				
ML34-0B		23.4	23.65	-1.06	0.35	**1.49**	1.6	1.60	0.00	0.00	**0.00**
ML34-0A		23.9					1.6				
ML35-10B		10.1	9.99	1.10	0.16	**1.56**	2.06	2.13	-3.29	0.10	**4.65**
ML35-10A		9.88					2.2				
ML35-9B		12.2	12.15	0.41	0.07	**0.58**	2.83	2.64	7.40	0.28	**10.47**
ML35-9A		12.1					2.44				
ML35-8B		14.4	14.50	-0.69	0.14	**0.98**	3.67	3.74	-1.87	0.10	**2.65**
ML35-8A		14.6					3.81				
ML35-7B		15.9	15.70	1.27	0.28	**1.80**	2.77	3.02	-8.28	0.35	**11.71**
ML35-7A		15.5					3.27				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
39.7	38.55	2.98	1.63	**4.22**	3.26	3.07	6.36	0.28	**9.00**	0.0041	0.00	0.00	0.00	**0.00**
37.4					2.87					0.0041				
37.3	38.45	-2.99	1.63	**4.23**	2.84	3.05	-6.73	0.29	**9.52**	0.0041	0.00	0.00	0.00	**0.00**
39.6					3.25					0.0041				
41.9	42.00	-0.24	0.14	**0.34**	3.42	3.39	1.03	0.05	**1.46**	0.0041	0.00	0.00	0.00	**0.00**
42.1					3.35					0.0041				
43.5	43.90	-0.91	0.57	**1.29**	4.93	5.00	-1.30	0.09	**1.84**	0.0041	0.00	0.00	0.00	**0.00**
44.3					5.06					0.0041				
48.5	47.55	2.00	1.34	**2.83**	7.2	7.07	1.91	0.19	**2.70**	0.0041	0.00	0.00	0.00	**0.00**
46.6					6.93					0.0041				
49.8	50.15	-0.70	0.49	**0.99**	10.7	10.80	-0.93	0.14	**1.31**	0.0041	0.00	0.00	0.00	**0.00**
50.5					10.9					0.0041				
0.003	0.02	-84.21	0.02	**119.09**	0.1	0.10	0.00	0.00	**0.00**	0.0041	0.00	0.00	0.00	**0.00**
0.035					0.1					0.0041				
37.3	36.25	2.90	1.48	**4.10**	11.8	11.50	2.61	0.42	**3.69**	0.0041	0.00	0.00	0.00	**0.00**
35.2					11.2					0.0041				
8.65	8.60	0.58	0.07	**0.82**	1.59	1.60	-0.31	0.01	**0.44**	0.0041	0.00	0.00	0.00	**0.00**
8.55					1.6					0.0041				
16	15.75	1.59	0.35	**2.24**	4.86	4.78	1.78	0.12	**2.52**	0.0041	0.00	0.00	0.00	**0.00**
15.5					4.69					0.0041				
17.2	17.20	0.00	0.00	**0.00**	6.59	6.61	-0.23	0.02	**0.32**	0.0041	0.00	0.00	0.00	**0.00**
17.2					6.62					0.0041				
11.2	11.35	-1.32	0.21	**1.87**	2.61	2.64	-0.95	0.04	**1.34**	0.0041	0.00	0.00	0.00	**0.00**
11.5					2.66					0.0041				
10.6	10.50	0.95	0.14	**1.35**	1.77	1.76	0.57	0.01	**0.80**	0.0041	0.00	0.00	0.00	**0.00**
10.4					1.75					0.0041				
9.66	9.74	-0.77	0.11	**1.09**	2.71	2.72	-0.37	0.01	**0.52**	0.0041	0.00	0.00	0.00	**0.00**
9.81					2.73					0.0041				
0.035	0.04	0.00	0.00	**0.00**	0.1	0.10	0.00	0.00	**0.00**	0.0041	0.00	0.00	0.00	**0.00**
0.035					0.1					0.0041				
10.1	10.15	-0.49	0.07	**0.70**	1.32	1.31	1.15	0.02	**1.63**	0.0041	0.00	0.00	0.00	**0.00**
10.2					1.29					0.0041				
9.09	9.15	-0.66	0.08	**0.93**	4.42	4.46	-0.79	0.05	**1.11**	0.0041	0.00	0.00	0.00	**0.00**
9.21					4.49					0.0041				
11.3	11.15	1.35	0.21	**1.90**	9.61	9.48	1.37	0.18	**1.94**	0.0041	0.00	0.00	0.00	**0.00**
11					9.35					0.0041				
11.3	11.20	0.89	0.14	**1.26**	9.58	9.53	0.52	0.07	**0.74**	0.0041	0.00	0.00	0.00	**0.00**
11.1					9.48					0.0041				
3.42	3.47	-1.44	0.07	**2.04**	0.1	0.10	0.00	0.00	**0.00**	0.0041	0.00	0.00	0.00	**0.00**
3.52					0.1					0.0041				
3.91	3.89	0.64	0.04	**0.91**	0.692	0.70	-0.50	0.00	**0.71**	0.002	0.00	0.00	0.00	**0.00**
3.86					0.699					0.002				
7.09	7.10	-0.07	0.01	**0.10**	1.16	1.14	2.20	0.04	**3.12**	0.0032	0.00	23.08	0.00	**32.64**
7.1					1.11					0.002				
13.3	13.35	-0.37	0.07	**0.53**	2.36	2.37	-0.42	0.01	**0.60**	0.002	0.00	0.00	0.00	**0.00**
13.4					2.38					0.002				
15.2	15.05	1.00	0.21	**1.41**	3.34	3.32	0.75	0.04	**1.07**	0.002	0.00	0.00	0.00	**0.00**
14.9					3.29					0.002				

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML35-6B		16.1	16.15	-0.31	0.07	**0.44**	2.68	2.53	5.93	0.21	**8.38**
ML35-6A		16.2					2.38				
ML35-5B		34.6	34.55	0.14	0.07	**0.20**	2.38	2.36	1.06	0.04	**1.50**
ML35-5A		34.5					2.33				
ML35-4B		50.2	49.70	1.01	0.71	**1.42**	3.49	3.39	3.10	0.15	**4.39**
ML35-4A		49.2					3.28				
ML35-3B	Mar-98	40.5	41.10	-1.46	0.85	**2.06**	2.26	1.91	18.32	0.49	**25.91**
ML35-3A		41.7					1.56				
ML35-2D-B		24.1	23.80	1.26	0.42	**1.78**	0.91	1.04	-12.50	0.18	**17.68**
ML35-2D-A		23.5					1.17				
ML35-2B		23.8	24.00	-0.83	0.28	**1.18**	1.19	1.05	13.88	0.21	**19.62**
ML35-2A		24.2					0.9				
ML35-1B-B		1.05	1.06	-0.94	0.01	**1.33**	0.78	0.78	0.00	0.00	**0.00**
ML35-1B-A		1.07					0.78				
ML35-1B		20.9	20.65	1.21	0.35	**1.71**	0.89	0.91	-2.20	0.03	**3.11**
ML35-1A		20.4					0.93				
ML35-0B		14.4	14.50	-0.69	0.14	**0.98**	0.96	0.87	10.34	0.13	**14.63**
ML35-0A		14.6					0.78				
ML24-6DUP		9.95	31.53	-68.44	30.51	**96.79**	1.47	3.81	-61.42	3.31	**86.86**
ML21-6		53.1					6.15				
ML21-1DUP		20	20.30	-1.48	0.42	**2.09**	1.49	1.26	18.73	0.33	**26.48**
ML21-1		20.6					1.02				
ML23-2DUP		44.4	45.30	-1.99	1.27	**2.81**	1.23	1.01	21.78	0.31	**30.80**
ML23-2		46.2					0.79				
ML23.5-0DU		31	31.20	-0.64	0.28	**0.91**	1.85	1.81	2.21	0.06	**3.13**
ML23.5-0		31.4					1.77				
ML25-2DUP		42.7	42.65	0.12	0.07	**0.17**	0.79	0.44	81.61	0.50	**115.41**
ML25-2		42.6					0.08				
ML11-5FDUP	Jun-98	48.7	49.50	-1.62	1.13	**2.29**	7.03	6.94	1.37	0.13	**1.94**
ML11-5		50.3					6.84				
ML12-5FDUP		56	55.60	0.72	0.57	**1.02**	5.8	5.95	-2.44	0.21	**3.45**
ML12-5		55.2					6.09				
ML13-9FDUP		5.3	4.11	29.11	1.69	**41.17**	2.92	1.94	50.52	1.39	**71.44**
ML13-9		2.91					0.96				
ML14-6FDUP		4.69	4.95	-5.16	0.36	**7.29**	1.96	2.01	-2.49	0.07	**3.52**
ML14-6		5.2					2.06				
ML15-5FDUP		6.64	7.07	-6.08	0.61	**8.60**	1.03	1.12	-7.62	0.12	**10.78**
ML15-5		7.5					1.2				
ML15-3		9.09	8.16	11.47	1.32	**16.21**	2.33	1.63	43.38	1.00	**61.36**
ML15-3		7.22					0.92				
ML31-10		27.5	27.50	0.00	0.00	**0.00**	4.8	4.65	3.23	0.21	**4.56**
ML31-10FDU		27.5					4.5				
ML32-9FDUP		6.66	6.72	-0.89	0.08	**1.26**	9.4	9.40	0.00	0.00	**0.00**
ML32-9		6.78					9.4				
ML33-8FDUP		13.2	13.35	-1.12	0.21	**1.59**	5.1	5.15	-0.97	0.07	**1.37**
ML33-8		13.5					5.2				
ML34-10	Jun-98	14.3	14.60	-2.05	0.42	**2.91**	2	2.01	-0.25	0.01	**0.35**
ML34-10		14.9					2.01				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
12.4	12.45	-0.40	0.07	**0.57**	2.82	2.84	-0.70	0.03	**1.00**	0.0036	0.00	28.57	0.00	**40.41**
12.5					2.86					0.002				
4.6	4.60	0.00	0.00	**0.00**	1.9	1.90	0.26	0.01	**0.37**	0.002	0.00	0.00	0.00	**0.00**
4.6					1.89					0.002				
9.18	9.12	0.71	0.09	**1.01**	4.21	4.20	0.36	0.02	**0.51**	0.0025	0.00	11.11	0.00	**15.71**
9.05					4.18					0.002				
10.1	10.35	-2.42	0.35	**3.42**	7.55	7.72	-2.14	0.23	**3.02**	0.002	0.00	0.00	0.00	**0.00**
10.6					7.88					0.002				
6.47	6.39	1.25	0.11	**1.77**	3.51	3.45	1.89	0.09	**2.67**	0.002	0.00	-16.67	0.00	**23.57**
6.31					3.38					0.0028				
6.3	6.32	-0.32	0.03	**0.45**	3.36	3.38	-0.44	0.02	**0.63**	0.002	0.00	-23.08	0.00	**32.64**
6.34					3.39					0.0032				
0.035	0.04	0.00	0.00	**0.00**	0.074	0.07	0.00	0.00	**0.00**	0.002	0.00	0.00	0.00	**0.00**
0.035					0.074					0.002				
0.708	0.73	-2.75	0.03	**3.89**	0.306	0.31	0.00	0.00	**0.00**	0.0046	0.00	39.39	0.00	**55.71**
0.748					0.306					0.002				
4.39	4.39	0.00	0.00	**0.00**	2.15	2.17	-0.69	0.02	**0.98**	0.0022	0.00	-4.35	0.00	**6.15**
4.39					2.18					0.0024				
3.08	17.04	-81.92	19.74	**115.86**	0.141	8.02	-98.24	11.14	**138.94**	0.0037	0.36	-98.97	0.50	**139.97**
31					15.9					0.716				
12.1	12.25	-1.22	0.21	**1.73**	6.89	6.96	-1.01	0.10	**1.42**	0.002	0.00	0.00	0.00	**0.00**
12.4					7.03					0.002				
4.39	4.43	-0.79	0.05	**1.12**	6.64	6.69	-0.67	0.06	**0.95**	0.0034	0.00	0.00	0.00	**0.00**
4.46					6.73					0.0034				
9.32	9.34	-0.16	0.02	**0.23**	6.56	6.62	-0.91	0.08	**1.28**	0.0034	0.00	0.00	0.00	**0.00**
9.35					6.68					0.0034				
2.89	2.91	-0.52	0.02	**0.73**	1.41	1.43	-1.05	0.02	**1.49**	0.0034	0.00	0.00	0.00	**0.00**
2.92					1.44					0.0034				
29.1	29.35	-0.85	0.35	**1.20**	13.5	13.65	-1.10	0.21	**1.55**	0.156	0.17	-6.59	0.02	**9.32**
29.6					13.8					0.178				
28.8	28.70	0.35	0.14	**0.49**	6.51	6.49	0.31	0.03	**0.44**	0.0023	0.00	0.00	0.00	**0.00**
28.6					6.47					0.0023				
18.4	11.59	58.76	9.63	**83.10**	1.83	0.93	96.35	1.27	**136.26**	0.0031	0.00	0.00	0.00	**0.00**
4.78					0.034					0.0031				
2.42	2.60	-6.74	0.25	**9.54**	0.034	0.03	0.00	0.00	**0.00**	0.0031	0.00	0.00	0.00	**0.00**
2.77					0.034					0.0031				
1.04	1.25	-16.47	0.29	**23.29**	0.636	0.68	-7.02	0.07	**9.92**	0.005	0.00	23.46	0.00	**33.17**
1.45					0.732					0.0031				
1.11	0.57	95.42	0.77	**134.95**	0.074	0.05	37.04	0.03	**52.38**	0.0031	0.00	0.00	0.00	**0.00**
0.026					0.034					0.0031				
31.9	32.00	-0.31	0.14	**0.44**	5.61	5.61	0.09	0.01	**0.13**	0.0036	0.00	0.00	0.00	**0.00**
32.1					5.6					0.0036				
26	26.15	-0.57	0.21	**0.81**	1.8	1.80	0.28	0.01	**0.39**	0.0036	0.00	0.00	0.00	**0.00**
26.3					1.79					0.0036				
31.3	31.45	-0.48	0.21	**0.67**	2.28	2.28	0.00	0.00	**0.00**	0.0036	0.00	-8.86	0.00	**12.53**
31.6					2.28					0.0043				
6.35	6.41	-0.86	0.08	**1.21**	1.2	1.21	-0.41	0.01	**0.59**	0.0023	0.00	0.00	0.00	**0.00**
6.46					1.21					0.0023				

