

THE MEMPHIS DEPOT TENNESSEE

ADMINISTRATIVE RECORD COVER SHEET

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APPENDIX B

ZVI PRB Bench- and Pilot-Scale Study Reports

- *Bench-Scale Treatability Report in Support of a Granular Iron Permeable Reactive Barrier Installation at Dunn Field, Memphis Army Depot, Memphis, TN*
- *Summary of the Memphis Depot Dunn Field Zero-Valent Iron Permeable Reactive Barrier Implementation Study*



**Bench-Scale Treatability Report in Support of a Granular
Iron Permeable Reactive Barrier Installation at Dunn Field,
Memphis Army Depot, Memphis, TN**

Prepared For:

CH2M Hill
115 Perimeter Center Place NE
Suite 700
Atlanta, GA 30346

Prepared By:

EnviroMetal Technologies Inc.
745 Bridge Street West, Suite 7
Waterloo, Ontario
Canada N2V 2G6

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1.0 INTRODUCTION AND BACKGROUND

This bench-scale treatability report was prepared for CH2M Hill to support the design of a granular iron permeable reactive barrier (PRB) for treatment of dissolved chlorinated volatile organic compounds (VOCs), present in groundwater at Dunn Field, Memphis Army Depot, Memphis, TN (the "site"). This report presents the results and data interpretation of a column treatability study conducted at the Institute for Groundwater Research, University of Waterloo (UW), Waterloo, Ontario, Canada, under contract to EnviroMetal Technologies Inc. (ETI).

1.1 Background Information on the EnviroMetal Process

As a consequence of the significant limitations of pump-and-treat systems, *in-situ* PRBs have been identified as an alternative groundwater remediation technology (Gillham, 1996; O'Hannesin and Gillham, 1998). The concept involves the construction of a permeable wall or barrier, containing appropriate reactive materials, across the path of a contaminant plume. As the contaminated groundwater passes through the wall, the contaminants are removed through chemical or physical processes. Various configurations of *in-situ* treatment systems have been evaluated, based on site-specific conditions. Advantages of *in-situ* PRBs include:

- low maintenance costs;
- no operating costs;
- long-term passive treatment;
- absence of waste materials requiring treatment or disposal;
- absence of invasive surface structures and equipment; and
- conservation of groundwater resources.

Several types of materials have been suggested for use in PRBs. The most advanced stage of application has been achieved with systems using granular iron to degrade chlorinated organic compounds. Under highly reducing conditions and in the presence of metallic surfaces, certain dissolved chlorinated organic compounds in groundwater degrade to non-toxic products such as ethene, ethane and chloride (Gillham and O'Hannesin, 1994). The process is abiotic reductive dehalogenation, with the metal serving to lower the solution redox potential (Eh) and as the electron source in the reaction. Using granular iron as the reactive metal, reaction half-lives (the time required to degrade one half of the original contaminant mass) are commonly several orders of magnitude lower than those measured under natural conditions.



The technology is particularly attractive for the remediation of contaminated groundwater because of the high rates of degradation, the granular iron is relatively inexpensive, the process requires no external energy supply and because most compounds are degraded with production of few, if any, hazardous (chlorinated) organic by-products.

To date, granular iron PRBs have been installed at over 125 sites in the United States, Canada, Europe, Japan and Australia. These PRBs have been installed at Superfund sites; as part of brownfield site redevelopment; at various active manufacturing, DOE and dry cleaning facilities; and landfills. A total of 28 PRBs have been installed at DoD facilities throughout the United States. With 16 full-scale systems, in addition to 12 pilot-scale systems, which have been installed at earlier stages of the technology to provide "proof of concept" and over the past years to demonstrate effective construction methods. The earliest commercial applications in California and Belfast, Ireland have been in operation for the past 10 years.

1.2 Approach to Technology Implementation at the Site

A granular iron PRB has been proposed as an *in-situ* treatment alternative to degrade VOCs in groundwater at the site. When viewed in the context of previous successful applications, the site appears quite amenable to treatment using this technology:

- i) the primary VOCs present, 1,1,2,2-tetrachloroethane (1122TeCA), carbon tetrachloride (CT), chloroform (TCM), tetrachloroethene (PCE), trichloroethene (TCE) and cis 1,2-dichloroethene (cDCE) have been successfully treated at other sites; and
- ii) the main inorganic chemistry of the plume appears to pose no significant impediments to technology application.

Based on the information provided to ETI by CH2M Hill, at the proposed PRB location with a water table of about 80 ft below ground surface (bgs), the VOC plume ranges from about 8 to 16 ft in saturated thickness ranging from a depth of 80 to 100 ft bgs. The estimated groundwater velocity at the proposed PRB location is variable with a groundwater velocity range of about 0.55 to 1.1 ft/day.

Several design parameters need to be addressed and quantified in order to apply the granular iron technology in the field, and to determine its cost-competitiveness with other treatment

technologies. This bench-scale test was initiated to provide design parameters (VOC degradation rates) for the anticipated maximum concentrations entering the PRB. Specifically, the following factors need to be investigated to facilitate field implementation of a treatment system at the site:

- i) The degradation rates of chlorinated VOCs present in site groundwater using a commercial granular iron source. Degradation rates determined using site groundwater allow refinement of the degradation rates and resulting residence time. This residence time within the iron treatment zone will provide the time for the VOCs to achieve concentrations below the regulatory limits.
- ii) The production and subsequent degradation rates of chlorinated compounds produced from the VOCs originally present in the site groundwater (e.g., dichloroethene (DCE) isomers and vinyl chloride (VC) from TCE and 1122TeCA). These can also affect the dimensions of the treatment system.
- iii) The volume of iron material required. This volume is based on the concentrations of VOCs present in groundwater entering the treatment zone and potential breakdown products, degradation rates and groundwater flow velocity.
- iv) The effects of the process on the inorganic chemistry of the groundwater, in particular, the potential for mineral precipitation. Mineral precipitates could affect the long-term operations and maintenance (O&M) requirements of the treatment system.

1.3 Bench-Scale Test Report Organization

The remainder of this report is organized as follows:

- Section 2.0 presents the detailed objectives and methods for the bench-scale test.
- Section 3.0 presents the organic and inorganic results from the bench-scale test.
- Section 4.0 discusses the calculated residence time required to meet the target levels, and provide a preliminary conceptual design for the treatment system.
- Section 5.0 summarizes the results.

2.0 BENCH-SCALE TEST OBJECTIVES AND METHODS

2.1 Bench-Scale Test Objectives

The primary objective of the bench-scale test was to provide the data necessary to determine the residence time for the dimensions of the granular iron system to remediate the VOCs present in the plume, and their chlorinated breakdown products, to below their regulatory criteria. Samples collected during the laboratory column test were used to evaluate the following specific objectives:

- determine degradation rates of VOCs in site groundwater using granular iron;
- characterization of chlorinated breakdown products, and evaluation of the rates of degradation of these products;
- changes in inorganic geochemistry as a result of the pH and Eh changes, including possible mineral precipitation.

2.2 Bench-Scale Test Methods

The bench-scale testing included two columns using groundwater collected from two separate locations, MW-54 and MW-77. The columns contained 100 % granular iron obtained from Connelly GPM of Chicago, IL (CC-1167, -18 to +84 US Standard Mesh size). The grain size distribution curve for this iron source is shown in Appendix A. The specific surface area of the granular iron was $1.5 \text{ m}^2/\text{g}$ determined by the BET method (Brunauer et al., 1938) on a Micromeretic Gemini 2375 surface analyzer. A hydraulic conductivity value of $3.3 \times 10^{-2} \text{ cm/sec}$ (94 ft/day) was obtained for this granular iron sample using a falling head permeameter test.

The column was constructed of Plexiglas™ with a length of 1.6 ft (50 cm) and an internal diameter of 1.5 in (3.8 cm) (Figures 1 and 2). Seven sampling ports were positioned along the length at distances of 0.08, 0.16, 0.33, 0.50, 0.66, 1.0, and 1.3 ft (2.5, 5, 10, 15, 20, 30, and 40 cm) from the inlet end. The column also allowed for the collection of samples from the influent (0 ft, 0 cm) and effluent lines (1.6 ft, 50 cm). Each sampling port consisted of a nylon Swagelok fitting (0.063 in, 0.16 cm) tapped into the side of the column, with a syringe

needle (16G) secured by the fitting. Glass wool was placed in the needle to exclude the iron particles. The sampling ports allowed samples to be collected along the central axis of the column. Each sample port was fitted with a Luer-Lok™ fitting, such that a glass syringe could be attached to the port to collect a sample. When not in operation the ports were sealed by Luer-Lok™ plugs.

To assure a homogeneous mixture, aliquots of iron were packed vertically in lift sections within the column. Values of bulk density, porosity, and pore volume (PV) were determined by weight (Table 1). The column experiment was performed at a site groundwater temperature of 18°C (64°F). An Ismatec™ IPN pump was used to feed the site water from a collapsible Teflon® bag to the influent end of the column. The pump tubing consisted of Viton®, and all the other tubing was Teflon® [0.125 in (0.32 cm) OD × 0.063 in (0.16 cm) ID]. Flow velocities of about 1.2 ft/day (36 cm/day) for MW-54 and 0.86 ft/day (26 cm/day) for MW-77 were selected in consultation with CH2M Hill to be in the range of the site groundwater velocity and to complete the tests within a reasonable time.

2.2.1 Groundwater Shipment and Storage

Groundwater was collected by CH2M Hill from monitoring well MW-54 and MW-77 at the site and shipped to UW in 4 L amber glass sample bottles with no headspace. Samples from the site were analyzed immediately upon arrival for select VOCs, using the methods described in this section.

The major VOCs detected in the water collected from MW-54 was TCM at a concentration of about 8 µg/L; 1,1,2-trichloroethane (112TCA) at a concentration of about 5 µg/L; 1122TeCA concentration of about 470 µg/L; TCE at a concentration of about 1,000 µg/L; cDCE concentration of about 30 µg/L and trans 1,2-dichloroethene (tDCE) of 7 µg/L. Laboratory grade CT and TCM chemicals were used to increase the CT and TCM concentrations in the site water influent reservoir to about 50 and 250 µg/L, respectively, which was considered to be more representative of anticipated design concentrations along the line of the proposed iron PRB.

The site water sample from MW-77 had a TCM concentration of about 5 µg/L; 112TCA concentration of about 10 µg/L; 1122TeCA of about 8,700 µg/L; PCE concentration of 20 µg/L; TCE concentration of 3,600 µg/L; cDCE concentration of about 130 µg/L and a

tDCE concentration of about 20 µg/L. Laboratory grade 1122TeCA chemical was used to increase the 1122TeCA concentration in the site water influent reservoir to about 15,000 µg/L, which was considered to be more representative of anticipated design concentrations along the line of the proposed iron PRB.

The column tests were conducted at 18°C (64°F) which is the anticipated groundwater temperature at the site. The site water was stored at 4°C (39°F) until required at which time it was siphoned from the field sample bottles into a collapsible Teflon® bag. Due to the holding capacity of this influent reservoir, as noted in Appendix C by reservoir number [RN], the influent reservoir was filled three times [a-c] for both MW-45 and MW-77 over the course of the test.

2.2.2 Sampling and Analysis

The columns were sampled every 3 to 10 PVs until steady state concentration profiles were achieved. In the bench-scale test, steady state is defined as the time when VOC concentrations versus distance profiles do not change significantly between sampling events. After removing the stagnant water from the sampling needle, 2.0 to 4.0 mL samples were collected from the sampling ports using glass on glass syringes, transferred to glass sample bottles, and analyzed immediately (no holding time). Samples for organic analyses, nitrate, sulphate, chloride, Eh and pH measurements were collected from each port as well as from the influent solution and the effluent overflow bottles. Samples for inorganic analyses were obtained from the influent solution and the effluent overflow bottles towards the end of the test as steady state conditions were approached.

Additional organic samples were sent to an independent laboratory chosen by CH2M Hill (Appendix B) to verify the organic influent and effluent results obtained from the UW laboratory.

2.3 Analytical Methods

2.3.1 Organic Analyses

The less volatile halogenated organic such as TCE, 1122TeCA, PCE, 1,1,1-trichloroethane (111TCA), 112TCA, CT and TCM were extracted from the water sample within the glass sample bottle using pentane with an internal standard of 1,2-dibromoethane, at a water to pentane ratio of 2.0 to 2.0 mL. The sample bottles were placed on a rotary shaker for 10 minutes to allow equilibration between the water and the pentane phases, then the pentane phase was transferred to an autosampler bottle. Using a Hewlett Packard 7673 autosampler, a 1.0 μ L aliquot of pentane with internal standard was automatically injected directly into a Hewlett Packard 5890 Series II gas chromatograph (GC). The chromatograph was equipped with a Ni^{63} electron capture detector (ECD) and DB-624 megabore capillary column (30 m x 0.538 mm ID, film thickness 3 μ m). The GC had an initial temperature of 50°C, with a temperature time program of 15°C/minute reaching a final temperature of 150°C. The detector temperature was 300°C. The carrier gas was helium and makeup gas was 5% methane and 95% argon, with a flow rate of 30 mL/min.

For the more volatile compounds such as the DCE isomers, VC, dichloromethane (DCM), 1,1-dichloroethane (11DCA) and 1,2-dichloroethane (12DCA), 4.0 mL samples were collected in glass on glass syringes and placed in 10 mL Teflon[®] faced septa crimp cap vials, creating a headspace with a ratio of 6.0 mL headspace to 4.0 mL aqueous sample. The samples were placed on a rotary shaker for 15 minutes to allow equilibration between the water and gas phase. Using a Hewlett Packard 7694 headspace auto sampler, a 1 mL stainless steel sample loop injected the samples directly onto a Hewlett Packard 5890 Series II GC.

For the DCE isomers and VC, the chromatograph was equipped with a HNU photoionization detector (PID) with a bulb ionization potential of 10.2 eV. The GC was fitted with a fused silica capillary NSW-PLOT column (15 m x 0.53 mm ID). The samples were placed in the analyzer oven for 2 minutes at 75°C, and subsequently injected onto the GC. The temperature program was 160°C for 5.5 minutes, then increased at 20 °C/min to 200°C and held for 5.5 minutes. The injector and detector temperatures were 100°C and 120°C, respectively. The carrier gas was helium with a flow rate of 5.5 mL/min. Data was collected with a Pentium 166 computer using HP-Chemstation Version 5.04.

For DCM, 11DCA and 12DCA, the GC was equipped with a Ni⁶³ ECD detector with a J&W DB-624 (30 m x 0.53 mm). The GC has an initial temperature of 50°C, with a temperature program of 10°C/min, reaching a final temperature of 130°C and then is held at 130°C for 0.5 minutes. The detector is set for 300°C and then injector temperature is 200°C. The carrier gas is helium with a flow rate of 7 mL/min.

Method detection limits (MDL) were determined for each compound as the minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDLs were determined from analysis of samples from a solution matrix containing the analytes of interest. Although MDLs are reported, these values are not subtracted from any reported VOC concentrations (Appendix C). The reason for this is that it indicates that the organic concentrations are approaching or advancing within the column, and is helpful when determining degradation rates. Detection limits for all compounds, as given in Table 2, were determined using the EPA procedure for MDL (US EPA, 1982).

2.3.2 Inorganic Analyses

Eh was determined using a combination Ag/AgCl reference electrode with a platinum button and a Markson™ Model 90 meter. The electrode was standardized with ZoBell™. Millivolt (mV) readings were converted to Eh, using the electrode reading and the standard potential of the Ag/AgCl electrode at a given temperature. The pH measurements were made using a combination pH/reference electrode and a Markson™ Model 90 meter, standardized with the pH buffer 7 and the appropriate buffer of either 4 or 10. A 2.0 mL sample was collected with a glass on glass syringe and analyzed immediately for Eh and then pH.

For nitrate, sulphate and chloride analyses, a 2.0 mL sample was collected and added to a 5 mL autosampler plastic vial. The samples were then placed on a Dionex AS-40 autosampler. A 25 µL sample was then injected onto a Dionex ion chromatograph (ICS-2000) equipped with an ion-eluent generator and conductivity detector. A Dionex IonPac AS18 column (4 x 250 mm) was used. The mobile phase used was 30 mM KOH at a flow rate of 1.2 mL/min. The data were collected with a Dell P4-3GHz computer using Dionex chromeleon 6.5 software.

Over the course of the test, two water samples were collected from the influent and two from each effluent, and sent to Philip Analytical Services, Mississauga, Ontario for cation and

anion analyses. Cation analyses, included As, Fe, Na, Mg, Ca, Cr, Cu, K, Mn, Si, etc. were performed using inductively coupled plasma (ICP). The anion samples were unfiltered and acidified to a pH of 2 with nitric acid. Anion analyses, including Cl, NO₃ and SO₄, were performed using ion chromatography. Alkalinity, ammonia (as N), total organic carbon (TOC) and dissolved organic carbon (DOC) analyses are determined by colorimetry. Detection limits for the inorganic parameters are included in Table 2.

3.0 BENCH-SCALE TEST RESULTS

3.1 Interlaboratory Comparison

An independent laboratory, Kemron Environmental Services (Kemron), was selected by CH2M Hill to verify UW organic analyses from three influent samples [0 PV, 43.7 PVs (MW-54) and 33.3 PVs (MW-77)] and a column effluent sample from each of the site waters [43.7 PV (MW-54) and 33.3 PV (MW-77); Appendix B]. As shown on Tables 3 and 4, a good comparison was observed between the two laboratories with the exception of MW-54 CT and TCM analyses from the influent sample (0 PV). It appears that the Kemron data was 2 to 4 times the concentration that was determined by UW. These samples were collected from the influent reservoir and were sampled just after the influent concentration of CT and TCM were increased to reflect more representative concentrations for the MW-54 site water. Since the other organic compounds have a similar concentration, the difference in CT and TCM appears to be incomplete mixing of the influent reservoir within the refrigerator prior to sending samples to Kemron. When compared later at 43.7 PVs, the CT and TCM for both the Kemron and UW have similar concentrations.

3.2 Degradation of Volatile Organic Compounds

Samples for measurement of VOC concentrations along the length of the column were taken approximately every 3 to 10 PVs (Appendix C). Using the distance for each sampling port and flow velocity, the residence time was calculated for each port. The results obtained when steady state conditions were reached are plotted as VOC concentration ($\mu\text{g/L}$) versus residence time within the column (hrs). Although some fluctuations in the influent concentrations occurred, this did not affect interpretation of the observed results, as the influent concentration for each profile was used to determine the degradation rates for that particular profile.

MW-54

The final steady-state concentration profiles for the columns are shown in Figures 3 to 5. At a flow velocity of about 1.2 ft/day (36 cm/day), one PV corresponds to a residence time of about 33 hrs. A total of 49 PVs of water were passed through the column. The CT and TCM concentrations decreased from influent concentrations of 55 and 502 µg/L to non-detectable values within a residence time of 1.6 hrs and 10 hrs, respectively (Figure 3). Due to the dechlorination of CT and TCM, approximately 50 µg/L of DCM was detected along the column, as anticipated since DCM does not degrade in the presence of granular iron (Figure 3). The 1122TeCA concentration decreased from an influent concentration of 496 µg/L to non-detectable values within a residence time of about 7 hrs along the column (Figure 4). TCE concentration decreased from an influent concentration of 788 µg/L to non-detectable values within a residence time of 6.6 hrs along the column (Figure 4). Due to the dechlorination of 1122TeCA and TCE, the cDCE concentration increased from an influent concentration of 41 µg/L to a peak concentration of 56 µg/L at a residence time of 3.2 hrs and then declined to non-detectable values within a residence time of 20 hrs along the column (Figure 5). The tDCE concentration followed the same trend as cDCE, due to the dechlorination of mainly 1122TeCA, and increased from an influent concentration of 5.6 to 26 µg/L at a residence time of 3.2 hrs and declined to non-detectable values within a residence time of 10 hrs along the column (Figure 5). There were sporadic and trace levels of 1,1-dichloroethene (11DCE) and VC found within the column and PCE was only detected in the influent at 3.0 µg/L (Appendix C). There were no detectable concentrations of 111TCA, 112TCA, 11DCA and 12DCA (Appendix C).

MW-77

The final steady-state concentration profiles for the columns are shown in Figures 6 to 8. At a flow velocity of about 0.86 ft/day (26 cm/day), one PV corresponds to a residence time of about 46 hrs. A total of 44 PVs of water were passed through the column. The 1122TeCA concentration declined from an influent concentration of 22,145 µg/L to non-detectable values within a residence time of about 14 hrs along the column (Figure 6). TCE concentrations declined from an influent concentration of 3,176 µg/L to non-detectable values within a residence time of about 18 hrs along the column (Figure 7). Due to the dechlorination of 1122TeCA and TCE, the cDCE concentration increased from an influent concentration of 177 to 3,685 µg/L at a residence time of 4.5 hrs and then declined to non-detectable values within a residence time of about 37 hrs along the column (Figure 7). The tDCE and 112TCA

concentrations followed the same trend as cDCE with an increase in the concentration due to the dechlorination of 1122TeCA. The tDCE concentration was 21 µg/L in the influent and increased to 1,434 µg/L at a residence time of about 2 hrs and then declined to non-detectable values within a residence time of about 18 hrs (Figure 7). For 112TCA, the influent concentration was 11 µg/L and increased to 66 µg/L at a residence time of 2 hrs followed by a decline in concentration to non-detectable values at a residence time of 14 hrs along the column (Figure 8). The PCE concentration of 48 µg/L in the influent declined to non-detectable values within a residence time of about 9 hrs along the column (Figure 8). The concentration of VC increased from non-detectable values in the influent to 106 µg/L at a residence time of 9 hrs followed by a decline in concentration to non-detectable values at a residence time of about 28 hrs along the column (Figure 8). Trace amounts of 11DCE, 12DCA and DCM were observed in the column. CT was only detected in the influent at 6 µg/L (Appendix C). There were no detectable concentrations of 111TCA, 11DCA and TCM.

3.3 Determination of VOC Degradation Parameters

The VOC degradation trends observed in groundwater in contact with granular iron are typically described using first-order kinetics:

$$C = C_o e^{-kt} \quad (1)$$

or

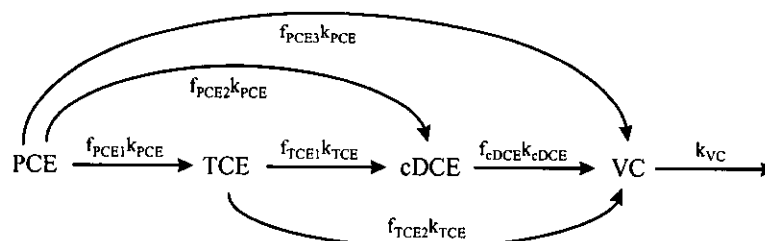
$$\ln\left(\frac{C}{C_o}\right) = -kt \quad (2)$$

where: C = VOC concentration in solution at time t,
 C_o = VOC concentration of the influent solution,
 k = first-order rate constant, and
 t = time.

The time at which the initial concentration declines by one-half, ($C/C_o = 0.5$), is the half-life.

ETI has developed a first-order kinetic model to simulate the degradation of VOCs with granular iron. In the model, potential breakdown products are concurrently produced and degraded as described by first-order kinetic equations. The model is an expression of the chemistry that is observed in the solution phase. For example, for the chlorinated ethenes (PCE, TCE, cDCE and VC) the production of chlorinated acetylene via a β -elimination pathway is considered to be the dominant degradation pathway (Eykholt, 1998; Arnold and Roberts, 1999). However, since chlorinated acetylenes are unstable, short-lived, intermediates that are rapidly reduced to ethene (Roberts et al., 1996; Sivavec et al., 1997), these compounds are not typically detected in the solution phase and are therefore not explicitly contained in the degradation model. Arnold et al. (2002) showed that β -elimination is also the major dechlorination pathway of 1122TeCA with granular iron, resulting in formation of 12DCE isomers as well as small amounts of TCE formed via the dehydrochlorination pathway.

The equations contained in the model were developed by ETI to describe the first-order kinetic degradation process occurring in a granular iron groundwater treatment zone. For example, PCE, TCE, cDCE and VC the model takes the form:



where: f = mole fraction (or percent molar conversions)
 k = first-order rate constant

In order to determine the VOC concentrations at a given time the following first-order equations are used:

$$dPCE / dt = -k_{PCE}PCE \quad (3)$$

$$dTCE / dt = f_{PCE1}k_{PCE}PCE - k_{TCE}TCE \quad (4)$$

$$dcDCE / dt = f_{PCE2}k_{PCE}PCE + f_{TCE1}k_{TCE}TCE - k_{cDCE}cDCE \quad (5)$$

$$dVC / dt = f_{PCE3}k_{PCE}PCE + f_{TCE2}k_{TCE}TCE + f_{cDCE}k_{cDCE}cDCE - k_{VC}VC \quad (6)$$

These equations were adapted for the computer program Scientist® for Windows® Version 2.0 (1995). The Scientist® program can be used to fit the first-order equations to experimental data using the least squares best-fit method. Least squares fitting is performed using a modified Powell algorithm to find a local minimum of the sum of squared deviations between observed data and model calculations. The degradation rate and molar conversion are determined for each compound sequentially starting with the most chlorinated compound.

The results from the model include half-lives and molar conversions for all VOCs selected and statistical fit data including coefficient of determination (r^2) values. The r^2 values indicate how well the degradation model represents the experimental data. The half-lives determined for the VOC profiles are shown in Table 5. Also shown are the corresponding r^2 values.

For MW-54, the degradation model provided relatively good fits to the CT, TCM, 1122TeCA, TCE, cDCE and tDCE concentration profiles, with r^2 values greater than 0.85. Steady state half-life values at groundwater temperature of 18°C (64°F) were 0.3 hrs for CT, 1.1 hrs for TCM, 1.5 hrs for 1122TeCA, 2 hrs for TCE, 2.4 hrs for cDCE and 1.2 hrs for tDCE for MW-54 (Table 3 and Appendix C). For MW-77, the degradation model provided relatively good fits for 1122TeCA, 112TCA, PCE, TCE, cDCE, tDCE, and VC, with r^2 values greater than 0.94. Steady state half-life values at groundwater temperature of 18°C (64°F) were 1.3 hrs for 1122TeCA, 2.5 hrs for 112TCA, 2.9 hrs for PCE, 2.7 hrs for TCE, 4.1 hrs for cDCE, 2.5 hrs for tDCE and 2.4 hrs for VC (Table 5 and Appendix C). Based on the half-lives determined from previous bench-scale testing with the same iron source at 25°C and corrected for 18°C, the half-lives determined in the bench-scale test were in the range of previously determined values.

The obtained half-life values for cDCE and tDCE were about 2 times higher in the MW-77, compared to the values in the MW-55 column. ETI notes that degradation behavior of lower chlorinated compound, like DCE isomers are controlled by two parameters; degradation half-life and the conversion rate from higher chlorinated compounds, in this case 1122TeCA and TCE. Figures 9 and 10 summarize the molar conversions determined using the degradation model for MW-54 and MW-77. For example, cDCE half-life in MW-54 is lower but the molar conversion from 1122TeCA to cDCE is higher (2.4 hrs, 66%), while MW-77 is the opposite (4.1 hr, 49%)

The calculated half-lives and molar conversions are used to develop residence time estimates for a field-scale PRB in Section 4.1.

3.4 Inorganic Results

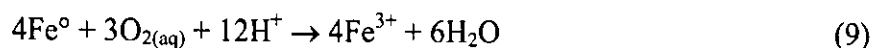
Similar to other subsurface environments, the composition of groundwater flowing through a granular iron PRB will undergo acid-base reactions, mineral precipitation/dissolution, oxidation/reduction reactions and mixing. These changes may lead to significant changes in aqueous inorganic chemistry, and the potential precipitation of a variety of mineral phases.

Two influent and effluent samples were collected from both columns as steady state approached. Changes in inorganic chemical constituents observed in the influent and effluent groundwater are summarized in Table 6. Appendix D contains the inorganic analytical data and the nitrate, chloride and sulphate profiles are shown in Appendix C. No change in concentration was observed arsenic, iron, sodium, sulphate, potassium and dissolved organic carbon (DOC) for MW-77 and chloride for MW-54. A slight decrease in concentration was observed for barium and strontium while a slight increase was observed for boron, molybdenum, zinc and DOC (MW-54). The chloride concentration increased in MW-77 due to the dechlorination process, an average mass balance of 92% as obtained. The column chloride profiles reflect similar concentrations.

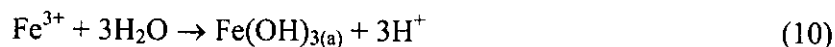
When iron is exposed to water, several reactions occur as a result of iron corrosion:



This iron corrosion drives the geochemical changes that occur as groundwater flows through the PRB. When groundwater first contacts the granular iron, dissolved oxygen corrodes the iron:



Hematite (Fe_2O_3) is the stable iron oxide that would occur in the upgradient zone of an iron PRB. However, the initial precipitate would probably be the amorphous iron hydroxide [$\text{Fe}(\text{OH})_{3(\text{a})}$] rather than the well-crystallized hematite (Drever, 1997):



After complete depletion of dissolved oxygen, the water corrosion of iron dominates to produce hydrogen and hydroxide resulting in an increase in pH and decline in Eh:

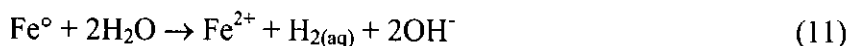


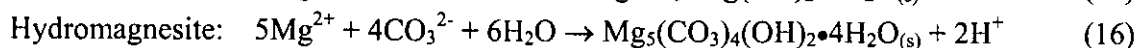
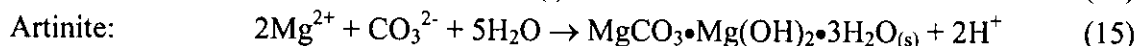
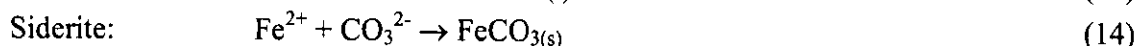
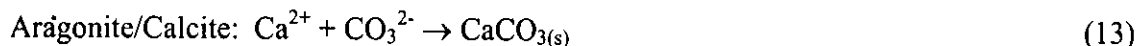
Figure 11 shows the Eh and pH profiles observed at steady state for both columns. The redox potential declined to reducing conditions as shown by the decline for MW-54 in Eh from an initial value of about +274 mV to a minimum value of about -353 mV and +330 mV to a minimum value of about -366 mV for MW-77 within the columns (Figure 11; Appendix C). Values of pH increased from 6.8 in the influent of the column to a maximum value of 9.5 for MW-54 and from 7.3 in the influent of the column to a maximum value of 9.5 for MW-77 within the columns (Figure 11; Appendix C). These trends are typically observed.

The hydrogen produced in Equation 11 can be stored within the iron grains, dissolved in the groundwater, exsolve into a gas and/or be consumed by biological organisms. Tests conducted with granular irons typically used in PRBs have resulted in water corrosion rates on the order of 0.1 to 1 mmol/kg Fe/day (Reardon, 1995 and ETI, unpublished data). The water corrosion rate depends on the iron type, dissolved inorganic species and temperature. Reardon (1995) found that corrosion rate increased by the presence of anions in the order of $\text{HCO}_3^- > \text{SO}_4^{2-} > \text{Cl}^-$ and Deng et al. (1998) found that hydrogen production was inhibited by $\text{PO}_4^{3-} > \text{BO}_3^{3-} > \text{H}_2\text{SiO}_4$. Reardon also notes that iron corrosion has been found to be constant over a pH range of 4 to 10. Recent test results indicate that corrosion rate declines significantly with decreasing temperature in the range of 2 to 30 °C, however, the scale of this temperature dependence is still under investigation (ETI, unpublished data).

As pH increases due to water corrosion, bicarbonate (HCO_3^-) in solution converts to carbonate (CO_3^{2-}) to buffer some of the pH increase:

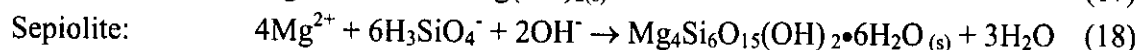
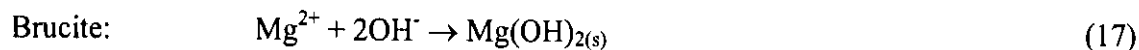


The carbonate may then combine with cations (Ca^{2+} , Fe^{2+} , and Mg^{2+}) in solution to form mineral precipitates:



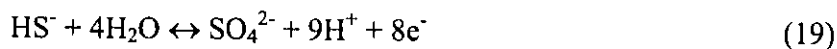
In analyses of iron obtained from previous laboratory studies and field sites, siderite as well as both calcite and aragonite, which are forms of calcium carbonate, have been identified. An average calcium concentration decreased from 17 mg/L in the influent to an average of 10 mg/L in the column effluent for MW-54 and 20 mg/L in the influent to an average of 12 mg/L in the column effluent for MW-77. Corresponding decreases in alkalinity from about 65 mg/L to about an average of 31 mg/L for MW-54 and 102 mg/L to about 21 mg/L for MW-77 was observed in the columns. Declines in calcium and alkalinity concentrations indicate formation of calcium carbonate minerals (see above). In analyses of iron obtained from previous laboratory studies and field sites, siderite as well as both calcite and aragonite, which are forms of calcium carbonate, have been identified.

Concentration of magnesium declined from 8.3 and 11 mg/L for MW-54 and MW-77 in the influent to about 0.07 and 0.12 mg/L, respectively, as groundwater flowed through the granular iron columns. Magnesium is known to substitute for calcium and iron in the structure of calcium and iron carbonates, resulting in a higher likelihood of forming solid mineral solutions ($\text{CaMg}(\text{CO}_3)_2$ or $\text{FeMg}(\text{CO}_3)_2$) rather than pure phases. Magnesium may also precipitate as magnesium hydroxide ($\text{Mg}(\text{OH})_2$) known as brucite and/or magnesium silicate ($\text{Mg}_4\text{Si}_6\text{O}_{15}(\text{OH})_2 \cdot 6\text{H}_2\text{O}$) known as sepiolite:



The concentration of silicon declined from about 17 mg/L in both columns to less than 1 mg/L in the columns. Silica may have been precipitating as amorphous silicate, sepiotilte (Eq. 18) and/or adsorbing onto iron hydroxides.

The concentration of sulphate remained the same at 17 mg/L in MW-54 and about 26 mg/L in MW-77. The column profiles also reflect these concentrations. At high Eh, the stable form of sulphur is sulphate (SO_4^{2-}), while at very low Eh sulphide (H_2S or HS^-) is the stable form with HS^- being predominant at pH greater than 7:



Given the low solubility of iron sulphide (FeS), the hydrogen sulphide produced precipitates out of solution.



Over time, iron sulphides transform into pyrite (FeS_2) and/or marcasite, a polymorph of pyrite. Sulphate reduction maybe mediated by biological activity and a reduction in sulphate is typically not observed in bench-scale column tests. However, declines in sulphate concentrations have been observed at a number of field sites as groundwater passes through the iron treatment zones. Sass et al. (2001) found evidence for the formation of marcasite in cores from two PRB field sites.

Figure 12 shows a decline of the low influent nitrate concentrations of 4.0 mg/L for both MW-54 and MW-77 to detectable concentrations at the first sampling port (1.6 hr for MW-54; 2.2 hr for MW-77) followed by non-detectable concentrations. It is apparent that nitrate at these concentrations did not adversely affect the degradation process. This same trend is observed for other waters with similar nitrate concentrations.

These inorganic changes are similar to those observed in other column PRB studies. The implication of these data to field scale PRB application is discussed in Section 4.4.

4.0 FIELD-SCALE TREATMENT SYSTEM DESIGN CONSIDERATIONS

4.1 Required Residence Time

Degradation rates (Table 5) and molar conversions (Figures 9 and 10) determined based on the column test results and concentrations from MW-54 and MW-77 were input into the first-order degradation model to determine possible residence time requirements in a field-scale system. The Scientist[®] program described in Section 3.2 may also be used to simulate the change in VOC concentrations over time using the first-order kinetic equations. In simulation mode, the model calculates the VOC concentrations over time, from which the time required for the VOCs to degrade to their regulatory criteria can be determined. The residence time calculation is shown conceptually in Figure 13.

These column tests were conducted at the anticipated field groundwater temperature of 18°C (64°F). If it is assumed that the groundwater temperature will not fall substantially below 18°C (64°F), it is reasonable to use the generated laboratory half-lives.

Based on data provided by CH2M Hill, we have evaluated two PRB locations (near well MW-54 and MW-77), assuming two alternative influent concentration scenarios at each location (Tables 7 and 8). Applying those scenarios, the residence times required to achieve the target risk levels in an iron PRB near MW-54 ranges from 24 hrs (1.0 days) to 26 hrs (1.1 days) (Table 7 and Figures 14 and 15). For a PRB near MW-77, the required residence time ranges from 27 hrs (1.1 days) to 29 hrs (1.2 days) (Table 8 and Figures 16 and 17).

4.2 Conceptual System Design

Based on information from CH2M Hill, the proposed PRBs be installed to a depth of up to 100 ft below ground surface (bgs). The anticipated iron saturated depths are 16 ft near MW-54 and 8 ft near MW-77. Based on the reported groundwater flow velocities of 0.55 and 1.1 ft/day near MW-54 and MW-77, respectively, and the required residence times, the iron zone thickness range from 0.55 to 0.61 ft for MW-54 and 1.2 to 1.3 ft for MW-77 (Tables 7 and 8).

The total volume of iron can be calculated as follows:

Volume of Iron = length of treatment zone × saturated depth × flow-through thickness

Assuming a bulk density for iron of 0.090 ton/ft³ and a PRB length of 1,070 ft, about 847 to 940 tons of granular iron (18/84 US Standard Mesh) may be needed to construct the proposed PRB near well MW-54 (Table 9). For a 410 ft long PRB near well MW-77, 354 to 384 tons of iron would be needed (Table 9).

A suitable construction method to achieve the depth of 100 ft is vertical hydrofracturing. Thin vertical treatment zones can be installed using this method which uses a specialized tool to orient the vertical fracture and initiate the fracture process. The tool is placed to the desired depth through a borehole and the interval for fracturing isolated by packers. A finer grained iron is suspended in a biodegradable slurry and pumped under low pressure (a few hundred psi) into the formation. The fracturing fluid causes the soil to separate creating an iron treatment zone a few inches in width with a controlled vertical thickness. Several fractures propagated from boreholes located along the line of installation coalesce to create a continuous PRB (i.e. a thin vertical plane of iron). Parallel vertical planes can be installed to increase the flow-through thickness of the granular iron system. GeoSierra is the contractor who is using this installation technique and costs should be obtained directly from GeoSierra (Grant Hocking 678-514-3300, www.geosierra.com).

4.3 Iron Consumption

As discussed in Section 3.3, there are many processes such as water corrosion, VOC degradation, dissolved oxygen reduction, sulphate and methane reduction that may consume the iron. These processes are not independent of one another and also depend on site conditions such as groundwater flow velocity, inorganic aqueous concentrations, VOC concentrations, biological activity and temperature. All of these factors make it difficult to gauge with exact certainty the time required to consume the iron in a PRB.

If water corrosion were to remain constant over time at a typical rate of 0.3 mmol/kg Fe/day, the iron is predicted to last several decades. However, Reardon (1995) and Gillham et al. (2001) noted declining hydrogen production over time at room temperature. This decline in corrosion rate was likely due to mineral precipitate formation on the surface of the iron over long periods of time. Sorel et al. (2000; 2001) found that the groundwater pH at the first commercial PRB in Sunnyvale, CA continues to increase from a value of 7.5 in the upgradient aquifer to a value of about 11 in the PRB and that dissolved hydrogen concentrations approach solubility. Clearly, water corrosion is still occurring at significant rates at this site after 10 years.

Other factors such as desaturation of the iron and oxidation by atmospheric oxygen would also affect the lifetime of the iron. Although there is some uncertainty in the conditions that may exist decades in the future, it seems reasonable to expect the iron in the PRB to last for many decades.

4.4 Possible Effect of Precipitation on Field-Scale Performance

Concern has been expressed regarding the potential for inorganic precipitates to reduce the activity of the iron and/or to reduce the permeability through pore clogging. Field experience to date indicates, that at most sites, carbonate precipitates represent the largest volume of precipitates.

Gillham et al. (2001) documented the migration of mineral precipitates through a bench-scale column of granular iron in a long-term test and verified what various research groups had visually observed. This means that it would take even longer for complete porosity loss to occur as the precipitation front moves through the PRB. In fact, in long-term column tests by Gillham et al. (2001), Eykholt (1999) and Sass (2001) indicated that complete porosity loss did not occur, even in cases where the precipitate had migrated through the entire column (i.e. effluent aqueous inorganic concentrations equaled influent). For example, Gillham et al. (2001) determined a maximum porosity loss due to carbonate formation of about 20% of the original porosity. In addition, these researchers found that the hydraulic conductivity of their systems only declined by a factor of two or three.

It is, however, important to note that the influent water used by these researchers contained no dissolved oxygen. Dissolved oxygen has resulted in a significant loss in hydraulic conductivity in bench-scale column tests (Mackenzie et al., 1997; Fort, 2000; and ETI, unpublished data) and field-scale above-ground and in-situ fixed-bed reactors. Mackenzie et al. (1997) and Fort (2000) both used iron-sand mixtures to overcome the loss in hydraulic conductivity.

Gillham et al. (2001) reported that the reactivity of the iron was low behind the zone of carbonate precipitate migration. Vikesland et al. (2000) also showed that various inorganic precipitates can reduce iron reactivity.

Core analyses from pilot-scale systems in Upstate NY and Denver, CO revealed porosity losses in the upgradient few inches of iron in the range of 10% of the initial porosity, with losses declining sharply over the first foot to below 2% (Vogan et al., 1998 and 1999). These porosity losses were calculated based on carbonate analyses of iron material retrieved by coring the treatment zone. The porosity loss measured in the core samples were consistent with that predicted on the basis of changes in the inorganic water chemistry. Assuming an initial porosity of 0.5, the porosity after 18 months (Denver) to 2 years (New York) in the first few inches of the iron zones had declined to about 0.45. Concurrent field data (VOC and groundwater velocity measurements) indicated that system hydraulics and iron reactivity had not been adversely affected by the precipitates. Laboratory permeameter tests performed on intact core samples from the New York site gave hydraulic conductivity values ranging from 6×10^{-2} to 10^{-1} cm/s. These compare favorably with hydraulic conductivity values of 5×10^{-2} to 10^{-1} cm/s for “fresh” iron.

A commercial system in Sunnyvale, CA (Sorel et al., 2001) has also been performing consistently for over 9 years. Groundwater at this site exhibits TDS in the range of 1,000 to 3,500 mg/L. No significant precipitates were observed in cores from an in situ reactive wall at the University of Waterloo Borden test site two and four years after it was installed (O’Hannesin and Gillham, 1998). Recent tests at the Borden PRB indicated that the reactivity of the iron in this system has been maintained for 10 years.

4.5 Potential for Biofouling of Reactive Material

There was no evidence of biofouling (sliming, etc.) observed during the bench-scale test. Field tests to date from other sites have been encouraging. Cores of the reactive wall at the Borden test site (O’Hannesin and Gillham, 1998), collected two years after the wall was installed, showed no significant population of iron oxidizing microbes, and only low numbers of sulphate reducers (Matheson and Tratnyek, 1994). Phospholipid-fatty acid analysis of groundwater from an above-ground test reactor at an industrial facility in California and an *in-situ* site in New York showed no enhanced microbial population in the reactive material relative to background groundwater samples. Core samples from the two sites described above were also analyzed for microbial population. The results indicated no evidence of increased microbial growth or fouling in the iron zone. Gu et al. (2001) found biomass 1 to 3 orders of magnitude higher in an iron PRB treating radionuclides and 120 mg/L of nitrate, compared to background soil and groundwater. They identified abundant sulphate reducers and denitrifiers in the PRB. However, no evidence of biofouling has been observed at the site

after about 2 years of operation. In summary, there is no reason to expect that microbial fouling would adversely affect PRB performance at Memphis Army Depot.

4.6 Maintenance

Other than groundwater monitoring, the major factor affecting maintenance costs is the possible need for periodic rejuvenation of iron sections affected by precipitates.

The objective of rejuvenation of the granular iron would be to restore the permeability loss due to precipitates and possibly to remove the precipitate from the iron to restore any lost reactivity of the iron. Possible rejuvenation methods may include:

- i) Using ultrasound to break-up the precipitate;
- ii) Using pressure pulse technology to break-up the precipitate; and
- iii) Using solid-stem augers to agitate the PRB.

To date these possible rejuvenation methods have not been needed and only ultrasound has been tested in a few limited field-scale tests to determine its effectiveness. At this point we can only state that these methods may prove to be successful in rejuvenating a PRB. Although inorganic results from the treatability study and data collected from long-term bench-scale tests and field sites indicate that mineral precipitates may not be a problem for perhaps decades at the site.

5.0 SUMMARY

Bench-scale testing using groundwater from monitoring wells MW-54 and MW-77 at Dunn Field, Memphis Army Depot, Memphis, TN, showed that:

- i) the granular iron technology can degrade the chlorinated VOCs present in the site waters to below the remediation goals;
- ii) the residence time required to degrade the VOC concentrations anticipated in PRBs located near well MW-54 and MW-77 to below the site risk target levels ranges from 1.0 to 1.2 days;
- iii) the low levels of nitrate appeared to pose no adverse affect on the granular iron technology;
- iv) redox potential (Eh) and pH trends were consistent with bench-scale tests with similar types of site water; and
- v) mineral precipitates (mainly carbonates) will likely occur in a field-scale in-situ treatment system, but should not significantly effect system performance for many years.

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Table 1: Iron and Column Properties

Materials:		
Iron Source	Connelly-GPM, Chicago, IL	
Iron Grain Size	1.0 to 0.17 mm (-18 to +84 mesh)	
Iron Surface Area	1.5 m ² /g	
Iron Hydraulic Conductivity	3.3 × 10 ⁻² cm/sec (94 ft/day)	
Column :	MW-54	MW-77
Test Temperature	18°C	
Flow Velocity	1.2 ft/day (36 cm/day)	0.86 ft/day (26 cm/day)
Residence Time	32.8 hrs	45.8 hrs
Pore Volume	296 mL	289 mL
Porosity	0.52	0.51
Bulk Density	3.16 g/cm ³ (197 lb/ft ³)	3.12 g/cm ³ (194 lb/ft ³)
Iron to Volume of Solution Ratio	6.1 g : 1 mL	6.2 g : 1 mL
Surface Area to Volume of Solution Ratio	9.1 m ² : 1 mL	9.2 m ² : 1 mL

Table 2: Method Detection Limits (MDL) and Detection Limits (DL)

Organic Compounds:		MDL (µg/L)
Tetrachloroethene		0.9
Trichloroethene		0.6
cis 1,2-Dichloroethene		1.9
trans 1,2-Dichloroethene		2.3
1,1-Dichloroethene		3.9
Vinyl Chloride		1.3
1,1,2,2-Tetrachloroethane		0.5
1,1,1-Trichloroethane		0.7
1,1,2-Trichloroethane		0.5
Carbon Tetrachloride		0.8
Chloroform		0.7
1,1-Dichloroethane		1.0
1,2-Dichloroethane		1.1
Dichloromethane		1.0
Inorganic Compounds:		DL (mg/L)
Arsenic		0.001
Boron		0.01
Barium		0.005
Calcium		0.05
Chromium		0.005
Iron		0.01
Potassium		1
Magnesium		0.05
Molybdenum		0.02
Sodium		0.1
Silicon		0.05
Strontium		0.001
Zinc		0.005
Chloride		0.5 (0.5 ^a)
Ammonia (as N)		0.03
Nitrate (as N)		0.2 (0.5 ^a)
Sulphate		0.5 (0.6 ^a)
Alkalinity (mg CaCO ₃ /L)		1
Total Organic Carbon (TOC)		0.2
Dissolved Organic Carbon (DOC)		0.2

^a MDL for UW profile analysis

Table 3: Interlaboratory Comparison for MW-54

Compound	Concentration (µg/L)					
	Influent (0 PV)		Influent (43.7 PV)		Effluent (43.7 PV)	
	Kemron ^a	UW ^b	Kemron ^c	UW ^d	Kemron ^c	UW ^d
PCE	4.0	2.5	3.8 4.4	3.6	nd	nd
TCE	746 712	741	839 789	796	nd	nd
cis 1,2-Dichloroethene	42 38	56	38 46	40	0.36	nd
trans 1,2-Dichloroethene	8.7	6.7	7.0 8.2	8.6	nd	nd
Vinyl Chloride	nd	nd	0.61	nd	nd	nd
1,1,1,2-Tetrachloroethane	nd	nd	0.35	na	nd	na
1,1,1,2-Tetrachloroethane	456 470	467	441 459	491	nd	nd
1,1,2-Trichloroethane	3.7	3.6	3.1 3.5	nd	nd	nd
1,2-Dichloroethane	nd	nd	1.2	nd	nd	nd
Carbon Tetrachloride	185 184	80	62 78	57	nd	nd
Chloroform	1,220 1,340	434	418 408	491	nd	nd
Chloromethane	nd	nd	nd	na	1.6	na
Dichloromethane	nd	nd	nd	nd	27	40

nd – non detect

na – not applicable

^a Date sampled 20 October 2003, sample received 23 October 2003, analyzed 27 October 2003^b Date sampled and analyzed 24 October 2003^c Date sampled 16 December 2003, sample received 17 December 2003 and analyzed 19 and 20 December 2003^d Date sampled and analyzed 15 September 2003

Table 4: Interlaboratory Comparison for MW-77

	Concentration (µg/L)					
	Influent (0 PV)		Influent (33.3 PV)		Effluent (33.3 PV)	
	Kemron ^a	UW ^b	Kemron ^c	UW ^d	Kemron ^c	UW ^d
Tetrachloroethene	14	11	54 58	51	nd	nd
Trichloroethene	2,780 3,030	3,094	3,400 3,620	3,285	nd	nd
cis 1,2-Dichloroethene	138	167	111 135	169	9.9	11
trans 1,2-Dichloroethene	25	26	18	16	nd	nd
Vinyl Chloride	nd	nd	nd	nd	0.88	nd
1,1,2,2-Tetrachloroethane	11,800 12,100	11,126	19,100 17,400	18,228	nd	nd
1,1,1-Trichloroethane	nd	7.9	3.4	nd	nd	nd
1,1,2-Trichloroethane	nd	7.9	9.4	12	nd	nd
1,2-Dichloroethane	nd	nd	2.5	na	1.5	1.5
Carbon Tetrachloride	nd	nd	nd	5.1	nd	nd
Chloroform	15	5	nd	nd	nd	nd
Dichloromethane	nd	na	nd	na	0.94	2.5

nd – non detect

na – not applicable

^a Date sampled 21 October 2003, sample received 23 October 2003, analyzed 27 October 2003^b Date sampled and analyzed 24 October 2003^c Date sampled 16 December 2003, sample received 17 December 2003 and analyzed 19 and 20 December 2003^d Date sampled and analyzed 15 September 2003

Table 5: Bench-Scale Test Half-Lives at 18°C at Steady State Conditions

Volatile Organic Compound	MW-54			MW-77		
	Modeled Influent Concentration (µg/L)	Half-Life at 18°C ^a (hr)	r ²	Modeled Influent Concentration (µg/L)	Half-Life at 18°C ^a (hr)	r ²
CT	55	0.3	1.000	-	-	-
TCM	502	1.1	0.995	-	-	-
1122TeCA	508	1.5	0.973	22,238	1.3	0.995
112TCA	nd	-	-	11 (66) ^b	2.5	0.997
PCE	3.2	-	-	50	2.9	0.968
TCE	841	2.0	0.905	3,296	2.7	0.973
cDCE	33 (156) ^b	2.4	0.855	142 (3,685) ^b	4.1	0.976
tDCE	5.1 (26) ^b	1.2	0.857	nd (1,434) ^b	2.5	0.998
VC	nd	-	-	nd (106) ^b	2.4	0.941

r² = Coefficient of determination

nd = non detect

a – Half-lives are based on the last VOC profiles detected in the column test

b – Peak concentrations due to the dechlorination of 1122TeCA and TCE

Table 6: Major Influent and Effluent Inorganic Concentrations at Steady State

	Concentration (mg/L)			
	MW-54 ^a		MW-77 ^b	
	Influent	Effluent	Influent	Effluent
Arsenic	<0.001 <0.001	<0.001 <0.001	<0.001 <0.001	<0.001 <0.001
Boron	0.01 0.02	0.13 0.12	0.01 0.01	0.21 0.18
Barium	0.134 0.134	0.010 0.009	0.092 0.092	0.012 0.011
Calcium	17 17	10 10	20 20	11 13
Iron	0.01 <0.01	0.01 0.01	<0.01 0.01	0.02 0.01
Potassium	<1 <1	1 <1	<1 <1	1 1
Magnesium	8.3 8.3	0.07 0.07	11 11	0.14 0.10
Molybdenum	0.04 <0.02	0.07 0.05	<0.02 <0.02	0.04 0.06
Sodium	17 17	18 18	36 35	37 36
Silicon	17 17	0.67 0.73	17 17	0.67 0.61
Strontium	0.125 0.125	0.074 0.075	0.066 0.066	0.059 0.070
Zinc	0.008 0.006	0.037 0.015	<0.005 0.006	0.005 <0.005
Chloride	14 13	15 15	25 25	42 42
Nitrate (as N)	3.7 3.6	<0.2 <0.2	2.4 2.4	<0.2 <0.2
Sulphate	17 17	17 17	25 26	29 27
Alkalinity (mg CaCO ₃ /L)	64 65	31 31	103 101	20 22
Ammonia (as N)	<0.03 0.05	3.0 2.7	0.04 0.05	1.3 1.3
Total Organic Carbon (TOC)	0.3 <0.2	1.4 0.9	4.0 6.4	2.4 2.4
Dissolved Organic Carbon (DOC)	0.6 <0.2	1.7 1.0	2.3 2.5	2.2 2.3

nd - not detected

a –effluent samples collected at PV 43.7 and 48.9

b –effluent samples collected at PV 36.1 and 40.3

Table 7: Residence Time Calculation for Site Water From MW-54

Volatile Organic Compound	Target Risk Levels ^a (µg/L)	Anticipated Field Half-Life (18°C) (hr)	Anticipated Field Concentration ^a (µg/L)	
			Scenario 1	Scenario 2
CT	3	0.3	ND	ND
TCM	12	1.1	502	502
1122TeCA	2.2	1.5	4,700	7,500
TCE	5	2.0	2,700	2,000
cDCE	35	2.4	70	60
tDCE	50	1.2	ND	ND
VC	2 ^b	2.4 ^c	ND	ND
DCM	Does Not Degrade		43 ^d	
Residence Time ^b			24 hrs (1.0 days)	26 hrs (1.1 days)
Groundwater Flow Velocity ^a			0.55 ft/day	
Required Iron Thickness			0.55	0.61

ND = not detected

^a Provided by CH2M HILL^b U.S. Federal MCL assumed in the absence of a site target risk level^c Assumed VC half-life based on site water from MW-77^d Generated due to dechlorination of TCM.

Table 8: Residence Time Calculation for Site Water From MW-77

Volatile Organic Compound	Target Risk Levels ^a (µg/L)	Anticipated Field Half-Life (18°C) (hr)	Anticipated Field Concentration ^a (µg/L)	
			Scenario 1	Scenario 2
1122TeCA	2.2	1.3	4,700	6,200
112TCA	2	2.5	ND	ND
PCE	2.5	2.9	ND	ND
TCE	5	2.7	1,700	1,700
cDCE	35	4.1	64	60
tDCE	50	2.5	ND	ND
VC	2 ^b	2.4	ND	ND
Residence Time			27 hrs (1.1 days)	29 hrs (1.2 days)
Groundwater Flow Velocity ^a			1.1 ft/day	
Required Iron Thickness			1.2	1.3

ND = not detected

^a Provided by CH2M HILL^b U.S. Federal MCL assumed in the absence of a site target risk level

Table 9: Proposed PRB Design Parameters

PRB/ Scenario	Residence Time (days)	GW Velocity (ft/day)	PRB Length (ft)	Saturated Thickness (ft)	Iron Thickness (ft)	Iron Volume (ft ³)	Iron Amount ^a (ton)
PRB near MW-54							
Scenario 1	1.0	0.55	1,070	16	0.55	9,416	847
Scenario 2	1.1				0.61	10,443	940
PRB near MW-77							
Scenario 1	1.1	1.1	410	8	1.2	3,936	354
Scenario 2	1.2				1.3	4,264	384

^a Assuming a bulk density of 0.09 ton/ft³

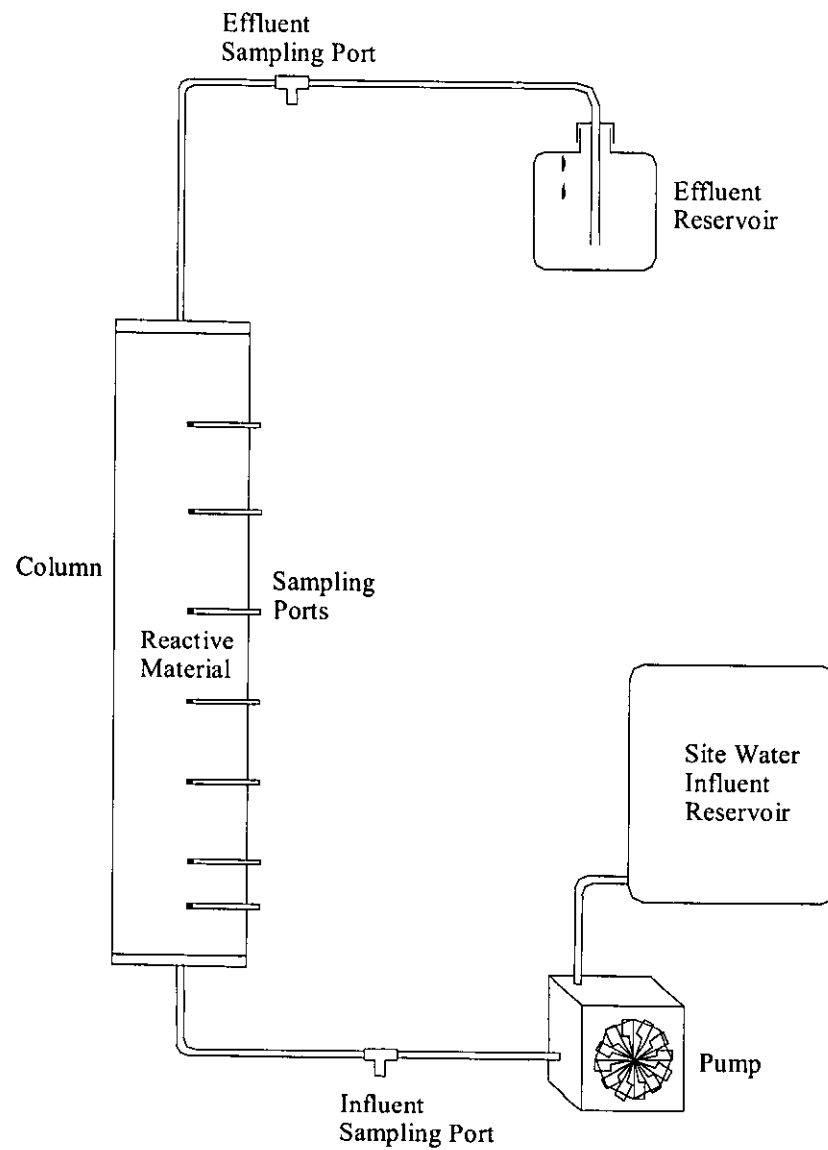


Figure 1: Schematic of the apparatus used in the bench-scale test.

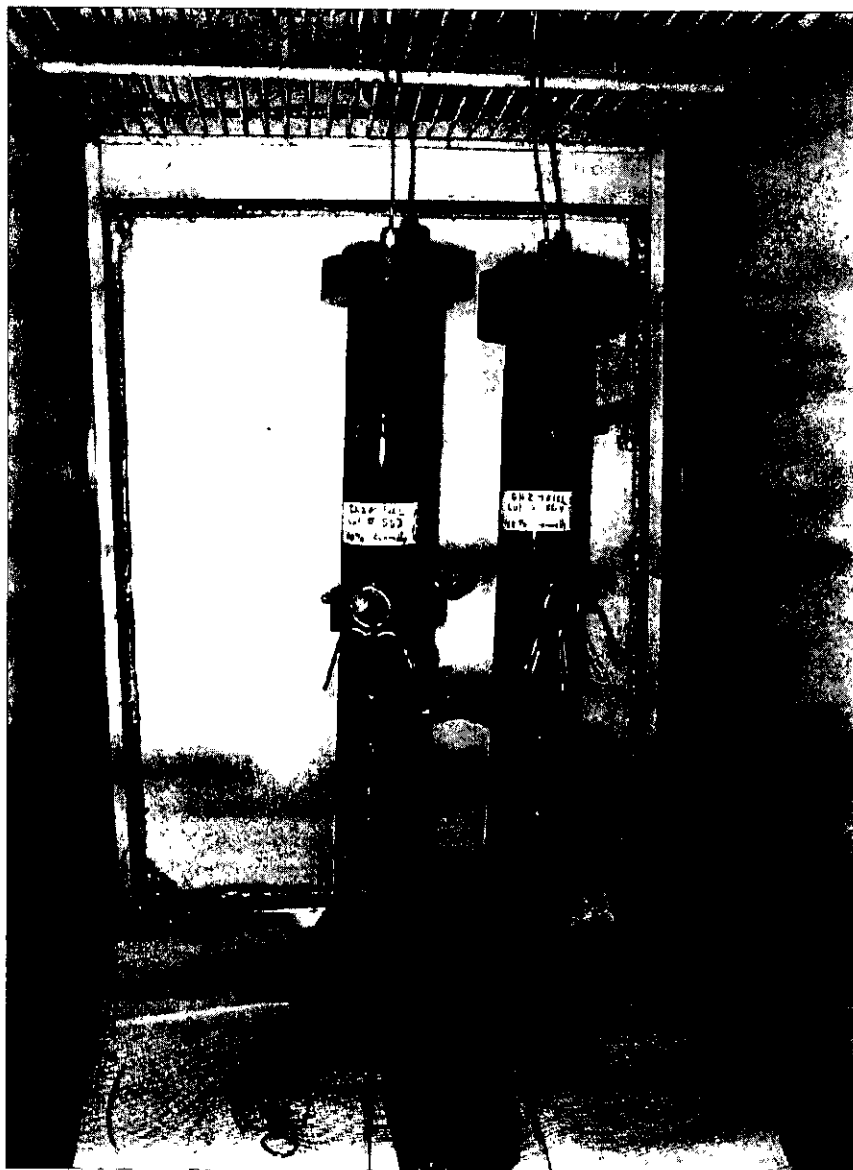


Figure 2: Photograph of granular iron columns in refrigerator at 18°C (64°F).

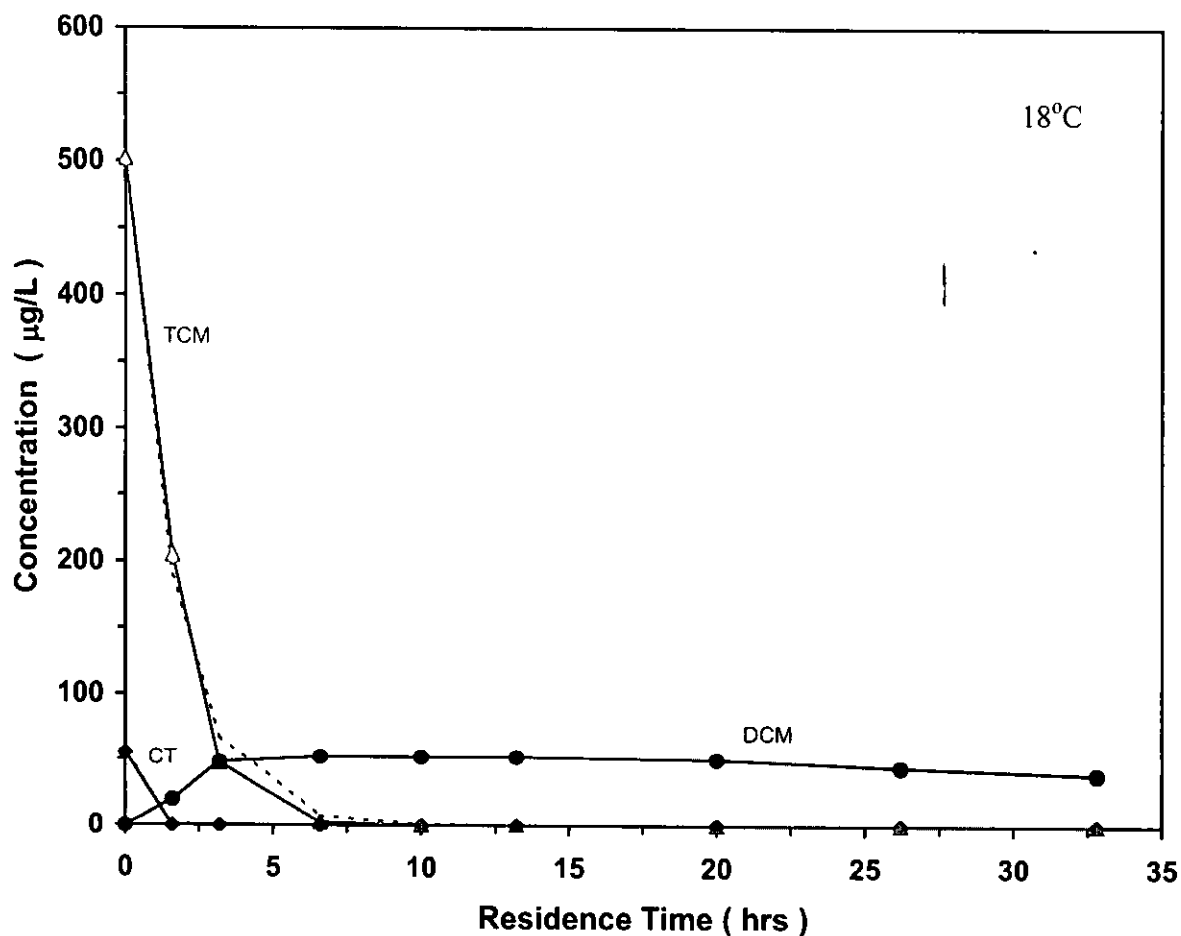


Figure 3: Carbon tetrachloride (CT), chloroform (TCM) and dichloromethane (DCM) concentration profiles versus residence time (solid line) along the bench-scale test column for MW-54. The dotted line represents the least squares best fit of the first-order kinetic model to the data.

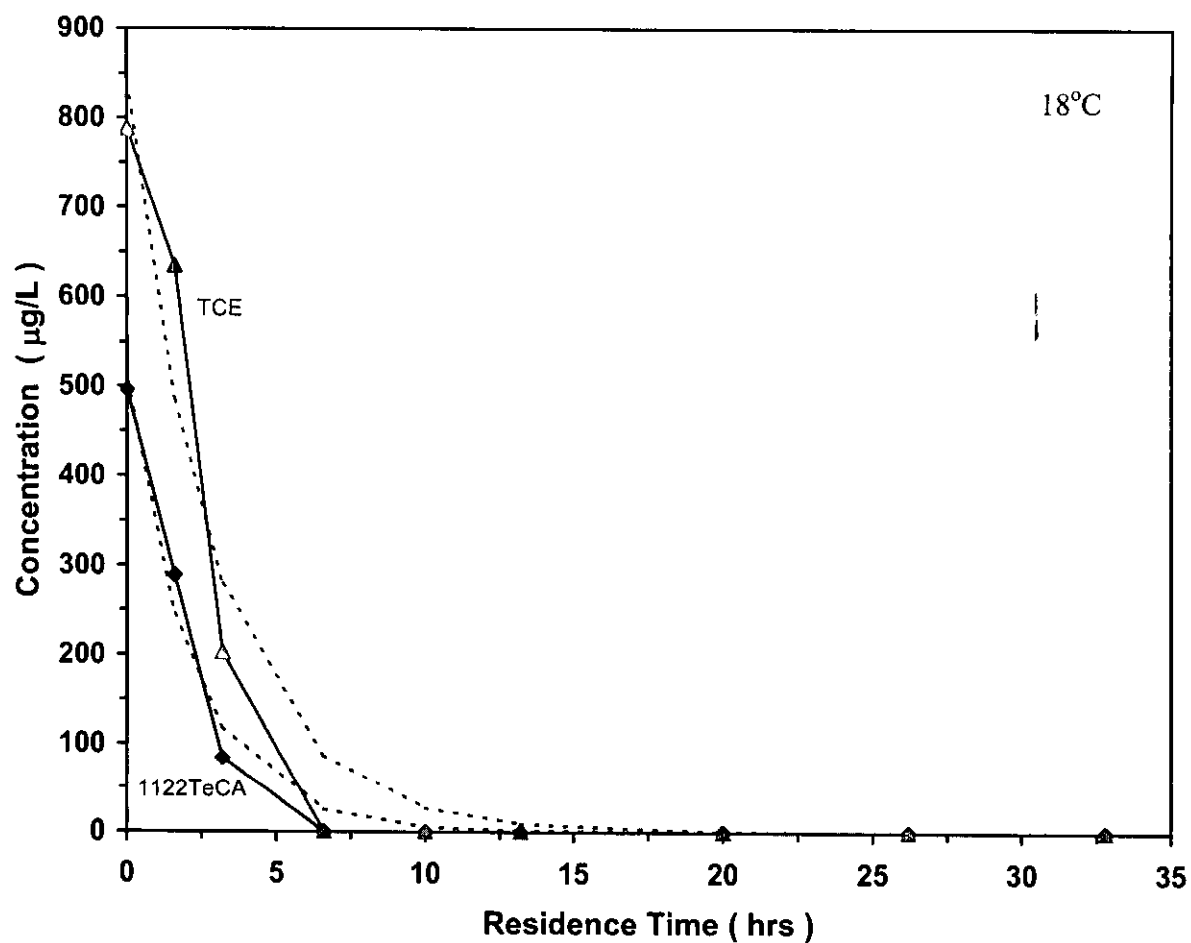


Figure 4: 1,1,2,2-Tetrachloroethane (1122TeCA) and trichloroethene (TCE) concentration profiles versus residence time (solid line) along the bench-scale test column for MW-54. The dotted line represents the least squares best fits of the first-order kinetic model to the data.

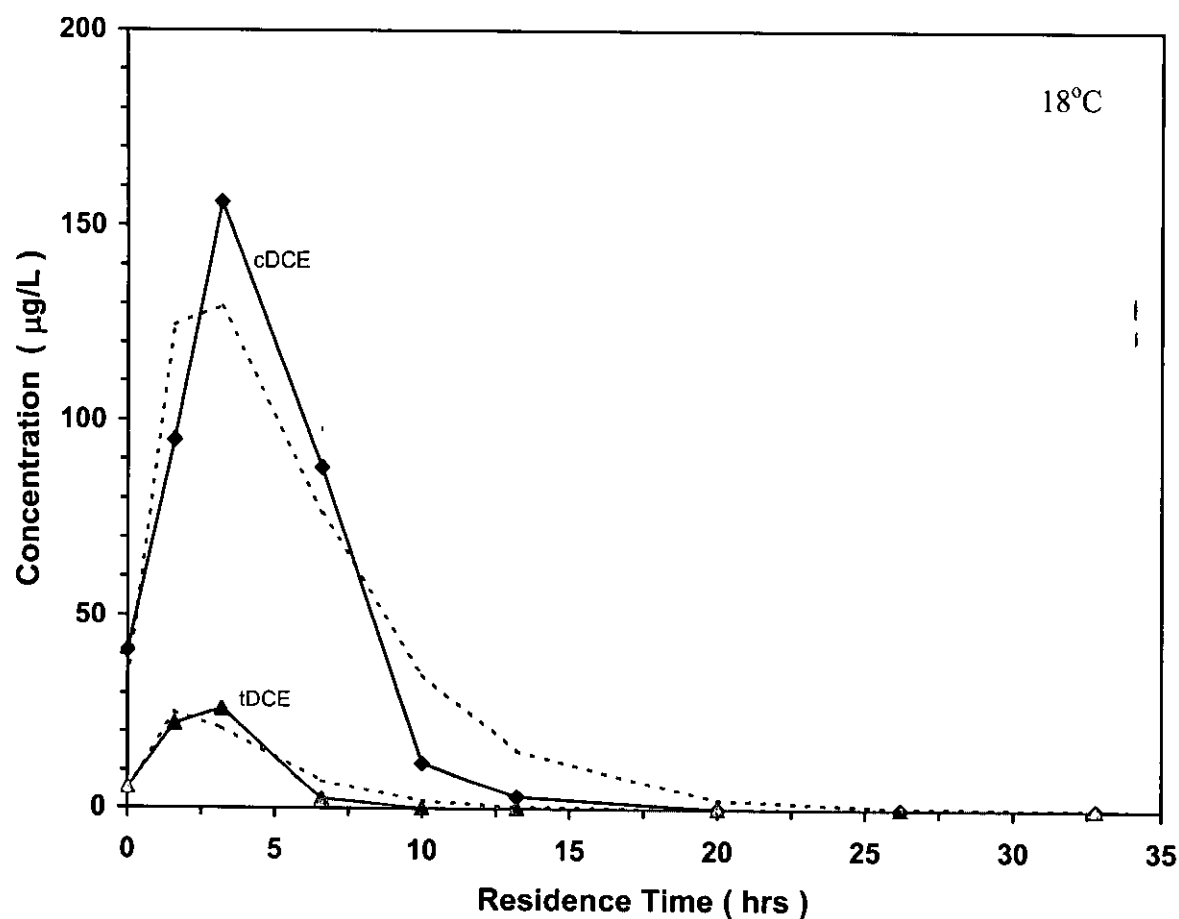


Figure 5: cis 1,2-dichloroethene (cDCE) and trans 1,2-dichloroethene (tDCE) concentration profiles versus residence time (solid line) along the bench-scale test column for MW-54. The dotted line represents the least squares best fits of the first-order kinetic model to the data.

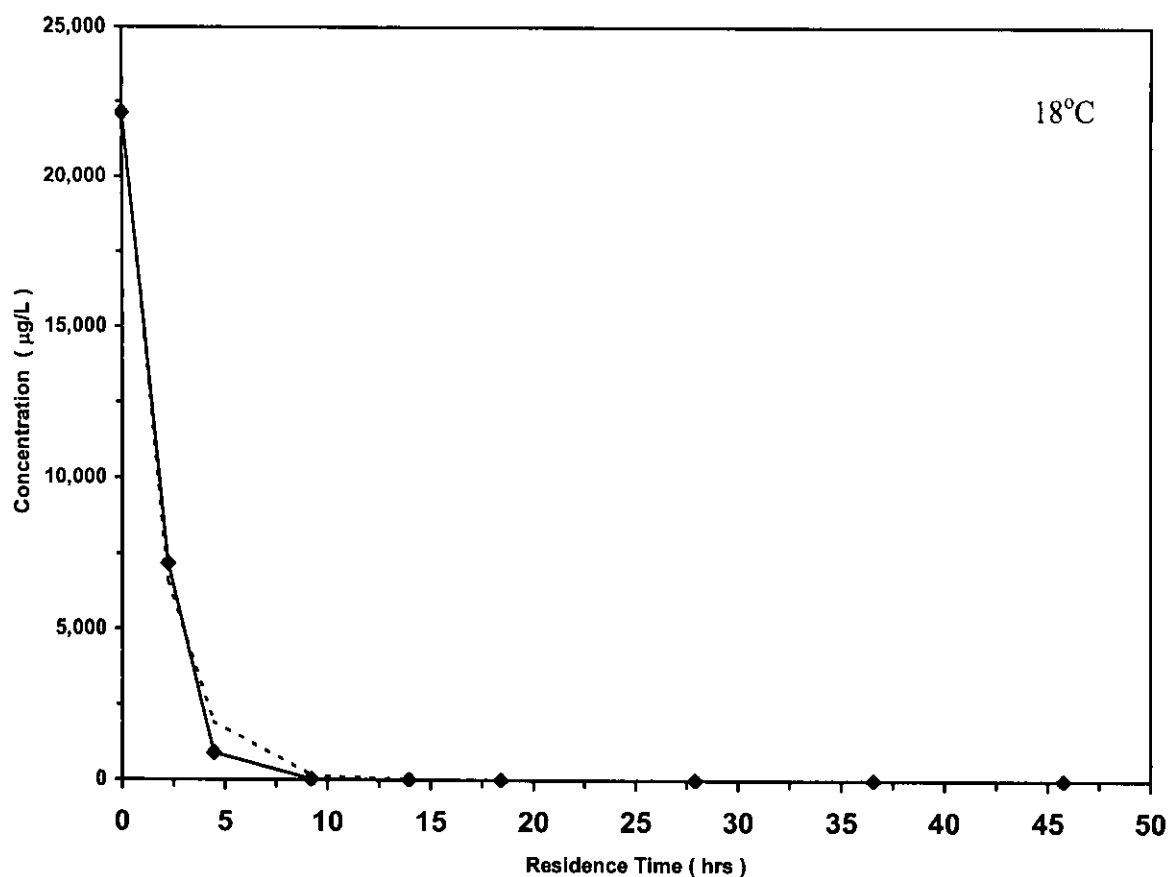


Figure 6: 1,1,2,2-Tetrachloroethane (1122TeCA) concentration profile versus residence time (solid line) along the bench-scale test column for MW-77. The dotted line represents the least squares best fits of the first-order kinetic model to the data.

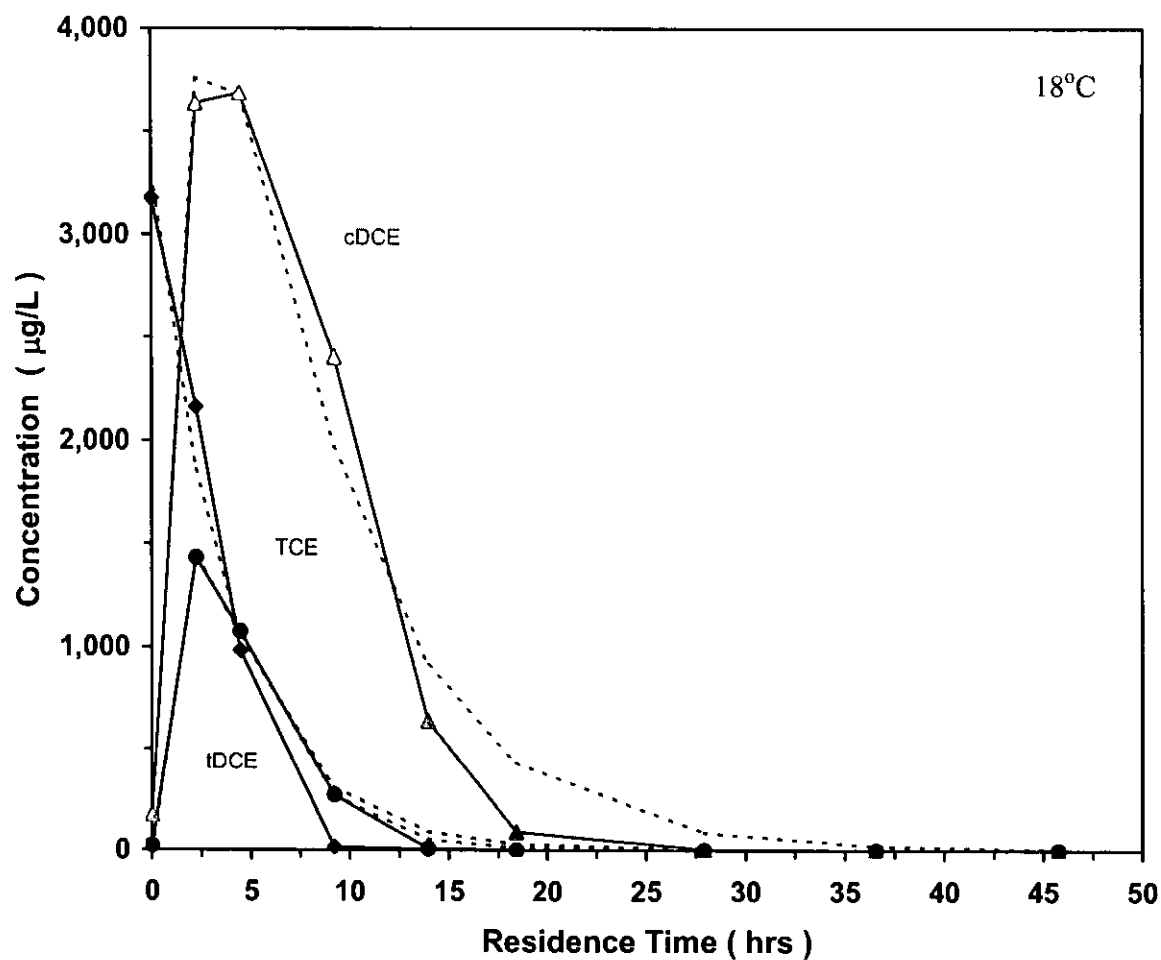


Figure 7: Trichloroethene (TCE), cis 1,2-dichloroethene (cDCE) and trans 1,2-dichloroethene (tDCE) concentration profiles versus residence time (solid line) along the bench-scale test column for MW-77. The dotted line represents the least squares best fits of the first-order kinetic model to the data.