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML34-7FDUP		16.8	16.70	0.60	0.14	**0.85**	2.61	2.71	-3.51	0.13	**4.97**
ML34-7		16.6					2.8				
ML35-7		13.2	13.15	0.38	0.07	**0.54**	3.79	3.81	-0.39	0.02	**0.56**
ML35-7		13.1					3.82				
ML21-6DUP		52.5	52.50	0.00	0.00	**0.00**	6.31	6.48	-2.55	0.23	**3.60**
ML21-6		52.5					6.64				
ML22.5-5DU		22.8	22.80	0.00	0.00	**0.00**	4.43	4.72	-6.04	0.40	**8.55**
ML22.5-5		22.8					5				
ML22.5-1DU		28.3	28.45	-0.53	0.21	**0.75**	1.75	1.78	-1.69	0.04	**2.38**
ML22.5-1		28.6					1.81				
ML24-7DUP		7.41	7.42	-0.13	0.01	**0.19**	2.01	2.06	-2.19	0.06	**3.10**
ML24-7		7.43					2.1				
ML11-10	Dec-98	11.9	11.90	0.00	0.00	**0.00**	6.16	6.28	-1.83	0.16	**2.59**
ML11-10DUP		11.9					6.39				
ML11-0		38.1	37.85	0.66	0.35	**0.93**	1.04	1.17	-11.11	0.18	**15.71**
ML11-0DUP		37.6					1.3				
ML12-9DUP		29.6	29.75	-0.50	0.21	**0.71**	6.44	6.47	-0.46	0.04	**0.66**
ML12-9		29.9					6.5				
ML13-7DUP		5.5	5.46	0.73	0.06	**1.04**	2.78	2.76	0.72	0.03	**1.02**
ML13-7		5.42					2.74				
ML14-8DUP		5.03	5.03	0.00	0.00	**0.00**	2.39	2.40	-0.42	0.01	**0.59**
ML14-8		5.03					2.41				
ML15-10		39.6	39.80	-0.50	0.28	**0.71**	4.77	4.66	2.47	0.16	**3.49**
ML15-10		40					4.54				
ML15-6DUP		12.2	12.10	0.83	0.14	**1.17**	3.71	3.82	-2.75	0.15	**3.89**
ML15-6		12					3.92				
ML21-7DUP		21.7	21.70	0.00	0.00	**0.00**	5.42	5.48	-1.00	0.08	**1.42**
ML21-7		21.7					5.53				
ML21-1DUP		22.2	22.25	-0.22	0.07	**0.32**	0.76	0.77	-1.30	0.01	**1.84**
ML21-1		22.3					0.78				
ML23.5-5DUP		21.2	21.20	0.00	0.00	**0.00**	1.37	1.23	11.38	0.20	**16.10**
ML23.5-5		21.2					1.09				
ML25-6DUP		12.4	12.35	0.40	0.07	**0.57**	1.73	1.77	-1.98	0.05	**2.80**
ML25-6		12.3					1.8				
ML31-9DUP		23.9	23.90	0.00	0.00	**0.00**	4.34	4.40	-1.36	0.08	**1.93**
ML31-9		23.9					4.46				
ML32-10		19.7	19.65	0.25	0.07	**0.36**	7.77	7.75	0.26	0.03	**0.36**
ML32-10DUP		19.6					7.73				
ML32-5D	Dec-98	48.2	47.20	2.12	1.41	**3.00**	5.34	5.46	-2.11	0.16	**2.98**
ML32-5		46.2					5.57				
ML33-7DUP		19.6	19.73	-0.68	0.32	**1.63**	4.87	4.78	1.88	0.09	**1.88**
ML33-7D		19.5		-1.18			4.78		0.00		
ML33-7		20.1		1.86			4.69		-1.88		
ML34-7DUP		17.5	17.55	-0.28	0.07	**0.40**	2.31	2.32	-0.22	0.01	**0.31**
ML34-7		17.6					2.32				
ML34-6DUP		17.7	18.55	-4.58	1.20	**6.48**	2.33	2.27	2.87	0.09	**4.06**
ML34-6		19.4					2.2				

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca	Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg	Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
18.4 18.2	18.30	0.55	0.14	**0.77**	7.57 7.52	7.55	0.33	0.04	**0.47**	0.0023 0.0023	0.00	0.00	0.00	**0.00**
12 11.9	11.95	0.42	0.07	**0.59**	2.6 2.62	2.61	-0.38	0.01	**0.54**	0.0023 0.0023	0.00	0.00	0.00	**0.00**
29.4 29.1	29.25	0.51	0.21	**0.73**	14.2 14	14.10	0.71	0.14	**1.00**	0.849 0.84	0.84	0.53	0.01	**0.75**
30.3 30.9	30.60	-0.98	0.42	**1.39**	4.38 4.48	4.43	-1.13	0.07	**1.60**	0.0016 0.0016	0.00	0.00	0.00	**0.00**
9.14 9.14	9.14	0.00	0.00	**0.00**	5.69 5.67	5.68	0.18	0.01	**0.25**	0.215 0.211	0.21	0.94	0.00	**1.33**
1.89 1.91	1.90	-0.53	0.01	**0.74**	0.108 0.095	0.10	6.40	0.01	**9.06**	0.002 0.0016	0.00	11.11	0.00	**15.71**
28.2 27.5	27.85	1.26	0.49	**1.78**	12.7 12.5	12.60	0.79	0.14	**1.12**	0.0023 0.0037	0.00	-23.33	0.00	**33.00**
18.2 18.1	18.15	0.28	0.07	**0.39**	11.9 11.8	11.85	0.42	0.07	**0.60**	0.168 0.17	0.17	-0.59	0.00	**0.84**
49.9 50.1	50.00	-0.20	0.14	**0.28**	5.26 5.27	5.27	-0.09	0.01	**0.13**	0.0023 0.0023	0.00	0.00	0.00	**0.00**
4.17 4.12	4.15	0.60	0.04	**0.85**	0.056 0.056	0.06	0.00	0.00	**0.00**	0.0023 0.0023	0.00	0.00	0.00	**0.00**
4.03 4.02	4.03	0.12	0.01	**0.18**	0.037 0.037	0.04	0.00	0.00	**0.00**	0.0023 0.0023	0.00	0.00	0.00	**0.00**
32.1 32.5	32.30	-0.62	0.28	**0.88**	1.89 1.87	1.88	0.53	0.01	**0.75**	0.0016 0.0026	0.00	-23.81	0.00	**33.67**
10.6 10.5	10.55	0.47	0.07	**0.67**	2.2 2.2	2.20	0.00	0.00	**0.00**	0.0016 0.0016	0.00	0.00	0.00	**0.00**
26.6 26.2	26.40	0.76	0.28	**1.07**	9.14 9	9.07	0.77	0.10	**1.09**	0.0016 0.0016	0.00	0.00	0.00	**0.00**
12.7 12.9	12.80	-0.78	0.14	**1.10**	7.52 7.62	7.57	-0.66	0.07	**0.93**	0.0019 0	0.00	100.00	0.00	**141.42**
6.69 6.78	6.74	-0.67	0.06	**0.94**	2.67 2.69	2.68	-0.37	0.01	**0.53**	0.0016 0.0016	0.00	0.00	0.00	**0.00**
2.46 2.44	2.45	0.41	0.01	**0.58**	1.12 1.14	1.13	-0.88	0.01	**1.25**	0.0016 0.0016	0.00	0.00	0.00	**0.00**
34.9 34.2	34.55	1.01	0.49	**1.43**	7.04 6.99	7.02	0.36	0.04	**0.50**	0.0019 0.0016	0.00	8.57	0.00	**12.12**
40.4 40.4	40.40	0.00	0.00	**0.00**	2.93 2.96	2.95	-0.51	0.02	**0.72**	0.0028 0.0016	0.00	27.27	0.00	**38.57**
44.6 47.2	45.90	-2.83	1.84	**4.01**	9.47 9.74	9.61	-1.41	0.19	**1.99**	0.0024 0.0016	0.00	20.00	0.00	**28.28**
35.1 35.6 35.6	35.43	-0.94 0.47 0.47	0.29	**0.81**	3.84 3.89 3.9	3.88	-0.95 0.34 0.60	0.03	**0.83**	0.0024 0.0024 0.0024	0.00	0.00 0.00 0.00	0.00	**0.00**
22.6 23	22.80	-0.88	0.28	**1.24**	8.22 8.35	8.29	-0.78	0.09	**1.11**	0.0019 0.0019	0.00	0.00	0.00	**0.00**
19.3 19.3	19.30	0.00	0.00	**0.00**	7.07 7.15	7.11	-0.56	0.06	**0.80**	0.0024 0.0024	0.00	0.00	0.00	**0.00**

Table J2 **Statistical Results for Selected Cation Duplicates**

Sample	Session	Na (mg/L)	Ave Na (mg/L)	% Diff Na	Std Dev Na (mg/L)	% StdDev Na	K (mg/L)	Ave K (mg/L)	% Diff K	Std Dev K (mg/L)	% StdDev K
ML35-0		17.1	17.20	-0.58	0.14	**0.82**	0.41	0.40	2.50	0.01	**3.54**
ML35-0DUP		17.3					0.39				
MW18		135	135.00	0.00	0.00	**0.00**	1.79	1.50	19.73	0.42	**27.91**
MW18DUP		135					1.2				
MW35D		17.6	17.70	-0.56	0.14	**0.80**	1.54	1.39	10.79	0.21	**15.26**
MW35D DUP		17.8					1.24				
Average	**(n = 242)**			**1.65**		**2.17**			**7.69**		**9.87**

Ave = Average
% Diff = % Difference = (Concentration - Ave) / Ave*100
Std Dev = Standard Deviation
% StdDev = Std Dev / Ave*100

Set < = value for statistics
Take absolute value of % Diff for Ave calculation

Ca (mg/L)	Ave Ca (mg/L)	% Diff Ca	Std Dev Ca (mg/L)	% StdDev Ca
1.9 1.92	1.91	-0.52	0.01	**0.74**
11.4 11.4	11.40	0.00	0.00	**0.00**
15.6 15.7	15.65	-0.32	0.07	**0.45**
		2.56		**3.52**

Mg (mg/L)	Ave Mg (mg/L)	% Diff Mg	Std Dev Mg (mg/L)	% StdDev Mg
1.01 1.04	1.03	-1.46	0.02	**2.07**
9.83 9.94	9.89	-0.56	0.08	**0.79**
5.8 5.83	5.82	-0.26	0.02	**0.36**
		3.68		**5.34**

Cr (mg/L)	Ave Cr (mg/L)	% Diff Cr	Std Dev Cr (mg/L)	% StdDev Cr
0.002 0.0019	0.00	2.56	0.00	**3.63**
0.0035 0.002	0.00	27.27	0.00	**38.57**
0.0038 0.002	0.00	31.03	0.00	**43.89**
		5.08		**6.44**

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML11-8	Nov-96	24.3	13.2	<0.05	0.07	
ML11-8 dup		---	---	<.05	0.07	
ML11-6		62.5	43.4	<.05	1.48	
ML11-6 dup		62.3	43	---	---	
ML12-8		6.34	4.45	<.05	<.05	
ML12-8 dup		6.31	4.51	---	---	
ML13-8		5.24	<.5	<.05	<.05	
ML13-8dup		5.34	<.5			
ML13-6		6.38	<.5	<.05	<.05	
ML13-6dup				<.05	<.05	
ML13-5		7.34	<.5	<.05	<.05	
ML13-5dup				<.05	<.05	
ML14-6		7.97	1.12	<.05	<.05	
ML14-6dup				<.05	<.05	
ML14-4		11.9	<.5	<.05	<.05	
ML14-4dup		12.1	<.5			
ML15-6		25.8	18.2	<.05	<.05	
ML15-6dup				<.05	<.05	
ML15-3		31.6	<.5	<.05	<.05	
ML15-3dup		31.2	<.5	<.05	<.05	
ML15-2		105	13.7	<.05	<.05	
ML15-2dup		105	14			
ML21-5		143	138	0.13	5.48	
ML21-5 dup				0.13	5.46	
ML21-1		15.1	18.4	0.06	0.73	
ML21-1dup		14.8	18.2			
ML22-7 11/12		10.6	5.92	<.05	<.05	
ML22-7 11/12dup		10.4	5.61			
ML22-6		44.4	<.5	<.05	<.05	
ML22-6dup				<.05		
ML22-2		32.6	<.5	<.05	<.05	
ML22-2dup		32.4	<.5			

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML24-1		48.4	3.27	<.05	<.05	
ML24-1dup		48.2	3.13	<.05	<.05	
ML25-5		117	6.73	<.05	<.05	
ML25-5dup				<.05	<.05	
ML25-4		73.6	5.82	<.05	<.05	
ML25-4dup					<.05	
ML25-1		5.31	3.17	<.05	<.05	
ML25-1dup		5.33	3.33	---	---	
ML31-8		45.9	16.1	0.05	0.48	
ML31-8dup		45.3	16.2	0.05	0.48	
ML31-0		13.4	4.27	<.05	1.4	
ML31-0 dup		13.3	4.18	---	---	
ML32-7		8.27	8.46	<.05	<.05	
ML32-7dup		---	---	<.05	<.05	
ML32-4	Nov-96	112	63.3	0.06	2.87	
ML32-4 dup		111	62.3	---	---	
ML33-8		8.34	8.55	<.05	0.26	
ML33-8dup		8.22	8.59			
ML33-6		13.1	5.28	<.05	<.05	
ML33-6dup				<.05	<.05	
ML34-6dup		39.1	1.64			
ML34-6		39.2	1.6	<.05	<.05	
ML34-5		42.5	0.78	<.05	<.05	
ML34-5dup				<.05	<.05	
ML35-10		182	18.5	0.09	1.05	
ML35-10dup		180	18.5			
ML35-4		95.1	<.5	<0.05	<0.05	
ML35-4dup				<0.05	<0.05	
ML35-1		18.1	<.5	<0.05	<0.05	
ML35-1dup		18.2	<.5			
ML11-3	Feb-97	55.7	53.1	<.05	2.25	
ML11-3 dup		55.0	51.7	<.05	-----	