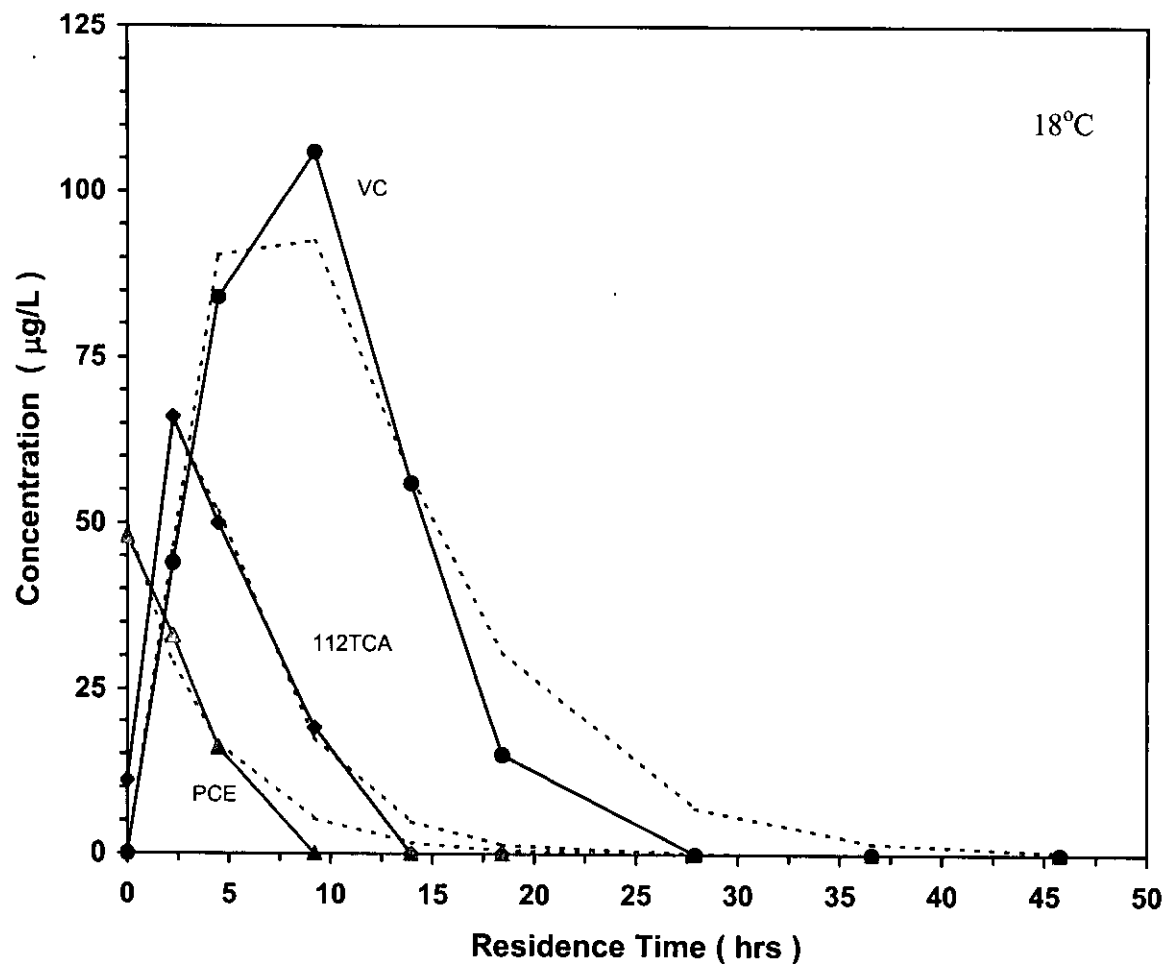
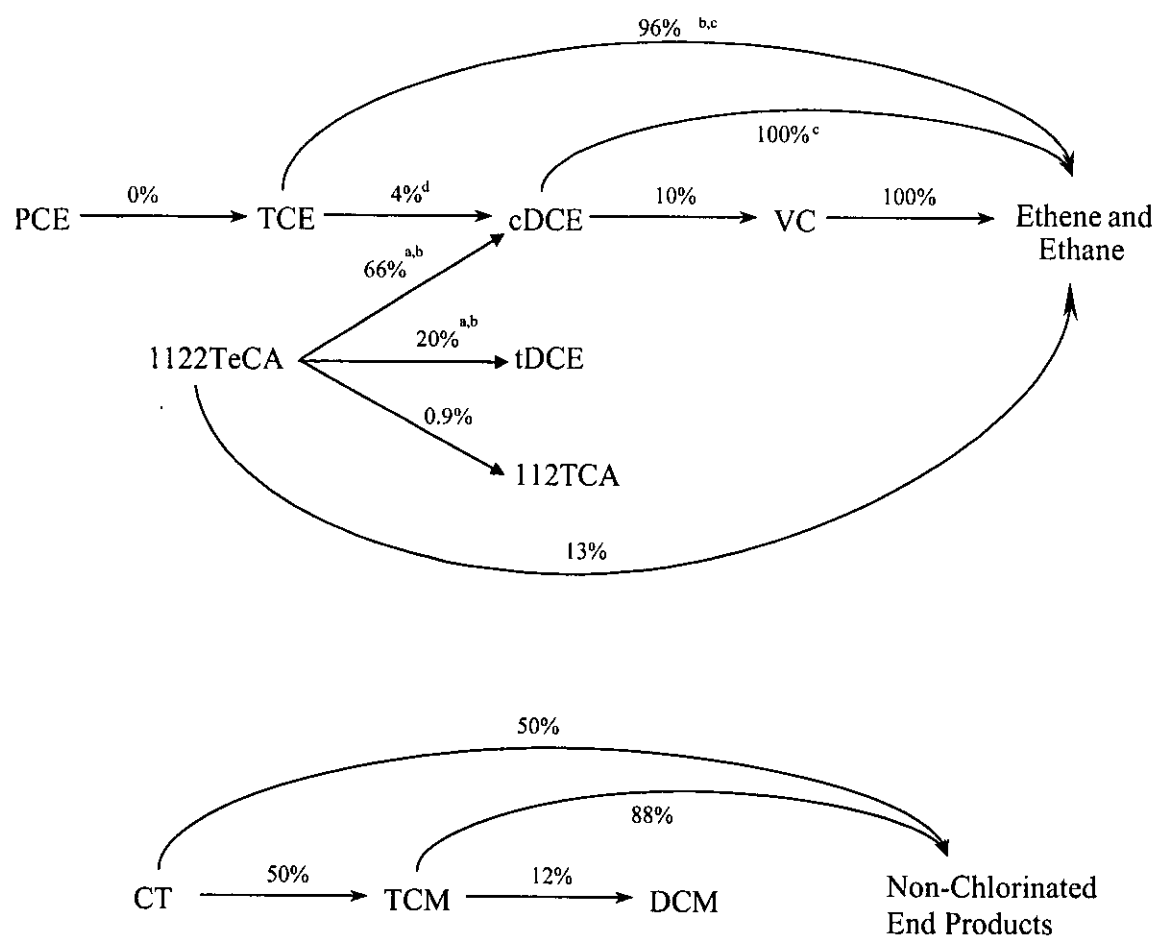
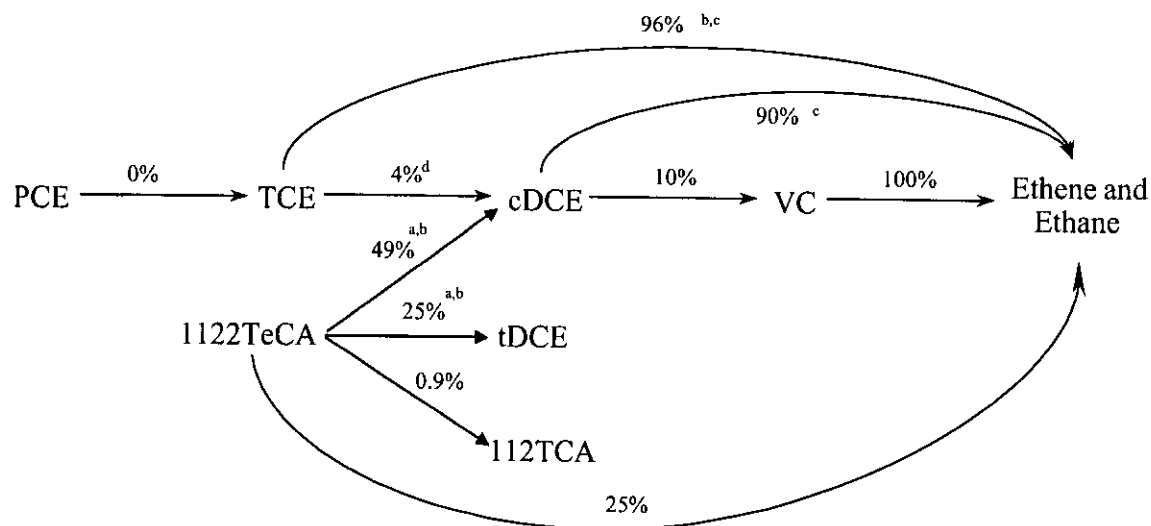


Figure 8: 1,1,2-Trichloroethane (112TCA), tetrachloroethene (PCE) and vinyl chloride (VC) concentration profile versus residence time (solid line) along the bench-scale test column for MW-77. The dotted line represents the least squares best fits of the first-order kinetic model to the data.



- ^a Degradation pathway through dichloroacetylene
- ^b Degradation pathway through chloroacetylene
- ^c Degradation pathway through acetylene
- ^d Fixed molar conversion (typical)

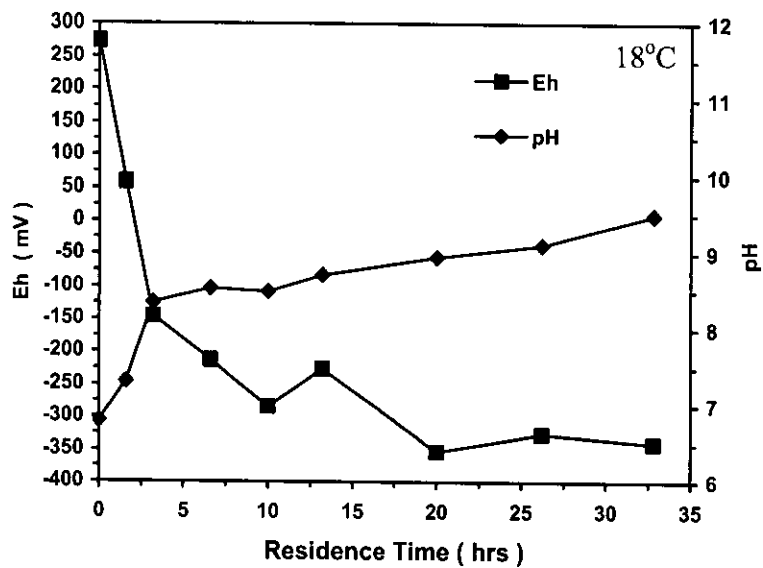
Figure 9: Molar conversions obtained from the least squares best fits of the first-order kinetic model to the bench-scale test column data for MW-54.



- ^a Degradation pathway through dichloroacetylene
- ^b Degradation pathway through chloroacetylene
- ^c Degradation pathway through acetylene
- ^d Fixed molar conversion (typical)

Figure 10: Molar conversions obtained from the least squares best fits of the first-order kinetic model to the bench-scale test column data for MW-77.

a)



b)

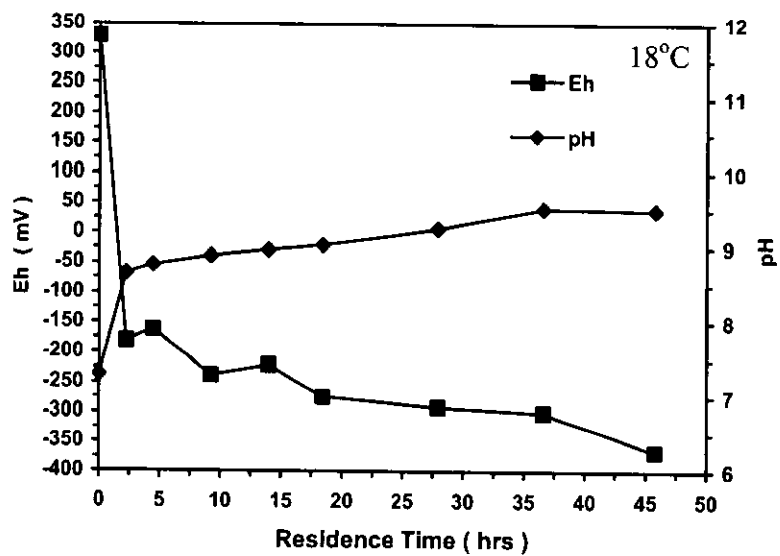


Figure 11: Redox potential (Eh) and pH profiles versus residence time along the bench-scale test columns for a) MW-54 and b) MW-77.

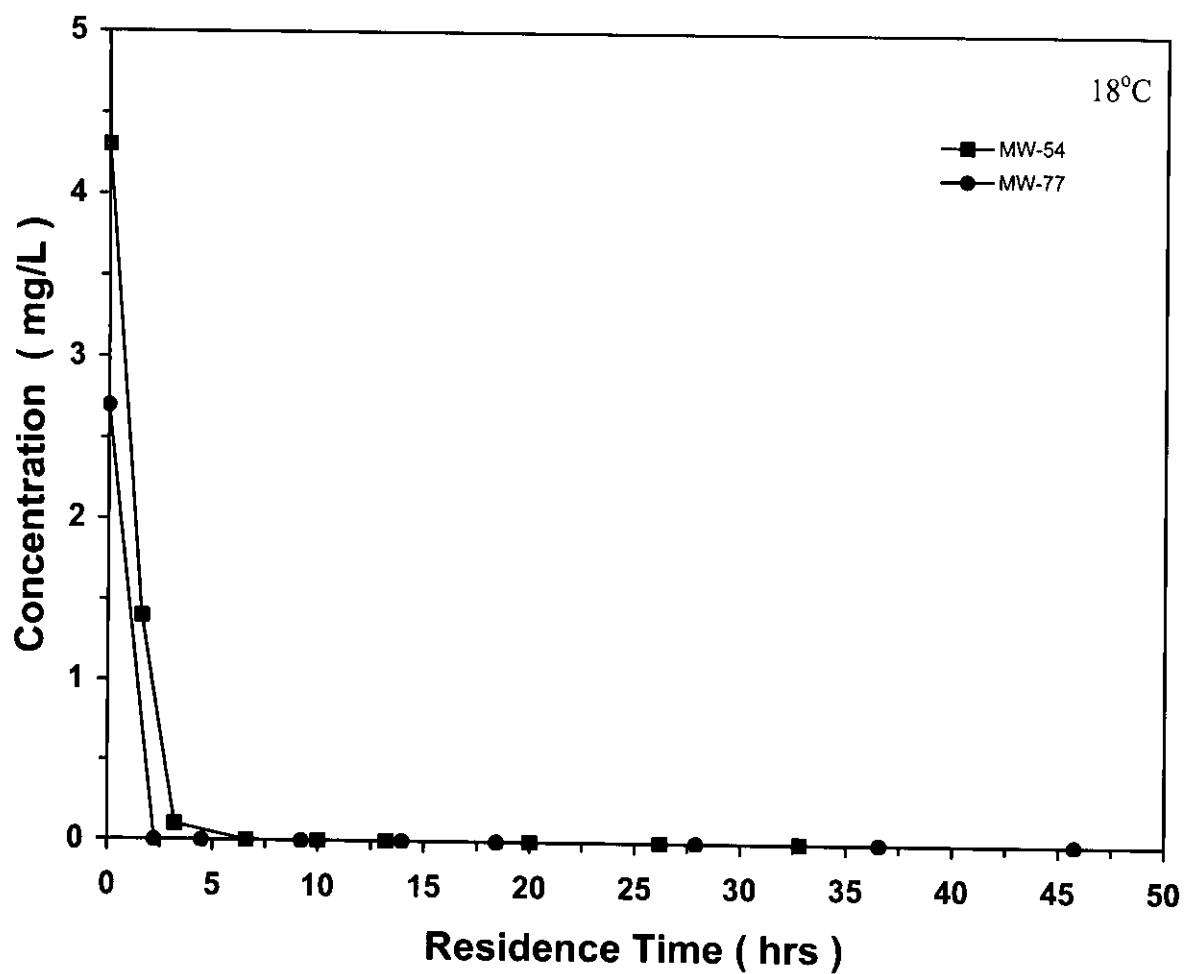


Figure 12: Nitrate (as N) profiles versus residence time along the bench-scale test columns for MW-54 and MW-77.

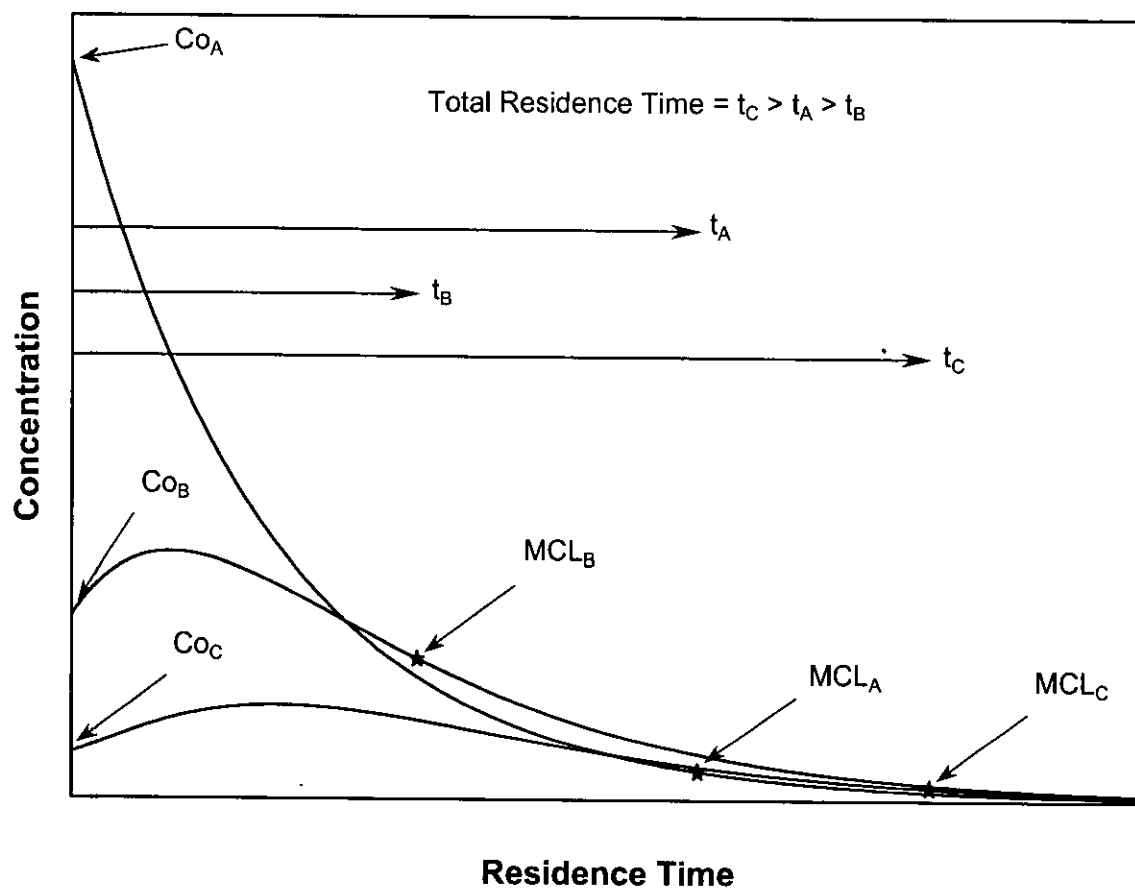


Figure 13: Illustration of residence time calculations using the degradation model.

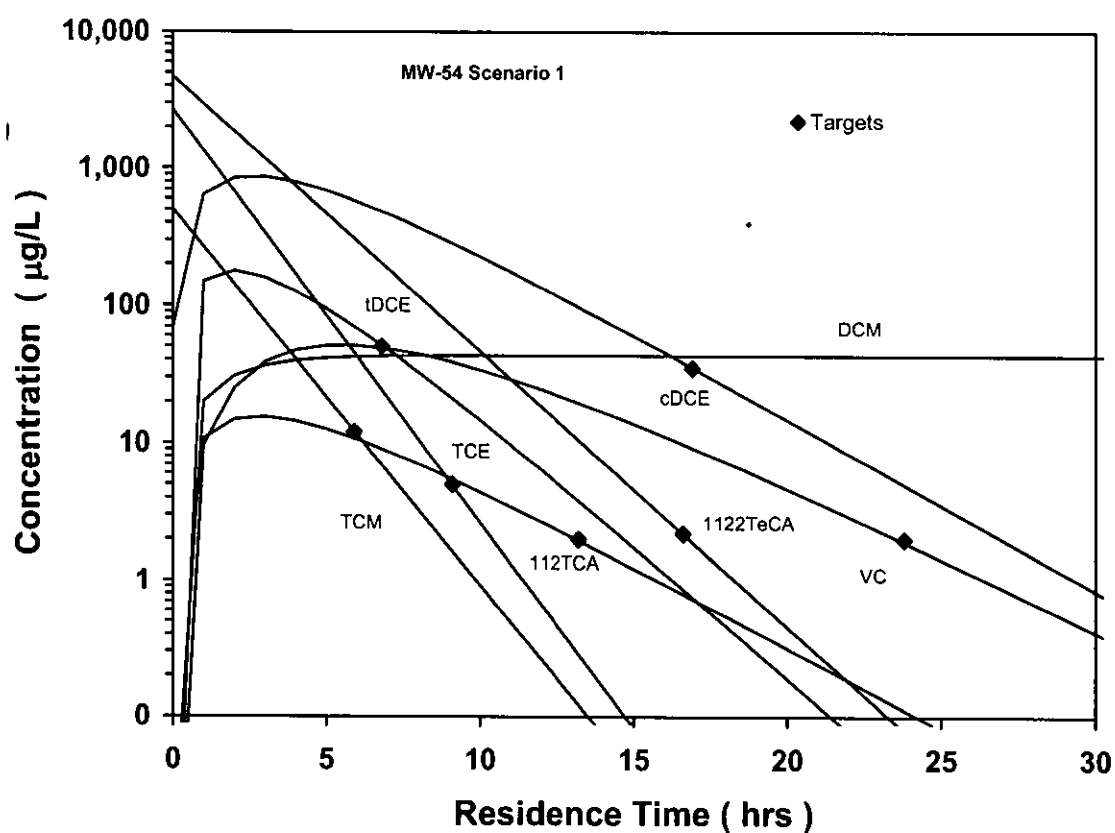


Figure 14: First-order kinetic model simulation results using concentrations and half-lives and molar conversions determined from the bench-scale column test for MW-54 and Scenario 1 of influent concentration.

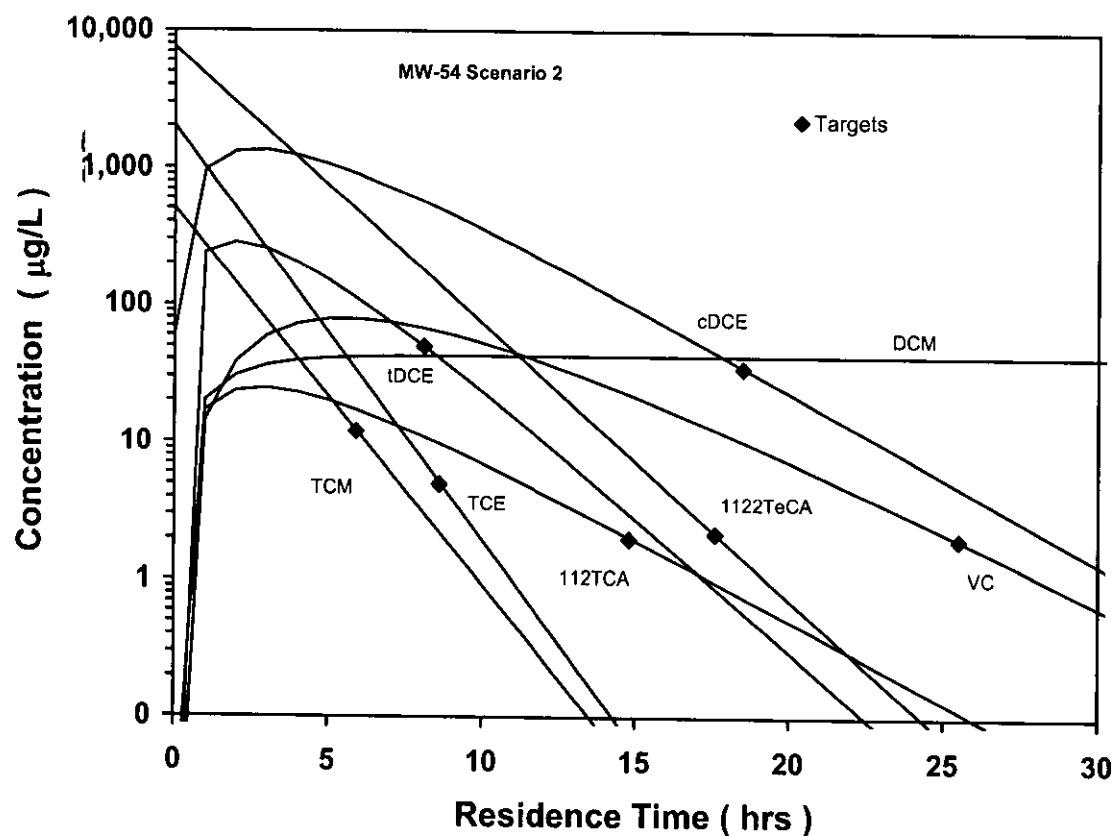


Figure 15: First-order kinetic model simulation results using concentrations and half-lives and molar conversions determined from the bench-scale column test for MW-54 and Scenario 2 of influent concentration.

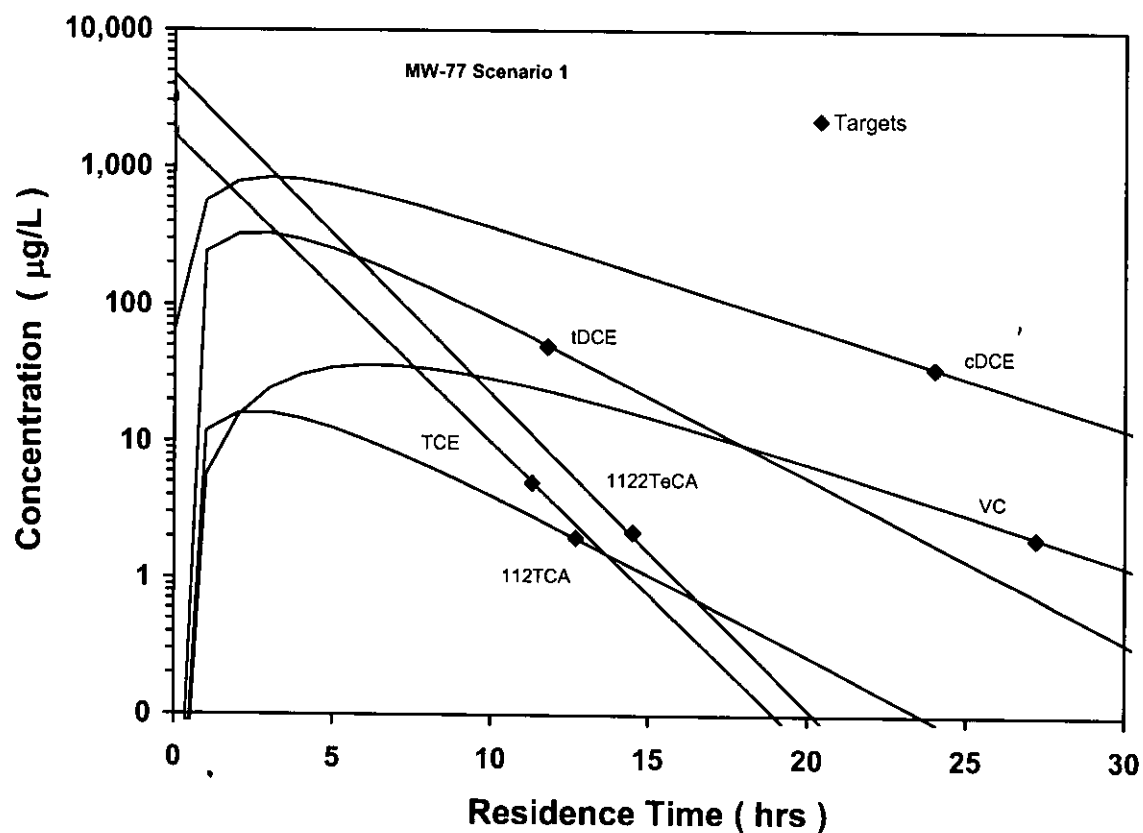


Figure 16: First-order kinetic model simulation results using concentrations and half-lives and molar conversions determined from the bench-scale column test for MW-77 and Scenario 1 of influent concentration.

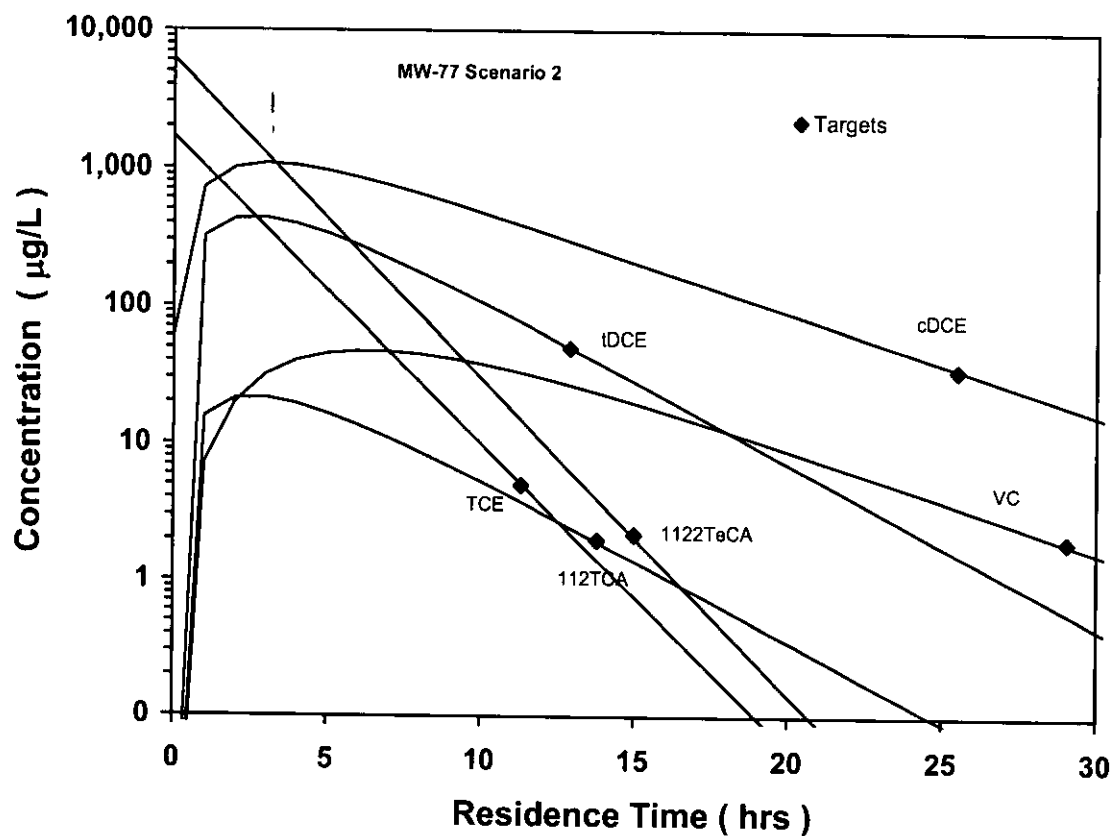


Figure 17: First-order kinetic model simulation results using concentrations and half-lives and molar conversions determined from the bench-scale column test for MW-77 and Scenario 2 of influent concentration.

Appendix A

Grain Size Distribution Curve

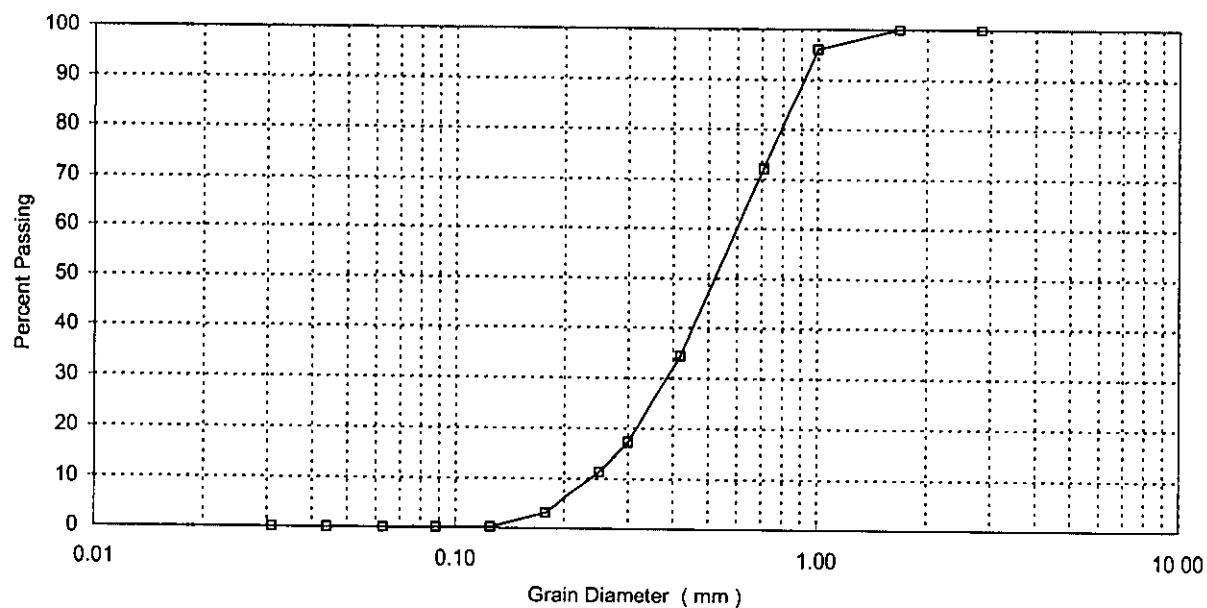
Grain Size Distribution Curve

Date: 08-Aug-03
UW Number: UW 255
Iron Type/Date: Connolly 18/84

US Sieve Mesh #	mm	Wt Retained On sieve (grams)	Percent (%)	Percent Passing (%)
7	2.830	0.00	0.00	100.00
12	1.680	0.01	0.01	99.99
18	1.000	3.93	3.94	96.05
25	0.710	23.77	23.87	72.18
40	0.420	37.57	37.72	34.46
50	0.300	17.18	17.24	17.22
60	0.250	5.84	5.86	11.36
80	0.177	8.27	8.30	3.06
120	0.125	2.87	2.88	0.18
170	0.088	0.04	0.04	0.14
230	0.063	0.13	0.13	0.02
325	0.044	0.01	0.01	0.01
<325	0.031	0.01	0.01	0.00

99.60 100.00
 Total Wt Total %

Grain Size Distribution Curve for Connolly Iron (UW# 255)



Appendix B

Interlaboratory Comparison

LABORATORY REPORT

L0310530

10/30/03 08:03

Submitted By

Kemron Environmental Services
109 Starlite Park
Marietta, Ohio 45750
(740)373-4071

For

Account Name: CCI/CH2MHILL
115 Perimeter Place NE
Suite 700
Atlanta, GA 30346
Attention: David Nelson

Account Number: 207-630
Work ID: 42577/UNIV OF WATERLOO

P.O. Number: 56952

Sample Summary

Client ID	Lab ID	Date Collected	Date Recieved
MW-54 C O P V	L0310530-01	20-OCT-03	23-OCT-03
MW-77 C O P V	L0310530-02	21-OCT-03	23-OCT-03

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0310530

Report Date : October 30, 2003

Sample Number: L0310530-01
 Client ID: MW-54
 Matrix: Water
 Workgroup Number: WG152829
 Collect Date: 20-OCT-03

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 5
 Units: ug/L

Instrument: HPMS11
 Prep Date: 10/27/2003 11:48
 Cal Date: 10/17/2003 14:43
 Run Date: 10/27/2003 11:48
 File ID: 11M17973

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	500	12.5
Benzene	71-43-2		U	25.0	0.625
Bromobenzene	108-86-1		U	25.0	0.625
Bromochloromethane	74-97-5		U	25.0	1.00
Bromodichloromethane	75-27-4		U	25.0	1.25
Bromoform	75-25-2		U	25.0	2.70
Bromomethane	74-83-9		U	50.0	2.50
2-Butanone	78-93-3		U	500	12.5
n-Butylbenzene	104-51-8		U	25.0	1.25
sec-Butylbenzene	135-98-8		U	25.0	1.25
tert-Butylbenzene	98-06-6		U	25.0	1.25
Carbon disulfide	75-15-0		U	25.0	2.50
Carbon tetrachloride	56-23-5	185		25.0	1.25
Chlorobenzene	108-90-7		U	25.0	0.625
Chlorodibromomethane	124-48-1		U	25.0	1.25
Chloroethane	75-00-3		U	50.0	2.50
2-Chloroethyl vinyl ether	110-75-8		U	50.0	10.0
Chloroform	67-66-3	1220	I	25.0	0.625
Chloromethane	74-87-3		U	50.0	1.25
2-Chlorotoluene	95-49-8		U	25.0	0.625
4-Chlorotoluene	106-43-4		U	25.0	1.25
1,2-Dibromo-3-chloropropane	96-12-8		U	25.0	5.00
1,2-Dibromoethane	106-93-4		U	25.0	1.25
Dibromomethane	74-95-3		U	25.0	1.25
1,2-Dichlorobenzene	95-50-1		U	25.0	0.625
1,3-Dichlorobenzene	541-73-1		U	25.0	1.25
1,4-Dichlorobenzene	106-46-7		U	25.0	0.625
Dichlorodifluoromethane	75-71-8		U	50.0	1.25
1,1-Dichloroethane	75-34-3		U	25.0	0.625
1,2-Dichloroethane	107-06-2		U	25.0	1.25
1,1-Dichloroethene	75-35-4		U	25.0	2.50
cis-1,2-Dichloroethene	156-59-2	41.5		25.0	1.25
trans-1,2-Dichloroethene	156-60-5	8.74	J	25.0	1.25
1,2-Dichloropropane	78-87-5		U	25.0	0.625
1,3-Dichloropropane	142-28-9		U	25.0	1.00
2,2-Dichloropropane	594-20-7		U	25.0	1.25
cis-1,3-Dichloropropene	10061-01-5		U	25.0	1.25
trans-1,3-Dichloropropene	10061-02-6		U	25.0	2.50
1,1-Dichloropropene	563-58-6		U	25.0	1.25
Ethylbenzene	100-41-4		U	25.0	1.25
2-Hexanone	591-78-6		U	50.0	12.5
Hexachlorobutadiene	87-68-3		U	25.0	1.25
Isopropylbenzene	98-82-8		U	25.0	1.25
p-Isopropyltoluene	99-87-6		U	25.0	1.25
4-Methyl-2-pentanone	108-10-1		U	50.0	12.5
Methylene chloride	75-09-2		U	25.0	1.25
Naphthalene	91-20-3		U	50.0	1.00
n-Propylbenzene	103-65-1		U	25.0	0.625
Styrene	100-42-5		U	25.0	0.625
1,1,1,2-Tetrachloroethane	630-20-6		U	25.0	1.25
1,1,2,2-Tetrachloroethane	79-34-5	456		25.0	0.625
Tetrachloroethene	127-18-4	3.99	J	25.0	1.25
Toluene	108-88-3		U	25.0	1.25
1,2,3-Trichlorobenzene	87-61-6		U	25.0	0.625
1,2,4-Trichlorobenzene	120-82-1		U	25.0	1.00
1,1,1-Trichloroethane	71-55-6		U	25.0	1.25
1,1,2-Trichloroethane	79-00-5	3.71	J	25.0	1.25
Trichloroethene	79-01-6	746		25.0	1.25
Trichlorofluoromethane	75-69-4		U	50.0	1.25

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0310530

Report Date : October 30, 2003

Sample Number: L0310530-01	Prep Method: 5030B	Instrument: HPMS11
Client ID: MW-54	Analytical Method: 8260B	Prep Date: 10/27/2003 11:48
Matrix: Water	Analyst: CMS	Cal Date: 10/17/2003 14:43
Workgroup Number: WG152829	Dilution: 5	Run Date: 10/27/2003 11:48
Collect Date: 20-OCT-03	Units: ug/L	File ID: 11M17973

Analyte	CAS. Number	Result	Qual	RL	MDL
1,2,3-Trichloropropane	96-18-4		U	25.0	3.75
1,2,4-Trimethylbenzene	95-63-6		U	25.0	1.25
1,3,5-Trimethylbenzene	108-67-8		U	25.0	1.25
Vinyl acetate	108-05-4		U	50.0	12.5
Vinyl chloride	75-01-4		U	50.0	1.25
o-Xylene	95-47-6		U	25.0	1.25
m,p-Xylene	136777-61-2		U	25.0	2.50
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	91.5	86	118		
1,2-Dichloroethane-d4	87.7	80	120		
Toluene-d8	103	88	110		
4-Bromofluorobenzene	101	86	115		

I Semiquantitative result (out of instrument calibration range)

J The analyte was positively identified, but the quantitation was below the RL

U Not detected at or above the method detection limit

Sample Number: L0310530-01	Prep Method: 5030B	Instrument: HPMS11
Client ID: MW-54	Analytical Method: 8260B	Prep Date: 10/27/2003 13:51
Matrix: Water	Analyst: CMS	Cal Date: 10/17/2003 14:43
Workgroup Number: WG152829	Dilution: 50	Run Date: 10/27/2003 13:51
Collect Date: 20-OCT-03	Units: ug/L	File ID: 11M17977
Sample Tag: D1		

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5000	125
Benzene	71-43-2		U	250	6.25
Bromobenzene	108-86-1		U	250	6.25
Bromochloromethane	74-97-5		U	250	10.0
Bromodichloromethane	75-27-4		U	250	12.5
Bromoform	75-25-2		U	250	27.0
Bromomethane	74-83-9		U	500	25.0
2-Butanone	78-93-3		U	5000	125
n-Butylbenzene	104-51-8		U	250	12.5
sec-Butylbenzene	135-98-8		U	250	12.5
tert-Butylbenzene	98-06-6		U	250	12.5
Carbon disulfide	75-15-0		U	250	25.0
Carbon tetrachloride	56-23-5	184	J	250	12.5
Chlorobenzene	108-90-7		U	250	6.25
Chlorodibromomethane	124-48-1		U	250	12.5
Chloroethane	75-00-3		U	500	25.0
2-Chloroethyl vinyl ether	110-75-8		U	500	100
Chloroform	67-66-3	1340		250	6.25
Chloromethane	74-87-3		U	500	12.5
2-Chlorotoluene	95-49-8		U	250	6.25
4-Chlorotoluene	106-43-4		U	250	12.5
1,2-Dibromo-3-chloropropane	96-12-8		U	250	50.0
1,2-Dibromoethane	106-93-4		U	250	12.5
Dibromomethane	74-95-3		U	250	12.5
1,2-Dichlorobenzene	95-50-1		U	250	6.25
1,3-Dichlorobenzene	541-73-1		U	250	12.5
1,4-Dichlorobenzene	106-46-7		U	250	6.25
Dichlorodifluoromethane	75-71-8		U	500	12.5
1,1-Dichloroethane	75-34-3		U	250	6.25
1,2-Dichloroethane	107-06-2		U	250	12.5
1,1-Dichloroethene	75-35-4		U	250	25.0
cis-1,2-Dichloroethene	156-59-2	37.9	J	250	12.5
trans-1,2-Dichloroethene	156-60-5		U	250	12.5

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0310530

Report Date : October 30, 2003

Sample Number: L0310530-01
 Client ID: MW-54
 Matrix: Water
 Workgroup Number: WG152829
 Collect Date: 20-OCT-03
 Sample Tag: D1

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 50
 Units: ug/L

Instrument: HPMS11
 Prep Date: 10/27/2003 13:51
 Cal Date: 10/17/2003 14:43
 Run Date: 10/27/2003 13:51
 File ID: 11M17977

Analyte	CAS. Number	Result	Qual	RL	MDL
1,2-Dichloropropane	78-87-5		U	250	6.25
1,3-Dichloropropane	142-28-9		U	250	10.0
2,2-Dichloropropane	594-20-7		U	250	12.5
cis-1,3-Dichloropropene	10061-01-5		U	250	12.5
trans-1,3-Dichloropropene	10061-02-6		U	250	25.0
1,1-Dichloropropene	563-58-6		U	250	12.5
Ethylbenzene	100-41-4		U	250	12.5
2-Hexanone	591-78-6		U	500	125
Hexachlorobutadiene	87-68-3		U	250	12.5
Isopropylbenzene	98-82-8		U	250	12.5
p-Isopropyltoluene	99-87-6		U	250	12.5
4-Methyl-2-pentanone	108-10-1		U	500	125
Methylene chloride	75-09-2		U	250	12.5
Naphthalene	91-20-3		U	500	10.0
n-Propylbenzene	103-65-1		U	250	6.25
Styrene	100-42-5		U	250	6.25
1,1,1,2-Tetrachloroethane	630-20-6		U	250	12.5
1,1,2,2-Tetrachloroethane	79-34-5	470		250	6.25
Tetrachloroethene	127-18-4		U	250	12.5
Toluene	108-88-3		U	250	12.5
1,2,3-Trichlorobenzene	87-61-6		U	250	6.25
1,2,4-Trichlorobenzene	120-82-1		U	250	10.0
1,1,1-Trichloroethane	71-55-6		U	250	12.5
1,1,2-Trichloroethane	79-00-5		U	250	12.5
Trichloroethene	79-01-6	712		250	12.5
Trichlorofluoromethane	75-69-4		U	500	12.5
1,2,3-Trichloropropane	96-18-4		U	250	37.5
1,2,4-Trimethylbenzene	95-63-6		U	250	12.5
1,3,5-Trimethylbenzene	108-67-8		U	250	12.5
Vinyl acetate	108-05-4		U	500	125
Vinyl chloride	75-01-4		U	500	12.5
o-Xylene	95-47-6		U	250	12.5
m-, p-Xylene	136777-61-2		U	250	25.0
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	89.9	86	118		
1,2-Dichloroethane-d4	86.8	80	120		
Toluene-d8	104	88	110		
4-Bromofluorobenzene	101	86	115		

J The analyte was positively identified, but the quantitation was below the RL
 U Not detected at or above the method detection limit

Sample Number: L0310530-02
 Client ID: MW-77
 Matrix: Water
 Workgroup Number: WG152829
 Collect Date: 21-OCT-03

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 50
 Units: ug/L

Instrument: HPMS11
 Prep Date: 10/27/2003 12:19
 Cal Date: 10/17/2003 14:43
 Run Date: 10/27/2003 12:19
 File ID: 11M17974

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5000	125
Benzene	71-43-2		U	250	6.25
Bromobenzene	108-86-1		U	250	6.25
Bromochloromethane	74-97-5		U	250	10.0
Bromodichloromethane	75-27-4		U	250	12.5
Bromoform	75-25-2		U	250	27.0
Bromomethane	74-83-9		U	500	25.0

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0310530

Report Date : October 30, 2003

Sample Number: L0310530-02
 Client ID: MW-77
 Matrix: Water
 Workgroup Number: WG152829
 Collect Date: 21-OCT-03

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 50
 Units: ug/L

Instrument: HPMS11
 Prep Date: 10/27/2003 12:19
 Cal Date: 10/17/2003 14:43
 Run Date: 10/27/2003 12:19
 File ID: 11M17974

Analyte	CAS. Number	Result	Qual	RL	MDL
2-Butanone	78-93-3		U	5000	125
n-Butylbenzene	104-51-8		U	250	12.5
sec-Butylbenzene	135-98-8		U	250	12.5
tert-Butylbenzene	98-06-6		U	250	12.5
Carbon disulfide	75-15-0		U	250	25.0
Carbon tetrachloride	56-23-5		U	250	12.5
Chlorobenzene	108-90-7		U	250	6.25
Chlorodibromomethane	124-48-1		U	250	12.5
Chloroethane	75-00-3		U	500	25.0
2-Chloroethyl vinyl ether	110-75-8		U	500	100
Chloroform	67-66-3	15.0	J	250	6.25
Chloromethane	74-87-3		U	500	12.5
2-Chlorotoluene	95-49-8		U	250	6.25
4-Chlorotoluene	106-43-4		U	250	12.5
1,2-Dibromo-3-chloropropane	96-12-8		U	250	50.0
1,2-Dibromoethane	106-93-4		U	250	12.5
Dibromomethane	74-95-3		U	250	12.5
1,2-Dichlorobenzene	95-50-1		U	250	6.25
1,3-Dichlorobenzene	541-73-1		U	250	12.5
1,4-Dichlorobenzene	106-46-7		U	250	6.25
Dichlorodifluoromethane	75-71-8		U	500	12.5
1,1-Dichloroethane	75-34-3		U	250	6.25
1,2-Dichloroethane	107-06-2		U	250	12.5
1,1-Dichloroethene	75-35-4		U	250	25.0
cis-1,2-Dichloroethene	156-59-2	138	J	250	12.5
trans-1,2-Dichloroethene	156-60-5	24.5	J	250	12.5
1,2-Dichloropropane	78-87-5		U	250	6.25
1,3-Dichloropropane	142-28-9		U	250	10.0
2,2-Dichloropropane	594-20-7		U	250	12.5
cis-1,3-Dichloropropene	10061-01-5		U	250	12.5
trans-1,3-Dichloropropene	10061-02-6		U	250	25.0
1,1-Dichloropropene	563-58-6		U	250	12.5
Ethylbenzene	100-41-4		U	250	12.5
2-Hexanone	591-78-6		U	500	125
Hexachlorobutadiene	87-68-3		U	250	12.5
Isopropylbenzene	98-82-8		U	250	12.5
p-Isopropyltoluene	99-87-6		U	250	12.5
4-Methyl-2-pentanone	108-10-1		U	500	125
Methylene chloride	75-09-2		U	250	12.5
Naphthalene	91-20-3		U	500	10.0
n-Propylbenzene	103-65-1		U	250	6.25
Styrene	100-42-5		U	250	6.25
1,1,1,2-Tetrachloroethane	630-20-6		U	250	12.5
1,1,1,2,2-Tetrachloroethane	79-34-5	11800	I	250	6.25
Tetrachloroethene	127-18-4	14.3	J	250	12.5
Toluene	108-88-3		U	250	12.5
1,2,3-Trichlorobenzene	87-61-6		U	250	6.25
1,2,4-Trichlorobenzene	120-82-1		U	250	10.0
1,1,1-Trichloroethane	71-55-6		U	250	12.5
1,1,2-Trichloroethane	79-00-5		U	250	12.5
Trichloroethene	79-01-6	2780		250	12.5
Trichlorofluoromethane	75-69-4		U	500	12.5
1,2,3-Trichloropropane	96-18-4		U	250	37.5
1,2,4-Trimethylbenzene	95-63-6		U	250	12.5
1,3,5-Trimethylbenzene	108-67-8		U	250	12.5
Vinyl acetate	108-05-4		U	500	125
Vinyl chloride	75-01-4		U	500	12.5
o-Xylene	95-47-6		U	250	12.5
m-, p-Xylene	136777-61-2		U	250	25.0

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0310530

Report Date : October 30, 2003

Sample Number: L0310530-02
 Client ID: MW-77
 Matrix: Water
 Workgroup Number: WGI52829
 Collect Date: 21-OCT-03

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 50
 Units: ug/L

Instrument: HPMS11
 Prep Date: 10/27/2003 12:19
 Cal Date: 10/17/2003 14:43
 Run Date: 10/27/2003 12:19
 File ID: 11M17974

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	86.8	86	118	
1,2-Dichloroethane-d4	84.9	80	120	
Toluene-d8	104	88	110	
4-Bromofluorobenzene	101	86	115	

I Semiquantitative result (out of instrument calibration range)

J The analyte was positively identified, but the quantitation was below the RL

U Not detected at or above the method detection limit

Sample Number: L0310530-02
 Client ID: MW-77
 Matrix: Water
 Workgroup Number: WGI52829
 Collect Date: 21-OCT-03
 Sample Tag: B1

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 500
 Units: ug/L

Instrument: HPMS11
 Prep Date: 10/27/2003 14:22
 Cal Date: 10/17/2003 14:43
 Run Date: 10/27/2003 14:22
 File ID: 11M17978

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	50000	1250
Benzene	71-43-2		U	2500	62.5
Bromobenzene	108-86-1		U	2500	62.5
Bromochloromethane	74-97-5		U	2500	100
Bromodichloromethane	75-27-4		U	2500	125
Bromoform	75-25-2		U	2500	270
Bromomethane	74-83-9		U	5000	250
2-Butanone	78-93-3		U	50000	1250
n-Butylbenzene	104-51-8		U	2500	125
sec-Butylbenzene	135-98-8		U	2500	125
tert-Butylbenzene	98-06-6		U	2500	125
Carbon disulfide	75-15-0		U	2500	250
Carbon tetrachloride	56-23-5		U	2500	125
Chlorobenzene	108-90-7		U	2500	62.5
Chlorodibromomethane	124-48-1		U	2500	125
Chloroethane	75-00-3		U	5000	250
2-Chloroethyl vinyl ether	110-75-8		U	5000	1000
Chloroform	67-66-3		U	2500	62.5
Chloromethane	74-87-3		U	5000	125
2-Chlorotoluene	95-49-8		U	2500	62.5
4-Chlorotoluene	106-43-4		U	2500	125
1,2-Dibromo-3-chloropropane	96-12-8		U	2500	500
1,2-Dibromoethane	106-93-4		U	2500	125
Dibromomethane	74-95-3		U	2500	125
1,2-Dichlorobenzene	95-50-1		U	2500	62.5
1,3-Dichlorobenzene	541-73-1		U	2500	125
1,4-Dichlorobenzene	106-46-7		U	2500	62.5
Dichlorodifluoromethane	75-71-8		U	5000	125
1,1-Dichloroethane	75-34-3		U	2500	62.5
1,2-Dichloroethane	107-06-2		U	2500	125
1,1-Dichloroethene	75-35-4		U	2500	250
cis-1,2-Dichloroethene	156-59-2	138	J	2500	125
trans-1,2-Dichloroethene	156-60-5		U	2500	125
1,2-Dichloropropane	78-87-5		U	2500	62.5
1,3-Dichloropropane	142-28-9		U	2500	100
2,2-Dichloropropane	594-20-7		U	2500	125
cis-1,3-Dichloropropene	10061-01-5		U	2500	125
trans-1,3-Dichloropropene	10061-02-6		U	2500	250
1,1-Dichloropropene	563-58-6		U	2500	125
Ethylbenzene	100-41-4		U	2500	125
2-Hexanone	591-78-6		U	5000	1250

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0310530

Report Date : October 30, 2003

Sample Number: L0310530-02
 Client ID: MW-77
 Matrix: Water
 Workgroup Number: W0152829
 Collect Date: 31-OCT-03
 Sample Tag: D1

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 500
 Units: ug/L

Instrument: HPMS11
 Prep Date: 10/27/2003 14:22
 Cal Date: 10/17/2003 14:43
 Run Date: 10/27/2003 14:22
 File ID: 11M17978

Analyte	CAS. Number	Result	Qual	RL	MDL
Hexachlorobutadiene	87-68-3		U	2500	125
Isopropylbenzene	98-82-8		U	2500	125
p-Isopropyltoluene	99-87-6		U	2500	125
4-Methyl-2-pentanone	108-10-1		U	5000	1250
Methylene chloride	75-09-2		U	2500	125
Naphthalene	91-20-3		U	5000	100
n-Propylbenzene	103-65-1		U	2500	62.5
Styrene	100-42-5		U	2500	62.5
1,1,1,2-Tetrachloroethane	630-20-6		U	2500	125
1,1,1,2-Tetrachloroethane	79-34-5	12100		2500	62.5
Tetrachloroethane	127-18-4		U	2500	125
Toluene	108-88-3		U	2500	125
1,2,3-Trichlorobenzene	87-61-6		U	2500	62.5
1,2,4-Trichlorobenzene	120-82-1		U	2500	100
1,1,1-Trichloroethane	71-55-6		U	2500	125
1,1,2-Trichloroethane	79-00-5		U	2500	125
Trichloroethane	79-01-6	3030		2500	125
Trichlorofluoromethane	75-69-4		U	5000	125
1,2,3-Trichloropropane	96-18-4		U	2500	375
1,2,4-Trimethylbenzene	95-63-6		U	2500	125
1,3,5-Trimethylbenzene	108-67-8		U	2500	125
Vinyl acetate	108-05-4		U	5000	1250
Vinyl chloride	75-01-4		U	5000	125
o-Xylene	95-47-6		U	2500	125
m-,p-Xylene	136777-61-2		U	2500	250
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	89.6	86	118		
1,2-Dichloroethane-d4	87.1	80	120		
Toluene-d8	103	88	110		
4-Bromofluorobenzene	100	86	115		

J The analyte was positively identified, but the quantitation was below the RL

U Not detected at or above the method detection limit

LABORATORY REPORT

L0312394

12/29/03 14:28

Submitted By

KEMRON Environmental Services
156 Starlite Drive
Marietta, Ohio 45750
(740)373-4071

For

Account Name: CCI/CH2M HILL
115 Perimeter Place NE
Suite 700
Atlanta, GA 30346
Attention: David Nelson

Account Number: 207-630
Work ID: 42577/CH2MHILL

P.O. Number: 56952

Sample Summary

Client ID	Lab ID	Date Collected	Date Received
563-EFF @ 44PV	L0312394-01	16-DEC-03	17-DEC-03
564-EFF @ 34PV	L0312394-02	16-DEC-03	17-DEC-03
563-BAG @ 44PV	L0312394-03	16-DEC-03	17-DEC-03
564-BAG @ 34PV	L0312394-04	16-DEC-03	17-DEC-03

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-01	Prop Method: 5030B	Instrument: HPMS8
Client ID: 563-EFF	Analytical Method: 8260B	Prep Date: 12/20/2003 17:17
Matrix: Water	Analyst: MMS	Cal Date: 12/14/2003 16:43
Workgroup Number: W0157325	Dilution: 1	Run Date: 12/20/2003 17:17
Collect Date: 16-DEC-03	Units: ug/L	File ID: 6M311393

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	3.15	J	10.0	2.50
Benzene	71-43-2		U	1.00	0.125
Bromobenzene	108-86-1		U	1.00	0.125
Bromochloromethane	74-97-5		U	1.00	0.200
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.540
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	10.0	2.50
n-Butylbenzene	104-51-8		U	1.00	0.250
sec-Butylbenzene	135-98-8		U	1.00	0.250
tert-Butylbenzene	98-06-6		U	1.00	0.250
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
2-Chloroethyl vinyl ether	110-75-8		U	10.0	2.00
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3	1.62		1.00	0.250
2-Chlorotoluene	95-49-8		U	1.00	0.125
4-Chlorotoluene	106-43-4		U	1.00	0.250
1,2-Dibromo-3-chloropropane	96-12-8		U	5.00	1.00
1,2-Dibromoethane	106-93-4		U	1.00	0.250
Dibromomethane	74-95-3		U	1.00	0.250
1,2-Dichlorobenzene	95-50-1		U	1.00	0.125
1,3-Dichlorobenzene	541-73-1		U	1.00	0.250
1,4-Dichlorobenzene	106-46-7		U	1.00	0.125
Dichlorodifluoromethane	75-71-8		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.361	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.125
1,3-Dichloropropane	142-28-9		U	1.00	0.200
2,2-Dichloropropane	594-20-7		U	1.00	0.250
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
1,1-Dichloropropene	563-58-6		U	1.00	0.250
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	10.0	2.50
Hexachlorobutadiene	87-68-3		U	1.00	0.250
Isopropylbenzene	98-82-8		U	1.00	0.250
p-Isopropyltoluene	99-87-6		U	1.00	0.250
4-Methyl-2-pentanone	108-10-1		U	10.0	2.50
Methylene chloride	75-09-2	27.1		5.00	0.250
Naphthalene	91-20-3		U	1.00	0.200
n-Propylbenzene	103-65-1		U	1.00	0.125
Styrene	100-42-5		U	1.00	0.125
1,1,1,2-Tetrachloroethane	630-20-6		U	1.00	0.250
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,2,3-Trichlorobenzene	87-61-6		U	1.00	0.125
1,2,4-Trichlorobenzene	120-82-1		U	1.00	0.200
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Trichlorofluoromethane	75-69-4		U	1.00	0.250

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-01
 Client ID: 563-EFF
 Matrix: Water
 Workgroup Number: W0157325
 Collect Date: 16-DEC-03

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: MEB
 Dilution: 1
 Units: ug/L

Instrument: HPMS8
 Prep Date: 12/20/2003 17:17
 Cal Date: 12/14/2003 16:43
 Run Date: 12/20/2003 17:17
 File ID: 8M311393

Analyte	CAS. Number	Result	Qual	RL	MDL
1,2,3-Trichloropropane	96-18-4		U	1.00	0.750
1,2,4-Trimethylbenzene	95-63-6		U	1.00	0.250
1,3,5-Trimethylbenzene	108-67-8		U	1.00	0.250
Vinyl acetate	108-05-4		U	10.0	2.50
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m,p-Xylene	136777-61-2		U	1.00	0.500
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	91.8	86	118		
1,2-Dichloroethane-d4	99.9	80	120		
Toluene-d8	104	88	110		
4-Bromofluorobenzene	110	86	115		

J The analyte was positively identified, but the quantitation was below the RL

U Not detected at or above the method detection limit

Sample Number: L0312394-02
 Client ID: 564-EFF
 Matrix: Water
 Workgroup Number: W0157325
 Collect Date: 16-DEC-03

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: MEB
 Dilution: 1
 Units: ug/L

Instrument: HPMS8
 Prep Date: 12/20/2003 17:48
 Cal Date: 12/14/2003 16:43
 Run Date: 12/20/2003 17:48
 File ID: 8M311394

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	4.63	J	10.0	2.50
Benzene	71-43-2	0.182	J	1.00	0.125
Bromobenzene	108-86-1		U	1.00	0.125
Bromochloromethane	74-97-5		U	1.00	0.200
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoforn	75-25-2		U	1.00	0.540
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	10.0	2.50
n-Butylbenzene	104-51-8		U	1.00	0.250
sec-Butylbenzene	135-98-8		U	1.00	0.250
tert-Butylbenzene	98-06-6		U	1.00	0.250
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
2-Chloroethyl vinyl ether	110-75-8		U	10.0	2.00
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
2-Chlorotoluene	95-49-8		U	1.00	0.125
4-Chlorotoluene	106-43-4		U	1.00	0.250
1,2-Dibromo-3-chloropropane	96-12-8		U	5.00	1.00
1,2-Dibromomethane	106-93-4		U	1.00	0.250
Dibromomethane	74-95-3		U	1.00	0.250
1,2-Dichlorobenzene	95-50-1		U	1.00	0.125
1,3-Dichlorobenzene	541-73-1		U	1.00	0.250
1,4-Dichlorobenzene	106-46-7		U	1.00	0.125
Dichlorodifluoromethane	75-71-8		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2	1.52		1.00	0.250
1,1-Dichloroethane	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethane	156-59-2	9.91		1.00	0.250
trans-1,2-Dichloroethane	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.125

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-02
 Client ID: 564-EFF
 Matrix: Water
 Workgroup Number: W0157325
 Collect Date: 16-DEC-03

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: MBS
 Dilution: 1
 Units: ug/L

Instrument: HPMS6
 Prep Date: 12/20/2003 17:48
 Cal Date: 12/14/2003 16:43
 Run Date: 12/20/2003 17:48
 File ID: 8M311394

Analyte	CAS. Number	Result	Qual	RL	MDL
1,3-Dichloropropane	142-28-9		U	1.00	0.200
2,2-Dichloropropane	594-20-7		U	1.00	0.250
cis-1,3-Dichloropropane	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropane	10061-02-6		U	1.00	0.300
1,1-Dichloropropane	563-58-6		U	1.00	0.250
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	10.0	2.50
Hexachlorobutadiene	87-68-3		U	1.00	0.250
Isopropylbenzene	98-82-8		U	1.00	0.250
p-Isopropyltoluene	99-87-6		U	1.00	0.250
4-Methyl-2-pentanone	108-10-1		U	10.0	2.50
Methylene chloride	75-09-2	0.938	J	5.00	0.250
Naphthalene	91-20-3		U	1.00	0.200
n-Propylbenzene	103-65-1		U	1.00	0.125
Styrene	100-42-5		U	1.00	0.125
1,1,1,2-Tetrachloroethane	630-20-6		U	1.00	0.250
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,2,3-Trichlorobenzene	87-61-6		U	1.00	0.125
1,2,4-Trichlorobenzene	120-82-1		U	1.00	0.200
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Trichlorofluoromethane	75-69-4		U	1.00	0.250
1,2,3-Trichloropropane	96-18-4		U	1.00	0.750
1,2,4-Trimethylbenzene	95-63-6		U	1.00	0.250
1,3,5-Trimethylbenzene	108-67-8		U	1.00	0.250
Vinyl acetate	108-05-4		U	10.0	2.50
Vinyl chloride	75-01-4	0.882	J	1.00	0.250
m-Xylene	95-47-6		U	1.00	0.250
m,p-Xylene	136777-61-2		U	1.00	0.300
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	91.8	86	118		
1,2-Dichloroethane-d4	98.8	80	120		
Toluene-d8	105	88	110		
4-Bromofluorobenzene	108	86	115		

J The analyte was positively identified, but the quantitation was below the RL
 U Not detected at or above the method detection limit

Sample Number: L0312394-03
 Client ID: 563-BAG
 Matrix: Water
 Workgroup Number: W0157257
 Collect Date: 16-DEC-03
 Sample Tag: D1

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 10
 Units: ug/L

Instrument: HPMS6
 Prep Date: 12/19/2003 22:13
 Cal Date: 12/24/2003 19:30
 Run Date: 12/19/2003 22:13
 File ID: 6K41760

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	25.0
Benzene	71-43-2		U	10.0	1.25
Bromobenzene	108-86-1		U	10.0	1.25
Bromochloromethane	74-97-5		U	10.0	2.00
Bromodichloromethane	75-27-4		U	10.0	2.50
Bromoform	75-25-2		U	10.0	5.40
Bromomethane	74-83-9		U	10.0	5.00
2-Butanone	78-93-3		U	100	25.0
n-Butylbenzene	104-51-8		U	10.0	2.50

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-03
 Client ID: 563-BAG
 Matrix: Water
 Workgroup Number: WG157257
 Collect Date: 16-DEC-03
 Sample Tag: D1

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 10
 Units: ug/L

Instrument: HPMS6
 Prep Date: 12/19/2003 22:13
 Cal Date: 11/24/2003 19:30
 Run Date: 12/19/2003 22:13
 File ID: 6M41760

Analyte	CAS. Number	Result	Qual	RL	MDL
sec-Butylbenzene	135-98-8		U	10.0	2.50
tert-Butylbenzene	98-06-6		U	10.0	2.50
Carbon disulfide	75-15-0		U	10.0	5.00
Carbon tetrachloride	56-23-5	62.2		10.0	2.50
Chlorobenzene	108-90-7		U	10.0	1.25
Chlorodibromomethane	124-48-1		U	10.0	2.50
Chloroethane	75-00-3		U	10.0	5.00
2-Chloroethyl vinyl ether	110-75-8		U	100	20.0
Chloroform	67-66-3	418		10.0	1.25
Chloromethane	74-87-3		U	10.0	2.50
2-Chlorotoluene	95-49-8		U	10.0	1.25
4-Chlorotoluene	106-43-4		U	10.0	2.50
1,2-Dibromo-3-chloropropane	96-12-8		U	50.0	10.0
1,2-Dibromomethane	106-93-4		U	10.0	2.50
Dibromomethane	74-95-3		U	10.0	2.50
1,2-Dichlorobenzene	95-50-1		U	10.0	1.25
1,3-Dichlorobenzene	541-73-1		U	10.0	2.50
1,4-Dichlorobenzene	106-46-7		U	10.0	1.25
Dichlorodifluoromethane	75-71-8		U	10.0	2.50
1,1-Dichloroethane	75-34-3		U	10.0	1.25
1,2-Dichloroethane	107-06-2		U	10.0	2.50
1,1-Dichloroethene	75-35-4		U	10.0	5.00
cis-1,2-Dichloroethene	156-59-2	37.8		10.0	2.50
trans-1,2-Dichloroethene	156-60-5	6.95	J	10.0	2.50
1,2-Dichloropropane	78-87-5		U	10.0	1.25
1,3-Dichloropropane	142-28-9		U	10.0	2.00
2,2-Dichloropropane	594-20-7		U	10.0	2.50
cis-1,3-Dichloropropane	10061-01-5		U	10.0	2.50
trans-1,3-Dichloropropane	10061-02-6		U	10.0	5.00
1,1-Dichloropropene	563-58-6		U	10.0	2.50
Ethylbenzene	100-41-4		U	10.0	2.50
2-Hexanone	591-78-6		U	100	25.0
Hexachlorobutadiene	87-68-3		U	10.0	2.50
Isopropylbenzene	98-82-8		U	10.0	2.50
p-Isopropyltoluene	99-87-6		U	10.0	2.50
4-Methyl-2-pentanone	108-10-1		U	100	25.0
Methylene chloride	75-09-2		U	50.0	2.50
Naphthalene	91-20-3		U	10.0	2.00
n-Propylbenzene	103-65-1		U	10.0	1.25
Styrene	100-42-5		U	10.0	1.25
1,1,1,2-Tetrachloroethane	630-20-6		U	10.0	2.50
1,1,1,2,2-Tetrachloroethane	79-34-5	441		10.0	1.25
Tetrachloroethene	127-18-4	3.63	J	10.0	2.50
Toluene	108-88-3		U	10.0	2.50
1,2,3-Trichlorobenzene	87-61-6		U	10.0	1.25
1,2,4-Trichlorobenzene	120-82-1		U	10.0	2.00
1,1,1-Trichloroethane	71-55-6		U	10.0	2.50
1,1,2-Trichloroethane	79-00-5	3.07	J	10.0	2.50
Trichloroethene	79-01-6	839		10.0	2.50
Trichlorofluoromethane	75-69-4		U	10.0	2.50
1,2,3-Trichloropropane	96-18-4		U	10.0	7.50
1,2,4-Trimethylbenzene	95-63-6		U	10.0	2.50
1,3,5-Trimethylbenzene	108-67-8		U	10.0	2.50
Vinyl acetate	108-05-4		U	100	25.0
Vinyl chloride	75-01-4		U	10.0	2.50
o-Xylene	95-47-6		U	10.0	2.50
m-,p-Xylene	136777-61-2		U	10.0	5.00

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-03	Prep Method: 5030B	Instrument: HPMS6
Client ID: 563-BAG	Analytical Method: 8260B	Prep Date: 12/19/2003 22:13
Matrix: Water	Analyst: CMS	Cal Date: 11/24/2003 19:30
Workgroup Number: WG157257	Dilution: 10	Run Date: 12/19/2003 22:13
Collect Date: 16-DEC-03	Units: ug/L	File ID: 6M41760
Sample Tag: D1		

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	94.5	86	116	
1,2-Dichloroethane-d4	96.5	80	120	
Toluene-d8	92.8	88	110	
4-Bromofluorobenzene	102	86	115	

J The analyte was positively identified, but the quantitation was below the RL
 U Not detected at or above the method detection limit

Sample Number: L0312394-03	Prep Method: 5030B	Instrument: HPMS6
Client ID: 563-BAG	Analytical Method: 8260B	Prep Date: 12/19/2003 23:17
Matrix: Water	Analyst: CMS	Cal Date: 11/24/2003 19:30
Workgroup Number: WG157257	Dilution: 1	Run Date: 12/19/2003 23:17
Collect Date: 16-DEC-03	Units: ug/L	File ID: 6M41762

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	10.0	2.50
Benzene	71-43-2		U	1.00	0.125
Bromobenzene	106-86-1		U	1.00	0.125
Bromochloromethane	74-97-5		U	1.00	0.200
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.540
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	10.0	2.50
n-Butylbenzene	104-51-8		U	1.00	0.250
sec-Butylbenzene	135-98-8		U	1.00	0.250
tert-Butylbenzene	98-06-6		U	1.00	0.250
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	78.1		1.00	0.250
Chlorobenzene	108-90-7	0.317	J	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
2-Chloroethyl vinyl ether	110-75-8		U	10.0	2.00
Chloroform	67-66-3	408	I	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
2-Chlorotoluene	95-49-8		U	1.00	0.125
4-Chlorotoluene	106-43-4		U	1.00	0.250
1,2-Dibromo-3-chloropropane	96-12-8		U	5.00	1.00
1,2-Dibromoethane	106-93-4		U	1.00	0.250
Dibromomethane	74-95-3		U	1.00	0.250
1,2-Dichlorobenzene	95-50-1		U	1.00	0.125
1,3-Dichlorobenzene	541-73-1		U	1.00	0.250
1,4-Dichlorobenzene	106-46-7		U	1.00	0.125
Dichlorodifluoromethane	75-71-8		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2	1.19		1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	45.9		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	8.19		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.125
1,3-Dichloropropane	142-28-9		U	1.00	0.200
2,2-Dichloropropane	594-20-7		U	1.00	0.250
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
1,1-Dichloropropene	563-58-6		U	1.00	0.250
Ethylbenzene	100-41-4	0.291	J	1.00	0.250
2-Hexanone	591-78-6		U	10.0	2.50
Hexachlorobutadiene	87-68-3		U	1.00	0.250

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-03	Prep Method: 5030B	Instrument: HPMS6
Client ID: 563-BAG	Analytical Method: 8260B	Prep Date: 12/19/2003 23:17
Matrix: Water	Analyst: CMS	Cal Date: 11/24/2003 19:30
Workgroup Number: WGI57257	Dilution: 1	Run Date: 12/19/2003 23:17
Collect Date: 16-DEC-03	Units: ug/L	File ID: 6M41762

Analyte	CAS. Number	Result	Qual	RL	MDL
Isopropylbenzene	98-82-8		U	1.00	0.250
p-Isopropyltoluene	99-87-6		U	1.00	0.250
4-Methyl-2-pentanone	108-10-1		U	10.0	2.50
Methylene chloride	75-09-2		U	5.00	0.250
Naphthalene	91-20-3		U	1.00	0.200
n-Propylbenzene	103-65-1		U	1.00	0.125
Styrene	100-42-8		U	1.00	0.125
1,1,1,2-Tetrachloroethane	630-20-6	0.347	J	1.00	0.250
1,1,2,2-Tetrachloroethane	79-34-5	459	I	1.00	0.125
Tetrachloroethene	127-18-4	4.37		1.00	0.250
Toluene	108-88-3	0.346	J	1.00	0.250
1,2,3-Trichlorobenzene	87-61-6		U	1.00	0.125
1,2,4-Trichlorobenzene	120-82-1		U	1.00	0.200
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	3.52		1.00	0.250
Trichloroethene	79-01-6	789	I	1.00	0.250
Trichlorofluoromethane	75-69-4		U	1.00	0.250
1,2,3-Trichloropropane	96-18-4		U	1.00	0.750
1,2,4-Trimethylbenzene	95-63-6		U	1.00	0.250
1,3,5-Trimethylbenzene	108-67-8		U	1.00	0.250
Vinyl acetate	108-05-4		U	10.0	2.50
Vinyl chloride	75-01-4	0.614	J	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m,p-Xylene	136777-61-2		U	1.00	0.500
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	101	86	118		
1,2-Dichloroethane-d4	103	80	120		
Toluene-d8	92.6	88	110		
4-Bromofluorobenzene	107	86	115		

I Semiquantitative result (out of instrument calibration range)

J The analyte was positively identified, but the quantitation was below the RL

U Not detected at or above the method detection limit

Sample Number: L0312394-04	Prep Method: 5030B	Instrument: HPMS6
Client ID: 564-BAG	Analytical Method: 8260B	Prep Date: 12/19/2003 22:45
Matrix: Water	Analyst: CMS	Cal Date: 11/24/2003 19:30
Workgroup Number: WGI57257	Dilution: 100	Run Date: 12/19/2003 22:45
Collect Date: 16-DEC-03	Units: ug/L	File ID: 6M41761
Sample Tag: D1		

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	1000	250
Benzene	71-43-2		U	100	12.5
Bromobenzene	108-86-1		U	100	12.5
Bromochloromethane	74-97-5		U	100	20.0
Bromodichloromethane	75-27-4		U	100	25.0
Bromoform	75-25-2		U	100	50.0
Bromomethane	74-83-9		U	100	50.0
2-Butanone	78-93-3		U	1000	250
n-Butylbenzene	104-51-8		U	100	25.0
sec-Butylbenzene	135-98-8		U	100	25.0
tert-Butylbenzene	98-06-6		U	100	25.0
Carbon disulfide	75-15-0		U	100	50.0
Carbon tetrachloride	56-23-5		U	100	25.0
Chlorobenzene	108-90-7		U	100	12.5
Chlorodibromomethane	124-48-1		U	100	25.0
Chloroethane	75-00-3		U	100	50.0

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-04
 Client ID: 564-BAG
 Matrix: Water
 Workgroup Number: W0157257
 Collect Date: 16-DEC-03
 Sample Tag: D1

Prep Method: 5030B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 100
 Units: ug/L

Instrument: HPMS6
 Prep Date: 12/19/2003 22:45
 Cal Date: 11/24/2003 19:30
 Run Date: 12/19/2003 22:45
 File ID: 6M41761

Analyte	CAS. Number	Result	Qual	RL	MDL
2-Chloroethyl vinyl ether	110-75-8		U	1000	200
Chloroform	67-66-3		U	100	12.5
Chloromethane	74-87-3		U	100	25.0
2-Chlorotoluene	95-49-8		U	100	12.5
4-Chlorotoluene	106-43-4		U	100	25.0
1,2-Dibromo-3-chloropropane	96-12-8		U	500	100
1,2-Dibromoethane	106-93-4		U	100	25.0
Dibromomethane	74-95-3		U	100	25.0
1,2-Dichlorobenzene	95-50-1		U	100	12.5
1,3-Dichlorobenzene	541-73-1		U	100	25.0
1,4-Dichlorobenzene	106-46-7		U	100	12.5
Dichlorodifluoromethane	75-71-8		U	100	25.0
1,1-Dichloroethane	75-34-3		U	100	12.5
1,2-Dichloroethane	107-06-3		U	100	25.0
1,1-Dichloroethene	75-35-4		U	100	50.0
cis-1,2-Dichloroethene	156-59-2	111		100	25.0
trans-1,2-Dichloroethene	156-60-5		U	100	25.0
1,2-Dichloropropane	78-87-5		U	100	12.5
1,3-Dichloropropane	142-28-9		U	100	20.0
2,2-Dichloropropane	594-20-7		U	100	25.0
cis-1,3-Dichloropropane	10061-01-5		U	100	25.0
trans-1,3-Dichloropropane	10061-02-6		U	100	50.0
1,1-Dichloropropene	563-58-6		U	100	25.0
Ethylbenzene	100-41-4		U	100	25.0
2-Hexanone	591-78-6		U	1000	250
Hexachlorobutadiene	87-68-3		U	100	25.0
Isopropylbenzene	98-82-8		U	100	25.0
p-Isopropyltoluene	99-87-6		U	100	25.0
4-Methyl-2-pentanone	108-10-1		U	1000	250
Methylene chloride	75-09-2		U	500	25.0
Naphthalene	91-20-3		U	100	20.0
n-Propylbenzene	103-65-1		U	100	12.5
Styrene	100-42-5		U	100	12.5
1,1,1,2-Tetrachloroethane	630-20-6		U	100	25.0
1,1,2,2-Tetrachloroethane	79-34-5	19100		100	12.5
Tetrachloroethene	127-18-4	53.6	J	100	25.0
Toluene	108-88-3		U	100	25.0
1,2,3-Trichlorobenzene	87-61-6		U	100	12.5
1,2,4-Trichlorobenzene	120-82-1		U	100	20.0
1,1,1-Trichloroethane	71-55-6		U	100	25.0
1,1,2-Trichloroethane	79-00-5		U	100	25.0
Trichloroethene	79-01-6	3400		100	25.0
Trichlorofluoromethane	75-69-4		U	100	25.0
1,2,3-Trichloropropane	96-18-4		U	100	75.0
1,2,4-Trimethylbenzene	95-63-6		U	100	25.0
1,3,5-Trimethylbenzene	108-67-8		U	100	25.0
Vinyl acetate	108-05-4		U	1000	250
Vinyl chloride	75-01-4		U	100	25.0
o-Xylene	95-47-6		U	100	25.0
m-,p-Xylene	136777-61-2		U	100	50.0
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	92.0	86	118		
1,2-Dichloroethane-d4	98.7	80	120		
Toluene-d8	91.9	88	110		
4-Bromofluorobenzene	102	86	115		

J The analyte was positively identified, but the quantitation was below the RL

U Not detected at or above the method detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-04
 Client ID: 564-BAG
 Matrix: Water
 Workgroup Number: W0157237
 Collect Date: 16-DEC-03

Prep Method: 5010B
 Analytical Method: 8260B
 Analyst: CMS
 Dilution: 10
 Units: ug/L

Instrument: HPMS6
 Prep Date: 12/19/2003 23:48
 Cal Date: 11/24/2003 19:30
 Run Date: 12/19/2003 23:48
 File ID: 6M41763