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML11-8		8.08	12.8	<.05	<.05	
ML11-8 dup		-----	-----	<.05	<.05	
ML12-5		36.2	14.7	<.05	<.05	
ML12-5 dup		-----	-----	<.05	<.05	
ML12-7		3.32	5.50	<.05	0.08	
ML12-7 dup		3.25	5.43	<.05	-----	
ML13-10		4.75	<.5	<.05	<.05	
ML13-10 dup		4.66	<.5	-----	-----	
ML13-5		3.57	<.5	<.05	<.05	
ML13-5 dup		3.51	<.5	-----	-----	
ML13-9		4.39	<.5	<.05	<.05	
ML13-9 dup		-----	-----	<.05	<.05	
ML14-7		3.26	<.5	<.05	<.05	
ML14-7 dup		3.18	<.5	-----	-----	
ML15-1		55.0	<.5	<.05	<.05	
ML15-1 dup		54.5	<.5	<.05	-----	
ML15-10		3.25	6.66	<.05	0.55	
ML15-10 dup		3.24	6.66	<.05	-----	
ML15-5		4.36	4.98	<.05	<.05	
ML15-5 dup		-----	-----	<.05	<.05	
ML21-1		15.6	18.8	<.05	0.82	
ML21-1 dup		33.1	35.3	-----	-----	
ML21-5		132	131	<.05	4.31	
ML21-5 dup		134	130	<.05	-----	
ML23-4		38.3	<.5	<.05	<.05	
ML23-4 dup		38.1	<.5	-----	-----	
ML24-6		11.9	<.5	-----	-----	
ML24-6 dup		12.0	<.5	<.05	<.05	
ML31-1	Feb-97	17.6	24.2	<.05	0.89	
ML31-1 dup		-----	-----	-----	0.90	
ML31-10		11.8	18.3	<.05	0.28	
ML31-10 dup		-----	-----	<.05	0.28	
ML31-5		148	63.1	<.05	8.35	
ML31-5 dup		153	64.8	<.05	-----	

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML32-10		8.81	12.2	<.05	1.04	
ML32-10 dup		-----	-----	<.05	1.05	
ML32-8		18.6	24.7	<.05	0.13	
ML32-8 dup		18.5	24.4		-----	
ML33-10		10.1	5.88	<.05	0.10	
Ml33-10 dup		-----	-----	<.05	0.09	
ML33-5		32.7	8.73	<.05	<.05	
Ml33-5 dup		32.5	8.71	-----	-----	
ML34-0		14.6	<.5	<.05	<.05	
ML34-0 dup		14.4	<.5	-----	-----	
ML34-9		27.4	<.5	<.05	<.05	
ML34-9 dup		27.1	<.5	-----	-----	
ML35-10		17.9	1.91	<.05	<.05	
ML35-10 dup		-----	-----	<.05	<.05	
ML35-3		77.9	<.5	<.05	<.05	
ML35-3 dup		77.3	<.5	-----	-----	
ML35-4		82.4	<.5	<.05	<.05	
ML35-4 dup		82.1	<.5	-----	-----	
ML11-9	Jun-97	5.34	10.3	<.1	<.1	
ML11-9 dup		5.36	10.4	<.1	<.1	
ML11-4		114	108	<.1	3.53	
ML11-4 dup		114	106	<.1	3.58	
ML12-7		2.22	2.92	<.1	<.1	
ML12-7dup		2.17	2.88	<.1	<.1	
ML13-0		79.1	<.1	<.1	<.1	
ML13-0 dup		79.2	<.1	<.1	<.1	
ML14-10		3.85	0.28	<.1	<.1	
ML14-10 dup		3.87	0.25	<.1	<.1	
ML14-6		2.81	0.1	<.1	<.1	
ML14-6 dup		2.79	0.11	<.1	<.1	
ML14-6 rep		3.33	<.1	<.1	<.1	
ML15-8		1.92	4.25	<.1	<.1	
ML15-8 dup		1.93	4.20	<.1	<.1	

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML21-3		42.4	39.3	<.1	1.07	
ML21-3 dup		42.2	39.7	<.1	1.06	
ML22-2		39.1	<.1	<.1	<.1	
ML22-2 dup		39.2	<.1	<.1	<.1	
ML23-3		76.5	<.1	<.1	<.1	
ML23-3 dup		77.2	<.1	-----	<.1	
ML24-6	Jun-97	12.4	<.1	<.1	<.1	
ML24-6 dup		12.5	<.1	<.1	<.1	
ML25-4		83.7	<.1	<.1	<.1	
ML25-4 dup		83.4	<.1	-----	<.1	
ML31-10		18.7	16.8	<.1	<.1	
ML31-10 dup		18.7	16.8	<.1	<.1	
ML31-5		113	72.4	<.1	5.45	
ML31-5 dup		113	72.2	<.1	5.47	
ML32-7		14.4	6.6	<.1	<.1	
ML32-7dup		14.5	6.61	<.1	<.1	
ML33-9		8.82	6.91	<.1	<.1	
ML33-9 dup		8.79	6.88	<.1	<.1	
ML33-0		18.6	<.1	<.1	<.1	
ML33-0 dup		18.7	<.1	<.1	<.1	
ML33-0 rep		18.3	<.1	<.1	<.1	
ML34-2		31.9	<.1	<.1	<.1	
ML34-2 dup		32.2	<.1	<.1	<.1	
ML35-10		20.1	2.85	<.1	<.1	
ML35-10 dup		19.7	2.85	<.1	<.1	
ML35-4		52	1.01	-----	<.1	
ML35-4 rep		47.0	<.1	<.1	<.1	
ml 11-10 Dup	Sep-97	5.80	6.62			-----
ml 11-10		5.80	6.62			0.14
ml 11-2 F. Rep		47.4	66.3			0.62
ml 11-2		52.2	75.2			0.68
ml 11-1 Dup		29.3	35.5			-----
ml 11-1		29.3	35.7			0.46

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ml 12-10		3.97	8.56			0.66
ml 12-10 Dup		-----	-----			0.65
ml 12-8 Dup		5.80	3.16			-----
ml 12-8		5.80	3.13			0.13
ml 12-2 Unfiltered		90.0	66.1			1.59
ml 12-2 Filtered		90.2	66.8			1.62
ml 13-7 Dup		5.32	1.06			-----
ml 13-7		5.32	1.05			<.1
ml 13-6 Dup		-----	-----			<.1
ml 13-6		4.81	1.02			<.1
ml 14-10		3.94	1.13			<.1
ml 14-10 Dup		-----	-----			<.1
ml 15-10		9.86	11.0			<.1
ml 15-10 Dup		-----	-----			<.1
ml 15-9 Dup		7.91	5.87			-----
ml 15-9		7.94	5.86			<.1
ml 15-0 Dup		55.6	7.03			-----
ml 15-0		55.5	6.95			<.1
ml 22-2 Dup	Sep-97	52.6	1.25			-----
ml 22-2		52.6	1.25			<.1
ml 23-3 Dup		53.0	1.05			-----
ml 23-3		53.1	1.06			<.1
ml 24-7 Dup		-----	-----			<.1
ml 24-7		14.2	<1			<.1
ml 24-6 Dup		15.5	<1			-----
ml 24-6		15.5	<1			<.1
ml 31-10		22.8	18.8			0.11
ml 31-10 Dup		-----	-----			0.11
ml 31-5B		118	74.2			4.73
ml 31-5		120	77.6			4.75
ml 31-2 Dup		14.3	29.0			-----
ml 31-2		14.3	29.0			0.63
ml 32-0		14.5	4.86			0.71
ml 32-0 Dup		14.5	4.85			-----

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ml 32-9 Dup		5.86	32.4			-----
ml 32-9		5.87	32.4			0.97
ml 33-8 F. Rep		10.6	14.7			<.1
ml 33-8 Dup		-----	-----			<.1
ml 33-8		10.6	14.6			<.1
ml 33-7 F. Rep		12.5	9.3			<.1
ml 33-7		12.6	9.23			<.1
ml 33-6 F. Rep		12.2	2.12			<.1
ml 33-6 Dup		12.2	1.85			-----
ml 33-6		12.2	1.85			<.1
ml 33-4 F. Rep		20.4	1.17			<.1
ml 33-4		19.4	1.15			<.1
ml 33-10		17.1	9.01			<.1
ml 33-10 F. Rep		16.9	9.07			<.1
ml 34-10		12.0	1.44			<.1
ml 34-10 Dup		-----	-----			<.1
ml 34-1 Dup		17.3	1.31			-----
ml 34-1		17.2	1.31			<.1
ml 35-4 Dup		30.4	1.07			-----
ml 35-4		30.4	1.07			<.1
ML 11-5 dup	Mar-98	70.8	63.4	<.1	2.02	
ML 11-5		71.5	62.7	<.1	2.04	
ML 11-4 rep		68.7	36.3	<.1	0.76	
ML 11-4		68.6	35.7	<.1	0.77	
ML 12-9 dup		3.46	23.6	<.1	0.72	
ML 12-9		3.4	24	<.1	0.73	
ML 12-6 rep		4.12	0.51	<.1	<.1	
ML 12-6		3.95	0.5	<.1	<.1	
ML 13-5 dup		3	<.1	<.1	<.1	
ML 13-5		3	<.1	<.1	<.1	
ML 13-2 rep	Mar-98	53.1	0.64	<.1	<.1	
ML 13-2		52.7	0.63	<.1	<.1	
ML 14-3 dup		20.1	<.1	<.1	<.1	
ML 14-3		20.1	<.1	<.1	<.1	

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML 15-9 dup		41.3	8.53	<.1	0.14	
ML 15-9		41.8	8.64	<.1	0.14	
ML 15-2 rep		46.6	<.1	<.1	<.1	
ML 15-2		46.8	<.1	<.1	<.1	
ML 15-0		50.8	8.27	<.1	<.1	
ML 15-0 dup		50.3	8.4	<.1	<.1	
ML 21-7 rep		59.6	17.5	<.1	0.44	
ML 21-7 dup		60.3	15.3	<.1	0.52	
ML 21-7		60.9	15.6	<.1	0.51	
ML 21-3 rep		24.6	29.8	<.1	0.56	
ML 21-3		24.3	29.4	<.1	0.51	
ML 21-1 rep		13.6	28.2	<.1	0.47	
ML 21-1		19.9	16.8	<.1	1.13	
ML 22.5-7 rep		6.48	0.76	<.1	<.1	
ML 22.5-7		6.51	1.01	<.1	<.1	
ML 22.5-4 dup		17	0.89	<.1	<.1	
ML 22.5-4		17.2	0.92	<.1	<.1	
ML 23-6 dup		16.9	<.1	<.1	<.1	
ML 23-6		16.9	<.1	<.1	<.1	
ML 23-5 dup		15.9	8.26	<.1	<.1	
ML 23-5		15.9	8.27	<.1	<.1	
ML 23.5-5 rep		28.6	<.1	<.1	<.1	
ML 23.5-5		28.7	<.1	<.1	<.1	
ML 23.5-4		36.1	<.1	<.1	<.1	
ML 23.5-4 Dup		36.0	<.1	<.1	<.1	
ML24-5 rep dup		23.7	<.1	<.1	<.1	
ML 24-5 rep		23.9	<.1	<.1	<.1	
ML 24-5		23.4	<.1	<.1	<.1	
ML 24-2 rep		59.2	<.1	<.1	<.1	
ML 24-2		57.9	<.1	<.1	<.1	
ML 25-2 rep		53.2	1.48	<.1	<.1	
ML 25-2 dup		53.4	1.31	<.1	<.1	
ML 25-2		53.5	1.31	<.1	<.1	
ML 31-8 dup		69.1	27.7	<.1	0.81	
ML 31-8		69.5	28.2	<.1	0.81	

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML 31-6D		114	43.5	<.1	2.83	
ML 31-6		117	41.8	<.1	2.85	
ML 31-4B dup		0.29	0.48	<.1	<.1	
ML 31-4B		0.31	0.46	<.1	<.1	
ML 33-7 D		20.6	1.42	<.1	<.1	
ML 33-7		20.4	1.14	<.1	<.1	
ML 33-5 dup		51.8	2.75	<.1	<.1	
ML 33-5		52.4	2.89	<.1	<.1	
ML 33-1 dup	Mar-98	51.7	1.46	<.1	<.1	
ML 33-1		51.6	1.52	<.1	<.1	
ML 34-6 dup		31.4	<.1	<.1	<.1	
ML 34-6		31.7	<.1	<.1	<.1	
ML 34-1 D		24.7	<.1	<.1	<.1	
ML 34-1		24.4	<.1	<.1	<.1	
ML 35-2D		15	<.1	<.1	<.1	
ML 35-2 dup		14.9	<.1	<.1	<.1	
ML 35-2		15	<.1	<.1	<.1	
ML 12-3	Jun-98	81.6	75.4	<.1	0.99	
ML 12-3 REP		81.6	73.3	<.1	0.96	
ML 12-9		2.59	13.0	<.1	<.1	
ML 12-9 REP		2.68	13.1	<.1	<.1	
ML 13-1 REP		61.9	<.1	<.1	<.1	
ML 13-1		60.9	<.1	<.1	<.1	
ML 14-6 REP		3.84	<.1	<.1	<.1	
ML 14-6		4.28	<.1	<.1	<.1	
ML 15-5 REP		6.83	0.18	<.1	<.1	
ML 15-5		6.31	0.86	<.1	<.1	
ML 31-6 REP		111	46.5	<.1	3.28	
ML 31-6		108	45.7	<.1	3.14	
ML 32-5 REP		81.7	49.2	<.1	1.33	
ML 32-5		82.4	52.2	<.1	1.68	
ML 33-7 REP		20.1	4.62	<.1	<.1	
ML 33-7		20.5	4.44	<.1	<.1	

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML 34-3 REP		60.2	<.1	<.1	<.1	
ML 34-3		51.9	<.1	<.1	<.1	
ML 22.5-8		5.37	12.3	<.1	<.1	
ML 22.5-8 REP		7.10	<.1	<.1	<.1	
ML 22.5-1 REP		21.1	24.0	<.1	0.33	
ML 22.5-1		21.1	23.8	<.1	0.29	
ML 24-1 REP		36.2	<.1	<.1	<.1	
ML 24-1		36.6	<.1	<.1	<.1	
ML 25-7		3.90	6.93	<.1	<.1	
ML 25-7 REP		3.88	7.02	<.1	<.1	
ML 25-2 REP		44.1	1.32	<.1	<.1	
ML 25-2		44.2	1.12	<.1	<.1	
ML 25-2 Dup	Dec-98	43.9	0.59	<0.1	<0.1	
ML 25-2		44.1	0.54	<0.1	<0.1	
ML 24-3 Dup		47.7	<0.1	<0.1	<0.1	
ML 24-3		47.3	<0.1	<0.1	<0.1	
ML 21-3 Dup		20.4	43.4	<0.1	0.35	
ML 21-3		20.4	43.5	<0.1	0.33	
ML 11-0 Dup		57.3	35.1	<0.1	1.54	
ML 11-0		57.1	35.3	<0.1	1.61	
ML 12-5 Dup	Dec-98	69.5	56.2	<0.1	0.29	
ML 12-5		69.0	58.2	<0.1	0.27	
ML 13-2 Dup		44.3	1.76	<0.1	<0.1	
ML 13-2		42.9	1.69	<0.1	<0.1	
ML 15-6 Dup		3.67	5.93	<0.1	<0.1	
ML 15-6		3.68	5.91	<0.1	<0.1	
ML 15-2 Dup		51.2	<0.1	<0.1	<0.1	
ML 15-2		51.3	<0.1	<0.1	<0.1	
ML 31-3D		15.7	31.2	<0.1	0.86	
ML 31-3		15.9	30.5	<0.1	0.87	
ML 32-5D		91.2	30.5	<0.1	1.85	
ML 32-5		90.9	31.2	<0.1	1.64	

Table J3 **Summary of Anion Results for Duplicates**

Sample	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
ML 33-7D		15.3	10.9	<0.1	<0.1	
ML 33-7		15.4	11.1	<0.1	<0.1	
ML 34-7D		14.5	<0.1	<0.1	<0.1	
ML 34-7		14.2	<0.1	<0.1	<0.1	
ML 35-0 Dup		21.5	1.04	<0.1	<0.1	
ML 35-0		21.6	1.09	<0.1	<0.1	

Table J4 **Summary of Organic Results for Duplicates**

Sample	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	Ave TCE (µg/L)	% Diff TCE	Std Dev TCE (µg/L)	% StdDev TCE	Ave c-DCE (µg/L)	% Diff c-DCE	Std Dev c-DCE (µg/L)	% StdDev c-DCE	Ave VC (µg/L)	% Diff VC	Std Dev VC (µg/L)	% Std Dev VC
MW18	Nov-96	32.6	15.4	2.1	32.15	1.40	0.64	**1.98**	15.20	1.32	0.28	**1.86**	2.10	0.00	0.00	**0.00**
MW18dup		31.7	15	2.1												
ML11-1	Feb-97	18.5	1.8	ND	18.10	2.21	0.57	**3.13**	1.80	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML11-1 dup		17.7	1.8	ND												
ML12-7		ND	BLQ	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML12-7 dup		ND	BLQ	ND												
ML13-1		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML13-1 dup		ND	ND	BLQ												
ML21-5		195	91.3	7.3	203.00	-3.94	11.31	**5.57**	92.50	-1.30	1.70	**1.83**	7.40	-1.35	0.14	**1.91**
ML21-5 dup		210	93.7	7.5												
ML14-9		ND	BLQ	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML14-9 dup		ND	ND	BLQ												
ML15-1		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML15-1 dup		ND	ND	ND												
ML22-4		BLQ	ND	1.0	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	0.95	4.81	0.06	**6.81**
ML22-4 dup		ND	ND	0.9												
ML25-1		133	42.5	0.9	140.00	-5.00	9.90	**7.07**	44.00	-3.41	2.12	**4.82**	1.00	-10.00	0.14	**14.14**
ML25-1 dup		147	45.5	1.1												
ML31-3		2.4	ND	ND	2.60	-7.69	0.28	**10.88**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML31-3 dup		2.8	ND	ND												
ML32-6		7.7	3.3	2.9	7.25	6.21	0.64	**8.78**	3.26	1.90	0.09	**2.69**	2.60	11.54	0.42	**16.32**
ML32-6 dup		6.8	3.2	2.3												
ML33-1		22.1	26.5	6.0	22.50	-1.78	0.57	**2.51**	27.25	-2.75	1.06	**3.89**	6.20	-3.23	0.28	**4.56**
ML33-1 dup		22.9	28.0	6.4												
ML33-8		3.7	1.4	ND	3.20	15.63	0.71	**22.10**	1.30	7.69	0.14	**10.88**	1.00	0.00	0.00	**0.00**
ML33-8 dup		2.7	1.2	ND												
ML34-0		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML34-0 dup		ND	ND	BLQ												
ML35-2		ND	BLQ	1.5	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.49	-0.67	0.01	**0.95**
ML35-2 dup		ND	BLQ	1.5												
MW38		1.3	ND	ND	1.26	4.88	0.09	**6.89**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
MW38 dup		1.2	ND	ND												

Table J4 **Summary of Organic Results for Duplicates**

Sample	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	Ave TCE (µg/L)	% Diff TCE	Std Dev TCE (µg/L)	% StdDev TCE	Ave c-DCE (µg/L)	% Diff c-DCE	Std Dev c-DCE (µg/L)	% StdDev c-DCE	Ave VC (µg/L)	% Diff VC	Std Dev VC (µg/L)	% Std Dev VC
ML11-6	Jun-97	16.1	13.1	ND	15.80	1.90	0.42	**2.69**	13.10	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML11-6 dup		15.5	13.1	ND												
ML13-2		ND	2.0	1.0	1.00	0.00	0.00	**0.00**	2.15	-6.98	0.21	**9.87**	1.00	0.00	0.00	**0.00**
ML13-2 dup		ND	2.3	ND												
ML14-5		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML14-5 dup		ND	ND	BLQ												
ML15-1		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML15-1 dup		ND	ND	ND												
ML21-6		157	152	36.8	156.00	0.64	1.41	**0.91**	151.50	0.33	0.71	**0.47**	36.95	-0.41	0.21	**0.57**
ML21-6 dup		155	151	37.1												
ML22-2		ND	39.8	3.4	1.00	0.00	0.00	**0.00**	41.20	-3.40	1.98	**4.81**	3.45	-1.45	0.07	**2.05**
ML22-2 dup		ND	42.6	3.5												
ML23-3		3.1	49.8	8.7	3.25	-4.62	0.21	**6.53**	52.15	-4.51	3.32	**6.37**	8.55	1.75	0.21	**2.48**
ML23-3 dup		3.4	54.5	8.4												
ML31-3		3.0	ND	ND	2.80	7.14	0.28	**10.10**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML31-3 dup		2.6	ND	ND												
ML32-6		9.4	7.4	6.5	9.10	3.30	0.42	**4.66**	7.30	1.37	0.14	**1.94**	6.25	4.00	0.35	**5.66**
ML32-6 dup		8.8	7.2	6.0												
ML33-8		1.3	1.1	BLQ	1.35	-3.70	0.07	**5.24**	1.10	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML33-8 dup		1.4	1.1	BLQ												
ML33-0		ND	ND	0.9	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	0.95	-5.26	0.07	**7.44**
ML33-0 dup		ND	ND	BLQ												
ML34-1		3.8	3.1	2.0	3.85	-1.30	0.07	**1.84**	3.05	1.64	0.07	**2.32**	1.90	5.26	0.14	**7.44**
ML34-1 dup		3.9	3.0	1.8												
ML35-4		1.2	8.4	2.6	1.45	-17.24	0.35	**24.38**	8.95	-6.15	0.78	**8.69**	2.95	-11.86	0.49	**16.78**
ML35-4 dup		1.7	9.5	3.3												
MW35D		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
MW35D dup		ND	ND	ND												
MW46		63.9	6.3	2.0	63.30	0.95	0.85	**1.34**	6.20	1.61	0.14	**2.28**	1.95	2.56	0.07	**3.63**
MW46 dup		62.7	6.1	1.9												
BLO923	Sep-97	ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
BLO923DUP		ND	ND	ND												
ML11-6DUP		2.5	4.6	ND	2.55	-1.96	0.07	**2.77**	4.60	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML11-6		2.6	4.6	ND												

Table J4 **Summary of Organic Results for Duplicates**

Sample	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	Ave TCE (µg/L)	% Diff TCE	Std Dev TCE (µg/L)	% StdDev TCE	Ave c-DCE (µg/L)	% Diff c-DCE	Std Dev c-DCE (µg/L)	% StdDev c-DCE	Ave VC (µg/L)	% Diff VC	Std Dev VC (µg/L)	% Std Dev VC
ML11-2DUP		23.9	1.0	ND	28.05	-14.80	5.87	**20.92**	1.15	-13.04	0.21	**18.45**	1.00	0.00	0.00	**0.00**
ML11-2		32.2	1.3	ND												
ML12-4DUP		49.9	27.4	BLQ	49.50	0.81	0.57	**1.14**	27.20	0.74	0.28	**1.04**	1.00	0.00	0.00	**0.00**
ML12-4		49.1	27.0	BLQ												
ML13-2DUP		ND	1.5	0.9	1.00	0.00	0.00	**0.00**	1.55	-3.23	0.07	**4.56**	0.95	-5.26	0.07	**7.44**
ML13-2		ND	1.6	1.0												
ML14-10		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML14-10DUP		ND	ND	ND												
ML14-5DUP		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML14-5		ND	ND	BLQ												
ML15-9DUP		3.7	4.3	1.1	3.80	-2.63	0.14	**3.72**	4.40	-2.27	0.14	**3.21**	1.15	-4.35	0.07	**6.15**
ML15-9		3.9	4.5	1.2												
ML22-4DUP		ND	ND	1.1	1.10	-9.09	0.14	**12.86**	1.00	0.00	0.00	**0.00**	1.05	4.76	0.07	**6.73**
ML22-4		1.2	ND	1.0												
ML23-6DUP		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML23-6		ND	ND	ND												
ML25-1DUP		17.1	6.6	1.4	17.25	-0.87	0.21	**1.23**	6.50	1.54	0.14	**2.18**	1.25	12.00	0.21	**16.97**
ML25-1		17.4	6.4	1.1												
ML31-5B		861	46.3	22.0	866.00	-0.58	7.07	**0.82**	47.65	-2.83	1.91	**4.01**	22.60	-2.65	0.85	**3.75**
ML31-5		871	49.0	23.2												
ML31-2DUP		28.6	ND	ND	29.00	-1.38	0.57	**1.95**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML31-2		29.4	ND	ND												
ML32-4DUP		302	51.4	16.3	313.00	-3.51	15.56	**4.97**	54.50	-5.69	4.38	**8.04**	17.05	-4.40	1.06	**6.22**
ML32-4		324	57.6	17.8												
ML33-5DUP		ND	2.2	3.0	1.00	0.00	0.00	**0.00**	2.20	0.00	0.00	**0.00**	3.00	0.00	0.00	**0.00**
ML33-5		ND	2.2	3.0												
ML33-2A		1.2	1.0	12.0	1.10	9.09	0.14	**12.86**	1.00	0.00	0.00	**0.00**	14.60	-17.81	3.68	**25.18**
ML33-2		ND	BLQ	17.2												
ML34-10	Sep-97	ND	ND	1.0	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	0.95	5.26	0.07	**7.44**
ML34-10 DUP		ND	ND	0.9												
ML34-4D		ND	ND	1.6	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.55	3.23	0.07	**4.56**
ML34-4		ND	ND	1.5												
ML34-2 FDUP		1.1	3.7	2.0	1.00	10.00	0.14	**14.14**	3.70	0.00	0.00	**0.00**	2.20	-9.09	0.28	**12.86**
ML34-2		0.9	3.7	2.4												

Table J4 **Summary of Organic Results for Duplicates**

Sample	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	Ave TCE (µg/L)	% Diff TCE	Std Dev TCE (µg/L)	% StdDev TCE	Ave c-DCE (µg/L)	% Diff c-DCE	Std Dev c-DCE (µg/L)	% StdDev c-DCE	Ave VC (µg/L)	% Diff VC	Std Dev VC (µg/L)	% Std Dev VC
ML35-7 FDUP		ND	1.4	1.9	1.00	0.00	0.00	**0.00**	1.40	0.00	0.00	**0.00**	1.85	2.70	0.07	**3.82**
ML35-7		ND	1.4	1.8												
MW18		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
MW18 Dup		ND	ND	ND												
MW50		548	14.7	ND	542.50	1.01	7.78	**1.43**	16.55	-11.18	2.62	**15.81**	1.05	-4.76	0.07	**6.73**
MW50 FDUP		537	18.4	1.1												
ML-12-4 DUPLICA	Mar-98	52.7	3.8	BLQ	52.88	-0.34	0.25	**0.48**	3.58	6.33	0.32	**8.95**	1.00	0.00	0.00	**0.00**
ML-12-4		53.1	3.4	BLQ												
ML-13-4 DUPLICATE		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.20	-16.91	0.29	**23.91**
ML-13-4		ND	ND	1.4												
ML-14-6 FIELD DUPLICATE		ND	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML-14-6 DUPLICATE		ND	ND	BLQ		0.00				0.00				0.00		
ML-14-6		ND	ND	BLQ		0.00				0.00				0.00		
ML-15-9 DUPLICATE		1.6	BLQ	BLQ	1.45	10.34	0.21	**14.63**	1.00	0.30	0.00	**0.43**	1.00	0.00	0.00	**0.00**
ML-15-9		1.3	1.0	BLQ												
ML-15-7 DUPLICATE		1.5	2.1	1.4	1.40	7.14	0.14	**10.10**	2.01	2.44	0.07	**3.45**	1.39	0.40	0.01	**0.56**
ML-15-7		1.3	2.0	1.4												
ML-21-1 DUPLICATE		3658.0	BLQ	ND	3614.00	1.22	62.23	**1.72**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML-21-1		3570.0	BLQ	ND												
ML-23-2 DUPLICATE		1.1	9.9	2.7	1.05	4.76	0.07	**6.73**	9.61	3.06	0.42	**4.32**	3.08	-13.41	0.58	**18.96**
ML-23-2		BLQ	9.3	3.5												
ML-22.5-5 FIELD DUPLICATE		6.3	6.1	20.5	7.00	-10.00	0.75	**10.79**	6.22	-2.27	0.21	**3.31**	24.89	-17.48	3.78	**15.20**
ML-22.5-5 DUPLICATE		7.8	6.1	26.7		11.43				-1.53				7.42		
ML-22.5-5		6.9	6.5	27.4		-1.43				3.79				10.06		
ML-22.5-1 DUPLICATE		695.2	3.8	BLQ	720.95	-3.57	36.42	**5.05**	3.66	4.58	0.24	**6.48**	1.00	0.00	0.00	**0.00**
ML-22.5-1		746.7	3.5	ND												
ML-24-4 DUPLICA	Mar-98	1.4	8.7	2.2	1.20	16.67	0.28	**23.57**	8.37	3.54	0.42	**5.00**	1.95	13.05	0.36	**18.45**
ML-24-4		ND	8.1	1.7												
ML-24-1 DUPLICATE		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML-24-1		ND	ND	ND												
ML-25-2 FIELD DUPLICATE		2.4	2.9	2.5	2.68	-10.58	0.40	**14.96**	2.74	7.33	0.28	**10.36**	2.82	-11.18	0.45	**15.81**
ML-25-2		3.0	2.5	3.1												
ML-31-6D		318.1	40.2	25.5	315.30	0.89	3.96	**1.26**	40.45	-0.51	0.29	**0.73**	25.67	-0.83	0.30	**1.18**
ML-31-6		312.5	40.7	25.9												