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	25.0
Benzene	71-43-2		U	10.0	1.25
Bromobenzene	108-86-1		U	10.0	1.25
Bromochloromethane	74-97-5		U	10.0	2.00
Bromodichloromethane	75-27-4	12.7		10.0	2.50
Bromoform	75-25-2	19.1		10.0	5.40
Bromomethane	74-83-9		U	10.0	5.00
2-Butanone	78-93-3		U	100	25.0
n-Butylbenzene	104-51-8		U	10.0	2.50
sec-Butylbenzene	135-98-8		U	10.0	2.50
tert-Butylbenzene	98-06-6		U	10.0	2.50
Carbon disulfide	75-15-0		U	10.0	5.00
Carbon tetrachloride	56-23-8		U	10.0	2.50
Chlorobenzene	108-90-7		U	10.0	1.25
Chlorodibromomethane	124-48-1		U	10.0	2.50
Chloroethane	75-00-3		U	10.0	5.00
2-Chloroethyl vinyl ether	110-75-8		U	100	20.0
Chloroform	67-66-3	6.61	J	10.0	1.25
Chloromethane	74-87-3		U	10.0	2.50
2-Chlorotoluene	95-49-8		U	10.0	1.25
4-Chlorotoluene	106-43-4		U	10.0	2.50
1,2-Dibromo-3-chloropropane	96-12-6		U	50.0	10.0
1,2-Dibromomethane	106-93-4		U	10.0	2.50
Dibromomethane	74-95-3		U	10.0	2.50
1,2-Dichlorobenzene	95-50-1		U	10.0	1.25
1,3-Dichlorobenzene	541-73-1		U	10.0	2.50
1,4-Dichlorobenzene	106-46-7		U	10.0	1.25
Dichlorodifluoromethane	75-71-8		U	10.0	2.50
1,1-Dichloroethane	75-34-3		U	10.0	1.25
1,2-Dichloroethane	107-06-2	2.54	J	10.0	2.50
1,1,1-Dichloroethane	75-35-4		U	10.0	5.00
cis-1,2-Dichloroethane	156-59-2	133		10.0	2.50
trans-1,2-Dichloroethane	156-60-5	18.4		10.0	2.50
1,2-Dichloropropane	78-87-5		U	10.0	1.25
1,3-Dichloropropane	142-28-9		U	10.0	2.00
2,2-Dichloropropane	594-20-7		U	10.0	2.50
cis-1,3-Dichloropropane	10061-01-5		U	10.0	2.50
trans-1,3-Dichloropropane	10061-02-6		U	10.0	5.00
1,1-Dichloropropane	563-58-6		U	10.0	2.50
Ethylbenzene	100-41-4		U	10.0	2.50
2-Hexanone	591-78-6		U	100	25.0
Hexachlorobutadiene	87-68-3		U	10.0	2.50
Isopropylbenzene	98-82-8		U	10.0	2.50
p-Isopropyltoluene	99-87-6		U	10.0	2.50
4-Methyl-2-pentanone	108-10-1		U	100	25.0
Methylene chloride	75-09-3		U	50.0	3.50
Naphthalene	91-20-3		U	10.0	2.00
n-Propylbenzene	103-65-1		U	10.0	1.25
Styrene	100-42-5		U	10.0	1.25
1,1,1,2-Tetrachloroethane	610-20-6		U	10.0	2.50
1,1,1,2,2-Tetrachloroethane	79-34-6	17400	I	10.0	1.25
Tetrachloroethene	127-18-4	57.8		10.0	2.50
Toluene	108-88-3		U	10.0	2.50
1,2,3-Trichlorobenzene	87-61-6		U	10.0	1.25
1,2,4-Trichlorobenzene	120-82-1		U	10.0	2.00
1,1,1-Trichloroethane	71-55-6	3.37	J	10.0	2.50
1,1,2-Trichloroethane	79-00-5	9.38	J	10.0	2.50
Trichloroethene	79-01-6	3620	I	10.0	2.50
Trichlorofluoromethane	75-69-4		U	10.0	2.50

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0312394

Report Date : December 29, 2003

Sample Number: L0312394-04	Prep Method: 8030B	Instrument: HPMS6
Client ID: 564-BAG	Analytical Method: 8260B	Prep Date: 12/19/2003 23:48
Matrix: Water	Analyst: CMS	Cal Date: 11/24/2003 19:30
Workgroup Number: W0157257	Dilution: 10	Run Date: 12/19/2003 23:48
Collect Date: 16-DEC-03	Units: ug/L	File ID: 6M41763

Analyte	CAS. Number	Result	Qual	RL	MDL
1,1,1-Trichloropropane	96-18-4		U	10.0	7.50
1,1,4-Trimethylbenzene	95-63-6		U	10.0	2.50
1,3,5-Trimethylbenzene	108-67-8		U	10.0	2.50
Vinyl acetate	108-05-4		U	100	25.0
Vinyl chloride	75-01-4		U	10.0	2.50
o-Xylene	95-47-6		U	10.0	2.50
m,p-Xylene	136777-61-2		U	10.0	5.00
Surrogate	% Recovery	Lower	Upper	Qual	
Dibromofluoromethane	92.2	86	118		
1,2-Dichloroethane-d4	99.5	80	120		
Toluene-d8	93.1	88	110		
4-Bromofluorobenzene	106	86	115		

I Semiquantitative result (out of instrument calibration range)

J The analyte was positively identified, but the quantitation was below the RL

U Not detected at or above the method detection limit

KEMRON ENVIRONMENTAL SERVICES
METHOD BLANK SUMMARY

Login Number: L0312394
Blank File ID: 6M41744
Date Analyzed: 12/19/03
Time Analyzed: 11:44
Analyst: CMB

Work Group: WG157257
Blank Sample ID: WG157257-01
Instrument ID: HPMS6
Method: 8260B

This Method Blank Applies To The Following Samples:

Client ID	Lab Sample ID	Lab File ID	Time Analyzed	TAG
LCS	WG157257-02	6M41745	12/19/03 14:16	
LCS2	WG157257-03	6M41746	12/19/03 14:48	
563-BAG	L0312394-03	6M41760	12/19/03 22:13	D1
564-BAG	L0312394-04	6M41761	12/19/03 22:45	D1
563-BAG	L0312394-03	6M41762	12/19/03 23:17	
564-BAG	L0312394-04	6M41763	12/19/03 23:48	

KEMRON ENVIRONMENTAL SERVICES
METHOD BLANK SUMMARY

Login Number: L0312394
Blank File ID: 8M311381
Date Analyzed: 12/20/03
Time Analyzed: 11:17
Analyst: MRS

Work Group: WG157325
Blank Sample ID: WG157325-01
Instrument ID: HPMSB
Method: 8260B

This Method Blank Applies To The Following Samples:

Client ID	Lab Sample ID	Lab File ID	Time Analyzed	TAG
LCS	WG157325-02	8M311382	12/20/03 11:47	
563-EFF	L0312394-01	8M311393	12/20/03 17:17	
564-EFF	L0312394-02	8M311394	12/20/03 17:48	

KEMRON ENVIRONMENTAL SERVICES
METHOD BLANK REPORT

Login Number: L0312394 Run Date: 12/19/2003 Sample ID: RG157257-01
Instrument ID: HPMS6 Run Time: 13:44 Prep Method: 5030B
File ID: 5M41744 Analyst: CMS Method: 8260B
Workgroup (AAB#): RG157257 Matrix: Water Units: ug/L
Contract #: DACA87-94-D-0009 Cal ID: HPMS6-24-NOV-03

Analytes	MDL	RDL	Concentration	Dilution	Qualifier
Acetone	2.50	10.0	2.50	1	U
Benzene	0.125	1.00	0.125	1	U
Bromobenzene	0.125	1.00	0.125	1	U
Bromochloromethane	0.200	1.00	0.200	1	U
Bromodichloromethane	0.250	1.00	0.250	1	U
Bromoform	0.540	1.00	0.540	1	U
Bromomethane	0.500	1.00	0.500	1	U
2-Butanone	2.50	10.0	2.50	1	U
n-Butylbenzene	0.250	1.00	0.250	1	U
sec-Butylbenzene	0.250	1.00	0.250	1	U
tert-Butylbenzene	0.250	1.00	0.250	1	U
Carbon disulfide	0.500	1.00	0.500	1	U
Carbon tetrachloride	0.250	1.00	0.250	1	U
Chlorobenzene	0.125	1.00	0.125	1	U
Chlorodibromomethane	0.250	1.00	0.250	1	U
Chloroethane	0.500	1.00	0.500	1	U
2-Chloroethyl vinyl ether	2.00	10.0	2.00	1	U
Chloroform	0.125	1.00	0.125	1	U
Chloromethane	0.250	1.00	0.250	1	U
2-Chlorotoluene	0.125	1.00	0.125	1	U
4-Chlorotoluene	0.250	1.00	0.250	1	U
1,2-Dibromo-3-chloropropane	1.00	5.00	1.00	1	U
1,2-Dibromoethane	0.250	1.00	0.250	1	U
Dibromomethane	0.250	1.00	0.250	1	U
1,2-Dichlorobenzene	0.125	1.00	0.125	1	U
1,3-Dichlorobenzene	0.250	1.00	0.250	1	U
1,4-Dichlorobenzene	0.125	1.00	0.125	1	U
Dichlorodifluoromethane	0.250	1.00	0.250	1	U
1,1-Dichloroethane	0.125	1.00	0.125	1	U
1,2-Dichloroethane	0.250	1.00	0.250	1	U
1,1-Dichloroethene	0.500	1.00	0.500	1	U
cis-1,2-Dichloroethene	0.250	1.00	0.250	1	U
trans-1,2-Dichloroethene	0.250	1.00	0.250	1	U
1,2-Dichloropropane	0.125	1.00	0.125	1	U
1,1-Dichloropropane	0.200	1.00	0.200	1	U
2,2-Dichloropropane	0.250	1.00	0.250	1	U
cis-1,3-Dichloropropene	0.250	1.00	0.250	1	U
trans-1,3-Dichloropropene	0.500	1.00	0.500	1	U
1,1-Dichloropropene	0.250	1.00	0.250	1	U
Ethylbenzene	0.250	1.00	0.250	1	U
2-Hexanone	2.50	10.0	2.50	1	U
Hexachlorobutadiene	0.250	1.00	0.414	1	J

KEMRON FORMS - Modified 11/19/2003

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Report generated 12/29/2003 14:31

**KEMRON ENVIRONMENTAL SERVICES
METHOD BLANK REPORT**

Login Number: L0312394 Run Date: 12/19/2003 Sample ID: WG157257-01
 Instrument ID: HPMS6 Run Time: 13.44 Prep Method: 5030B
 File ID: 6M41744 Analyst: CMS Method: A260B
 Workgroup (AAB#): WG157257 Matrix: Water Units: ug/L
 Contract #: Cal ID: HPMS6-24-NOV-03

Analytes	MDL	RDL	Concentration	Dilution	Qualifier
Isopropylbenzene	0.250	1.00	0.250	1	U
p-Isopropyltoluene	0.250	1.00	0.250	1	U
4-Methyl-2-pentanone	2.50	10.0	2.50	1	U
Methylene chloride	0.250	5.00	0.250	1	U
Naphthalene	0.200	1.00	0.200	1	U
n-Propylbenzene	0.125	1.00	0.125	1	U
Styrene	0.125	1.00	0.125	1	U
1,1,1,2-Tetrachloroethane	0.250	1.00	0.250	1	U
1,1,2,2-Tetrachloroethane	0.125	1.00	0.125	1	U
Tetrachloroethene	0.250	1.00	0.250	1	U
Toluene	0.250	1.00	0.250	1	U
1,2,3-Trichlorobenzene	0.125	1.00	0.125	1	U
1,2,4-Trichlorobenzene	0.200	1.00	0.200	1	U
1,1,1-Trichloroethane	0.250	1.00	0.250	1	U
1,1,2-Trichloroethane	0.250	1.00	0.250	1	U
Trichloroethene	0.250	1.00	0.250	1	U
Trichlorofluoromethane	0.250	1.00	0.250	1	U
1,2,3-Trichloropropane	0.750	1.00	0.750	1	U
1,2,4-Trimethylbenzene	0.250	1.00	0.250	1	U
1,3,5-Trimethylbenzene	0.250	1.00	0.250	1	U
Vinyl acetate	2.50	10.0	2.50	1	U
Vinyl chloride	0.250	1.00	0.250	1	U
o-Xylene	0.250	1.00	0.250	1	U
m-,p-Xylene	0.500	1.00	0.500	1	U

Surrogates	% Recovery	Surrogate Limits	Qualifier
Dibromofluoromethane	91.3	86 - 118	PASS
1,2-Dichloroethane-d4	98.8	80 - 120	PASS
Toluene-d8	91.4	88 - 110	PASS
4-Bromofluorobenzene	99.7	86 - 116	PASS

* Analyte detected above RDL

ND Analyte Not detected at or above reporting limit

**KEMRON ENVIRONMENTAL SERVICES
METHOD BLANK REPORT**

Login Number: L03112394 Run Date: 12/20/2003 Sample ID: WQ157325-01
 Instrument ID: HPMS8 Run Time: 11.17 Prep Method: 5030B
 File ID: SM311381 Analyst: MRS Method: 8260B
 Workgroup (AAB#): WQ157325 Matrix: Water Units: ug/L
 Contract #: DAC87-94-D-0009 Cal ID: HPMS8-14-DEC-03

Analytes	MDL	RDL	Concentration	Dilution	Qualifier
Acetone	2.50	10.0	2.50	1	U
Benzene	0.125	1.00	0.125	1	U
Bromobenzene	0.125	1.00	0.125	1	U
Bromochloromethane	0.200	1.00	0.200	1	U
Bromodichloromethane	0.250	1.00	0.250	1	U
Bromoform	0.540	1.00	0.540	1	U
Bromomethane	0.500	1.00	0.500	1	U
2-Butanone	2.50	10.0	2.50	1	U
n-Butylbenzene	0.250	1.00	0.250	1	U
sec-Butylbenzene	0.250	1.00	0.250	1	U
tert-Butylbenzene	0.250	1.00	0.250	1	U
Carbon disulfide	0.500	1.00	0.500	1	U
Carbon tetrachloride	0.250	1.00	0.250	1	U
Chlorobenzene	0.125	1.00	0.125	1	U
Chlorodibromomethane	0.250	1.00	0.250	1	U
Chloroethane	0.500	1.00	0.500	1	U
1-Chloroethyl vinyl ether	2.00	10.0	2.00	1	U
Chloroform	0.125	1.00	0.125	1	U
Chloromethane	0.250	1.00	0.250	1	U
2-Chlorotoluene	0.125	1.00	0.125	1	U
4-Chlorotoluene	0.250	1.00	0.250	1	U
1,2-Dibromo-3-chloropropane	1.00	5.00	1.00	1	U
1,2-Dibromoethane	0.250	1.00	0.250	1	U
Dibromomethane	0.250	1.00	0.250	1	U
1,2-Dichlorobenzene	0.125	1.00	0.125	1	U
1,3-Dichlorobenzene	0.250	1.00	0.250	1	U
1,4-Dichlorobenzene	0.125	1.00	0.125	1	U
Dichlorodifluoromethane	0.250	1.00	0.250	1	U
1,1-Dichloroethane	0.125	1.00	0.125	1	U
1,2-Dichloroethane	0.250	1.00	0.250	1	U
1,1-Dichloroethane	0.500	1.00	0.500	1	U
cis-1,2-Dichloroethene	0.250	1.00	0.250	1	U
trans-1,2-Dichloroethene	0.250	1.00	0.250	1	U
1,2-Dichloropropane	0.125	1.00	0.125	1	U
1,3-Dichloropropane	0.200	1.00	0.200	1	U
2,2-Dichloropropane	0.250	1.00	0.250	1	U
cis-1,3-Dichloropropene	0.250	1.00	0.250	1	U
trans-1,3-Dichloropropene	0.500	1.00	0.500	1	U
1,1-Dichloropropene	0.250	1.00	0.250	1	U
Ethylbenzene	0.250	1.00	0.250	1	U
2-Hexanone	2.50	10.0	2.50	1	U
Hexachlorobutadiene	0.250	1.00	0.250	1	U

KEMRON FORMS - Modified 11/19/2003

Version 1.3

Report generated 12/29/2003 14:31

KEMRON ENVIRONMENTAL SERVICES
METHOD BLANK REPORT

Login Number: LQ112394 Run Date: 12/20/2003 Sample ID: WG157325-01
Instrument ID: HPMS8 Run Time: 11.17 Prep Method: 5030B
File ID: SM111381 Analyst: MES Method: 8260B
Workgroup (AAB#): WG157325 Matrix: Water Units: ug/L
Contract #: Cal ID: HPMS8-14-DEC-03

Analytes	MDL	RDL	Concentration	Dilution	Qualifier
Isopropylbenzene	0.250	1.00	0.250	1	U
p-Isopropyltoluene	0.250	1.00	0.250	1	U
4-Methyl-2-pentanone	2.50	10.0	2.50	1	U
Methylene chloride	0.250	5.00	0.250	1	U
Naphthalene	0.200	1.00	0.200	1	U
n-Propylbenzene	0.125	1.00	0.125	1	U
Styrene	0.125	1.00	0.125	1	U
1,1,1,1-Tetrachloroethane	0.250	1.00	0.250	1	U
1,1,2,2-Tetrachloroethane	0.125	1.00	0.125	1	U
Tetrachloroethene	0.250	1.00	0.250	1	U
Toluene	0.250	1.00	0.250	1	U
1,2,3-Trichlorobenzene	0.125	1.00	0.125	1	U
1,2,4-Trichlorobenzene	0.200	1.00	0.200	1	U
1,1,1-Trichloroethane	0.250	1.00	0.250	1	U
1,1,2-Trichloroethane	0.250	1.00	0.250	1	U
Trichloroethene	0.250	1.00	0.250	1	U
Trichlorofluoromethane	0.250	1.00	0.250	1	U
1,2,3-Trichloropropane	0.750	1.00	0.750	1	U
1,2,4-Trimethylbenzene	0.250	1.00	0.250	1	U
1,3,5-Trimethylbenzene	0.250	1.00	0.250	1	U
Vinyl acetate	2.50	10.0	2.50	1	U
Vinyl chloride	0.250	1.00	0.250	1	U
o-Xylene	0.250	1.00	0.250	1	U
m-,p-Xylene	0.500	1.00	0.500	1	U

Surrogates	% Recovery	Surrogate Limits	Qualifier
Dibromofluoromethane	91.4	86 - 118	PASS
1,2-Dichloroethane-d4	95.7	80 - 120	PASS
Toluene-d8	106	88 - 110	PASS
4-Bromofluorobenzene	109	86 - 115	PASS

* Analyte detected above RDL

ND Analyte Not detected at or above reporting limit

KEMRON ENVIRONMENTAL SERVICES
LABORATORY CONTROL SAMPLES

Login Number: L0312394 Analyst: CMS Prep Method: 5030B
Instrument ID: HPMS6 Matrix: Water Method: 8260B
Workgroup (AAB#): WG157257 Units: ug/L
Sample ID: WG157257-02 LCS File ID: 6M41745 Run Date: 12/19/2003 14:16
Sample ID: WG157257-03 LCS2 File ID: 6M41746 Run Date: 12/19/2003 14:48

Analytes	LCS			LCS2			%RPD	%Rec Limits	RPD Limit	Q
	Known	Found	% REC	Known	Found	% REC				
Acetone	20.0	20.5	102	20.0	20.5	103	1.03	40 - 142	63	
Benzene	20.0	20.4	102	20.0	21.1	105	3.29	80 - 121	21	
Bromobenzene	20.0	20.2	101	20.0	20.6	103	1.59	80 - 120	18	
Bromochloromethane	20.0	21.8	108	20.0	21.9	110	1.64	80 - 124	20	
Bromodichloromethane	20.0	22.5	112	20.0	22.7	114	1.12	80 - 131	25	
Bromoform	20.0	22.0	110	20.0	22.4	112	1.79	74 - 130	35	
Bromomethane	20.0	18.4	91.8	20.0	18.7	93.5	1.78	61 - 151	56	
2-Butanone	20.0	24.1	120	20.0	23.1	115	4.21	58 - 149	56	
n-Butylbenzene	20.0	19.2	95.9	20.0	19.7	98.4	2.57	80 - 131	29	
sec-Butylbenzene	20.0	19.6	98.0	20.0	20.3	101	3.47	80 - 127	28	
tert-Butylbenzene	20.0	19.1	95.4	20.0	19.4	97.1	1.68	80 - 126	27	
Carbon disulfide	20.0	21.6	108	20.0	22.9	115	9.8	58 - 138	49	
Carbon tetrachloride	20.0	20.4	102	20.0	21.1	105	3.51	80 - 137	32	
Chlorobenzene	20.0	20.1	101	20.0	20.7	104	2.96	80 - 120	16	
Chlorodibromomethane	20.0	21.4	107	20.0	22.0	110	2.5	80 - 127	26	
Chloroethane	20.0	18.9	94.3	20.0	19.5	97.7	3.57	77 - 133	34	
2-Chloroethyl vinyl ether	20.0	28.0	140	20.0	29.3	146	4.31	10 - 211	125	
Chloroform	20.0	19.8	98.9	20.0	20.4	102	3.02	80 - 128	23	
Chloromethane	20.0	18.3	91.5	20.0	18.9	94.5	3.19	60 - 130	43	
2-Chlorotoluene	20.0	21.1	106	20.0	21.1	106	0.0267	80 - 127	28	
4-Chlorotoluene	20.0	20.4	102	20.0	21.2	106	4.14	80 - 128	26	
1,2-Dibromo-3-chloropropane	20.0	22.0	110	20.0	21.5	108	2.29	65 - 129	39	
1,2-Dibromoethane	20.0	22.4	112	20.0	22.4	112	0.236	80 - 125	20	
Dibromomethane	20.0	21.6	108	20.0	22.2	111	2.62	80 - 126	24	
1,2-Dichlorobenzene	20.0	20.1	100	20.0	20.4	102	1.72	80 - 128	18	
1,3-Dichlorobenzene	20.0	19.7	98.3	20.0	20.0	100	1.95	80 - 120	16	
1,4-Dichlorobenzene	20.0	19.4	96.9	20.0	19.7	98.6	1.78	80 - 120	15	
Dichlorodifluoromethane	20.0	17.3	86.4	20.0	17.7	88.6	2.62	50 - 133	51	
1,1-Dichloroethane	20.0	20.2	101	20.0	20.8	104	2.8	80 - 125	21	
1,2-Dichloroethane	20.0	22.5	112	20.0	22.6	113	0.631	80 - 129	29	
1,1-Dichloroethene	20.0	20.7	104	20.0	21.8	109	4.97	80 - 132	26	
cis-1,2-Dichloroethene	20.0	20.2	101	20.0	20.6	103	2.12	80 - 121	19	
trans-1,2-Dichloroethene	20.0	20.3	101	20.0	20.9	104	2.96	80 - 127	24	
1,2-Dichloropropane	20.0	20.5	103	20.0	21.5	107	4.53	80 - 120	20	
1,3-Dichloropropane	20.0	21.7	109	20.0	22.0	110	1.04	80 - 120	20	
2,2-Dichloropropane	20.0	21.0	105	20.0	21.6	108	2.74	80 - 133	29	
cis-1,3-Dichloropropene	20.0	23.8	119	20.0	24.3	122	2.13	80 - 132	26	
trans-1,3-Dichloropropene	20.0	22.3	112	20.0	22.6	113	1.43	80 - 130	25	
1,1-Dichloropropene	20.0	21.1	105	20.0	21.6	108	2.61	74 - 139	40	
Ethylbenzene	20.0	20.2	101	20.0	20.6	103	1.95	80 - 122	20	

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Version 1.2
Report generated 12/29/2003 14:33

KEMRON ENVIRONMENTAL SERVICES
LABORATORY CONTROL SAMPLES

Login Number: L0312394 Analyst: CMS Prep Method: 5030B
Instrument ID: HPMS6 Matrix: Water Method: 8260B
Workgroup (AAB#): NG157257 Units: ug/L
Sample ID: NG157257-02 LCS File ID: 6M41745 Run Date: 12/19/2003 14:16
Sample ID: NG157257-03 LCS2 File ID: 6M41746 Run Date: 12/19/2003 14:48

Analytes	LCS			LCS2			%RPD	%Rec Limits	RPD Limit	Q
	Known	Found	% REC	Known	Found	% REC				
2-Hexanone	20.0	24.0	120	20.0	24.6	123	2.21	56 - 136	49	
Hexachlorobutadiene	20.0	16.3	81.5	20.0	16.4	82.1	.734	72 - 132	36	
Isopropylbenzene	20.0	20.9	104	20.0	21.6	108	3.54	80 - 122	24	
p-Isopropyltoluene	20.0	19.7	98.3	20.0	20.3	101	3.04	80 - 122	24	
4-Methyl-2-pentanone	20.0	26.7	133	20.0	28.0	140	4.97	64 - 140	47	
Methylene chloride	20.0	20.0	100	20.0	20.4	102	2.01	80 - 122	22	
Naphthalene	20.0	19.6	98.0	20.0	20.1	101	2.79	59 - 149	55	
n-Propylbenzene	20.0	20.8	104	20.0	21.2	106	1.73	80 - 129	27	
Styrene	20.0	21.4	107	20.0	22.0	110	2.58	80 - 123	20	
1,1,1,2-Tetrachloroethane	20.0	24.1	120	20.0	24.3	121	.862	80 - 130	25	
1,1,2,2-Tetrachloroethane	20.0	21.6	108	20.0	21.7	109	.649	79 - 125	28	
Tetrachloroethane	20.0	19.3	96.7	20.0	20.0	100	3.55	80 - 124	22	
Toluene	20.0	20.4	102	20.0	21.0	105	2.86	80 - 124	22	
1,2,3-Trichlorobenzene	20.0	18.7	93.7	20.0	19.4	96.8	3.2	62 - 140	48	
1,2,4-Trichlorobenzene	20.0	18.5	92.4	20.0	18.8	94.0	1.65	77 - 131	33	
1,1,1-Trichloroethane	20.0	21.7	108	20.0	22.2	111	2.19	80 - 134	28	
1,1,2-Trichloroethane	20.0	21.7	109	20.0	21.9	110	.798	80 - 125	20	
Trichloroethane	20.0	19.3	96.7	20.0	20.3	101	4.73	80 - 122	21	
Trichlorofluoromethane	20.0	18.3	91.3	20.0	18.7	93.7	2.55	62 - 151	55	
2,2,3-Trichloropropane	20.0	22.5	112	20.0	21.6	108	3.79	80 - 126	25	
1,2,4-Trimethylbenzene	20.0	19.5	97.5	20.0	19.9	99.4	1.9	80 - 125	26	
1,3,5-Trimethylbenzene	20.0	20.4	102	20.0	20.9	105	2.41	80 - 127	25	
Vinyl acetate	20.0	28.6	143	20.0	28.6	143	.1	10 - 285	201	
Vinyl chloride	20.0	19.3	96.5	20.0	19.6	97.8	1.3	65 - 140	46	
o-Xylene	20.0	20.2	101	20.0	20.8	104	2.61	80 - 122	18	
m,p-Xylene	40.0	40.8	102	40.0	41.7	104	2.27	80 - 122	21	

Surrogates	LCS	LCS2	Surrogate Limits	Qualifier
	% Recovery	% Recovery		
Dibromofluoromethane	94.4	94.2	86 - 118	PASS
1,2-Dichloroethane-d4	97.8	96.7	80 - 120	PASS
Toluene-d8	91.5	90.4	88 - 110	PASS
4-Bromofluorobenzene	95.7	96.6	86 - 115	PASS

FAILS %REC LIMIT

FAILS RPD LIMIT

Appendix C

Laboratory Organic Analyses for Bench-Scale Testing Involving the Granular Iron Technology

Treatability Test
CH2M Hill MW-54

Column Identification: 563
Column Composition: 100% Connolly (UW #255) 18/84
Pore Volume (PV): 296 mL
Porosity: 0.52
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 1.2 ft/day (36 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	1.6	3.2	6.6	10.0	13.2	20.0	26.2	32.8

	PV	RN	Influent		Organic Concentration (µg/L)						Effluent	HL	r2
CTET	4.3	a	80	nd	nd	nd	nd	nd	nd	nd	nd		
	9.8	a	63	nd	nd	nd	nd	nd	nd	nd	nd		
	12.8	a	64	nd	nd	nd	nd	nd	nd	nd	nd		
	20.4	a	64	nd	nd	nd	nd	nd	nd	nd	nd		
	25.7	b	47	nd	nd	nd	nd	nd	nd	nd	nd		
	35.6	b	42	nd	nd	nd	nd	nd	nd	nd	nd	0.3	1.000
	40.2	b	42	nd	nd	nd	nd	nd	nd	nd	nd	0.3	1.000
	43.7	c	57	nd	nd	nd	nd	nd	nd	nd	nd	0.3	1.000
	48.9	c	55	nd	nd	nd	nd	nd	nd	nd	nd	0.3	1.000
TCM	4.3	a	398	3.2	nd	nd	nd	nd	nd	nd	nd		
	9.8	a	413	23	6.3	nd	nd	nd	nd	nd	nd		
	12.8	a	442	21	1.9	nd	nd	nd	nd	8.0	nd		
	20.4	a	425	47	nd	nd	nd	nd	nd	nd	nd		
	25.7	b	350	76	2.5	nd	nd	nd	nd	nd	nd		
	35.6	b	433	125	8.2	nd	nd	nd	nd	nd	nd	0.8	0.996
	40.2	b	408	135	23	nd	nd	nd	nd	nd	nd	0.9	0.997
	43.7	c	491	160	35	nd	nd	nd	nd	nd	nd	0.9	0.962
	48.9	c	502	205	47	2.7	nd	nd	nd	nd	nd	1.1	0.995
1122TECA	4.3	a	525	4.0	nd	nd	nd	nd	60	nd	nd		
	9.8	a	540	22	nd	nd	nd	nd	nd	nd	nd		
	12.8	a	527	27	1.2	nd	nd	nd	nd	nd	nd		
	20.4	a	496	68	1.9	nd	nd	nd	nd	nd	nd		
	25.7	b	499	116	6.2	nd	19	nd	nd	nd	nd		
	35.6	b	526	216	22	nd	nd	nd	nd	nd	nd	1.1	0.978
	40.2	b	449	222	38	nd	nd	nd	nd	nd	nd	1.3	0.967
	43.7	c	491	241	52	1.4	nd	nd	nd	nd	nd	1.3	0.983
	48.9	c	496	289	84	nd	nd	nd	nd	nd	nd	1.5	0.973

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-54

Column Identification: 563
Column Composition: 100% Connelly (UW #255) 18/84
Pore Volume (PV): 296 mL
Porosity: 0.52
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 1.2 ft/day (36 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	1.6	3.2	6.6	10.0	13.2	20.0	26.2	32.8

	PV	RN	Influent	Organic Concentration (µg/L)								Effluent	HL	r2
111TCA	4.3	a	nd	nd	nd	nd	nd	nd	nd	nd	nd	1		
	9.8	a	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	12.8	a	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	20.4	a	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	25.7	b	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	35.6	b	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	40.2	b	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	43.7	c	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	48.9	c	nd	nd	nd	nd	nd	nd	nd	nd	nd			
112TCA	4.3	a	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	9.8	a	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	12.8	a	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	20.4	a	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	25.7	b	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	35.6	b	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	40.2	b	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	43.7	c	nd	nd	nd	nd	nd	nd	nd	nd	nd			
	48.9	c	nd	nd	nd	nd	nd	nd	nd	nd	nd			
PCE	4.3	a	2.5	nd	nd	nd	nd	nd	nd	nd	nd			
	9.8	a	2.3	nd	nd	nd	nd	nd	nd	nd	nd			
	12.8	a	2.3	nd	nd	nd	nd	nd	nd	nd	nd			
	20.4	a	1.9	nd	nd	nd	nd	nd	nd	nd	nd			
	25.7	b	2.9	nd	nd	nd	nd	nd	nd	nd	nd			
	35.6	b	2.9	nd	nd	nd	nd	nd	nd	nd	nd			
	40.2	b	3.1	nd	nd	nd	nd	nd	nd	nd	nd			
	43.7	c	3.6	nd	nd	nd	nd	nd	nd	nd	nd			
	48.9	c	3.2	nd	nd	nd	nd	nd	nd	nd	nd			

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-54

Column Identification: 563
Column Composition: 100% Connelly (UW #255) 18/84
Pore Volume (PV): 296 mL
Porosity: 0.52
Column Length: 16 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 1.2 ft/day (36 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	1.6	3.2	6.6	10.0	13.2	20.0	26.2	32.8

	PV	RN	Influent		Organic Concentration (µg/L)						Effluent		HL	r2
TCE	4.3	a	776	18	nd	nd	6.1	nd	26	nd	nd			
	9.8	a	757	103	1.8	nd	nd	nd	nd	nd	nd			
	12.8	a	759	111	2.0	nd	nd	nd	nd	15	2.3			
	20.4	a	693	204	4.5	nd	nd	nd	nd	nd	nd			
	25.7	b	750	370	14	nd	nd	nd	nd	nd	nd			
	35.6	b	752	514	58	nd	nd	nd	nd	nd	nd	1.5	0.908	
	40.2	b	686	508	105	nd	nd	nd	nd	nd	nd	1.8	0.851	
	43.7	c	796	566	141	1.2	nd	nd	nd	nd	nd	1.7	0.983	
	48.9	c	788	635	203	nd	nd	nd	nd	nd	nd	2.0	0.905	
cDCE	4.3	a	56	170	170	80	nd	nd	nd	nd	nd			
	9.8	a	36	131	85	79	70	30	nd	nd	nd			
	12.8	a	37	120	81	77	58	21	nd	nd	nd			
	20.4	a	37	112	85	40	28	16	7.5	nd	nd			
	25.7	b	18	97	72	20	10	9.8	nd	nd	nd			
	35.6	b	23	76	152	28	9.1	nd	nd	nd	nd	2.3	0.701	
	40.2	b	28	60	142	37	11	nd	nd	nd	nd	2.4	0.639	
	43.7	c	40	119	158	93	11	3.1	nd	nd	nd	3.1	0.888	
	48.9	c	41	95	156	88	12	3.1	nd	nd	nd	2.4	0.855	
tDCE	4.3	a	6.7	21	6.8	nd	nd	nd	nd	nd	nd			
	9.8	a	4.6	24	4.8	nd	nd	nd	nd	nd	nd			
	12.8	a	4.6	23	3.1	nd	nd	nd	nd	nd	nd			
	20.4	a	6.5	27	6.3	nd	nd	nd	nd	nd	nd			
	25.7	b	3.2	26	9.0	nd	nd	nd	nd	nd	nd			
	35.6	b	6.1	21	22	nd	nd	nd	nd	nd	nd	1.5	0.899	
	40.2	b	4.8	18	24	nd	nd	nd	nd	nd	nd	1.5	0.804	
	43.7	c	8.6	22	21	nd	nd	nd	nd	nd	nd	1.2	0.924	
	48.9	c	5.6	22	26	2.5	nd	nd	nd	nd	nd	1.2	0.857	

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-54

Column Identification: 563
Column Composition: 100% Connolly (UW #255) 18/84
Pore Volume (PV): 296 mL
Porosity: 0.52
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 1.2 ft/day (36 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	1.6	3.2	6.6	10.0	13.2	20.0	26.2	32.8

	PV	RN	Influent	Organic Concentration (µg/L)							Effluent	HL	r2
11DCE													
	4.3	a	nd	1.4	4.0	1.6	nd	nd	nd	nd	nd		
	9.8	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	12.8	a	nd	nd	nd	nd	nd	nd	nd	5.5	nd		
	20.4	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	25.7	b	nd	2.4	nd	nd	nd	nd	nd	nd	nd		
	35.6	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	40.2	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	43.7	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	48.9	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
VC													
	4.3	a	nd	2.5	16	nd	nd	nd	nd	nd	nd		
	9.8	a	nd	nd	nd	2.7	nd	3.7	nd	nd	nd		
	12.8	a	nd	nd	nd	nd	5.6	7.8	nd	3.9	nd		
	20.4	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	25.7	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	35.6	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	40.2	b	nd	nd	nd	3.9	nd	nd	nd	nd	nd		
	43.7	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	48.9	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
DCM													
	45.1	c	nd	25	41	48	48	49	44	44	40		
	47.1	c	nd	20	48	52	52	52	50	44	39		
11DCA													
	45.1	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	47.1	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
12DCA													
	45.1	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	47.1	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-54

Column Identification. 563
Column Composition 100% Connolly (UW #255) 18/84
Pore Volume (PV) 296 mL
Porosity. 0.52
Column Length: 1.6 ft (50 cm)
Column Diameter 1.5 in (3.8 cm)
Flow Velocity: 1.2 ft/day (36 cm/day)
Column Temp. 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	1.6	3.2	6.6	10.0	13.2	20.0	26.2	32.8

PV	RN	Influent	Organic Concentration (µg/L)							Effluent	HL	r2
Nitrate (NO3-N)												
12.1	a	4.0	0.2	nd	nd	nd	na	na	na	na		
13.5	a	3.9	0.2	nd	nd	nd	nd	nd	nd	nd		
24.3	b	3.8	0.2	nd	nd	nd	na	na	na	na		
24.9	b	3.7	0.1	nd	nd	nd	nd	nd	nd	nd		
34.8	b	3.7	0.5	nd	nd	nd	nd	nd	nd	nd		
41.5	b	3.9	1.2	nd	nd	nd	nd	na	nd	nd		
49.5	c	4.3	1.4	0.1	nd	nd	nd	nd	nd	nd		
Chloride (Cl-)												
13.5	a	12	13	14	13	14	13	14	15	14		
24.9	b	13	14	14	15	14	14	14	15	15		
34.8	b	13	13	14	14	14	15	14	14	14		
41.5	b	12	13	13	14	14	14	na	15	14		
49.5	c	14	14	15	15	15	16	15	16	16		
Sulphate (SO4=)												
41.5	b	18	18	17	17	16	16	na	17	18		
49.5	c	19	19	19	18	17	17	17	17	19		

PV = pore volume
RN = reservoir number
HL = half life (hours)
r2 = coefficient of determination
nd = not detected
na = not applicable

Treatability Test
CH2M Hill MW-54

Column Identification: 563
Column Composition: 100% Connelly (UW #255) 18/84
Pore Volume (PV): 296 mL
Porosity: 0.52
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 1.2 ft/day (36 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	1.6	3.2	6.6	10.0	13.2	20.0	26.2	32.8

PV	RN	Influent		Organic Concentration (µg/L)						Effluent	HL	r2
pH Values												
3.7	a	6.6	8.7	9.0	9.2	9.2	9.2	9.1	9.2	9.0		
8.1	a	6.7	8.5	8.73	9.0	9.1	9.4	9.3	9.5	9.2		
13.5	a	7.2	8.6	8.8	9.2	9.2	9.3	9.5	9.3	9.3		
18.8	a	7.6	8.8	8.8	9.1	9.2	9.3	9.5	9.6	9.5		
28.7	b	6.8	8.5	8.7	8.9	9.1	9.2	9.4	9.8	9.4		
34.8	b	7.1	8.7	8.8	8.9	9.1	9.1	9.3	9.7	9.5		
40.8	b	7.2	8.7	8.8	8.9	8.8	9.1	9.3	9.6	9.7		
44.3	c	6.6	8.2	8.5	9.0	9.0	9.2	9.3	9.6	9.7		
49.5	c	6.9	8.2	8.8	8.8	9.0	9.0	9.2	9.4	9.6		
58.5	d	6.8	7.3	8.4	8.5	8.5	8.7	9.0	9.1	9.5		
Eh (mV)												
3.7	a	257	-197	-156	-132	-189	-124	-116	-149	-91		
8.1	a	359	-14	-36	35	-253	-195	-448	-231	-287		
13.5	a	349	-26	-29	-176	-154	-251	-311	-422	-118		
18.8	a	313	50	-281	-336	-113	-292	-260	-304	-380		
28.7	b	312	2	-229	-207	-267	-274	-274	-366	-405		
34.8	b	262	72	-147	-256	-188	-256	-221	-366	-226		
40.8	b	350	54	-217	-234	-181	-171	-306	-326	-256		
44.3	c	324	26	-297	-399	-308	-479	-508	-536	-414		
49.5	c	321	94	-225	-211	-299	-256	-291	-377	-443		
58.5	d	274	59	-146	-213	-284	-226	-353	-326	-340		

PV = pore volume
RN = reservoir number
HL = half life (hours)
r2 = coefficient of determination
nd = not detected
na = not applicable

eof//

Treatability Test
CH2M Hill MW-77

Column Identification: 564
Column Composition: 100% Connolly (UW #255) 18/84
Pore Volume (PV): 289 mL
Porosity: 0.51
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 0.86 ft/day (26 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	2.2	4.5	9.2	14.0	18.4	27.9	36.6	45.8