Table J4 **Summary of Organic Results for Duplicates**

Sample	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	Ave TCE (µg/L)	% Diff TCE	Std Dev TCE (µg/L)	% StdDev TCE	Ave c-DCE (µg/L)	% Diff c-DCE	Std Dev c-DCE (µg/L)	% StdDev c-DCE	Ave VC (µg/L)	% Diff VC	Std Dev VC (µg/L)	% Std Dev VC
ML-31-1 Dup		34.3	2.6	2.2	34.10	0.59	0.28	**0.83**	2.85	-8.77	0.35	**12.41**	2.35	-6.38	0.21	**9.03**
ML-31-1		33.9	3.1	2.5												
ML-32-6B		ND	ND	ND	22.25	-95.51	30.05	**135.07**	5.86	-82.92	6.87	**117.27**	5.40	-81.47	6.22	**115.22**
ML-32-6		43.5	10.7	9.8												
ML-32-3D		321.3	3.3	BLQ	321.68	-0.13	0.59	**0.18**	3.26	1.33	0.06	**1.89**	1.00	0.00	0.00	**0.00**
ML-32-3		322.1	3.2	BLQ												
ML-33-9 DUPLICATE		BLQ	ND	BLQ	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML-33-9		ND	ND	ND												
ML-33-7		BLQ	5.1	24.7	1.00	0.00	0.00	**0.00**	5.03	1.52	0.11	**2.15**	24.47	0.83	0.29	**1.18**
ML-33-7D		BLQ	5.0	24.3												
ML-34-1D		1.3	1.5	1.9	1.29	0.08	0.00	**0.11**	1.42	6.72	0.14	**9.50**	1.99	-4.70	0.13	**6.65**
ML-34-1		1.3	1.3	2.1												
ML-35-3 DUPLICATE		2.8	5.6	4.9	2.85	-1.75	0.07	**2.48**	5.65	-0.81	0.07	**1.15**	5.20	-5.99	0.44	**8.47**
ML-35-3		2.9	5.7	5.5												
MW-46 Field Dup		239.5	7.7	2.5	225.78	6.07	19.38	**8.58**	7.27	6.49	0.67	**9.18**	2.48	0.12	0.00	**0.17**
MW-46		212.1	6.8	2.5												
MW-18 DUPLICATE		7.0	6.2	BLQ	6.84	2.34	0.23	**3.31**	7.01	-11.59	1.15	**16.39**	1.00	0.00	0.00	**0.00**
MW-18		6.7	7.8	BLQ												
ML11-8	Jun-98	BLQ	3.0	ND	1.00	0.00	0.00	**0.00**	2.76	9.52	0.37	**13.46**	1.00	0.00	0.00	**0.00**
ML11-8 6/11/98		BLQ	2.5	ND												
ML11-5		53.0	30.4	BLQ	52.99	0.00	0.00	**0.00**	30.42	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML11-5 6/11/98		53.0	30.4	BLQ												
ML12-9		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML12-9 F. Dup		ND	ND	ND												
ML-33-7	Jun-98	ND	3.7	22.9	1.00	0.00	0.00	**0.00**	3.81	-2.92	0.16	**4.12**	23.16	-1.06	0.35	**1.51**
ML-33-7		ND	3.9	23.4												
ML21-5 FDUP	Dec-98	156	137	11.7	153.68	1.36	2.96	**1.93**	135.82	0.79	1.51	**1.11**	12.14	-3.83	0.66	**5.41**
ML21-5		152	135	12.6												
ML22.5-2 FDUP		14.6	2.2	<1.0	14.44	1.09	0.22	**1.54**	2.53	-13.18	0.47	**18.64**	1.00	0.00	0.00	**0.00**
ML22.5-2		14.3	2.9	<1.0												
ML23.5-1 FDUP		3.0	7.0	4.1	2.97	1.82	0.08	**2.57**	7.25	-3.68	0.38	**5.21**	4.25	-3.36	0.20	**4.75**
ML23.5-1		2.9	7.5	4.4												
ML24-7 FDUP		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML24-7		ND	ND	<1.0												

Table J4 **Summary of Organic Results for Duplicates**

Sample	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	Ave TCE (µg/L)	% Diff TCE	Std Dev TCE (µg/L)	% StdDev TCE	Ave c-DCE (µg/L)	% Diff c-DCE	Std Dev c-DCE (µg/L)	% StdDev c-DCE	Ave VC (µg/L)	% Diff VC	Std Dev VC (µg/L)	% Std Dev VC
ML24-1 FDUP		ND	7.8	1.2	1.00	0.00	0.00	**0.00**	8.14	-4.58	0.53	**6.47**	1.30	-7.25	0.13	**10.25**
ML24-1		ND	8.5	1.4												
ML25-4 FDUP		ND	19.0	4.8	1.00	0.00	0.00	**0.00**	19.62	-3.18	0.88	**4.49**	5.04	-5.11	0.36	**7.23**
ML25-4		ND	20.2	5.3												
ML11-7 FDUP		1.2	4.6	ND	1.20	3.33	0.06	**4.71**	4.86	-6.08	0.42	**8.59**	1.00	0.00	0.00	**0.00**
ML11-7		1.2	5.2	ND												
ML11-5 FDUP		26.8	33.2	<1.0	27.48	-2.55	0.99	**3.61**	32.27	2.89	1.32	**4.08**	1.00	0.00	0.00	**0.00**
ML11-5		28.2	31.3	<1.0												
ML12-1 FDUP		11.8	<1.0	ND	11.89	-0.96	0.16	**1.36**	1.05	-4.76	0.07	**6.73**	1.00	0.00	0.00	**0.00**
ML12-1		12.0	1.1	ND												
ML13-5 FDUP		ND	ND	1.0	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.09	-8.30	0.13	**11.74**
ML13-5		ND	ND	1.2												
ML14-7 FDUP		ND	ND	<1.0	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML14-7		ND	ND	<1.0												
ML15-5 FDUP		ND	<1.0	<1.0	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML15-5		ND	<1.0	<1.0												
ML31-3D		6.8	ND	ND	7.24	-5.82	0.60	**8.23**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
ML31-3		7.7	ND	ND												
ML32-5D		470	48.1	17.8	447.75	5.02	31.82	**7.11**	48.96	-1.84	1.27	**2.60**	18.62	-4.54	1.20	**6.43**
ML32-5		425	49.9	19.5												
ML33-7D	Dec-98	ND	2.8	15.6	1.00	0.00	0.00	**0.00**	2.86	-3.27	0.13	**4.63**	16.13	-3.32	0.76	**4.69**
ML33-7		ND	2.9	16.7												
ML34-5 FDUP		ND	1.1	2.9	1.00	0.00	0.00	**0.00**	1.11	0.32	0.00	**0.45**	3.17	-9.44	0.42	**13.34**
ML34-5		ND	1.1	3.5												
MW18		ND	ND	ND	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
MW18 FDUP		ND	ND	ND												
Average	**(n = 96)**					**3.52**		**4.96**		**2.98**		**4.31**		**3.77**		**5.20**

BLQ Below limit of quantitat **Ave** = Average (use absolute value)
BLQ = 1 ppb **% Diff** = % Difference = (Concentration - Ave) / Ave*100
ND None detected **Std Dev** = Standard Deviation
% StdDev = Std Dev / Ave*100

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Table J5 **Summary of Inorganic Results for Blanks**

Field Blanks	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Co (mg/L)	Mo (mg/L)	Al (mg/L)
BLANK CATI	Nov-96	0.27	<2.2	<0.057	0	<0.012	<0.0043	<0.0078	<0.034	<0.050
BLANK EQUI		0.37	<2.2	0.063	<0.14	<0.012	<0.0043	<0.0078	<0.034	<0.050
FIELD BLAN		0.19	<2.2	<0.057	<0.14	<0.012	<0.0043	<0.0078	<0.034	<0.050
DECON BLAN		0.75	<2.2	<0.057	<0.14	<0.012	<0.0043	<0.0078	<0.034	<0.050
DECON BLAN		0.79	<2.2	0.079	<0.14	<0.012	<0.0043	<0.0078	<0.034	<0.050
BLANK#7 .4		0.126	<0.68	0.04	<0.075	<0.0028	<0.0037	<0.0094	<0.0040	<0.098
DECON.45 B		<0.034	<0.68	<0.032	<0.075	0.0036	<0.0037	<0.0094	<0.0040	<0.098
DECON.45 B		0.387	<0.68	<0.032	<0.075	<0.0028	<0.0037	<0.0094	<0.0040	<0.098
ML11-BLANK	Feb-97	0.841	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML12-BLANK		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML14-BLANK		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML15-BLANK		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML31-BLANK		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML32-BLANK		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML33-BLANK		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML34-BLANK		0.056	<0.98	<0.023	<0.077	0.0204	<0.0022	<0.0073	<0.016	<0.039
ML35-BLANK		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
BLANK 226		<0.044	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
BLANK 227		0.909	<0.98	<0.023	<0.077	<0.0067	<0.0022	<0.0073	<0.016	<0.039
ML11-BLANK	Jun-97	0.696	<0.58	<0.013	<0.073	<0.0063	<0.0036	<0.0060	<0.092	<0.026
ML12-BLANK		0.564	<0.58	<0.013	<0.073	0.001	<0.0036	<0.0060	<0.092	<0.026
ML13-BLANK		0.897	<0.58	<0.013	<0.073	<0.0063	<0.0036	<0.0060	<0.092	0.04
ML14-BLANK		0.593	<0.58	<0.013	<0.073	0.0084	<0.0036	<0.0060	<0.092	<0.026
ML15-BLANK		<0.045	0.62	<0.013	<0.073	<0.0063	0.0047	<0.0060	<0.092	<0.026
ML31-BLANK		0.854	<0.53	<0.030	<0.039	0.072	0.0056	<0.0071	<0.056	<0.030
ML32-BLANK		0.895	<0.53	<0.030	<0.039	<0.012	<0.0032	<0.0071	<0.056	<0.030
ML33-BLANK		<0.047	<0.53	0.091	<0.039	<0.012	<0.0032	<0.0071	<0.056	<0.030
ML34-BLANK		0.59	<0.53	0.05	<0.039	<0.012	<0.0032	<0.0071	<0.056	<0.030
ML35-BLANK		0.592	<0.67	<0.039	<0.071	<0.0071	<0.0040	<0.0074	<0.062	<0.027
BL922A	Sep-97	1.016	<0.90	0.342	0.102	<0.0074	<0.0004	<0.0075	<0.011	<0.028
BL922ADUP		1.001	<0.90	0.313	0.071	<0.0074	<0.0004	<0.0075	<0.011	<0.028
WLBLANK970		0.595	<0.90	<0.0058	<0.038	<0.0074	<0.0004	<0.0075	<0.011	<0.028
WLBLANK970		0.562	<0.90	<0.0058	<0.038	<0.0074	<0.0004	<0.0075	<0.011	<0.028
BL922B		0.56	<0.90	<0.0058	<0.038	<0.0074	<0.0004	<0.0075	<0.011	<0.028
BL922BDUP		0.619	<0.90	<0.0058	<0.038	<0.0074	<0.0004	<0.0075	<0.011	<0.028
1-BLANK		0.556	<0.90	<0.0058	<0.038	<0.0074	<0.0004	<0.0075	<0.011	<0.028
1-BLANKDUP		0.58	<0.90	<0.0058	<0.038	<0.0074	<0.0004	<0.0075	<0.011	<0.028
BL0923		0.651	<0.90	<0.0058	<0.038	<0.0074	0.0007	<0.0075	<0.011	<0.028
BL0923DUP		0.632	<0.90	<0.0058	<0.038	<0.0074	<0.0004	<0.0075	<0.011	<0.028
ML12-6BLANK	Mar-98	0.175	<0.79	<0.043	<0.073	<0.019	<0.010	<0.0081	<0.0054	<0.033
ML13BLANK		<0.30	<0.86	0.058	<0.059	<0.0062	<0.0028	<0.0064	<0.018	<0.036
F.BLANK6/9	Jun-98	<0.032	<0.92	<0.024	<0.060	0.0088	<0.0032	<0.0035	<0.010	<0.031
F.BLANK6/12/98		<0.032	<0.92	0.032	<0.060	<0.0028	<0.0032	<0.0035	<0.010	0.049
F.BLANK6/13/98		<0.032	<0.92	0.318	0.141	<0.0028	<0.0032	<0.0035	<0.010	<0.031

Field Blanks	Session	As (mg/L)	Se (mg/L)	Cd (mg/L)	Be (mg/L)	Cu (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)
BLANK CATI	Nov-96	<0.031	<0.036	<0.0027	<0.0035	<0.0047	<0.0029	<0.013	<0.0014
BLANK EQUI		<0.031	<0.036	<0.0027	<0.0035	<0.0047	<0.0029	<0.013	<0.0014
FIELD BLAN		<0.031	<0.036	<0.0027	<0.0035	<0.0047	<0.0029	<0.013	<0.0014
DECON BLAN		<0.031	<0.036	<0.0027	<0.0035	<0.0047	<0.0029	<0.013	<0.0014
DECON BLAN		<0.031	<0.036	<0.0027	<0.0035	<0.0047	<0.0029	<0.013	<0.0014
BLANK#7 .4		<0.025	<0.031	<0.0015	<0.0009	<0.0036	<0.0012	<0.014	<0.0013
DECON.45 B		<0.025	<0.031	<0.0015	<0.0009	<0.0036	<0.0012	<0.014	<0.0013
DECON.45 B		<0.025	<0.031	<0.0015	<0.0009	<0.0036	0.0023	<0.014	<0.0013
ML11-BLANK	Feb-97	<0.014	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	<0.0017
ML12-BLANK		<0.014	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	<0.0017
ML14-BLANK		<0.014	<0.015	<0.0021	<0.0011	0.0035	<0.0036	<0.011	0.0057
ML15-BLANK		<0.014	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	0.0062
ML31-BLANK		<0.014	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	<0.0017
ML32-BLANK		0.023	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	<0.0017
ML33-BLANK		<0.014	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	<0.0017
ML34-BLANK		<0.014	<0.015	<0.0021	<0.0011	<0.0033	0.0051	<0.011	<0.0017
ML35-BLANK		<0.014	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	<0.0017
BLANK 226		<0.014	0.016	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	<0.0017
BLANK 227		<0.014	<0.015	<0.0021	<0.0011	<0.0033	<0.0036	<0.011	0.0035
ML11-BLANK	Jun-97	<0.015	<0.022	<0.0025	<0.0032	<0.0047	<0.0044	<0.011	<0.0015
ML12-BLANK		<0.015	<0.022	<0.0025	<0.0032	<0.0047	<0.0044	<0.011	<0.0015
ML13-BLANK		<0.015	<0.022	<0.0025	<0.0032	<0.0047	<0.0044	<0.011	<0.0015
ML14-BLANK		<0.015	0.025	<0.0025	<0.0032	<0.0047	<0.0044	<0.011	<0.0015
ML15-BLANK		<0.015	<0.022	<0.0025	<0.0032	<0.0047	<0.0044	<0.011	<0.0015
ML31-BLANK		<0.016	<0.016	<0.0013	<0.0028	<0.0052	<0.0037	<0.0072	0.0037
ML32-BLANK		<0.016	<0.016	<0.0013	<0.0028	<0.0052	<0.0037	<0.0072	<0.0009
ML33-BLANK		<0.016	<0.016	<0.0013	<0.0028	<0.0052	<0.0037	<0.0072	0.0057
ML34-BLANK		0.021	<0.016	<0.0013	<0.0028	<0.0052	<0.0037	<0.0072	0.0012
ML35-BLANK		<0.012	<0.024	<0.0022	<0.0035	<0.0052	<0.0020	<0.0098	0.0028
BL922A	Sep-97	<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	<0.0022
BL922ADUP		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	<0.0022
WLBLANK970		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	<0.0022
WLBLANK970		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	<0.0022
BL922B		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	0.0027
BL922BDUP		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	0.0032
1-BLANK		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	<0.0022
1-BLANKDUP		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	<0.0022
BL0923		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	0.0003
BL0923DUP		<0.020	<0.024	<0.0023	<0.0004	<0.0036	<0.0041	<0.014	0.0026
ML12-6BLANK	Mar-98	<0.019	<0.029	<0.0028	<0.0018	<0.0063	<0.0034	<0.013	0.0071
ML13BLANK		<0.020	<0.021	0.0015	<0.0012	<0.0025	<0.0025	<0.015	<0.016
F.BLANK6/9	Jun-98	<0.024	<0.021	<0.0013	<0.0018	<0.0054	<0.0016	<0.010	<0.0012
F.BLANK6/12/98		<0.024	<0.021	<0.0013	<0.0018	<0.0054	<0.0016	<0.010	<0.0012
F.BLANK6/13/98		<0.024	<0.021	<0.0013	<0.0018	<0.0054	<0.0016	<0.010	<0.0012