	PV	RN	Influent	Organic Concentration (µg/L)							Effluent	HL	r2
CTET													
	4.0	a	1.1	nd	nd	nd	nd	nd	nd	nd	nd		
	9.9	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	16.1	a	4.8	nd	nd	nd	nd	nd	nd	nd	nd		
	20.1	b	1.5	nd	nd	nd	nd	nd	nd	nd	nd		
	30.7	b	3.2	nd	nd	nd	nd	nd	nd	nd	nd		
	33.3	b	5.1	nd	nd	nd	nd	nd	nd	nd	nd		
	37.0	b	6.2	nd	nd	nd	nd	nd	nd	nd	nd		
	43.7	c	2.8	nd	nd	nd	nd	nd	nd	nd	nd		
TCM													
	4.0	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	9.9	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	16.1	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	20.1	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	30.7	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	33.3	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	37.0	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	43.7	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
1122TECA													
	4.0	a	11249	101	1.4	9.5	nd	nd	nd	nd	nd		
	9.9	a	21238	3112	140	nd	nd	nd	nd	nd	nd		
	16.1	a	18966	2197	204	nd	nd	nd	nd	nd	nd		
	20.1	b	20211	9658	895	6.5	nd	nd	nd	nd	nd		
	27.7	b	23328	1989	117	0.9	nd	nd	nd	nd	nd		
	30.7	b	20888	1549	339	3.2	nd	nd	nd	nd	nd	0.6	0.999
	33.3	b	18228	5064	879	nd	nd	nd	nd	nd	nd	1.2	0.999
	37.0	b	19529	7231	535	1.3	nd	nd	nd	nd	nd	1.4	0.987
	43.7	c	22145	7179	892	18	nd	nd	nd	nd	nd	1.3	0.995

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-77

Column Identification: 564
Column Composition: 100% Connelly (UW #255) 18/84
Pore Volume (PV): 289 mL
Porosity: 0.51
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 0.86 ft/day (26 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	2.2	4.5	9.2	14.0	18.4	27.9	36.6	45.8

	PV	RN	Influent		Organic Concentration (µg/L)						Effluent	HL	r2
111TCA													
	4.0	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	9.9	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	16.1	a	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	20.1	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	27.7	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	30.7	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	33.3	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	37.0	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	43.7	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
112 TCA													
	4.0	a	9.9	26	7.1	nd	nd	nd	nd	nd	nd		
	9.9	a	19	76	38	nd	nd	nd	nd	nd	nd		
	16.1	a	10	51	34	5.4	nd	nd	nd	nd	nd		
	20.1	b	10	52	45	9.5	nd	nd	nd	nd	nd		
	27.2	b	12	59	19	3.9	nd	nd	nd	nd	nd		
	30.7	b	11	50	36	11	nd	nd	nd	nd	nd	3.1	0.889
	33.3	b	12	47	41	11	nd	nd	nd	nd	nd	2.6	0.985
	37.0	b	12	42	20	1.0	nd	nd	nd	nd	nd	0.8	0.839
	43.7	c	11	66	50	19	nd	nd	nd	nd	nd	2.5	0.997
PCE													
	4.0	a	12	nd	nd	nd	nd	nd	nd	nd	nd		
	9.9	a	31	4.8	nd	nd	nd	nd	nd	nd	nd		
	16.1	a	37	nd	nd	nd	nd	nd	nd	nd	nd		
	20.1	b	35	15	2.5	nd	nd	nd	nd	nd	nd		
	27.7	b	39	16	4.1	nd	nd	nd	nd	nd	nd		
	30.7	b	50	18	8.3	nd	nd	nd	nd	nd	nd		
	33.3	b	51	24	9.2	nd	nd	nd	nd	nd	nd	1.9	0.997
	37.0	b	51	32	8.2	nd	nd	nd	nd	nd	nd	2.3	0.936
	42.4	c	48	23	21	nd	nd	nd	nd	nd	nd	2.7	0.945
	43.7	c	48	33	16	nd	nd	nd	nd	nd	nd	2.9	0.968

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-77

Column Identification: 564
Column Composition: 100% Connelly (UW #255) 18/84
Pore Volume (PV): 289 mL
Porosity: 0.51
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 0.86 ft/day (26 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	2.2	4.5	9.2	14.0	18.4	27.9	36.6	45.8

	PV	RN	Influent		Organic Concentration (µg/L)						Effluent	HL	r2
TCE	4.0	a	2969	411	16	6.0	nd	16	nd	nd	nd		
	9.9	a	3253	1592	146	2.0	1.6	1.7	1.4	1.7	2.4		
	16.1	a	2796	849	246	nd	nd	nd	nd	nd	nd		
	20.1	b	3375	1733	633	nd	nd	nd	nd	nd	nd		
	27.7	b	3335	1189	297	3.1	nd	nd	nd	nd	nd		
	30.7	b	3235	1115	564	7.9	nd	nd	nd	nd	nd	1.6	0.996
	33.3	b	3285	1682	571	nd	nd	nd	nd	nd	nd	2.0	0.989
	37.0	b	3415	1903	294	5.0	nd	nd	nd	nd	nd	1.9	0.960
	43.7	c	3176	2162	982	16	2.5	nd	nd	nd	nd	2.7	0.973
cDCE	4.0	a	175	2013	1951	1684	1625	963	nd	nd	nd		
	9.9	a	137	4836	4908	3548	3012	1060	1522	309	nd		
	16.1	a	136	2934	3120	1714	1379	1358	575	140	77		
	20.1	b	112	2701	3155	2564	910	385	131	87	17		
	27.7	b	151	1897	2641	1164	314	201	51	44	21		
	30.7	b	108	3320	3134	1922	536	131	23	25	19	5.1	0.972
	33.3	b	169	3317	3859	676	252	112	18	17	11	2.7	0.947
	43.7	c	177	3636	3685	2404	638	91	5.3	nd	nd	4.1	0.976
tDCE	4.0	a	28	820	705	339	12	1.3	nd	nd	nd		
	9.9	a	18	766	1172	102	94	16	nd	nd	nd		
	16.1	a	15	912	672	76	13	nd	nd	nd	nd		
	20.1	b	16	937	780	134	nd	nd	nd	nd	nd		
	27.7	b	20	925	437	29	5.9	nd	nd	nd	nd		
	30.7	b	12	864	714	97	1.6	nd	nd	nd	nd	2.8	0.96
	33.3	b	16	969	729	17	nd	nd	nd	nd	nd	1.6	0.973
	43.7	c	21	1434	1075	272	7.3	nd	nd	nd	nd	2.5	0.998

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-77

Column Identification: 564
Column Composition: 100% Connelly (UW #255) 18/84
Pore Volume (PV): 289 mL
Porosity: 0.51
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 0.86 ft/day (26 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	2.2	4.5	9.2	14.0	18.4	27.9	36.6	45.8

	PV	RN	Influent	Organic Concentration (µg/L)							Effluent	HL	r2
11DCE													
	4.0	a	nd	9.3	7.8	5.8	2.0	nd	nd	nd	nd		
	9.9	a	nd	6.0	4.1	nd	nd	2.1	nd	nd	nd		
	16.1	a	nd	8.9	3.1	nd	nd	nd	nd	nd	nd		
	20.1	b	nd	4.7	1.4	nd	1.7	nd	nd	nd	nd		
	27.7	b	nd	nd	nd	nd	nd	nd	nd	4.1	nd		
	30.7	b	nd	nd	2.3	nd	4.4	nd	nd	nd	nd		
	33.3	b	nd	nd	nd	nd	nd	nd	nd	nd	nd		
	43.7	c	nd	nd	nd	3.1	nd	nd	nd	nd	nd		
VC													
	4.0	a	nd	63	88	95	118	97	35	nd	nd		
	9.9	a	nd	22	81	44	85	77	76	44	12		
	16.1	a	nd	40	36	75	69	52	37	13	14		
	20.1	b	nd	33	24	79	43	31	5.3	nd	nd		
	27.7	b	nd	34	82	49	17	11	nd	nd	nd		
	30.7	b	nd	46	52	49	26	23	nd	nd	nd	1.8	0.919
	33.3	b	nd	30	44	18	15	5.9	9.6	nd	nd	1.1	0.873
	43.7	c	nd	44	84	106	56	15	nd	nd	nd	2.4	0.941
DCM													
	37.0	b	na	0.7	1.4	na	nd	nd	nd	0.8	2.5		
	41.7	c	nd	nd	1.4	3.1	4.8	2.1	1.1	8.3	nd		
11DCA													
	37.0	b	na	nd	nd	na	nd	nd	nd	nd	nd		
	41.7	c	nd	nd	nd	nd	nd	nd	nd	nd	nd		
12DCA													
	37.0	b	na	2.2	1.9	na	1.5	1.4	2.4	1.5	1.5		
	41.7	c	nd	nd	1.3	1.8	2.3	1.8	nd	1.5	1.2		

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-77

Column Identification: 564
Column Composition: 100% Connolly (UW #255) 18/84
Pore Volume (PV): 289 mL
Porosity: 0.51
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 0.86 ft/day (26 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	2.2	4.5	9.2	14.0	18.4	27.9	36.6	45.8

PV	RN	Influent	Organic Concentration (µg/L)							Effluent	HL	r2
Nitrate (NO3-N)												
9.2	a	4.0	0.5	0.2	nd	nd	na	na	na	na		
10.6	a	3.0	0.3	0.1	0.1	nd	nd	nd	0.1	nd		
18.7	b	3.0	nd	nd	nd	nd	na	na	na	na		
19.3	b	2.9	nd	0.1	nd	nd	nd	nd	nd	nd		
27.0	b	2.4	nd	nd	nd	nd	nd	nd	nd	nd		
32.0	b	2.5	nd	nd	nd	nd	nd	nd	nd	nd		
37.6	b	2.7	nd	nd	nd	nd	nd	nd	nd	nd		
Chloride (Cl-)												
10.6	a	24	36	34	34	34	34	36	38	41		
19.3	b	29	37	35	41	38	39	36	42	41		
27.0	b	25	35	37	46	42	41	40	1.9	40		
32.0	b	25	35	37	40	41	40	39	41	39		
37.6	b	26	34	36	39	39	38	37	45	53		
Sulphate (SO4-)												
32.0	b	27	28	27	27	27	27	29	28	30		
37.6	b	28	28	27	28	28	28	31	21	26		

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

Treatability Test
CH2M Hill MW-77

Column Identification: 564
Column Composition: 100% Connelly (UW #255) 18/84
Pore Volume (PV): 289 mL
Porosity: 0.51
Column Length: 1.6 ft (50 cm)
Column Diameter: 1.5 in (3.8 cm)
Flow Velocity: 0.86 ft/day (26 cm/day)
Column Temp: 18°C (64°F)

Column Distance (ft)	0.0	0.08	0.16	0.33	0.50	0.66	1.0	1.3	1.6
Residence Time (hr)	0.0	2.2	4.5	9.2	14.0	18.4	27.9	36.6	45.8

	PV	RN	Influent	Organic Concentration (µg/L)							Effluent	HL	r2
pH Values													
3.5	a		6.7	8.8	9.0	9.2	9.3	9.2	9.1	9.2	8.8		
6.1	a		6.8	8.6	8.9	9.1	9.3	9.4	9.4	9.3	9.2		
10.6	a		7.0	8.5	8.7	9.1	9.2	9.4	9.2	9.1	9.1		
14.5	a		7.0	8.5	8.6	9.1	9.3	9.5	9.5	9.6	9.2		
22.3	b		6.5	8.2	8.6	8.8	9.1	9.2	9.5	9.5	9.0		
27.0	b		6.7	8.5	8.7	8.9	9.2	9.1	9.4	9.5	9.0		
31.3	b		6.7	8.7	8.9	8.8	9.0	9.1	9.3	9.7	9.5		
34.0	b		6.6	8.6	9.0	9.1	9.2	9.6	9.9	8.8	9.4		
37.6	b		7.3	8.7	8.8	8.9	9.0	9.0	9.3	9.5	9.5		
Eh (mV)													
3.5	a		278	-156	-45	-131	-139	-187	-46	-231	-36		
6.1	a		351	82	45	-96	-33	-362	-329	-411	-236		
10.6	a		338	-52	-33	-36	-152	-250	-95	-246	-226		
14.5	a		329	-75	-197	-291	-146	-336	-360	-402	-278		
22.3	b		319	-242	-98	-193	-238	-295	-326	-317	-200		
27.0	b		315	-226	-217	-219	-181	-236	-157	-261	-178		
31.3	b		351	-266	-184	-110	-252	-242	-272	-347	-250		
34.0	b		322	-127	-63	-290	-308	-368	-318	-397	-267		
37.6	b		330	-181	-162	-238	-221	-275	-292	-301	-366		

PV = pore volume

RN = reservoir number

HL = half life (hours)

r2 = coefficient of determination

nd = not detected

na = not applicable

eof//

Appendix D

Laboratory Inorganic Analyses for Bench-Scale Testing Involving the Granular Iron Technology

Jan 17 2004 4:49PM Groundwater Lab

519 746 9785

P.3

Jan-16-04, 04:26pm From-PHILP SERVICES CORP.

0098008578

T-011 P.001/007 F-575

16-Jan-2004

Page: 1
Copy: 1 of 2

Received: 7-Jan-2004 09:26

PO #:

Status: Final

Job: 2450068

Attn: Greg Friday
Project:

Water Samples

Sample Id	Ag ICAP mg/L	Al ICAP mg/L	B ICAP mg/L	Ba ICAP mg/L	Be ICAP mg/L	Bi ICAP mg/L	Ca ICAP mg/L	Cd ICAP mg/L
UW-654 5631n	<0.005	<0.05	0.01	0.134	<0.0005	<0.2	16.7	<0.005
UW-655 5641n	<0.005	<0.05	0.01	0.092	<0.0005	<0.2	19.7	<0.005
UW-656 5636ft 43.7PV	<0.005	<0.05	0.13	0.010	<0.0005	<0.2	10.1	<0.005
UW-657 5646ft 34.1PV	<0.005	<0.05	0.21	0.012	<0.0005	<0.2	11.3	<0.005
UW-658 5636ft 48.9PV	<0.005	<0.05	0.12	0.009	<0.0005	<0.2	9.58	<0.005
UW-659 5631n	<0.005	<0.05	0.02	0.134	<0.0005	<0.2	16.7	<0.005
UW-660 5646ft	<0.005	<0.05	0.18	0.011	<0.0005	<0.2	12.6	<0.005
UW-661 5646ft	<0.005	<0.05	0.01	0.092	<0.0005	<0.2	19.9	<0.005
Blank	<0.005	<0.05	<0.01	<0.005	<0.0005	<0.2	<0.05	<0.005
QC Standard (found)	0.028	10.0	0.20	0.966	1.00	0.9	49.3	0.976
QC Standard (expected)	0.030	10.0	0.20	1.00	1.00	1.0	51.0	1.00
Repeat UW-654	<0.005	<0.05	<0.01	0.134	<0.0005	<0.2	16.7	<0.005

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519 746 9785

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16-Jan-2004

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Water Samples

Sample Id	Co ICAP mg/L	Cr ICAP mg/L	Cu ICAP mg/L	Fe ICAP mg/L	K ICAP mg/L	Mg ICAP mg/L	Mn ICAP mg/L	Mo ICAP mg/L
UM-654 513 in	0.012	<0.005	<0.005	0.01	<1	8.30	0.012	0.04
UM-655 564 in	<0.005	<0.005	<0.005	<0.01	<1	10.9	<0.005	<0.02
UM-656 523 eff 73.7PV	<0.005	<0.005	<0.005	0.01	1	0.07	<0.005	0.07
UM-657 564 eff 36.1PV	<0.005	<0.005	<0.005	0.02	1	0.14	<0.005	0.04
UM-658 563 eff 48.9PV	<0.005	<0.005	<0.005	0.01	<1	0.07	<0.005	0.05
UM-659 583 in	<0.005	<0.005	<0.005	<0.01	<1	8.33	<0.005	<0.02
UM-660 564 eff 40.3PV	<0.005	<0.005	<0.005	0.01	1	0.10	<0.005	0.06
UM-661 584 in	<0.005	<0.005	<0.005	0.01	<1	10.9	<0.005	<0.02
Blank	<0.005	<0.005	<0.005	<0.01	<1	<0.05	<0.005	<0.02
QC Standard (found)	0.989	1.00	1.01	0.93	10	10.7	0.999	1.06
QC Standard (expected)	1.00	1.00	1.00	1.00	10	11.0	1.00	1.10
Repeat UM-654	<0.005	<0.005	<0.005	0.01	<1	8.31	<0.005	<0.02

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Water Samples

Sample Id	Na ICAP mg/L	Ni ICAP mg/L	P ICAP mg/L	Si ICAP mg/L	Sn ICAP mg/L	Sr ICAP mg/L	Ti ICAP mg/L	V ICAP mg/L
UW-654 523 in	17.1	<0.02	<0.1	17.4	<0.05	0.125	<0.005	<0.005
UW-655 524 in	35.8	<0.02	<0.1	16.8	<0.05	0.066	<0.005	<0.005
UW-656 523 Gff 43.7PV	17.9	<0.02	<0.1	0.67	<0.05	0.074	<0.005	<0.005
UW-657 514 Gff 34.1PV	36.6	<0.02	<0.1	0.67	<0.05	0.059	<0.005	<0.005
UW-658 523 Gff 46.9PV	17.8	<0.02	<0.1	0.73	<0.05	0.075	<0.005	<0.005
UW-659 523 in	17.2	<0.02	<0.1	17.4	<0.05	0.125	<0.005	<0.005
UW-660 524 Gff 40.3PV	36.1	<0.02	<0.1	0.61	<0.05	0.070	<0.005	<0.005
UW-661 564 in	35.4	<0.02	<0.1	16.6	<0.05	0.066	<0.005	<0.005
Blank	<0.1	<0.02	<0.1	<0.05	<0.05	<0.001	<0.005	<0.005
QC Standard (found)	48.1	0.98	1.9	2.06	0.88	0.925	0.970	0.988
QC Standard (expected)	50.0	1.00	2.0	2.00	1.00	1.00	1.00	1.00
Repeat UW-654	17.2	<0.02	<0.1	17.4	<0.05	0.125	<0.005	<0.005

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Water Samples

Sample Id	Zn ICAE mg/L	Cl- SM 4110B mg/L	NO2-N SM 4110B mg/L	PO4-3 SM 4110B mg/L	NO3-N SM 4110B mg/L	SO4= SM 4110B mg/L	PH Units	Alk 4.2 SM 2320B mg CaCO3/L
UW-654 5631	0.008	13.6	<0.2	<1	3.7	16.8	7.03	64
UW-655 5641	<0.005	25.0	<0.2	<1	2.4	25.3	7.35	103
UW-656 56366 43.7PV	0.037	14.8	<0.2	<1	<0.2	17.4	10.1	31
UW-657 56466 36.1PV	0.005	42.4	<0.2	<1	<0.2	29.0	9.91	20
UW-658 56366 48.1PV	0.015	14.8	<0.2	<1	<0.2	17.3	10.3	31
UW-659 5631	0.006	13.1	<0.2	<1	3.6	16.5	7.25	65
UW-660 56466 40.3PV	<0.005	41.9	<0.2	<1	<0.2	27.4	9.88	22
UW-661 5641	0.006	25.3	<0.2	<1	2.4	25.9	7.69	101
Blank	<0.005	<0.5	<0.2	<1	<0.2	<0.5	---	<1
QC Standard (found)	0.993	20.4	10.4	49	9.9	49.0	7.02	258
QC Standard (expected)	1.00	20.0	10.0	50	10.0	50.0	7.00	250
Repeat UW-654	0.007	13.6	<0.2	<1	3.7	17.2	7.01	65



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Water Samples

Sample Id	NH3-N SM 4500H mg/L	DOC SM 5310C mg/L	Th. TDS Calc. mg/L	pHs Calc. pH Units	Cation Sum		Anion Sum		CAB Calc. %
					Calc.	eq/L	Calc.	eq/L	
UM-654 5231n	<0.03	0.6	112	8.35	2.29	2.28	-0.32	-0.32	
UM-655 5241n	0.04	2.3	180	8.12	3.47	3.46	-0.14	-0.14	
UM-656 523 eff 43.7PV	3.04	1.7	80	8.87	1.54	1.41	-4.33	-4.33	
UM-657 524 eff 36.1PV	1.28	2.2	133	9.04	2.29	2.21	-1.73	-1.73	
UM-658 523 eff 48.9PV	2.74	1.0	79	8.89	1.48	1.41	-2.38	-2.38	
UM-659 5231n	0.05	<0.2	112	8.35	2.30	2.27	-0.72	-0.72	
UM-660 524 eff 40.3PV	1.34	2.3	133	8.95	2.34	2.21	-2.90	-2.90	
UM-661 5241n	0.05	2.5	179	8.12	3.47	3.44	-0.32	-0.32	
Blank	<0.03	<0.2	3	12.6	0.04	0.06	20.6	20.6	
QC Standard (found)	1.52	4.6	342	7.36	5.79	7.46	12.5	12.5	
QC Standard (expected)	1.50	5.0	342	7.36	5.99	7.32	9.99	9.99	
Repeat UM-654	<0.03	0.6	113	8.35	2.29	2.31	0.25	0.25	

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Job: 2450058

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Water Samples

Sample Id	Hard(Calc) SM 2340B mg CaCO ₃ /L	CO ₃ ⁼ Calc. mg/L	HCO ₃ ⁻ Calc. mg/L	L.I. Calc. None	Colour SM 2120B TCU	Sp. Cond. SM 2510B umhos/cm	Pb-GFRAAS SW 7421 mg/L
UW-654	76.0	1	76	-1.3	8	233	<0.001
UW-655	94.4	1	123	-0.8	6	336	<0.001
UW-656	25.6	9	0	1.2	4	167	<0.001
UW-657	28.9	5	0	0.9	12	256	<0.001
UW-658	24.2	8	0	1.4	6	162	<0.001
UW-659	76.2	1	77	-1.1	4	228	<0.001
UW-660	32.0	7	0	0.9	4	260	<0.001
UW-661	94.9	1	121	-0.4	4	325	<0.001
Blank	0.3	nan	nan	nan	<2	<1	<0.001
QC Standard (found)	167.4	64	54	-0.3	50	719	0.026
QC Standard (expected)	172.6	75	0	-0.4	50	718	0.025
Repeat UW-654	76.0	1	77	-1.3	8	234	<0.001

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Water Samples

Sample Id	TOC SM 5310C mg/L
UW-654	0.3
UW-655	4.0
UW-656	1.4
UW-657	2.4
UW-658	0.5
UW-659	<0.2
UW-660	2.4
UW-661	6.4
Sample+Spike (found)	5.1
Sample+Spike (expected)	5.1
Blank	<0.2
QC Standard (found)	9.7
QC Standard (expected)	10.0
Repeat UW-654	0.4

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Job approved by:

Signed:

Ralph Robert, B.Sc.
Section Supervisor, Metals

Feb 20 2004 11:29 AM Groundwater Lab

315 776 3783

P.3

Feb-20-04 12:00pm From-PHILP SERVICES CORP.

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Attn: Wayne Nobel
Project:

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Job: 2451079

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Water Samples

Sample Id	As SW 7061 mg/L
UW-654 563 In	<0.001
UW-655 564 In	<0.001
UW-656 563 Eff 43.70V	<0.001
UW-657 564 Eff 36.11V	<0.001
UW-658 563 Eff 46.91V	<0.001
UW-659 563 In	<0.001
UW-660 564 Eff 40.31V	<0.001
UW-661 564 In	<0.001
Sample+Spike (found)	0.015
Sample+Spike (expected)	0.015
Blank	<0.001
QC Standard (found)	0.014
QC Standard (expected)	0.015
Repeat UW-654	<0.001

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Signed:

Malcolm Danziger
Project Manager

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9058908575

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Job approved by:

Signed:

Nathan Siebert, B.Sc.

Section Supervisor, Metals

Analytical Method Summary

Parameters	Units	LOQ	Analytical Method	Preservative	Holding Time
RCAP Calculations	Listed below	Listed below	PASC Internal Reference Method		
Total Dissolved Solids(Calculated)	mg/L	1			
Hardness(as CaCO ₃)	mg/L	0.1			
Bicarbonate(as CaCO ₃ , calculated)	mg/L	1			
Carbonate(as CaCO ₃ , calculated)	mg/L	1			
Cation Sum	meq/L	na			
Anion Sum	meq/L	na			
Saturation pH at 20oC	units	na			
Saturation pH at 4oC	units	na			
Langelier Index at 20oC	na	na			
Langelier Index at 4oC	na	na			
Ion Balance	%	na			
Colour	TCU	3	U.S. EPA Method No. 110.3(Modified)	General (unpreserved)	48 hours
Conductivity - @25oC	uS/cm	1	U.S. EPA Method No. 120.1	General (unpreserved)	28 days
pH	Units	0.01	U.S. EPA Method No. 150.1	General (unpreserved)	
Turbidity	NTU	0.2	U.S. EPA Method No. 180.1	General (unpreserved)	48 hours
RCAP 30 Package, ICPAES Scan(Cu,Mn,Fe,Zn,Ca,Mg,Na,K)	Listed below	Listed below	U.S. EPA Method No. 200.7	Metals (HNO ₃)	6 months
Copper	mg/L	0.005			
Iron	mg/L	0.01			
Manganese	mg/L	0.005			
Zinc	mg/L	0.005			
Calcium	mg/L	0.05			
Magnesium	mg/L	0.05			
Potassium	mg/L	1			
Sodium	mg/L	0.1			
Reactive Silica(SiO ₂)	mg/L	0.5	Standard Methods(17th ed.) No. 4500-Si G	Metals (HNO ₃)	
Alkalinity(as CaCO ₃)	mg/L	1	U.S. EPA Method No. 310.2	General (unpreserved)	14 days
Anions RCAP 30(Cl,NO ₂ -NO ₃ ,o-PO ₄ & SO ₄) by IC	Listed below	Listed below	U.S. EPA Method No. 300.0 or U.S. EPA Method No. 350.1, 354.1, 353.1, 365.1 and 375.4.	-General (unpreserved)	48 hours

Analytical Method Summary

Parameters	Units	LOQ	Analytical Method	Preservative	Holding Time
Chloride	mg/L	0.5			
Sulphate	mg/L	0.5			
Orthophosphate(as P)	mg/L	0.3			
Nitrite(as N) and Nitrate(as N)	mg/L	0.2			
Dissolved Organic Carbon(DOC)	mg/L	0.2	MOE Method No. ROM - 102ACE(Modified) Standard Method 5310C	Nutrients(H ₂ SO ₄)	28 days
Total Organic Carbon(TOC)	mg/L	0.2	MOE Method No. ROM - 102ACE(Modified) Standard Method 5310C	Nutrients(H ₂ SO ₄)	28 days
Ammonia(as N)	mg/L	0.03	ASTM Method No. D1426-79 C Refer - Method No. 1100106 Issue 122289 Standard Method 4500H	Nutrients(H ₂ SO ₄)	28 days

TECHNICAL MEMORANDUM

CH2MHILL

Summary of the Memphis Depot Dunn Field Zero-Valent Iron Permeable Reactive Barrier Implementation Study

PREPARED FOR: U.S. Army Corps of Engineers – Huntsville Center

PREPARED BY: CH2M HILL

DATE: February 23, 2007

PROJECT NUMBER: 334469.TS.PB

COPIES: Defense Logistics Agency (DLA)
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Tennessee Department of Environment and Conservation (TDEC)
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engineering-environmental Management, Inc. (e2M)
Mitretek Systems

1.0 Introduction

As part of the Remedial Design (RD) effort for Dunn Field of the former Defense Distribution Center (Memphis) (hereafter referred to as the Memphis Depot), a pilot-scale zero-valent iron (ZVI) permeable reactive barrier (PRB) was installed west of Dunn Field (also referred to as Off-Depot) using the jet grouting or “jetting” technique to evaluate the implementability and cost-effectiveness of a full-scale Off-Depot remedial action (RA).

As described in the *Zero-Valent Iron Permeable Reactive Barrier Implementation Study Work Plan* (Work Plan) (CH2M HILL, 2006a), this work included installing a 55-foot long, 8-foot high ZVI PRB from approximately 70 to 78 feet below ground surface (bgs), advancing confirmatory soil borings, and installing additional monitoring wells (MWs) in support of the Off-Depot Groundwater RD.

This technical memorandum (TM) summarizes the implementation activities and presents the effectiveness evaluation. This TM includes the following:

- Description of the study procedures and ZVI PRB implementation process.
- Field measurement methods and data collected.
- Summary of field and laboratory analytical data.
- Variances to field procedures.
- Potential quality assurance (QA) problems and corrective actions implemented.
- Copies of pertinent documentation.
- Impact on the Off-Depot RD.

2.0 Implementation Activities

2.1 Preliminary Activities

In accordance with the Work Plan, preliminary study activities included:

- Submission of application for MW installation.
- Survey of ZVI PRB alignment by Allen & Hoshall.
- Installation of a gate along the western perimeter fence of Dunn Field at the corner of Menager Avenue and Kyle Street.
- Coordination with the City of Memphis, Memphis Light, Gas and Water (MLGW), and Memphis Depot personnel on the location of utilities in the area.
- Designation of areas for temporary storage of equipment, construction materials, and waste management.

2.2 Monitoring Well Installation

As shown on Figure 1 and summarized on Table 1, 10 new Off-Depot MWs were installed to provide additional monitoring locations to assess ZVI PRB effectiveness; four of the MWs were installed after confirmation soil borings were collected (see Section 3). The MWs were installed and completed in accordance with the Work Plan. Soil boring logs and MW construction diagrams are provided in Attachment A.

The new downgradient MWs were positioned so that the impact of the ZVI PRB on chlorinated volatile organic compound (CVOC) concentrations in groundwater could be observed within the first few months of monitoring. New and existing MWs were located about 5 to 10, 20, and 40 feet downgradient of the ZVI PRB. Given the nearly instantaneous iron corrosion and CVOC dechlorination kinetics and relatively rapid groundwater flow rate, groundwater downgradient of the ZVI PRB was expected to be impacted within the desired timeframe.

Monitoring Well Development

Upon installation, each well was developed with a surge block in conjunction with a pump. No air, detergents, soaps, acids, bleaches, or additives were used during development. Well development started once the pump was placed in the water near the bottom of the well. Development continued until clear, sand-free formation water was produced and parameters, including pH, temperature, conductivity, and turbidity, had stabilized. Each well was surged approximately three to five times during development.

2.3 Hydraulic Conductivity Testing

Following development and baseline sampling, single-well aquifer tests (slug tests) were conducted in the following MWs:

Date	Monitoring Wells
Before ZVI PRB Construction	
May 2006	MW-189 to MW-193
After ZVI PRB Construction	
June 2006	MW-76, MW-77, MW-144, MW-157, MW-161 to MW-164, MW-189 to MW-195
Relevant Historical Slug Test Results	
August 2004	MW-31, MW-44, MW-54, MW-76, MW-79, MW-144, MW-145, MW-147, MW-148, MW-149, MW-150
March 2006	MW-161 to MW-164, MW-184

Rising head slug testing was done prior to and after ZVI PRB installation to assess whether the jetting process impacted the permeability of the fluvial aquifer around the PRB. In addition, the MWs installed in the ZVI PRB (MW-194 to MW-196) were tested after installation to assess in-place reactive media permeability. Slug testing results, which were analyzed with the Bouwer & Rice Method and Environmental Simulations Aquifer^{win32} software, are summarized in Table 2. Analysis details, including water level data versus time and the simulation outputs, are provided in Attachment B. Table 2 also includes historical slug test results for several existing MWs in the area: MW-31, MW-44, MW-54, MW-76, MW-79, MW-144, and MW-150.

Aquifer testing indicated much higher groundwater velocities than previously understood (up to 6 feet per day [ft/d] versus the previously estimated velocity of 1 ft/d). Despite the new hydrogeologic information, no additional iron was added to the pilot-scale ZVI PRB because significant CVOC reductions were still expected, just not to maximum contaminant levels (MCL). Furthermore, additional iron would have significantly increased study costs. However, these groundwater velocities could require a 5- to 6-foot thick full-scale ZVI PRB if it were installed in the same area.

2.4 ZVI PRB Installation

The ZVI PRB was installed by Hayward Baler, Inc. (HBI), with oversight provided by CH2M HILL (photographs are provided in Attachment C). This section details the following elements of the ZVI PRB implementation:

- Mobilization and site setup;
- Equipment;
- Reactive media and guar slurry preparation;
- Jetting (including test and production columns);
- Reactive media injection;
- Waste management; and
- Site restoration and demobilization.

2.4.1 Mobilization

HBI mobilized to the site on May 16, 2006. As shown on Figure 1, the ZVI PRB was installed west of Rozzelle Street between MW-144 and MW-161 on an undeveloped parcel beneath the MLGW power line corridor. The power lines are approximately 50 feet above ground surface.

Standard tractor trailers and removable goose neck trailers were used to mobilize the equipment to the site. The drilling and jetting equipment was staged near the study area.

During the mobilization and setup process, HBI made the necessary electrical connections/wiring of equipment; connection of hoses/plumbing, including obtaining a meter from MLGW to use the local fire hydrant for water; and ran high-pressure hoses. MLGW was contacted before any work was conducted beneath their transmission lines.

MLGW approved the location of the ZVI PRB and allowed the crane to operate in the area. Connex boxes, which housed much of HBI's equipment, were positioned with the crane. Waste Management (WM) delivered roll-off containers for jetting spoils management. CH2M HILL ordered sample kits and collected various field supplies.

2.4.2 Equipment

The primary equipment used by HBI to install the pilot-scale ZVI PRB is provided below. The general equipment layout is shown on Figure 2.

Equipment	Purpose
Air rotary track-mounted drill rig	Large equipment unloading and positioning.
High-pressure, extended-duty triplex pump	Jetting.
Hurricane 500E vacuum trailer	Collection and transfer of displaced formation materials and jetting slurry to roll-off containers.
Reed C50 grout pump	Pumping of reactive media into jetted columns.
Front-end loader	General construction activities.
SKYTRAK forklift	General construction activities.
cemen tech concrete dispenser	Mixing of sand and ZVI.
Guar slurry mixing and storage system	Preparation and storage of guar slurry.
Lined roll-off boxes	Temporary storage of liquid and solid waste from jetting operation.

2.4.3 Guar Slurry Preparation

The biopolymer guar slurry used during the jetting and reactive media injection processes was prepared by mixing 1,000 gallons of water from a local fire hydrant and 60 to 70 pounds guar gum in the batch mixing plant. The slurry was continuously mixed to maintain uniform properties (for example, pH and viscosity); additional guar gum, soda ash, and/or preservatives (to inhibit biological activity) were added during the study to maintain slurry stability.

2.4.4 Reactive Media Preparation

The reactive media consisted of sand and ZVI, which were delivered to the site and staged separately. Because it has a higher hydraulic conductivity, CONNELLY-GPM, INC. CC-1004 (-8+50 mesh) was used for the study instead of CC-1167 (-18+84 mesh), which was used in the bench-scale treatability test. CC-1167 was originally tested because GeoSierra's azimuth-controlled vertical hydraulic fracturing (ACVHF) method, which is included in the Record of Decision (ROD), specifies the finer ZVI material.

The iron was delivered to the site in forty-seven 3,000-pound bulk bags with an estimated dry bulk density of 150 pound per cubic foot (lb/ft³). The 70.5 tons of iron was stored underneath a weather-resistant tarp until it was mixed with the sand purchased from Memphis Stone and Gravel and injected into the jetted columns. The sand, which was

similar to the fluvial materials encountered at Dunn Field, had a proctor density of 106.4 lb/ft³ and was stored in a stockpile on the east side of the study area.

The sand and ZVI was blended on a volumetric basis using a cement stationary concrete mixer. Based on the Work Plan, which stipulated 4 tons of iron per 6-foot diameter, 8-foot tall column, the target iron percentage was 23.6 percent. Because 4.5 tons of iron were available for each of the columns (67.5 tons or 45 bags for 15 columns), the target iron percentage in the field increased to 26.5 percent. The sand was loaded into the concrete mixer with the front-end loader. The bags of ZVI were dispensed into the concrete mixer using a forklift; the bottoms of the bags were opened using a vertical blade welded to the top of the concrete mixer. Gates on the sand and ZVI hoppers were used to control the amount of material added to the mixture. The gate height was originally 1.5 inches for the iron and 3.75 inches for the sand; the ZVI gate was dropped to 1 inch after the initial magnetic separation test results were reviewed. The ZVI gate height was adjusted up and down during the course of the study based on the results of subsequent magnetic separation tests.

2.4.5 Test Columns

Prior to creating the 15 columns comprising the ZVI PRB, HBI completed three full-depth columns near the study area to verify mix design workability and establish the initial jetting parameters (discussed below).

- **Test 1:** grout
- **Test 2:** sand and guar slurry
- **Test 3:** ZVI, sand, and guar slurry

The test columns were installed with the same techniques planned for the production columns. The test column results are summarized in Table 3.

2.4.6 Production Columns

In general, the production columns were installed using the following two-phase process:

- **Phase I: Jetting** — The geometry of each of the 15 ZVI PRB columns was created using conventional jet grouting methods with a water and guar slurry drilling fluid.
- **Phase II: Injection** — A mixture of ZVI, sand, and guar slurry, along with an enzyme to break the guar slurry in situ, was pumped under low pressure into the column via tremie pipe.

Note that both phases were completed at each production column before the next column was started.

Phase I: Jetting

After the guar and water were hydrated, the guar slurry was transferred via centrifugal pump to a high-pressure, extended-duty triplex pump. Used as the drilling fluid, the guar slurry was injected under relatively low pressures and flow rates as the drill rods were advanced to the design depth. The pressure and flow rate were approximately 1,500 pounds per square inch (psi) and 25 gallons per minute (gpm), respectively.

The verticality of the drill rods was verified by using framing levels positioned on the mast and bubble levels on the rig frame once the mast was raised to full height and then several times during the drilling process. The weight of the drill string and the cutting tool used during the procedure minimized variance from vertical. Once the drill rod reached the design depth, the pressure, flow rate, and other jetting parameters were as follows:

- Pressure = 6,000 psi
- Flow rate = 100 gpm
- Rotation = 9 revolutions per minute (rpm)
- Retraction = 20 centimeters per minute (cm/min)

To establish column geometry, the drill rods were turned at a constant rate and then the pressure was increased until the pressure for eroding the formation materials was met (6,000 psi). A two-phase internal rod system was used to independently supply drilling fluid and air to two concentric nozzles. The drilling fluid was used to erode and remove the soil. Air, delivered by a compressor at approximately 80 psi, shrouded the drilling fluid and increased erosion efficiency.

Erosion was initiated at an average depth of 78.5 feet bgs (estimated to be 6 inches into the clay) with high-velocity injection of cutting and replacement fluids. The column termination depth was based on the findings from the four soil borings (SB-1 to SB-4) advanced during the Remedial Design Investigation (RDI) (CH2M HILL, 2006b).

This process continued with consistent, uniform rotation and lifting to create column geometry, while expelling eroded spoil out of the top of the borehole annulus. The reactive zone was anticipated to be 8 feet, extending from the top of the confining clay layer to at least 1 to 2 feet above the groundwater table. The drill rod was lowered to the bottom of the column again so that it could be re-jetted to loosen the soil and decrease the specific gravity of the column contents to facilitate displacement with the denser ZVI, sand, and guar slurry during the next construction step. After the column was created, the drilling tools were removed prior to injection of the ZVI, sand, and guar slurry. The biopolymer slurry temporarily supported the excavated column. The production column characteristics, including top and bottom elevation of column, jetting fluid volume, and jetting pressure, are summarized in Table 4.

The HBI drill rig had an electronic sensor board that measured and displayed the drilling tool rotational rate (rpm) and extraction rate (ft/min). The drill rig operator also used a stopwatch to monitor the extraction rate for the application. In addition, the pump operator monitored the pressure generated by the double pump system. The pressure component was critical to the effectiveness of the cutting and extraction process to create the desired column geometry.

Guar slurry consistency and injection flow rate were also monitored during the jetting process. Careful monitoring of the consistency helped ensure that the guar slurry did not break down prematurely. The guar slurry injection and extraction flow rates were also monitored to gauge cutting and reactive media emplacement effectiveness.

Groundwater levels in surrounding MWs were also periodically collected during the ZVI PRB installation. The data suggest a slight rise in the groundwater table within the immediate upgradient and downgradient monitoring wells during construction, with a gradual decrease to pre-construction conditions approximately 2 weeks after the ZVI PRB

was completed. In general, during the construction effort, groundwater elevations increased about 0.4 foot as a result of the jetting effort. As discussed in Section 5, the ZVI PRB installation does not appear to have measurably impacted groundwater flow in the area.

Phase II: Injection

After the column was jetted, the ZVI, sand, and guar slurry mix was injected using the grout pump and a tremie pipe positioned near the bottom of the column. The production column characteristics, including sand and iron hopper gate elevations, reactive media volume, and magnetic separation test results, are summarized in Table 4. Example calculations used in Table 4 are provided in Attachment D.

As discussed below, magnetic separation tests were conducted on samples of the ZVI, sand, and guar slurry mix collected just prior to injection. As summarized in Table 5, reactive media and return slurry samples were also collected from several of the columns and analyzed for total metals according to EPA SW846 6010B. The volume of reactive media was based on the number of concrete pump stroke counts (0.69 ft³/stroke).

During the injection, the orange return material mostly comprised fluvial sands and guar slurry. Reactive media injection continued until the returned material included ZVI as evidenced by a noticeable color shift from orange to gray or black. As shown on Table 4, the volume of reactive media injected into the jetted columns, 7.4 to 9.6 cubic yards (yd³), was within 15 percent of the design column volume of 8.4 yd³.

2.4.7 Magnetic Separation Testing

To assess the volume and mass of iron injected into each column, samples of the reactive media were collected just before injection into each column and analyzed using magnetic separation testing in accordance with the Work Plan. Samples were collected from the discharge of the concrete mixer, slowly dried using a toaster oven (powered by an onsite portable generator), and then weighed. The magnetic fraction was removed from the sample using several magnets glued to a trowel that was wrapped in a plastic bag, which was used to contain the separated materials. The magnetic and non-magnetic fractions were weighed before calculating the dry iron net weight percent as follows:

$$\text{Dry Iron Net Weight Percent} = \frac{\text{Net Weight of Magnetic Material}}{\text{Total Net Weight of Dry Sample}} \times 100$$

The magnetic separation test results for each column are summarized on Table 4. Because the concrete mixer delivered a consistent blend of iron and sand, the magnetic separation test results are assumed to represent the entire column. As necessary, the ZVI gate height was adjusted based on the results of the magnetic separation test; that is, the gate was lowered if the iron percentage was considerably above the design target.

2.4.8 Permeability Testing

To approximate in-place permeability, a ZVI, sand, and guar slurry mix sample was collected just prior to injection into the fourth column (Column 14) and submitted to Kemron Environmental Services' Geotechnical Laboratory in Atlanta, Georgia, for constant head (ASTM D2434) permeability testing. A magnetic separation test was also conducted on

the same sample. As discussed in Section 5, the hydraulic conductivity of the ZVI PRB material was also evaluated with in-place slug tests in June 2006.

As detailed in Attachment B, the permeability testing indicated a hydraulic conductivity of 0.1 centimeter per second (cm/s) (283 ft/d) for the mix. This result is more than 5 times the average hydraulic conductivity of the fluvial sands in the vicinity of the ZVI PRB and about twice the highest measured value (MW-162). This result suggested that the ZVI PRB was considerably more permeable than the formation.

2.4.9 Jetting Borehole Completion

Each of the 15 columns was completed by filling the borehole with the sand, iron, and guar slurry mix from the top of the column to approximately 5 feet bgs. The remainder of the boring was filled with cement grout, which was Type II Portland cement or API Class A cement with no more than 4 percent bentonite. The grout was mixed in the following proportions: 94 pounds of neat cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water. The grout had a mixed minimum specific density of 9.4 lb/gal or the manufacturer's recommended density. A section of PVC pipe was placed in the center of the borehole so the columns could be identified in the future.

2.5 Waste Management

Waste generated during the installation of the test and production ZVI PRB columns was managed by HBI and CH2M HILL as part of the field effort. The jetting spoils and slurry mixtures were collected directly from the top of the borehole using the Hurricane 500E vacuum trailer and transferred into the lined 30 yd³ roll-off containers on the south side of the study area (see Figure 2).

The residual solid material (primarily fluvial sands removed during the jetting process) in the lined roll-off containers were sampled prior to transport to Dunn Field for disposal. Characterization sampling results, which indicate that the residual solid materials could be spread out on Dunn Field per U.S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC) concurrence, are provided in Attachment E.

Confirmation soil boring material that was not archived was disposed of in a separate roll-off box and final disposal was handled by the subcontractor, ProSonic. Groundwater collected during MW development was transferred into drums prior to disposal within the groundwater extraction system.

2.6 Site Cleanup and Restoration

The site was restored to pre-construction conditions upon completion of the implementation study. The site was regraded (some of the residual sand was used for backfilling ruts, etc.) and grass seed was spread over disturbed areas. Gravel was placed on the surface of the ZVI PRB to allow the drill rig to access the site during the subsequent confirmation sample collection effort.

3.0 Confirmation Borings and Monitoring Well Installation

After the ZVI PRB was installed, nine soil borings were advanced by ProSonic during two separate confirmation sampling events. Five soil borings were installed in June 2006; another four were installed in late August 2006 to gather more information about the characteristics of the ZVI PRB. As discussed below, four of the borings were converted into MWs to monitor the groundwater quality within the ZVI PRB. The confirmation borings are shown on Figures 3a and 3b. The MWs are shown on Figure 1.

As listed in Table 6, the borings were installed at a range of radial distances to assess vertical and horizontal iron distribution. The soil cores were collected in continuous sampling mode from ground surface to the completion depth. The core samples were collected in plastic tube bags at the end of the core barrel subsequent to drilling each 10- to 20-foot length. Except for the 0 to 6 feet bgs interval, each confirmation boring was advanced in 10-foot increments down to 86 feet bgs. Because there may have been some sample loss from CB-1's 66 to 76 feet bgs interval, which terminated in the middle of the coarse and unconsolidated reactive zone, the last interval of confirmation borings (CB) CB-2, CB-3, CB-4, and CB-5 was increased to 20 feet after no iron was observed in CB-1. The clay at the bottom of the 20-foot soil cores likely helped with sample recoverability. The last intervals of CB-6 to CB-9 varied from 10 to 15 feet; sample recovery was good. The soil cuttings from the bottoms of the confirmation borings were archived.

The core samples were cut open and examined for geological characteristics immediately after they were placed in the plastic tube bags. Lithologic descriptions of unconsolidated materials found in the boreholes were recorded in accordance with the 1990 ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Confirmation boring logs are included in Attachment A. The estimated elevation of the top of the uppermost clay layer in the Jackson Formation/Upper Claiborne Unit is shown on Figures 3a and 3b. A cross section along the ZVI PRB is shown on Figure 3c.

As summarized in Table 6, soil cores with visual evidence of iron were sampled and analyzed with the magnetic separation test. During the June sampling event, tests were performed on samples from CB-2, CB-3, and CB-4; no iron was observed in borings 1 and 5. During the August sampling event, a magnetic separation test was conducted on a sample from CB-9. The results are discussed in Section 4.

3.1 Monitoring Well Installation in ZVI PRB

As discussed above, MW-194, MW-195, MW-196, and MW-196B were installed in CB-5 (ZVI PRB Column 3), CB-4 (8), CB-3 (11), and CB-7 (13), respectively. The 2-inch diameter PVC MWs were installed in accordance with the Work Plan; well construction details are included in Attachment A. The MW screen bottoms were positioned at the fluvial sand and clay interface. The MWs were completed with 3 by 3-foot flush-mount concrete wellhead protection pads. The MWs installed in the ZVI PRB were developed as described in Section 2.2.

3.2 Borehole Abandonment

CB-1, CB-2, CB-6, CB-8, and CB-9 were abandoned by first placing clean sand in the borehole from the bottom to approximately 45 to 50 feet bgs. A 2- to 5-foot thick bentonite

seal was placed on top of the sand. Cement grout was then placed from the bentonite seal up to approximately 10 to 20 feet bgs during the first round of grouting. The grout was pumped through a side-discharge tremie pipe with the downhole end of the pipe at the top of the bentonite seal. As the grout was forced through the pipe, the tremie pipe was lifted while the downhole end was kept below the surface of the grout. The grout seal was Type II Portland cement with not more than 4 percent bentonite. The grout was a mix of 94 pounds of cement, no more than 4 pounds of sodium bentonite powder, and no more than 8 gallons of potable water. The grout was verified to have a specific density of greater than 9.4 pounds per gallon.

4.0 ZVI PRB Column Characteristics

The final ZVI PRB configuration is shown on Figures 1 to 4. The ZVI column characteristics are detailed on Table 4 and summarized below.

Element	Design	Field Results						Assessment Method
		Minimum		Maximum		Average		
Length (ft)	55	55	(0)	55	(0)	55	(0)	Survey
Column bottom (ft bgs)	78	77.4	(-0.8)	78.7	(0.9)	78.0	(0)	Measured during drilling
Column top (ft bgs)	70	69.2	(-1.1)	70.5	(0.7)	69.8	(-0.3)	Measured during drilling
Column diameter (ft)	6	5.5	(-8.3)	6.4	(6.7)	5.8	(-3.3)	Calculated based on the column height and column volume.
Column volume (ft ³)	226	197	(-13)	260	(15)	220	(-2.7)	Based on number of concrete pump stroke counts until iron was observed.
Iron % (by volume)	26.5*	15.3	(-42)	44.0	(66)	32.7	(23)	Based on MST results.
		23.1	(-13)	30.4	(15)	27.5	(3.8)	Based on 4.5 tons per column and calculated dimensions.

Notes:

*Based on 4.5 tons (or 3 supersacks) of ZVI per 8-foot tall, 6-foot diameter column.

MST = magnetic separation test

Number in parentheses denotes percentage difference from design value.

Based on field measurements and subsequent calculations, the column dimensions (top and bottom elevations, volume, and diameter) appear to be reasonably consistent with the design values presented in the Work Plan. However, the percentage of iron in each of the columns appears to vary considerably. This assessment is based on the magnetic separation test results from the reactive media as it was injected into the jetted columns (see Table 4) and the nine confirmation borings (see Table 6).

The pattern presented on Figure 5 suggests that the variation in iron percentage over the entire column is strongly related to the mixing operation. The iron percentage (by mass) in the reactive media mix gradually increased from about 20 percent on the first column (Column 2) to nearly 55 percent in the seventh column (Column 9). HBI gradually increased the iron to sand ratio to achieve the design objective and use all of the ZVI. The iron

percentage in the final eight columns generally fluctuated around the 40 to 45 percent range by mass (about 32 to 37 percent by volume) as HBI tried to maintain a consistent iron-to-sand ratio. The fluctuation suggests influence from the gate height as well as the rate that the supersacks were emptied into the hopper.

While the aggregate iron percentage in each column (based on the confirmation boring magnetic separation tests) was generally consistent with the results during construction (based on the pre-injected reactive media magnetic separation tests), there was considerably iron percentage inconsistency within specific columns. Table 6 shows the variation within each column. Possible explanations for the variations are listed below and detailed in Table 7.

- Incomplete formation sediments removal during jetting process
- Sidewall sloughing
- Iron/sand segregation
- Fingering on column perimeter

Suggested remedies for a possible full-scale application are also provided in Table 7.

Another construction consideration is the variable clay surface that was encountered in the ZVI PRB study area. Based on the soil borings advanced during the RDI (SB-1 to SB-4) (CH2M HILL, 2006b), the clay surface was thought to have a relatively uniform elevation in the study area. As such, the pilot-scale ZVI PRB was installed to a specific elevation (78 ft bgs). However, following the installation of new monitoring wells and confirmation borings within the production columns, the data indicated that the clay surface in the study area is considerably more variable than originally envisioned. As shown in Figure 3c, there are portions of the ZVI PRB that are keyed several feet into the clay (northern columns) and above the top of the clay (southern columns).

The variable confining unit makes it challenging for a barrier system to uniformly intercept the CVOC plume without a significant pre-implementation assessment of the lithology along the system alignment. For a full-scale application, a highly variable clay surface and an elevation-guided installation method as used during the pilot test could result in ZVI/sand columns that are either above or below the top of clay (that is, the ZVI is not where it should be). This could create the potential for the groundwater plume to pass over or under ZVI PRB and may result in wasted iron (iron placed below the top of clay). Potential solutions include improving drilling techniques so that the top of clay is consistently identified during the installation process, using geophysics to delineate top of clay and/or a series of tightly-spaced lithologic borings to delineate top of clay before construction.

5.0 Groundwater Monitoring and Post-Installation Slug Testing

5.1 Groundwater Monitoring Methods

As summarized below, baseline and ZVI PRB effectiveness monitoring samples were collected from 10 new and 7 existing Off-Depot MWs.

Location	No.	Baseline	Monthly ZVI PRB Effectiveness Monitoring
New Off-Depot (before ZVI PRB installation)	5	MW-189 to MW-193	MW-189 through MW-193
New Off-Depot (after ZVI PRB installation)	1	None	MW-196C
New Off-Depot (in PRB) (after ZVI PRB installation)	4	None	MW-194, MW-195, MW-196, MW-196B
Existing Off-Depot	7	MW-54, MW-77, MW-144, MW-150, MW-161, MW-162, MW-163	MW-54, MW-77, MW-144, MW-150, MW-161, MW-162, MW-163
Total	17		

Groundwater levels were measured in MWs prior to and during each sampling event. Before sampling, each well was purged using a low-flow bladder pump to minimize both agitation of the groundwater and sample turbidity. The intent of the low-flow procedure is to remove stagnant water from the well and introduce fresh groundwater into the well at a rate that does not produce significant drawdown of the water level in the well being sampled.

During purging, water level and quality, including pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, conductivity and turbidity were monitored and recorded. Purging continued until field measurements stabilized for at least 30 minutes. Turbidity measurements were also collected with a goal of attaining 10 nephelometric turbidity units (NTU). However, the turbidity standard was not met in all cases prior to sampling. Samples were then collected using the same low flow technique and submitted to the laboratory for volatile organics analysis.

Tables 8 and 9 summarize the water levels and the field and analytic results for the baseline and monthly effectiveness monitoring events. As discussed above, the data suggest a slight rise in the groundwater table in both upgradient and downgradient MWs during construction with a gradual decrease to pre-construction conditions following completion of the field effort (see groundwater elevation graphs provided in Attachment F). The baseline and 4th effective monitoring event potentiometric surfaces are shown in Figures 4a and 4b, respectively. The 4th effective monitoring event data are considered representative of the post-construction potentiometric surface.

5.2 Groundwater Monitoring Results

Baseline and monthly effectiveness groundwater monitoring results are presented in Table 9. Several additional presentation methods are used to illustrate the impact of the ZVI PRB on groundwater quality.

- Table 10 presents the difference in TCE and 1,1,2,2-PCA concentrations between the baseline and 5th and 6th effectiveness monitoring events on a percentage basis.
- A series of graphs showing the concentration changes over time are presented in Attachment F.
- Figures 6a to 6e show TCE and 1,1,2,2-PCA concentrations in groundwater as a function of distance from the ZVI PRB via five likely groundwater flow pathways. Figure 7 shows the selected groundwater flow pathways.

- Figure 8 compares the April (Baseline), September/October (5th event), and December (6th and final event) TCE and 1,1,2,2-PCA concentrations in groundwater using isoconcentration maps.

5.2.1 September/October 2006 Results

The data through the 5th effectiveness monitoring event suggested improving groundwater quality on the downgradient side of the ZVI PRB. The data indicated a pattern of increasing concentrations upgradient (MW-77, MW-161, MW-189, and MW-190) and far downgradient (MW-54 and MW-150) of the ZVI PRB and decreasing concentrations just downgradient (MW-144, MW-163, and MW-191 to MW-193). MW-195, which is within the ZVI PRB, had volatile organic compound (VOC) concentrations below remedial goals.

The effectiveness monitoring data following the 5th event also indicated that groundwater quality was improving faster on the southern half of the area downgradient of the ZVI PRB (represented by MW-191, MW-144, MW-163, and MW-196C, which is in the middle). The uneven groundwater quality improvement may be attributed to the local groundwater flow pattern, which seems to be strongly influenced by the highly variable top of clay surface (Figures 3a, 3b, and 3c). The post-construction potentiometric surface (Figures 4b and 4c) indicates a preferential flow pathway through the southern and middle of the ZVI PRB. This is likely due to the clay channel in the same area and a clay surface high around MW-196, which diverts groundwater north and south. The clay surface high, which extends above the water table, is essentially creating a “no-to-low treatment” shadow over the northern downgradient MWs (MW-192 and MW-193).

5.2.2 December 2006 Results

The effectiveness of the ZVI PRB on downgradient water quality was less apparent following the last monitoring event in December 2006. Although the results at MW-195, which is within the ZVI PRB, were positive (more than 99 percent TCE and 1,1,2,2-PCA removal rate compared with influent concentrations at MW-161, MW-189, and MW-190), TCE and 1,1,2,2-PCA concentrations at MW-191 and MW-196C, which are just downgradient of the ZVI PRB, increased from the previous monitoring event. TCE and 1,1,2,2-PCA concentrations at MW-192, the third monitoring well downgradient of the ZVI PRB, decreased just slightly.

Interestingly, the groundwater elevations measured December 2006 monitoring event were approximately 0.5 foot lower than the previous event (September/October 2006) and nearly 1 foot lower than the first post-installation monitoring event in June 2006. The combination of the decreasing saturated thickness and the gap between the bottom of the ZVI PRB and the confining clay layer is likely preventing the system from completely treating the CVOC plume. In other words, the results from the September/October 2006 event had improved over the results from the last event because more of the groundwater was flowing through the ZVI PRB.

Finally, where most of the flow appears to be going through the ZVI PRB (for example, the MW-195 area), the results are encouraging, despite the potential of having an insufficient percentage of ZVI because of high groundwater velocities (see Section 2.3), based on laboratory results (EnviroMetal Technologies, Inc. [ETI], 2006) (see Attachment F).

5.3 Post-Hydraulic Conductivity Testing

As a comparison to pre-construction slug test results, slug tests were repeated in the following MWs in June 2006: MW-76, MW-144, MW-161 to MW-164, and MW-189 to MW-193. Slug tests were also conducted in MW-194 and MW-195, which were installed within the ZVI PRB. Pre- and post-construction slug testing results are summarized in Table 2; analysis details, including water level data versus time and the simulation outputs, are provided in Attachment B.

Overall, the post-construction slug testing results suggest decreases in permeability in the surrounding MWs. Although the geometric mean of the formation hydraulic conductivities before and after installation indicate a 40 percent decrease in permeability based on the slug test results, the data from the MWs closest to the ZVI PRB show the least significant change (see Table 2). At this time, it is difficult to ascertain what caused the decrease and whether it has long-term implications on ZVI PRB treatment effectiveness. Possible explanations include the following:

- Formation material compression/impact from jetting.
- Migration of iron fines.
- Migration of guar and subsequent increase in biomass in formation.
- Field method and data interpretation variation
- Changes are within typical slug test result variations.

Nevertheless, the water level and geochemical data do not suggest that groundwater is flowing around the ZVI PRB.

It is also important to note that the hydraulic conductivity of the ZVI column material (based on slug testing) appears to be lower than the values from the formation MWs. As indicated in Table 2, the average post-construction formation hydraulic conductivity was about 4 times higher than the ZVI PRB values (based on the June 2006 results only). The ZVI PRB values from the slug tests are also (much) lower than the laboratory permeability testing conducted on the pre-injection reactive media, which indicated a hydraulic conductivity of 283 feet per day. Because the slug tests were conducted about 2 weeks after construction, there may not have been enough time for the guar to dissipate. Also, though slug tests generally provide good order-of-magnitude estimates of hydraulic conductivity, the results are susceptible to well construction and development limitations. Incompletely developed wells may have a residual skin effect that may result in an underestimation of hydraulic conductivity.

Given that the sand used to form the ZVI PRB columns is similar to the fluvial sands and the iron, on its own, has a higher permeability than the fluvial sands, the ZVI PRB is likely as permeable, if not slightly more so, than the surrounding formation. Additional slug testing could be conducted to assess whether the ZVI PRB columns are now similar to, or more permeable than, the formation.

6.0 Summary and Conclusions

As part of the ZVI PRB design effort, a pilot-scale ZVI PRB was installed between MW-144 and MW-161 using the jet grouting or “jetting” technique to effectively evaluate its

implementability and cost-effectiveness. Key findings that could impact the expected effectiveness and cost of a full-scale ZVI PRB include the following:

- **Highly variable clay surface.** The top of the clay surface is highly variable, which could result in iron/sand columns that are either above or below the top of clay. As demonstrated by the pilot-scale ZVI PRB, consequences include the potential for the CVOC plume to pass over or under the full-scale ZVI PRB or that iron installed below the top of clay is essentially wasted. Despite the variable clay surface in the study area and the elevation-guided installation method, the groundwater monitoring results suggests that the pilot-scale ZVI PRB is effectively treating a portion of the CVOC plume.
- **High groundwater velocities.** Aquifer testing conducted as part of the study indicated much higher groundwater velocities than previously understood (up to 6 ft/d versus the previously approximation of 1 ft/d). Based on the previously conducted column studies (ETI, 2006), these new groundwater velocities could require a ZVI PRB with iron thicknesses up to 6 feet (see Attachment F). However, the CVOC concentrations at MW-195 suggest that 5 to 6 feet may not be necessary to treat the core of the plume.
- **Similarity of reactive media and formation material permeabilities.** Because the permeability of the reactive media is **not** significantly higher than that of the fluvial sands, it is possible that the groundwater could flow around or above the full-scale ZVI PRB.
- **Construction challenges.** Although seemingly a sounder installation approach than that used for previously jetted ZVI PRBs, the Memphis Depot method likely requires some modifications to address incomplete formation sediments removal during jetting process and the impact of sidewall sloughing and variable column diameter on overall system effectiveness. Possible solutions are provided in Table 7. Top of clay tagging would also have to be improved.
- **Inconsistent iron concentrations in the columns.** As discussed above, the percentage of iron from column to column and within each column was highly variable. At least partially, this can be attributed to the construction challenges in the previous bullet and the way the iron was handled on the surface. After 6 months of effectiveness monitoring, it is difficult to assess the impact of the variation on the long-term-effectiveness:
 - *Is complete uniformity required?*
 - *Can iron distribution be improved with better iron management and the modifications described in Table 7?*
 - *Are the magnetic separation tests and overall quality assurance methods reliable or indicative of the integrity of the ZVI PRB?*
- **Waste handling.** Waste management is a significant part of a jetted ZVI PRB installation. An efficient waste management method would be required before this method were implemented as a full-scale remedy.
- **Supplement technologies would be required.** Although an effective ZVI PRB offers plume containment, it does not address the plume that is already downgradient of the proposed full-scale ZVI PRB location or help to accelerate plume attenuation on the upgradient side. As such, multiple injection wells were proposed in the 60% Off-Depot RD to address elevated CVOC concentrations downgradient of the full-scale ZVI PRB location.

The results of the ZVI PRB implementation study suggest that the installation of an effective full-scale system would be challenging. Although decreasing CVOC concentrations across the ZVI PRB suggest that the pilot-scale system is treating groundwater in portions of the pilot study area, the formation of a uniform CVOC barrier has not been achieved.

Though installation modifications could be implemented to improve iron distribution uniformity, minimize formation materials inclusion, and adjust to the top of the considerably variable clay surface, other alternatives will be considered in the *Memphis Depot Off-Depot Groundwater Intermediate Remedial Design* to address the Off-Depot CVOC plume.

Based on the hydrogeologic and CVOC data collected since the ROD was signed and the challenges associated with the installation of a cost-effective, full-scale ZVI PRB, enhanced bioremediation through injection of a carbon donor substrate is considered a more appropriate remedy for the Off-Depot CVOC plume by the Memphis Depot Base Realignment and Closure Act (BRAC) Cleanup Team (BCT). Enhanced bioremediation is presently being implemented on the Main Installation and the facilities and equipment could be used for the Off-Depot RA. Enhanced bioremediation offers implementation flexibility in that the treatment area can be adjusted to address changes in plume geometry. Finally, the use of multiple rows or transects of injection wells along the CVOC plume and perpendicular to groundwater flow would be a more aggressive approach than a single ZVI PRB for meeting Dunn Field remediation action objectives (RAOs).

7.0 References

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Figures

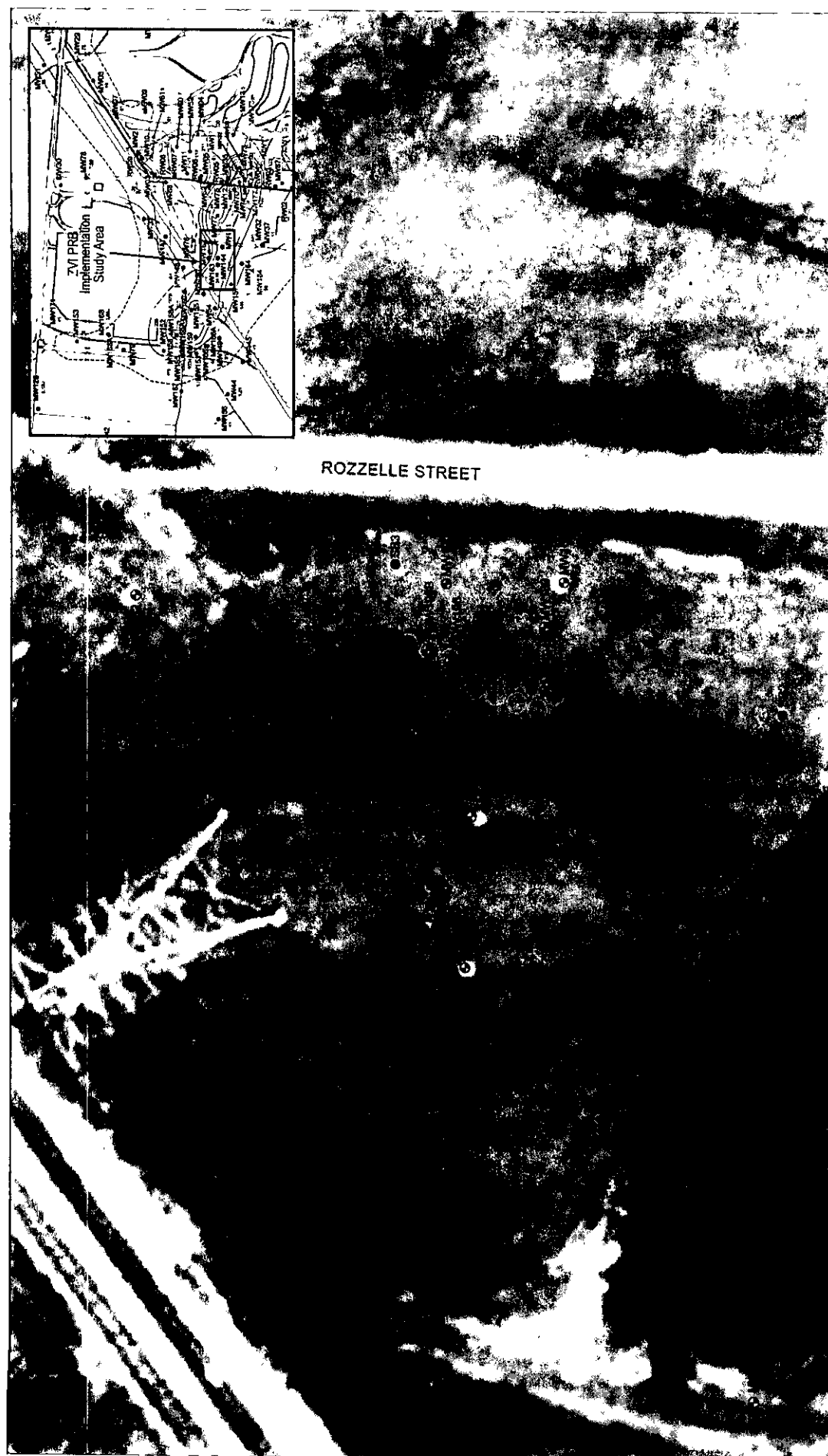


FIGURE 1
ZVI PRB Implementation Study Layout
Memphis Depot Dunn Field

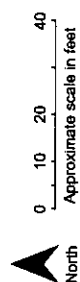
LEGEND

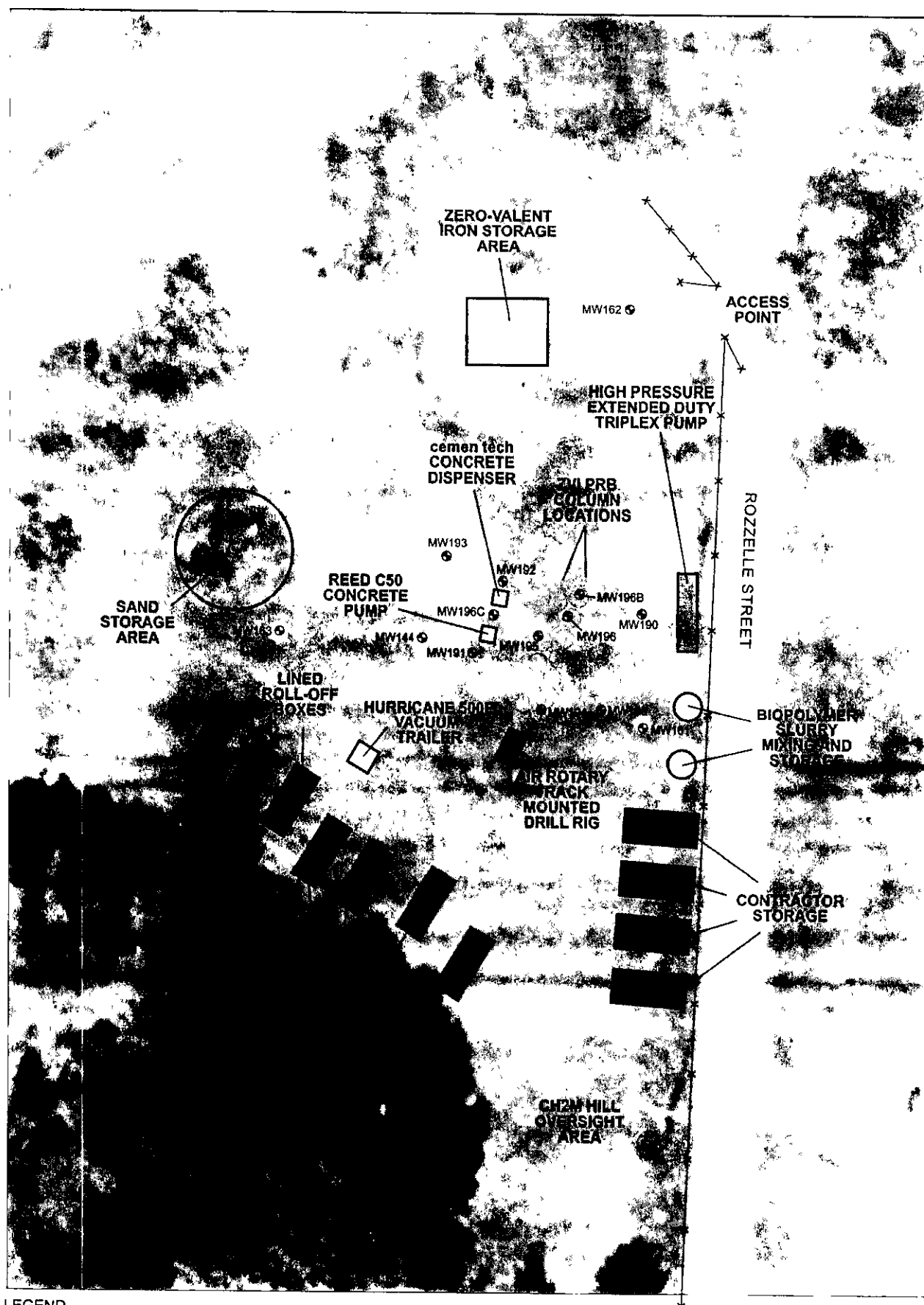
- Soil Boring (SB) (Remedial Design Investigation - October/November 2005)

- Monitoring Well (MW) - Existing

- Monitoring Well (MW) - New

- ZVI PRB Column





LEGEND

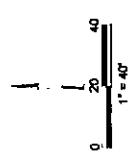
- Monitoring Well (Existing)
- ⊙ Monitoring Well (New)
- ZVI PRB Column



0 10 20 40
Approximate scale in feet

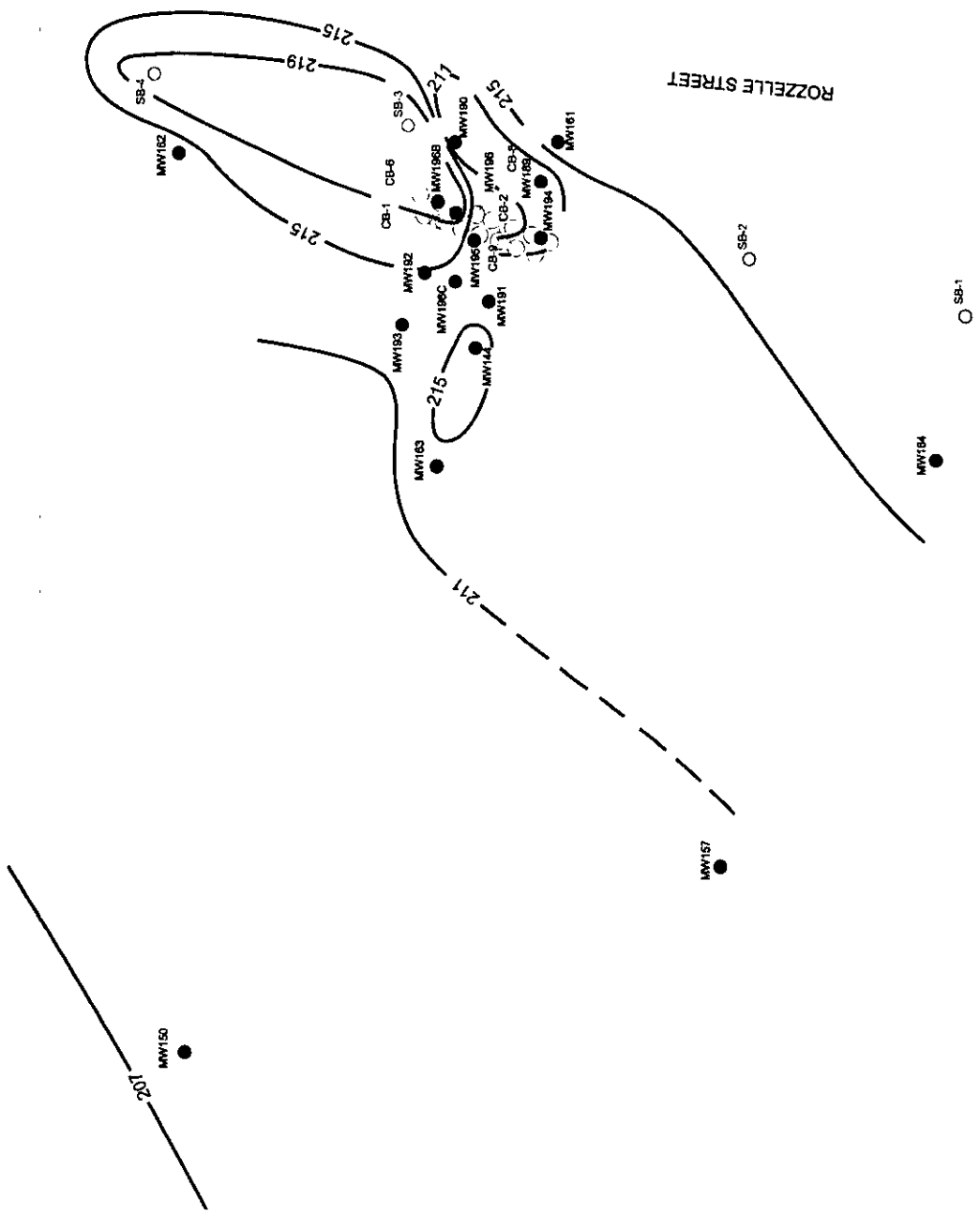
FIGURE 2

General Equipment Layout During ZVI PRB Installation
Memphis Depot Dunn Field



LEGEND

- MW MONITORING WELL SCREENED IN FLUWAL AQUIFER
- SB SOIL BORINGS
- CB CONFIRMATION BORING
- 210' TOP OF CLAY (FT MSL)
- ZVI PIR COLUMN



BORING OR WELL	GROUND ELEVATION	DEPTH TO CLAY	TOP OF CASING ELEVATION
CB-1	294.76	75	219.76
CB-2	293.46	78	215.46
CB-6	295.15	76	219.15
CB-8	294.49	82	212.49
CB-9	293.53	84	209.53
SB-1	289.00	69	220.00
SB-2	290.23	73	217.23
SB-3	294.77	75	219.77
SB-4	299.89	80	219.89
MW-76	303.30	89.5	213.80
MW-77	304.70	87	217.70
MW-144	291.89	76	215.89
MW-150	297.15	90	207.15
MW-157	286.83	76	210.83
MW-161	296.67	80	216.70
MW-162	299.89	86	213.90
MW-163	290.81	76	214.80
MW-164	287.70	72	215.70
MW-189	296.36	87	209.36
MW-190	297.32	88	209.32
MW-191	291.67	77	214.67
MW-192	293.10	78	215.10
MW-193	293.28	81	212.28
MW-194 (CB-5)	293.64	84	209.64
MW-195 (CB-4)	294.30	82	212.30
MW-196 (CB-3)	295.30	76	219.30
MW-196B (CB-7)	295.32	77	218.32
MW-196C	292.90	79	213.90

FIGURE 3A
Estimated Top of Uppermost Clay
in the Jackson Formation/Upper Calabone Group
Memphis Depositional Field

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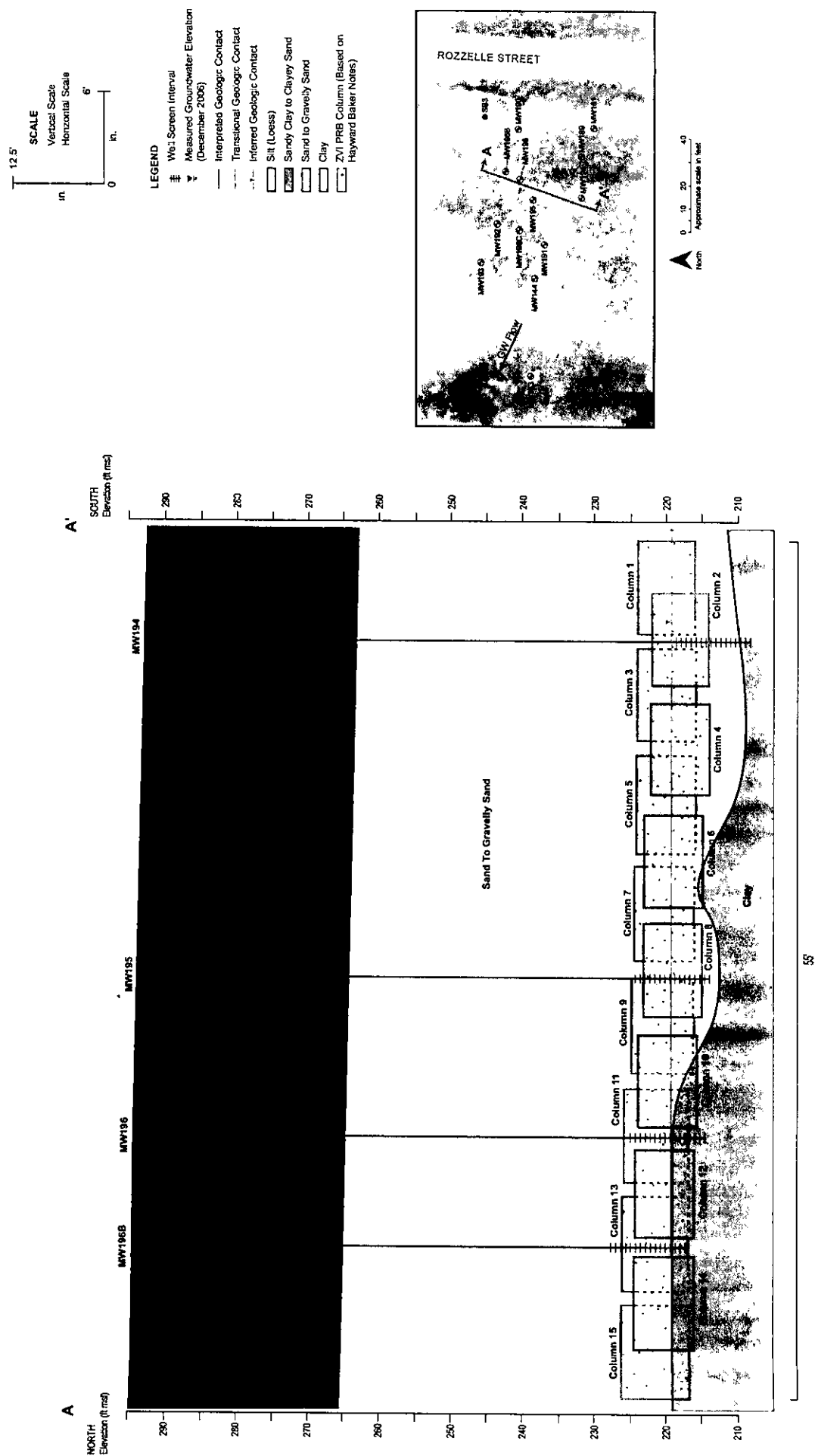