Field Blanks	Session	Ag (mg/L)	Tl (mg/L)	Pb (mg/L)	Sr (mg/L)	V (mg/L)	Ba (mg/L)	B (mg/L)	Ti (mg/L)
BLANK CATI	Nov-96	<0.0063	<0.014	<0.021	<0.0006	<0.010	<0.0020	<0.029	<0.016
BLANK EQUI		<0.0063	<0.014	<0.021	<0.0006	<0.010	<0.0020	<0.029	<0.016
FIELD BLAN		<0.0063	<0.014	<0.021	<0.0006	<0.010	<0.0020	<0.029	<0.016
DECON BLAN		<0.0063	<0.014	<0.021	<0.0006	<0.010	<0.0020	<0.029	<0.016
DECON BLAN		<0.0063	<0.014	<0.021	<0.0006	<0.010	<0.0020	<0.029	<0.016
BLANK#7 .4		<0.0068	<0.025	<0.0031	0.0009	<0.017	<0.0022	<0.036	<0.0041
DECON.45 B		<0.0068	<0.025	<0.0031	<0.0005	<0.017	<0.0022	<0.036	<0.0041
DECON.45 B		<0.0068	<0.025	<0.0031	<0.0005	<0.017	<0.0022	<0.036	<0.0041
ML11-BLANK	Feb-97	<0.0054	<0.022	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
ML12-BLANK		<0.0054	<0.022	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
ML14-BLANK		<0.0054	<0.022	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
ML15-BLANK		<0.0054	<0.022	<0.015	<0.0005	0.0013	<0.0021	<0.030	<0.0053
ML31-BLANK		<0.0054	<0.022	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
ML32-BLANK		<0.0054	<0.022	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
ML33-BLANK		<0.0054	0.026	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
ML34-BLANK		<0.0054	<0.022	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
ML35-BLANK		<0.0054	<0.022	<0.015	<0.0005	0.0061	<0.0021	<0.030	<0.0053
BLANK 226		<0.0054	<0.022	<0.015	<0.0005	<0.0046	<0.0021	<0.030	<0.0053
BLANK 227		<0.0054	<0.022	<0.015	0.0015	0.0067	0.0163	0.033	<0.0053
ML11-BLANK	Jun-97	<0.0026	<0.026	<0.0092	<0.0001	<0.0065	<0.0033	<0.046	<0.0073
ML12-BLANK		<0.0026	<0.026	<0.0092	<0.0001	<0.0065	<0.0033	<0.046	<0.0073
ML13-BLANK		<0.0026	<0.026	<0.0092	0.0002	<0.0065	<0.0033	<0.046	<0.0073
ML14-BLANK		<0.0026	<0.026	<0.0092	<0.0001	<0.0065	<0.0033	<0.046	<0.0073
ML15-BLANK		<0.0026	<0.026	<0.0092	0.0002	<0.0065	<0.0033	<0.046	<0.0073
ML31-BLANK		<0.0054	<0.033	<0.011	<0.0003	<0.0085	<0.0015	<0.056	<0.0089
ML32-BLANK		<0.0054	<0.033	<0.011	<0.0003	<0.0085	<0.0015	<0.056	<0.0089
ML33-BLANK		<0.0054	<0.033	<0.011	<0.0003	<0.0085	<0.0015	<0.056	<0.0089
ML34-BLANK		<0.0054	<0.033	<0.011	0.0012	<0.0085	<0.0015	<0.056	<0.0089
ML35-BLANK		0.0039	<0.029	<0.0085	<0.0001	<0.0043	<0.0025	<0.055	<0.0049
BL922A	Sep-97	<0.0049	<0.014	<0.017	0.0022	<0.010	<0.0023	<0.14	<0.013
BL922ADUP		<0.0049	<0.014	<0.017	0.002	<0.010	<0.0023	<0.14	<0.013
WLBLANK970		<0.0049	0.021	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
WLBLANK970		<0.0049	0.023	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
BL922B		<0.0049	<0.014	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
BL922BDUP		<0.0049	<0.014	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
1-BLANK		<0.0049	0.014	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
1-BLANKDUP		<0.0049	<0.014	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
BL0923		<0.0049	0.008	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
BL0923DUP		<0.0049	<0.014	<0.017	<0.0004	<0.010	<0.0023	<0.14	<0.013
ML12-6BLANK	Mar-98	<0.0030	<0.028	<0.020	0.001	<0.013	<0.0050	<0.079	<0.013
ML13BLANK		<0.0027	<0.030	<0.0060	0.0008	<0.0060	<0.0034	<0.060	<0.010
F.BLANK6/9	Jun-98	<0.0033	<0.036	<0.019	<0.0002	<0.0036	<0.0004	<0.018	<0.0080
F.BLANK6/12/98		<0.0033	<0.036	<0.019	0.0002	0.0099	<0.0004	<0.018	<0.0080
F.BLANK6/13/98		<0.0033	<0.036	<0.019	0.0011	<0.0036	0.0018	<0.018	<0.0080

Field Blanks	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Co (mg/L)	Mo (mg/L)	Al (mg/L)
F.BLANK6/15/98		<0.032	<0.92	0.194	<0.060	<0.0028	<0.0032	0.0065	<0.010	<0.031
F.BLANK6/16/98		<0.032	<0.92	<0.024	<0.060	<0.0028	<0.0032	<0.0035	<0.010	<0.031
ML12-3BLK		0.254	<0.43	<0.026	<0.034	0.0042	<0.0040	<0.0059	<0.0029	<0.023
ML13BLK		0.189	<0.43	<0.026	<0.034	<0.0026	<0.0040	<0.0059	<0.0029	<0.023
ML14BLANK		1.03	<0.43	0.081	<0.034	<0.0026	<0.0040	0.0066	<0.0029	<0.023
ML15BLK		5.03	<0.43	1.59	0.65	<0.0026	<0.0040	<0.0059	<0.0029	<0.023
ML31BLK		0.641	<0.43	<0.026	<0.034	<0.0026	<0.0040	<0.0059	<0.0029	<0.023
ML32BLK		0.249	<0.43	<0.026	<0.034	<0.0026	<0.0040	<0.0059	<0.0029	<0.023
ML33BLK		0.015	<0.43	<0.026	<0.034	<0.0026	<0.0040	0.0063	<0.0029	<0.023
ML35 BLK		0.117	<0.43	<0.026	<0.034	<0.0026	0.0054	<0.0059	<0.0029	<0.023
FB 12/3	Dec-98	0.254	<0.23	<0.028	<0.029	0	<0.0029	<0.0047	<0.0035	<0.030
FB 12/4		<0.021	<0.23	<0.028	<0.029	0	<0.0029	<0.0047	<0.0035	<0.030
FB 12/5		<0.021	<0.23	<0.028	<0.029	0	<0.0029	<0.0047	<0.0035	<0.030
FB 12/6		<0.021	0.28	<0.028	<0.029	0.0033	<0.0029	<0.0047	<0.0035	<0.030
FB 12/9		<0.021	<0.23	<0.028	<0.029	0	<0.0029	<0.0047	<0.0035	<0.030
FB 12/10		<0.021	<0.23	<0.028	<0.029	0.0034	<0.0029	<0.0047	<0.0035	<0.030
ML31 BLANK**		0.415	<0.23	<0.028	<0.029	0.0034	<0.0029	<0.0047	<0.0035	<0.030
ML32 BLANK**		1.3	<0.23	<0.028	<0.029	0	<0.0029	<0.0047	<0.0035	<0.030
ML33 BLANK**		1.55	<0.23	<0.028	<0.029	0.0167	<0.0029	<0.0047	<0.0035	<0.030

Trip Blanks	Session	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Mn (mg/L)	Co (mg/L)	Mo (mg/L)	Al (mg/L)
TRIP BLANK	Feb-97	0.82	<0.50	0.042	<0.035	0.0149	<0.0028	<0.0055	<0.010	<0.027
TRIP BLANK	Jun-97	<0.047	<0.67	0.073	<0.071	<0.0071	0.0066	<0.0074	<0.062	<0.027
TRIP BLANK dup	Jun-97	0.067	<0.67	0.052	<0.071	<0.0071	0.0082	<0.0074	<0.062	<0.027
TRIP B.6/9	Jun-98	<0.032	<0.92	<0.024	<0.060	<0.0028	<0.0032	<0.0035	<0.010	<0.031
TRIPBLK(UW)	Jun-98	5.11	<0.43	1.69	0.698	<0.0026	0.0077	<0.0059	<0.0029	<0.023

Field Blanks	Session	As (mg/L)	Se (mg/L)	Cd (mg/L)	Be (mg/L)	Cu (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)
F.BLANK6/15/98		<0.024	<0.021	<0.0013	<0.0018	<0.0054	<0.0016	<0.010	<0.0012
F.BLANK6/16/98		<0.024	<0.021	<0.0013	<0.0018	<0.0054	<0.0016	<0.010	<0.0012
ML12-3BLK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	0.0102	<0.0014
ML13BLK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	0.0052	<0.0014
ML14BLANK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	0.013	<0.0014
ML15BLK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	<0.0043	<0.0014
ML31BLK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	<0.0043	<0.0014
ML32BLK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	0.0032	<0.0043	<0.0014
ML33BLK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	<0.0043	<0.0014
ML35 BLK		<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	<0.0043	<0.0014
FB 12/3	Dec-98	<0.020	<0.019	<0.0017	<0.0005	<0.0041	0.0023	<0.011	<0.0014
FB 12/4		<0.020	<0.019	<0.0017	<0.0005	<0.0041	0.0024	<0.011	<0.0014
FB 12/5		<0.020	<0.019	<0.0017	<0.0005	<0.0041	<0.0019	<0.011	<0.0014
FB 12/6		<0.020	<0.019	<0.0017	<0.0005	<0.0041	0.0024	<0.011	<0.0014
FB 12/9		<0.020	0.021	<0.0017	<0.0005	<0.0041	<0.0019	<0.011	<0.0014
FB 12/10		<0.020	<0.019	<0.0017	<0.0005	<0.0041	<0.0019	<0.011	<0.0014
ML31 BLANK**		<0.020	<0.019	0.0018	<0.0005	<0.0041	<0.0019	<0.011	<0.0014
ML32 BLANK**		<0.020	<0.019	<0.0017	<0.0005	<0.0041	0.0024	<0.011	<0.0014
ML33 BLANK**		<0.020	<0.019	<0.0017	<0.0005	<0.0041	<0.0019	0.016	<0.0014

Trip Blanks	Session	As (mg/L)	Se (mg/L)	Cd (mg/L)	Be (mg/L)	Cu (mg/L)	Cr (mg/L)	Ni (mg/L)	Zn (mg/L)
TRIP BLANK	Feb-97	<0.010	<0.017	<0.0019	<0.0015	<0.0040	<0.0028	<0.010	0.0024
TRIP BLANK	Jun-97	0.014	<0.024	<0.0022	<0.0035	<0.0052	<0.0020	<0.0098	<0.0010
TRIP BLANK dup	Jun-97	<0.012	<0.024	<0.0022	<0.0035	<0.0052	<0.0020	0.0105	0.0027
TRIP B.6/9	Jun-98	<0.024	<0.021	<0.0013	<0.0018	<0.0054	<0.0016	<0.010	<0.0012
TRIPBLK(UW)	Jun-98	<0.020	<0.029	<0.0018	<0.0007	<0.0027	<0.0031	<0.0043	<0.0014

Field Blanks	Session	Ag (mg/L)	Tl (mg/L)	Pb (mg/L)	Sr (mg/L)	V (mg/L)	Ba (mg/L)	B (mg/L)	Ti (mg/L)
F.BLANK6/15/98		<0.0033	<0.036	<0.019	0.0003	<0.0036	<0.0004	<0.018	<0.0080
F.BLANK6/16/98		<0.0033	<0.036	<0.019	<0.0002	<0.0036	<0.0004	<0.018	<0.0080
ML12-3BLK		<0.0032	<0.016	<0.011	<0.0001	<0.0055	<0.0013	<0.018	<0.015
ML13BLK		<0.0032	0.016	<0.011	<0.0001	<0.0055	<0.0013	<0.018	<0.015
ML14BLANK		<0.0032	<0.016	<0.011	0.0021	<0.0055	<0.0013	<0.018	<0.015
ML15BLK		<0.0032	<0.016	<0.011	0.0141	<0.0055	0.0027	<0.018	<0.015
ML31BLK		<0.0032	<0.016	<0.011	<0.0001	<0.0055	<0.0013	<0.018	<0.015
ML32BLK		<0.0032	<0.016	<0.011	0.0003	0.0067	<0.0013	<0.018	<0.015
ML33BLK		<0.0032	<0.016	<0.011	0.0002	<0.0055	<0.0013	<0.018	<0.015
ML35 BLK		<0.0032	<0.016	<0.011	<0.0001	<0.0055	<0.0013	<0.018	<0.015
FB 12/3	Dec-98	<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044
FB 12/4		<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044
FB 12/5		<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044
FB 12/6		0.0026	<0.025	<0.014	<0.0002	0.0129	<0.0012	<0.016	<0.0044
FB 12/9		<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044
FB 12/10		<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044
ML31 BLANK**		<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044
ML32 BLANK**		<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044
ML33 BLANK**		<0.0023	<0.025	<0.014	<0.0002	<0.0059	<0.0012	<0.016	<0.0044

Trip Blanks	Session	Ag (mg/L)	Tl (mg/L)	Pb (mg/L)	Sr (mg/L)	V (mg/L)	Ba (mg/L)	B (mg/L)	Ti (mg/L)
TRIP BLANK	Feb-97	<0.011	<0.014	<0.014	<0.0003	<0.0058	<0.0022	0.036	<0.014
TRIP BLANK	Jun-97	0.0033	<0.029	<0.0085	0.0005	<0.0043	<0.0025	<0.055	<0.0049
TRIP BLANK dup	Jun-97	<0.0027	<0.029	<0.0085	0.0005	<0.0043	<0.0025	<0.055	<0.0049
TRIP B.6/9	Jun-98	<0.0033	<0.036	<0.019	<0.0002	0.0042	<0.0004	<0.018	<0.0080
TRIPBLK(UW)	Jun-98	<0.0032	<0.016	<0.011	0.015	<0.0055	0.004	<0.018	<0.015

Table J6 **Summary of Anion Results for Blanks**

Field Blanks	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
Field blank	Nov-96	<.5	<.5	<.05	<.05	
blank		<.5	<.5	<.05	<.05	
blank		<.5	<.5	<.05	<.05	
ML field blank		<.5	<.5	<.05	<.05	
Decon blank 11/19		<.5	<.5	<.05	<.05	
blank 4		<.5	<.5	<.05	<.05	
ML decon blank 11/20		<.5	<.5	<.05	<.05	
ML blank		<.5	<.5	<.05	<.05	
no data	Feb-97					
ML11-blank	Jun-97	<.1	<.1	<.1	<.1	
ML12-blank		<.1	<.1	<.1	<.1	
ML13-blank		<.1	<.1	<.1	<.1	
ML14-blank		<.1	0.33	<.1	<.1	
ML31-blank		<.1	<.1	<.1	<.1	
ML32-blank		<.1	<.1	<.1	<.1	
ML33-blank		<.1	<.1	<.1	<.1	
ML34-blank		<.1	<.1	<.1	<.1	
ML35-blank		<.1	<.1	<.1	<.1	
Field bl 6/20		<.1	<.1	<.1	<.1	
Field bl 6/21		<.1	<.1	<.1	<.1	
Field bl 6/24		<.1	<.1	<.1	<.1	
Field bl 6/25		<.1	<.1	<.1	<.1	
F. Blank	Sep-97	2.7	<1			<.1
9/17 F. Blank		<2	<1			<.1
9/18 F. Blank		<2	<1			<.1
9/21 F. Blank		<2	<1			<.1
9/23 F. Blank		<2	<1			<.1
ML 12-0 blk	Mar-98	<.1	<.1	<.1	<.1	
ML 13 (field blank)		<.1	<.1	<.1	<.1	
ML 14 (field blank)		<.1	<.1	<.1	<.1	
FB 3-10-98		10	9.57	<.1	<.1	
FB 3-12-98		9.5	9.41	<.1	<.1	
FB 3-13-98		9.62	9.46	<.1	<.1	
FB 3-14-98		3.4	<.1	<.1	0.12	
FB 3-17-98		1.88	<.1	<.1	<.1	
FB 3-18-98		9.78	9.34	<.1	<.1	
6/9 field blank	Jun-98	<.1	<.1	<.1	<.1	
6/12 field blank		<.1	0.28	<.1	<.1	
6/13 field blank		<.1	<.1	<.1	<.1	
6/15 field blank		0.24	<.1	<.1	<.1	
6/16 field blank		<.1	<.1	<.1	<.1	

Table J6 **Summary of Anion Results for Blanks**

Field Blanks	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
F.B. 12-3	Dec-98	<0.1	<0.1	<0.1	<0.1	
F.B. 12-4		<0.1	<0.1	<0.1	<0.1	
F.B. 12-5		<0.1	<0.1	<0.1	<0.1	
F.B. 12-6		<0.1	<0.1	<0.1	<0.1	
F.B. 12-9		<0.1	<0.1	<0.1	<0.1	
F.B.12-10		<0.1	<0.1	<0.1	<0.1	

Trip Blanks	Session	Cl (mg/L)	SO_4 (mg/L)	NO_2 (mg/L N)	NO_3 (mg/L N)	$NO_2 + NO_3$ (mg/L N)
Trip blank	Nov-96	<.5	<.5	<.05	<.05	
Trip blank	Jun-97	<.1	1.22	<.1	<.1	
Trip blank	Jun-97	<.1	1.53	<.1	<.1	
Trip Blank	Mar-98	<.1	<.1	<.1	<.1	
6/9 trip blank	Jun-98	<.1	<.1	<.1	<.1	
6/16 travel blank	Jun-98	1.81	4.99	<.1	<.1	
12-1 TRIP BLANK	Dec-98	<0.1	<0.1	<0.1	<0.1	

Table J7 **Summary of Organic Results for Blanks**

Field Blanks	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)
Decon Blank	Nov-96	ND	ND	ND
Equipment Blank		ND	ND	ND
Field Blank 11/7		ND	ND	ND
Field Blank 11/9		ND	ND	ND
Field Blank 11/12		ND	ND	ND
no data	Feb-97			
ML11-blank	Jun-97	1.1	ND	ND
ML12-blank		ND	ND	ND
ML13-blank		ND	ND	ND
ML14-blank		ND	ND	ND
ML31-blank		ND	ND	ND
ML32-blank		ND	ND	ND
ML33-blank		ND	ND	ND
ML34-blank		ND	ND	ND
ML35-blank		ND	ND	ND
Field bl 6/21		ND	ND	ND
Field bl 6/24		ND	ND	ND
Field bl 6/25		ND	ND	ND
Field blank		ND	ND	ND
Blank 9/17	Sep-97	ND	ND	ND
Blank 9/18		ND	ND	ND
Blank 9/21		ND	ND	ND
Blank 9/22		ND	ND	ND
Blank 9/23		ND	ND	ND
BLO922A		ND	ND	ND
BLO922B		ND	ND	ND
BLO923		ND	ND	ND
BLO923DUP		ND	ND	ND
FIELD BLANK 3\17\98	Mar-98	ND	4.9	ND
FIELD BLANK 3\18\98		ND	1.1	ND
FIELD BLANK 3\15\98		ND	ND	ND
FIELD BLANK 3\10\98		BLQ	7.8	ND
FIELD BLANK 3\11\98		BLQ	8.6	ND
FIELD BLANK 3\12\98		BLQ	4.5	ND
FIELD BLANK 3\13\98		ND	4.8	ND
FIELD BLANK 3/14/98		ND	7.3	ND
FIELD BLANK 6\9\98	Jun-98	ND	ND	ND
FIELD BLANK 6\12\98		ND	4.4	ND
FIELD BLANK 6\13\98		ND	7.1	ND
FIELD BLANK 6\15\98		ND	6.1	ND
FIELD BLANK 6\16\98		ND	7.6	ND
ML-14-BLANK		ND	ND	ND
ML-15 BLANK		ND	ND	ND
ML-32-BLANK		ND	1.7	ND

Table J7 **Summary of Organic Results for Blanks**

Field Blanks	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)
FIELD BLANK 12\3\98	Dec-98	ND	ND	ND
FIELD BLANK12/6/98		ND	1.666	ND
FIELD BLANK12/9/98		ND	ND	<1.0
FIELD BLANK12/10/98		ND	1.209	<1.0
ML31-BLANK		ND	2.41	ND
ML32-BLANK		ND	ND	ND
ML33-BLANK		ND	ND	ND

Trip Blanks	Session	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)
Trip Blank	Nov-96	ND	ND	ND
Trip blank	Jun-97	ND	ND	ND
TRIP BLANK 1	Mar-98	ND	ND	ND
TRIP BLANK 2	Mar-98	ND	ND	ND
TRIP BLANK 6\9\98	Jun-98	ND	ND	ND
TRIP BLANK 6\16\98	Jun-98	ND	ND	ND
TRIP BLANK 12\1\98	Dec-98	ND	ND	ND

ND None detected

Table J8 Comparison of Organic Samples Analyzed by ManTech and UW

Sample	Session	EPA Analyzed			UW Analyzed			Ave	% Diff
		TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	TCE (µg/L)	TCE
ML31-0	Nov-96	144	ND	ND	149	6	ND	146.50	-1.71
ML31-2		136	ND	ND	135	ND	ND	135.50	0.37
ML31-4		108	ND	ND	111	ND	ND	109.50	-1.37
ML31-6		356	49.3	31.3	352	88	55.7	354.00	0.56
ML31-8		205	34.1	19.9	213	75	28.4	209.00	-1.91
ML31-10		5.4	2.2	2.8	5.4	ND	2.8	5.40	0.00
ML32-0		169	1.7	BLQ	188	ND	ND	178.50	-5.32
ML32-2		78.5	ND	ND	74	ND	ND	76.25	2.95
ML32-4		465	47.8	26	482	63	18.3	473.50	-1.80
ML32-6		48	7.3	4.1	46	ND	4.5	47.00	2.13
ML32-8		2.5	1.3	BLQ	2.6	ND	ND	2.55	-1.96
ML32-10		5.5	BLQ	ND	NA	NA	NA	NA	NA
ML33-0		ND	1.3	1.4	1	ND	ND	1.00	0.00
ML33-2		23.4	13.4	3.5	20	ND	1.2	21.70	7.83
ML33-4		10.7	13.8	5.5	9.8	ND	2.3	10.25	4.39
ML33-6		2.2	3.3	1.2	2.7	ND	ND	2.45	-10.20
ML33-8		6.9	2.4	BLQ	7.8	ND	ND	7.35	-6.12
ML33-10		8.5	3.8	BLQ	8.4	ND	ND	8.45	0.59
ML34-0		ND	ND	1.4	ND	ND	ND	1.00	0.00
ML34-2		5.3	16.4	5.7	5.3	28	3.1	5.30	0.00
ML34-4		ND	1.5	1.9	ND	ND	ND	1.00	0.00
ML34-6		ND	BLQ	1.2	ND	ND	ND	1.00	0.00
ML34-8		ND	1.3	1.6	1.1	ND	ND	1.05	-4.76
ML34-10		ND	BLQ	ND	1.8	ND	ND	1.40	-28.57
ML35-0		3.7	BLQ	1.1	3.7	ND	ND	3.70	0.00
ML35-2		ND	1.1	1.1	1.1	ND	ND	1.05	-4.76
ML35-4		ND	6.5	2.2	ND	ND	ND	1.00	0.00
ML35-6		1.7	1.2	1.6	1.7	ND	ND	1.70	0.00
ML35-8		3.5	2.9	4.9	2.6	ND	2.6	3.05	14.75
ML35-10		ND	ND	ND	ND	ND	ND	1.00	0.00
ML31-0	Feb-97	49.5	ND	ND	53	6	ND	51.25	-3.41
ML31-2		45.6	BLQ	ND	50	ND	ND	47.80	-4.60
ML31-4		531	BLQ	ND	545	ND	ND	538.00	-1.30
ML31-6		680	52.2	30	692	54	37	686.00	-0.87
ML31-8		73.5	14.1	7.5	84	13	7	78.74	-6.67
ML31-10		4.5	2.1	3.6	6	ND	ND	5.27	-13.78
ML32-0		80.9	6.6	BLQ	74	10	ND	77.46	4.47
ML32-2		4.7	1.0	ND	644	ND	ND	324.34	-98.56
ML32-4		724	64.9	36.8	6.1	68	27	365.05	98.33
ML32-6		7.7	3.3	2.9	7	ND	6	7.35	4.76
ML32-8		2.0	1.3	BLQ	2.1	ND	ND	2.06	-1.97
ML32-10		4.8	BLQ	ND	ND	ND	ND	2.92	65.79
ML33-0		ND	BLQ	1.1	ND	ND	ND	1.00	0.00
ML33-2		4.9	26.5	28.8	2.8	20	20	3.87	27.60
ML33-4		BLQ	1.8	2.0	ND	ND	ND	1.00	0.00

Std Dev TCE (μg/L)	% StdDev TCE	Ave c-DCE (μg/L)	% Diff c-DCE	Std Dev c-DCE (μg/L)	% StdDev c-DCE	Ave VC (μg/L)	% Diff VC	Std Dev VC (μg/L)	% Std Dev VC
3.54	**2.41**	3.55	-71.83	3.61	**101.58**	1.00	0.00	0.00	**0.00**
0.71	**0.52**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
2.12	**1.94**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
2.83	**0.80**	68.80	-28.34	27.58	**40.08**	43.50	-28.05	17.25	**39.66**
5.66	**2.71**	54.45	-37.37	28.78	**52.85**	24.15	-17.60	6.01	**24.89**
0.00	**0.00**	1.60	37.50	0.85	**53.03**	2.80	0.00	0.00	**0.00**
13.44	**7.53**	1.35	25.93	0.49	**36.66**	1.00	0.00	0.00	**0.00**
3.18	**4.17**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
12.02	**2.54**	55.15	-13.33	10.39	**18.85**	22.15	17.38	5.44	**24.58**
1.41	**3.01**	4.15	75.90	4.45	**107.34**	4.30	-4.65	0.28	**6.58**
0.07	**2.77**	1.15	13.04	0.21	**18.45**	1.00	0.00	0.00	**0.00**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
0.00	**0.00**	1.15	13.04	0.21	**18.45**	1.20	16.67	0.28	**23.57**
2.40	**11.08**	7.20	86.11	8.77	**121.78**	2.35	48.94	1.63	**69.21**
0.64	**6.21**	7.40	86.49	9.05	**122.31**	3.90	41.03	2.26	**58.02**
0.35	**14.43**	2.15	53.49	1.63	**75.64**	1.10	9.09	0.14	**12.86**
0.64	**8.66**	1.70	41.18	0.99	**58.23**	1.00	0.00	0.00	**0.00**
0.07	**0.84**	2.40	58.33	1.98	**82.50**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.20	16.67	0.28	**23.57**
0.00	**0.00**	22.35	-26.62	8.41	**37.65**	4.40	29.55	1.84	**41.78**
0.00	**0.00**	1.25	20.00	0.35	**28.28**	1.45	31.03	0.64	**43.89**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.10	9.09	0.14	**12.86**
0.07	**6.73**	1.15	13.04	0.21	**18.45**	1.30	23.08	0.42	**32.64**
0.57	**40.41**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.05	4.76	0.07	**6.73**
0.07	**6.73**	1.05	4.76	0.07	**6.73**	1.05	4.76	0.07	**6.73**
0.00	**0.00**	3.75	73.33	3.89	**103.71**	1.60	37.50	0.85	**53.03**
0.00	**0.00**	1.10	9.09	0.14	**12.86**	1.30	23.08	0.42	**32.64**
0.64	**20.87**	1.95	48.72	1.34	**68.90**	3.75	30.67	1.63	**43.37**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
2.47	**4.83**	3.55	-71.83	3.61	**101.58**	1.00	0.00	0.00	**0.00**
3.11	**6.51**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
9.90	**1.84**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
8.49	**1.24**	53.10	-1.69	1.27	**2.40**	33.50	-10.45	4.95	**14.78**
7.43	**9.44**	13.55	4.08	0.78	**5.78**	7.27	3.69	0.38	**5.22**
1.03	**19.48**	1.57	36.22	0.80	**51.23**	2.29	56.31	1.82	**79.64**
4.90	**6.32**	8.31	-20.34	2.39	**28.76**	1.00	0.00	0.00	**0.00**
452.07	**139.38**	1.01	0.70	0.01	**0.98**	1.00	0.00	0.00	**0.00**
507.63	**139.06**	66.46	-2.32	2.18	**3.28**	31.89	15.34	6.92	**21.69**
0.49	**6.73**	2.16	53.75	1.64	**76.01**	4.45	-34.83	2.19	**49.26**
0.06	**2.78**	1.17	14.64	0.24	**20.70**	1.00	0.00	0.00	**0.00**
2.72	**93.05**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.07	6.72	0.10	**9.50**
1.51	**39.03**	23.26	14.02	4.61	**19.83**	24.39	17.99	6.20	**25.44**
0.00	**0.00**	1.41	28.93	0.58	**40.91**	1.48	32.36	0.68	**45.77**

Table J8 **Comparison of Organic Samples Analyzed by ManTech and UW**

Sample	Session	EPA Analyzed			UW Analyzed			Ave	% Diff
		TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	TCE (µg/L)	c-DCE (µg/L)	VC (µg/L)	TCE (µg/L)	TCE
ML33-6		1.7	1.8	1.1	1.4	ND	ND	1.53	8.56
ML33-8		3.7	1.4	ND	ND	ND	ND	2.35	57.45
ML33-10		NA	NA	NA	2.9	ND	ND	NA	NA
ML34-0		ND	ND	BLQ	ND	ND	ND	1.00	0.00
ML34-2		8.3	18.1	4.4	6.5	20	ND	7.39	12.10
ML34-4		ND	BLQ	1.5	ND	ND	ND	1.00	0.00
ML34-6		ND	BLQ	1.7	ND	ND	ND	1.00	0.00
ML34-8		ND	1.1	1.2	NA	NA	NA	NA	NA
ML34-10		ND	2.0	1.6	ND	ND	ND	1.00	0.00
ML35-0		23.0	ND	ND	20	ND	ND	21.52	7.08
ML35-2		ND	BLQ	1.5	ND	ND	ND	1.00	0.00
ML35-4		2.8	22.4	3.7	2.6	31	ND	2.68	2.80
ML35-6		0.9	1.4	2.7	1	ND	ND	0.96	-4.38
ML35-8		BLQ	1.5	4.2	ND	ND	ND	1.00	0.00
ML35-10		ND	1.3	1.6	ND	ND	ND	1.00	0.00
ML31-0	Jun-97	80.3	ND	ND	93	ND	ND	86.65	-7.33
ML31-2		42.3	ND	ND	23	ND	ND	32.65	29.56
ML31-4		180	ND	ND	198	ND	ND	189.00	-4.76
ML31-6		635	42.9	29.7	663	63	39	649.00	-2.16
ML31-8	Jun-97	109	14.9	13.6	92	8.6	ND	100.50	8.46
ML31-10		3.8	6.3	10.4	3.8	ND	ND	3.80	0.00
ML32-0		84.6	1.7	ND	92	ND	ND	88.30	-4.19
ML32-2		7.1	ND	ND	7	ND	ND	7.05	0.71
ML32-4		421	25.1	11.7	396	2.5	3.9	408.50	3.06
ML32-6		9.1	7.3	6.3	11	ND	ND	10.05	-9.45
ML32-8		1.4	5.1	7.3	1.1	ND	ND	1.25	12.00
ML32-10		3.0	ND	ND	3.1	BLQ	ND	3.05	-1.64
ML33-0		ND	ND	0.9	ND	ND	ND	1.00	0.00
ML33-2		4.9	3.4	16.3	2.7	ND	16	3.80	28.95
ML33-4		ND	3.2	2.9	ND	ND	ND	1.00	0.00
ML33-6		ND	1.2	2.1	ND	ND	ND	1.00	0.00
ML33-8		1.4	1.1	BLQ	1	BLQ	ND	1.20	16.67
ML33-10		0.9	ND	ND	ND	ND	ND	0.95	-5.26
ML34-0		ND	ND	BLQ	ND	ND	ND	1.00	0.00
ML34-2		1.2	5.1	1.7	BLQ	2.6	ND	1.10	9.09
ML34-4		ND	ND	1.2	ND	ND	ND	1.00	0.00
ML34-6		ND	ND	1.3	ND	ND	ND	1.00	0.00
ML34-8		ND	ND	1.1	ND	ND	ND	1.00	0.00
ML34-10		ND	ND	1.0	ND	ND	ND	1.00	0.00
ML35-0		2.7	ND	BLQ	2.4	ND	ND	2.55	5.88
ML35-2		ND	ND	1.8	ND	ND	ND	1.00	0.00
ML35-4		1.5	9.0	3.0	1.1	5.2	ND	1.30	15.38
ML35-6		ND	ND	1.8	ND	ND	ND	1.00	0.00
ML35-8		ND	1.3	3.2	ND	ND	ND	1.00	0.00
ML35-10		ND	1.8	1.7	ND	ND	ND	1.00	0.00

Std Dev TCE (μg/L)	% StdDev TCE	Ave c-DCE (μg/L)	% Diff c-DCE	Std Dev c-DCE (μg/L)	% StdDev c-DCE	Ave VC (μg/L)	% Diff VC	Std Dev VC (μg/L)	% Std Dev VC
0.19	**12.10**	1.40	28.57	0.57	**40.41**	1.07	6.72	0.10	**9.50**
1.91	**81.24**	1.20	16.67	0.28	**23.57**	1.00	0.00	0.00	**0.00**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
1.27	**17.11**	19.06	-4.96	1.34	**7.01**	2.71	63.15	2.42	**89.30**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.24	19.03	0.33	**26.91**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.33	24.64	0.46	**34.85**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
0.00	**0.00**	1.50	33.33	0.71	**47.14**	1.30	23.08	0.42	**32.64**
2.15	**10.01**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.24	19.35	0.34	**27.37**
0.11	**3.97**	26.71	-16.08	6.07	**22.74**	2.35	57.42	1.91	**81.20**
0.06	**6.20**	1.20	16.98	0.29	**24.01**	1.85	45.81	1.20	**64.79**
0.00	**0.00**	1.23	18.60	0.32	**26.30**	2.61	61.63	2.27	**87.15**
0.00	**0.00**	1.15	13.04	0.21	**18.45**	1.30	23.08	0.42	**32.64**
8.98	**10.36**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
13.65	**41.80**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
12.73	**6.73**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
19.80	**3.05**	52.95	-18.98	14.21	**26.84**	34.35	-13.54	6.58	**19.14**
12.02	**11.96**	11.75	26.81	4.45	**37.91**	7.30	86.30	8.91	**122.05**
0.00	**0.00**	3.65	72.60	3.75	**102.68**	5.70	82.46	6.65	**116.61**
5.23	**5.93**	1.35	25.93	0.49	**36.66**	1.00	0.00	0.00	**0.00**
0.07	**1.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
17.68	**4.33**	13.80	81.88	15.98	**115.80**	7.80	50.00	5.52	**70.71**
1.34	**13.37**	4.15	75.90	4.45	**107.34**	3.65	72.60	3.75	**102.68**
0.21	**16.97**	3.05	67.21	2.90	**95.05**	4.15	75.90	4.45	**107.34**
0.07	**2.32**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	0.95	-5.26	0.07	**7.44**
1.56	**40.94**	2.20	54.55	1.70	**77.14**	16.15	0.93	0.21	**1.31**
0.00	**0.00**	2.10	52.38	1.56	**74.08**	1.95	48.72	1.34	**68.90**
0.00	**0.00**	1.10	9.09	0.14	**12.86**	1.55	35.48	0.78	**50.18**
0.28	**23.57**	1.05	4.76	0.07	**6.73**	1.00	0.00	0.00	**0.00**
0.07	**7.44**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.14	**12.86**	3.85	32.47	1.77	**45.92**	1.35	25.93	0.49	**36.66**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.10	9.09	0.14	**12.86**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.15	13.04	0.21	**18.45**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.05	4.76	0.07	**6.73**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.21	**8.32**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.40	28.57	0.57	**40.41**
0.28	**21.76**	7.10	26.76	2.69	**37.85**	2.00	50.00	1.41	**70.71**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.40	28.57	0.57	**40.41**
0.00	**0.00**	1.15	13.04	0.21	**18.45**	2.10	52.38	1.56	**74.08**
0.00	**0.00**	1.40	28.57	0.57	**40.41**	1.35	25.93	0.49	**36.66**

Sample	Session	EPA Analyzed TCE (µg/L)	EPA Analyzed c-DCE (µg/L)	EPA Analyzed VC (µg/L)	UW Analyzed TCE (µg/L)	UW Analyzed c-DCE (µg/L)	UW Analyzed VC (µg/L)	Ave TCE (µg/L)	% Diff TCE
ML-31-0	Dec-98	NA	NA	NA	NA	NA	NA	NA	NA
ML-31-2		NA	NA	NA	NA	NA	NA	NA	NA
ML-31-4		NA	NA	NA	188	ND	ND	NA	NA
ML-31-6		NA	NA	NA	411	51	50	NA	NA
ML-31-8		NA	NA	NA	107	26	21	NA	NA
ML-31-10		NA	NA	NA	4.7	4.6	ND	NA	NA
ML-32-0		63.1	12.4	BLQ	91	15	ND	77.05	-18.11
ML-32-2		4.5	ND	ND	5.2	ND	ND	4.84	-7.44
ML-32-4		563	13.4	5.8	555	12	ND	558.95	0.71
ML-32-6		98.0	35.2	23.3	110	38	ND	104.01	-5.76
ML-32-8		1.3	6.0	20.2	1.1	8.9	ND	1.20	8.49
ML-32-10		1.2	ND	ND	1.1	ND	ND	1.16	5.01
ML-33-0		ND	ND	BLQ	ND	ND	ND	1.00	0.00
ML-33-2		11.8	4.3	14.2	11	5.7	ND	11.38	3.31
ML-33-4		ND	7.6	18.3	BLQ	ND	ND	1.00	0.00
ML-33-6		ND	1.5	13.0	BLQ	ND	ND	1.00	0.00
ML-33-8		ND	ND	2.2	BLQ	ND	ND	1.00	0.00
ML-33-10		ND	BLQ	BLQ	BLQ	ND	ND	1.00	0.00
ML-34-0		ND	ND	2.1	ND	ND	ND	1.00	0.00
ML-34-2		1.9	4.7	BLQ	1.9	3.8	ND	1.92	0.78
ML-34-4		ND	ND	3.3	ND	ND	ND	1.00	0.00
ML-34-6		ND	ND	3.7	ND	ND	ND	1.00	0.00
ML-34-8		ND	ND	2.6	BLQ	ND	ND	1.00	0.00
ML-34-10		ND	ND	1.6	ND	ND	ND	1.00	0.00
ML-35-0		1.1	ND	1.3	1	ND	ND	1.05	4.49
ML-35-2		ND	ND	4.0	ND	NA	ND	1.00	0.00
ML-35-4		ND	2.1	3.3	ND	ND	ND	1.00	0.00
ML-35-6		ND	1.1	2.3	ND	ND	ND	1.00	0.00
ML-35-8		ND	1.6	3.0	BLQ	ND	ND	1.00	0.00
ML-35-10		ND	2.6	1.3	BLQ	ND	ND	1.00	0.00
								Average	**6.71**

BLQ Below limit of quantitation (1 ppb)
ND None detected
NA Not available

Std Dev TCE (μg/L)	% StdDev TCE	Ave c-DCE (μg/L)	% Diff c-DCE	Std Dev c-DCE (μg/L)	% StdDev c-DCE	Ave VC (μg/L)	% Diff VC	Std Dev VC (μg/L)	% Std Dev VC
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
19.73	**25.60**	13.68	-9.69	1.87	**13.70**	1.00	0.00	0.00	**0.00**
0.51	**10.52**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
5.59	**1.00**	12.72	5.64	1.01	**7.98**	3.38	70.40	3.36	**99.56**
8.47	**8.14**	36.60	-3.82	1.98	**5.41**	12.16	91.78	15.79	**129.80**
0.14	**12.00**	7.43	-19.85	2.08	**28.07**	10.62	90.58	13.60	**128.10**
0.08	**7.08**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.53	**4.67**	4.98	-14.50	1.02	**20.51**	7.60	86.84	9.33	**122.81**
0.00	**0.00**	4.30	76.76	4.67	**108.56**	9.66	89.65	12.24	**126.78**
0.00	**0.00**	1.23	19.00	0.33	**26.86**	7.00	85.71	8.49	**121.22**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.60	37.50	0.85	**53.03**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.54	34.98	0.76	**49.47**
0.02	**1.11**	4.27	10.90	0.66	**15.42**	1.00	0.00	0.00	**0.00**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	2.15	53.41	1.62	**75.54**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	2.35	57.47	1.91	**81.28**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.81	44.64	1.14	**63.14**
0.00	**0.00**	1.00	0.00	0.00	**0.00**	1.30	22.78	0.42	**32.22**
0.07	**6.35**	1.00	0.00	0.00	**0.00**	1.14	12.59	0.20	**17.80**
0.00	**0.00**	NA	NA	NA	**NA**	2.52	60.33	2.15	**85.31**
0.00	**0.00**	1.55	35.55	0.78	**50.27**	2.15	53.53	1.63	**75.71**
0.00	**0.00**	1.05	4.40	0.07	**6.22**	1.66	39.69	0.93	**56.13**
0.00	**0.00**	1.32	24.18	0.45	**34.20**	2.02	50.61	1.45	**71.57**
0.00	**0.00**	1.79	43.99	1.11	**62.22**	1.14	12.17	0.20	**17.20**
	9.49		**19.03**		**26.91**		**23.60**		**33.37**

Ave = Average
% Diff = % Difference = (Concentration - Ave) / Ave*100
Std Dev = Standard Deviation
% StdDev = Std Dev / Ave*100

Set ND and BLQ = 1 ppb for statistics
Take absolute value of % Diff for Ave calculation