FIGURE 3C
Lithologic Cross-Section Along ZVI PRB Alignment
Memphis Depot Dunn Field ZVI PRB Implementation Study
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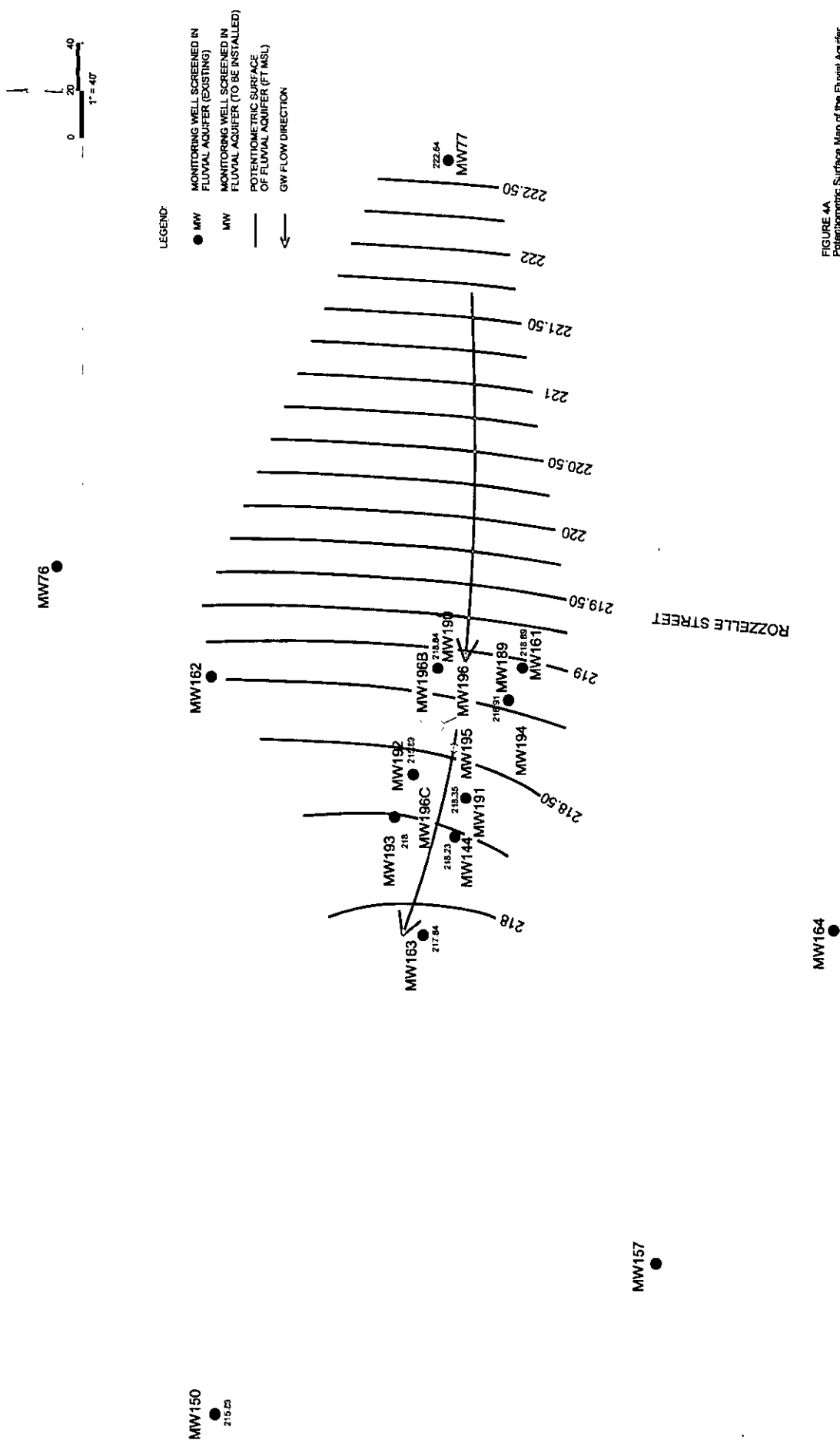
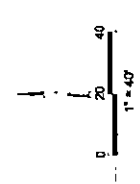


FIGURE 4A
Potentiometric Surface Map of the Fluvial Aquifer
April 2006 (Baseeline Levels)
Version: Export Data File

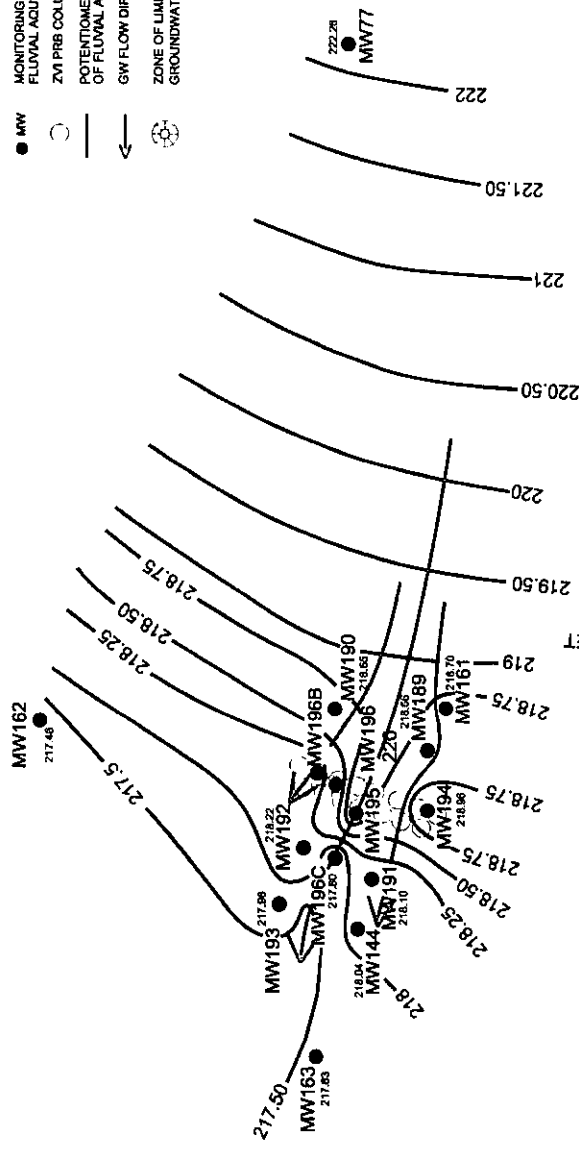
CH2MHILL



- LEGEND:
- MW
 - ZM PRB COLUMN
 - POTENTIOMETRIC SURFACE OF FLUVAL AQUIFER (FT MSL)
 - GW FLOW DIRECTION
 - ⊗ ZONE OF LIMITED TO NO GROUNDWATER FLOW

MW76

MW150
●
215.77



BORING OR WELL	DEPTH TO WATER (ft bgs)	TOP OF CASING ELEVATION
MW-54	79.88'	215.46
MW-77	82.16'	222.26
MW-144	73.95'	218.04
MW-150	81.04'	215.77
MW-161	77.70'	218.70
MW-162	82.22'	217.48
MW-163	73.00'	217.63
MW-169	77.70'	218.66
MW-180	78.67'	218.65
MW-191	73.95'	218.14
MW-192	74.66'	218.22
MW-194	75.32'	217.96
MW-195	74.30'	218.96
MW-196	75.10'	218.79
MW-198B	DRY	N/A
MW-198C	78.70'	218.13
MW-199C	75.10'	217.80

MW157
●

MW164
●

FIGURE 4B
Potentiometric Surface Map of the Fluvial Aquifer
August/September 2006 4th Effectiveness Monitoring Event
Memphis Depot Dam Field

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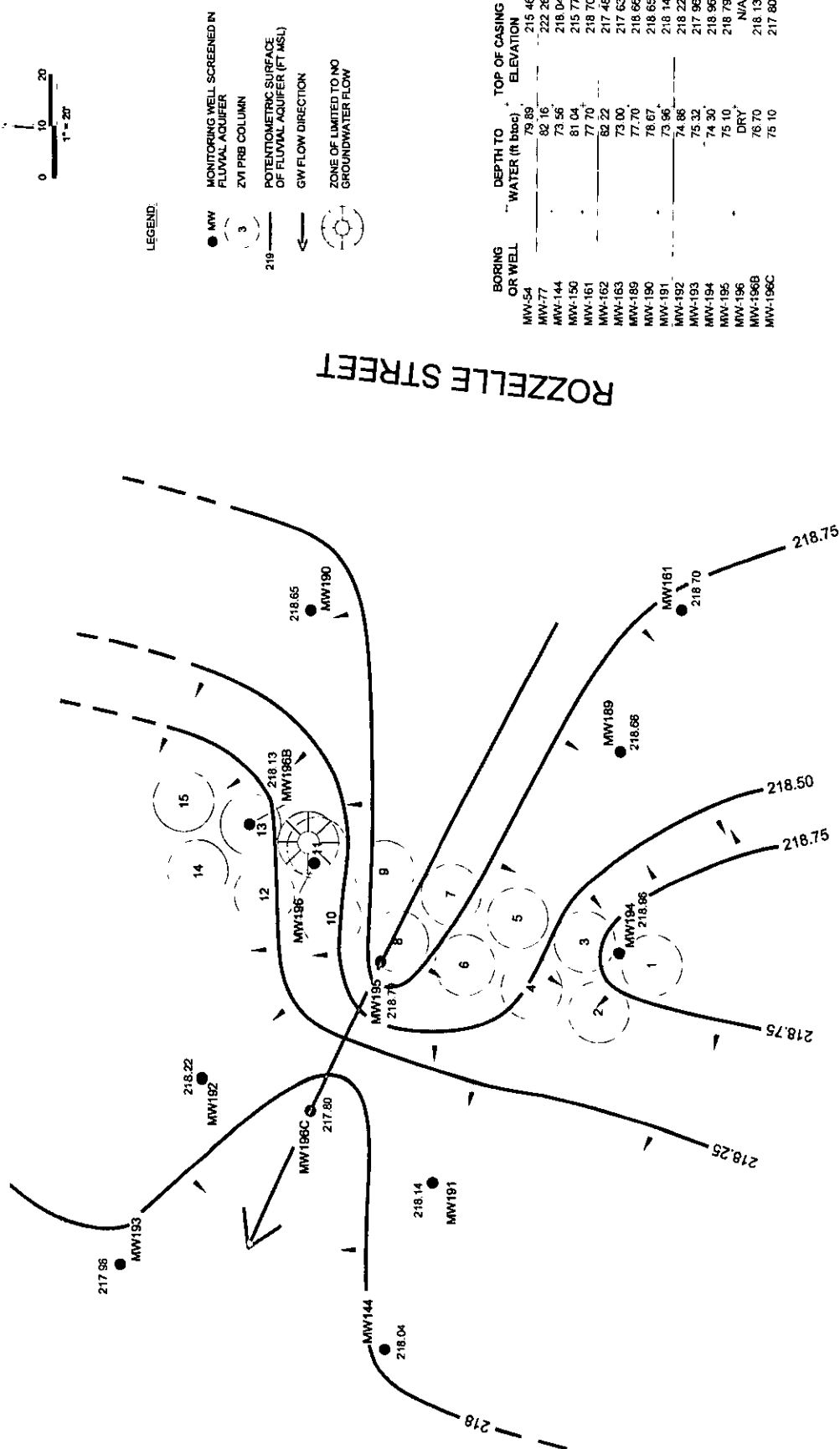


FIGURE 4C
Potentiometric Surface Map of the Fluvial Aquifer
August/September 2006 4th Effectiveness Monitoring Event
Memphis Depot/Dunn Field

ATL/CADI/PROJECTS/148071 DDMT/PRD 2004/GROWATER 07-NOV-2006

Figure 5
Iron Percentage as a Function of Column Construction Sequence

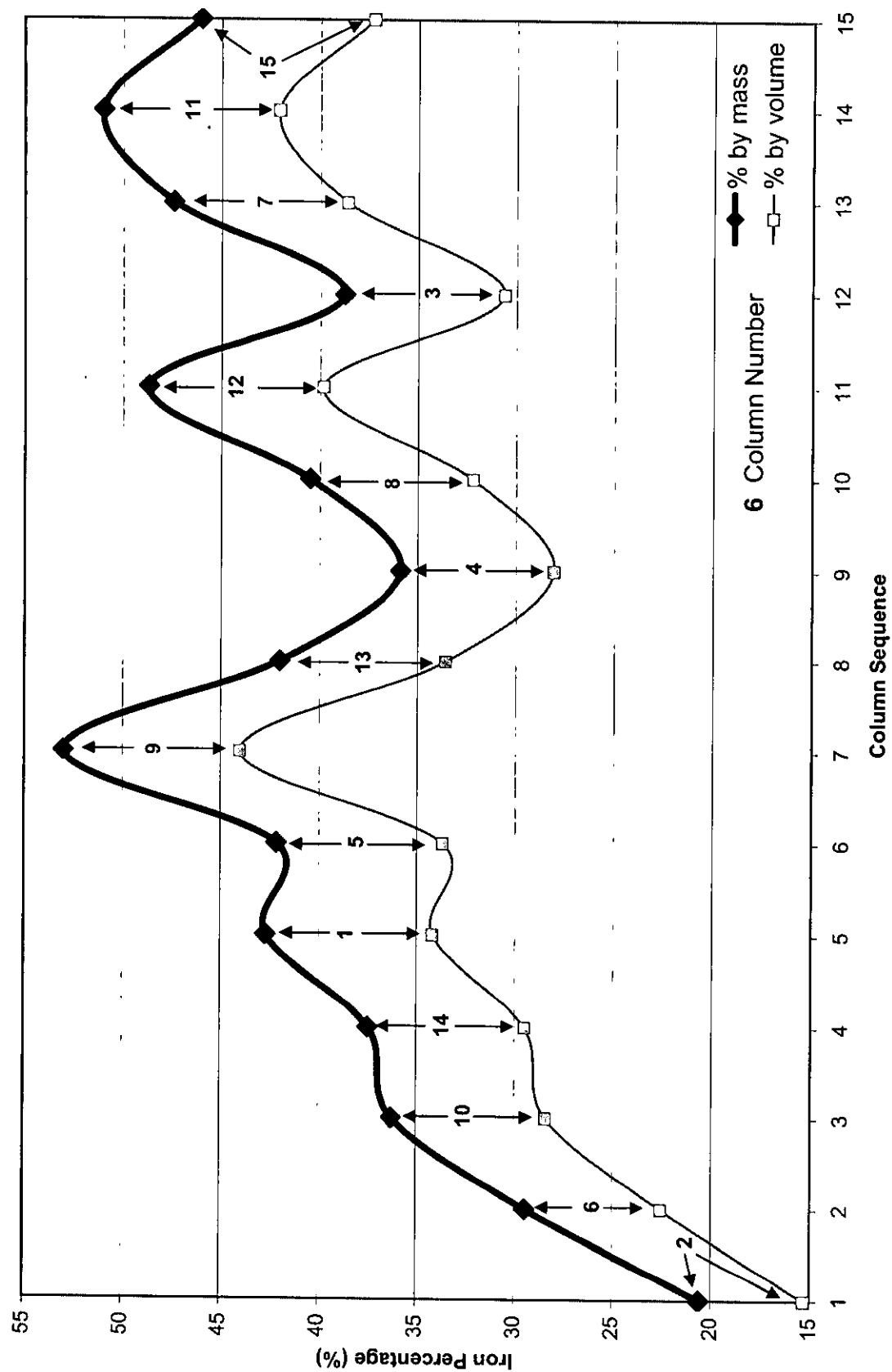


Figure 6B
Path 1B

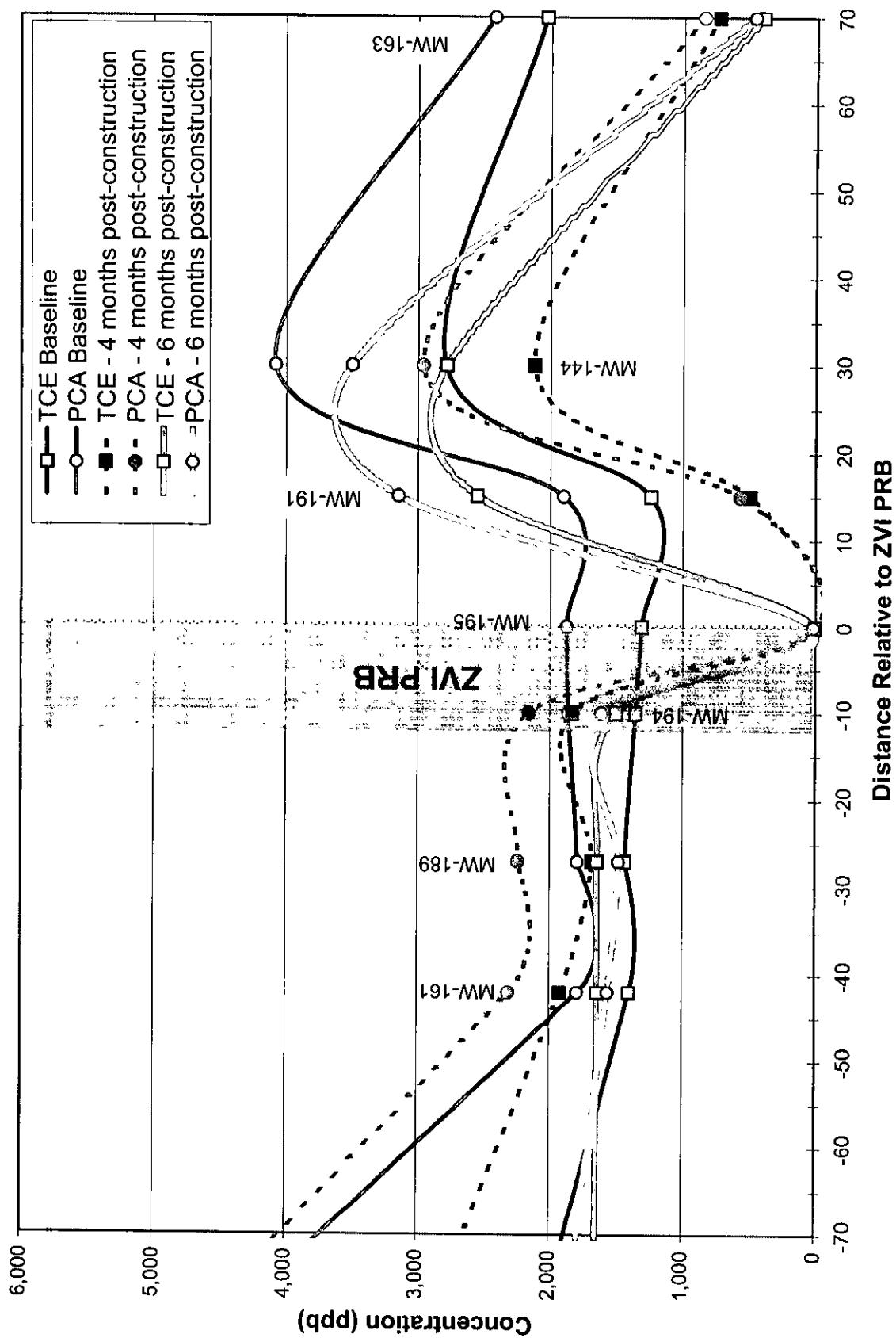


Figure 6D
Path 3A

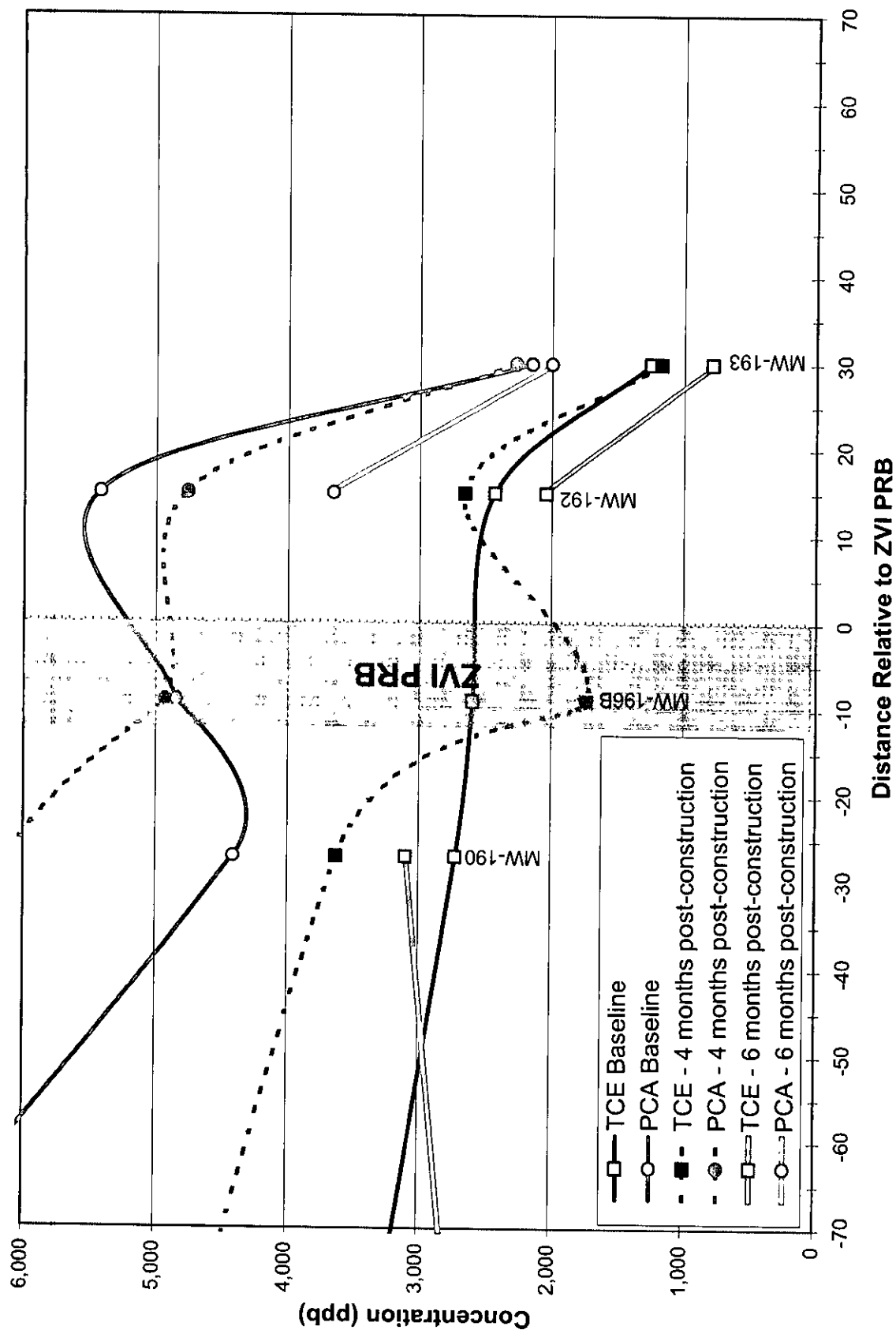
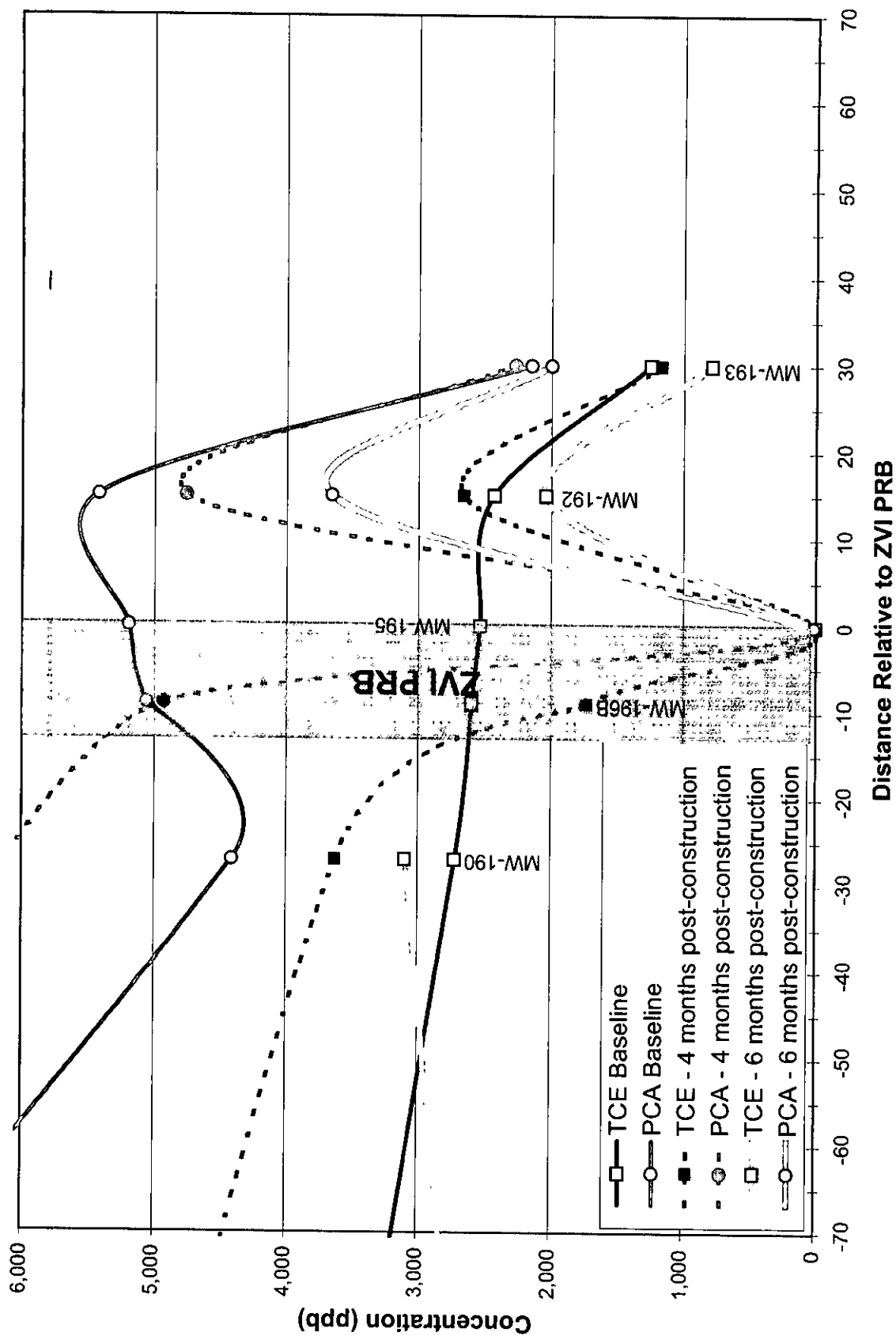
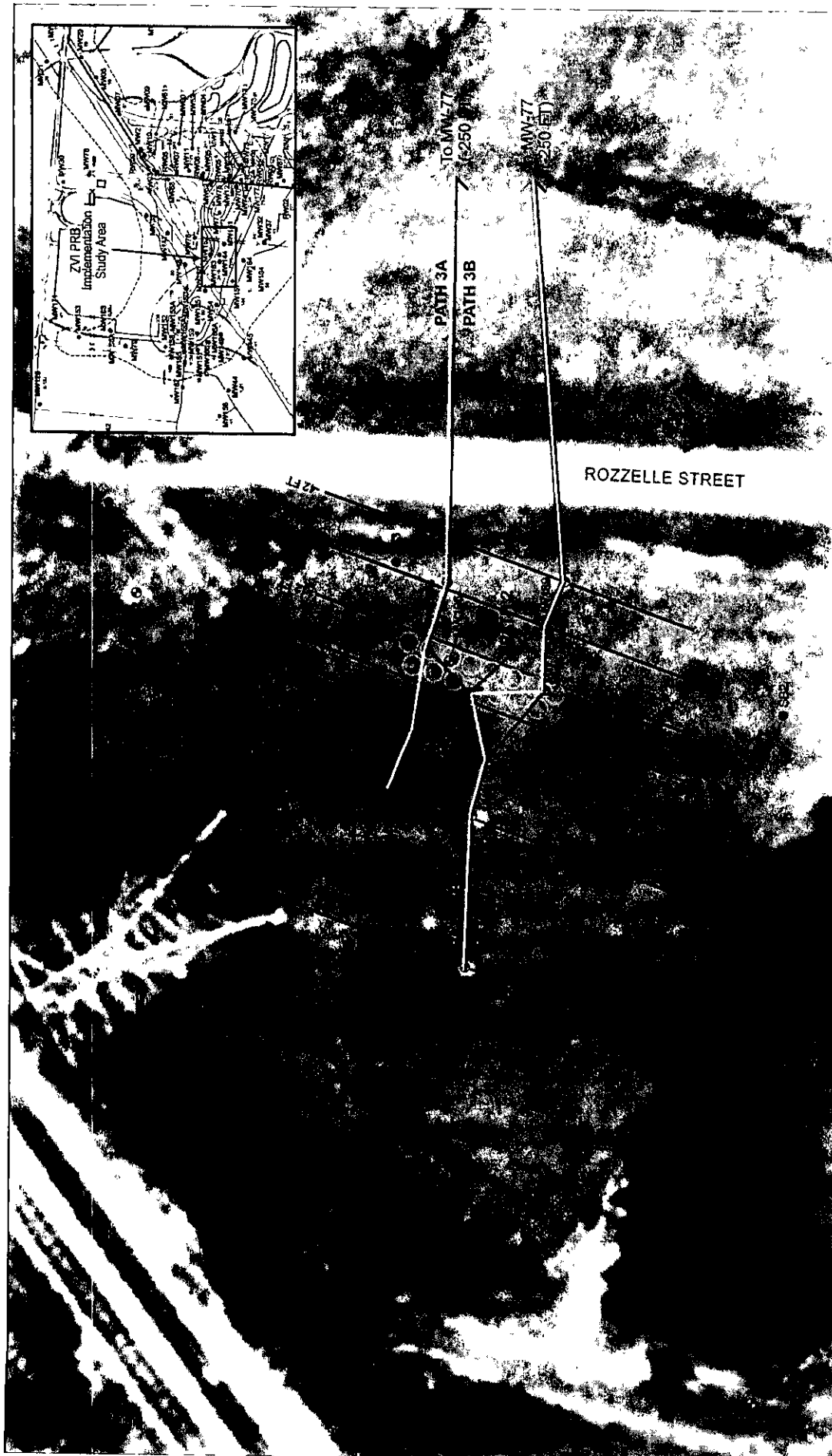


Figure 6E
Path 3B





NOTE
Data shown on Figures 6A to 6E.

North

0 10 20 40
Approximate scale in feet

- LEGEND**
- Soil Boring (SB) (Remedial Design Investigation - October/November 2005)
 - Monitoring Well (MW) - Existing
 - Monitoring Well (MW) - New
 - ZVI PRB Column
 - 15 FT — Distance from Downgradient Edge of ZVI PRB in Direction of Groundwater Flow

FIGURE 7
Groundwater Data vs. Distance Transects
Memphis Depot Dunn Field

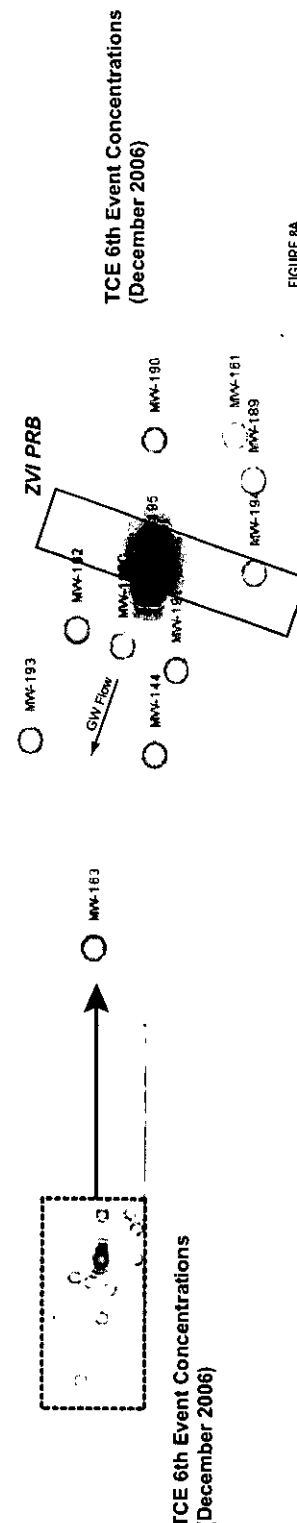
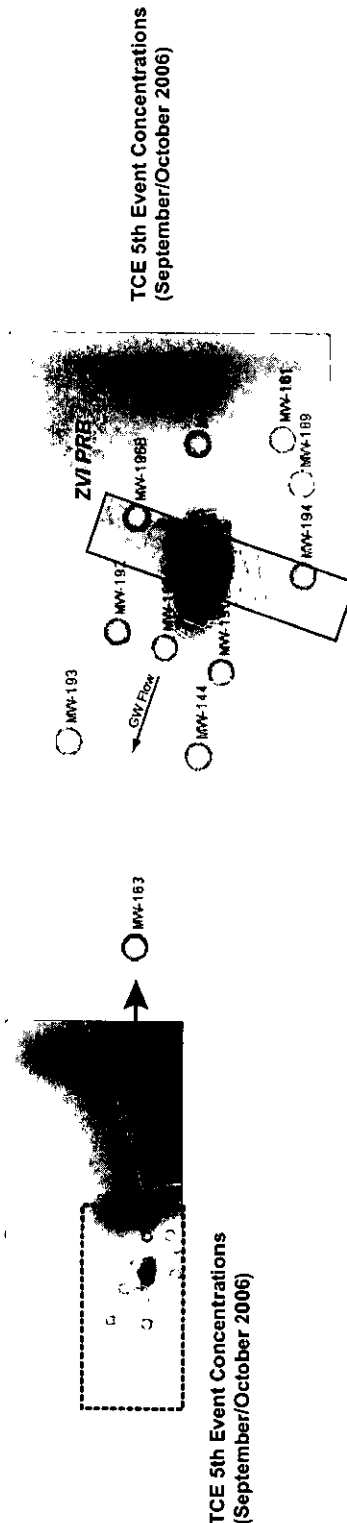
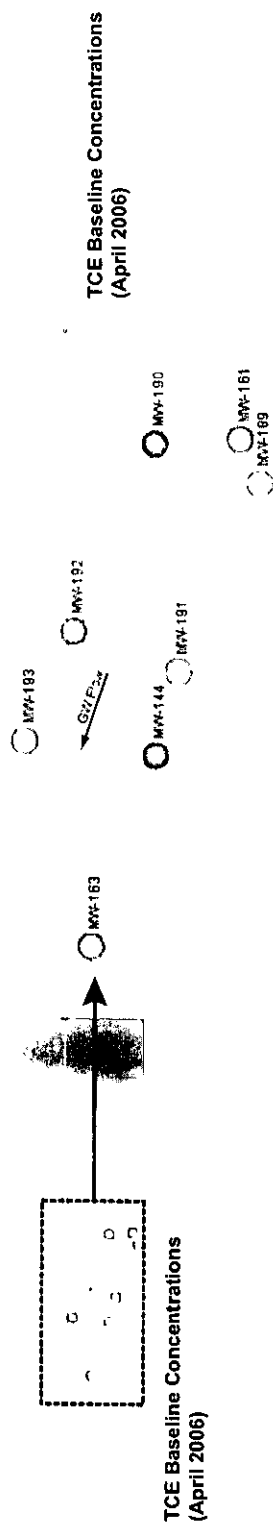
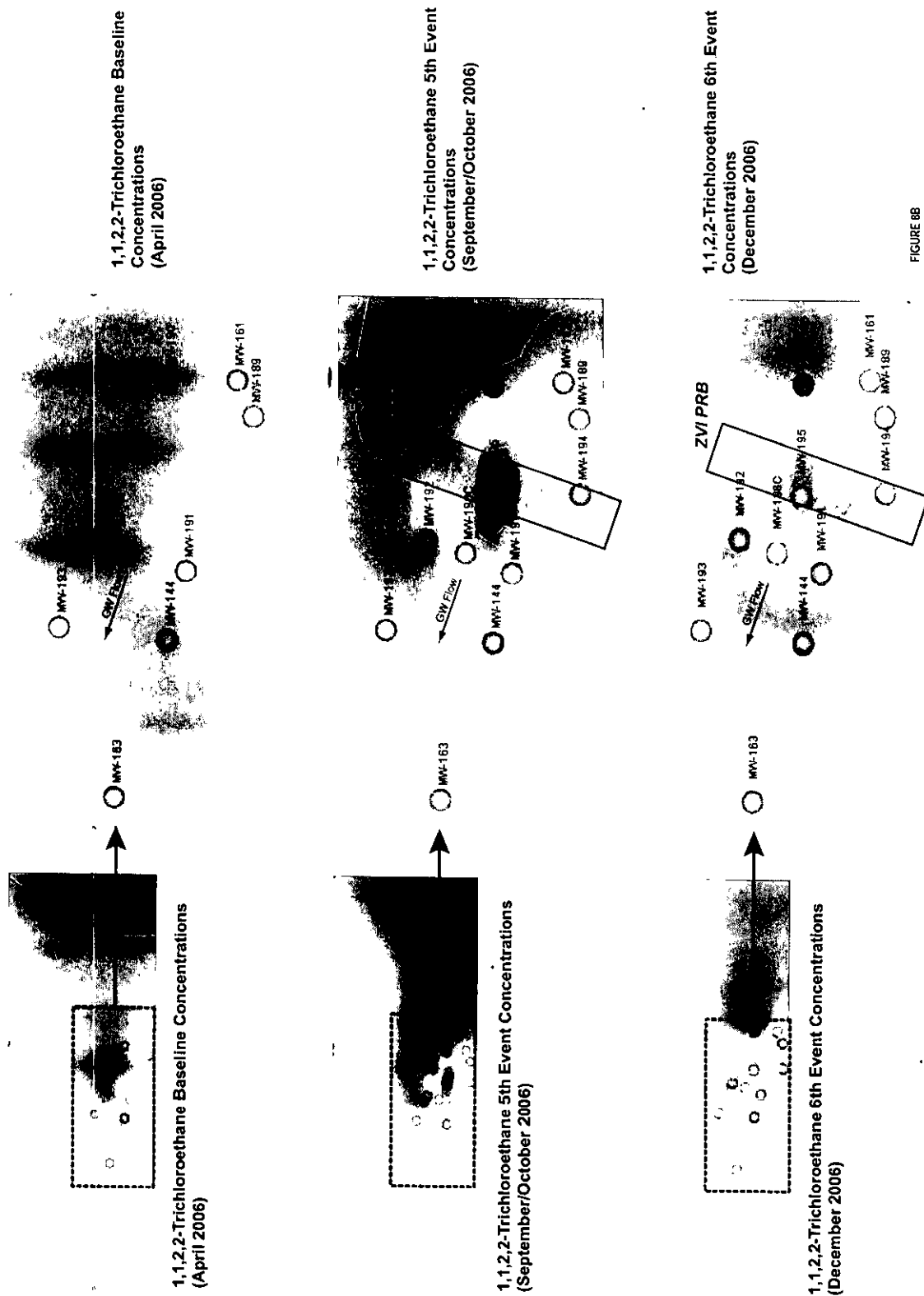


FIGURE 8A
TCE Concentrations in Groundwater
Mariposa Depot Duri Field ZVI PRB Implementation Study
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Tables

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TABLE 1
 New ZVI PRB Effectiveness Monitoring Wells
Memphis Depot Dunn Field ZVI PRB Implementation Study

Well Number	Location	Purpose
MW-189	10 feet upgradient of the pilot-scale ZVI PRB; in-line with MW-161 and MW-144.	Assess upgradient CVOC concentrations and groundwater geochemistry.
MW-190	10 feet upgradient of the pilot-scale ZVI PRB.	
MW-191	10 feet downgradient of the pilot-scale ZVI PRB; in-line with MW-161 and MW-144.	Assess downgradient CVOC concentrations and groundwater geochemistry.
MW-192	10 feet downgradient of the pilot-scale ZVI PRB; other side of the ZVI PRB from MW-191 in the direction of groundwater flow.	
MW-193	30 feet downgradient of the pilot-scale ZVI PRB; other side of the ZVI PRB from MW-191 in the direction of groundwater flow.	Assess downgradient CVOC concentrations and groundwater geochemistry.
MW-194	Installed within the ZVI PRB after the confirmation soil cores were collected.	Assess CVOC concentrations and groundwater geochemistry within the ZVI PRB
MW-195		
MW-196		
MW-196b		
MW-196c	10 feet downgradient of the pilot-scale ZVI PRB; in-line with MW-195.	Assess downgradient CVOC concentrations and groundwater geochemistry.

TABLE 2

Summary of Off-Depot Slug Test Results

Memphis Depot Dunn Field ZVI PRB Implementation Study

Well ID	Location Relative to Pilot-Scale ZVI PRB	Test Date	Penetration ¹	Well Screen within the saturated zone (L, ft) ²	Saturated Thickness (D, ft) ³	K (cm/s)	K (ft/day)	% Change	GW Velocity (ft/d)
MW-31	500 feet sidegradient	Aug. 2004	Fully	10.2	10.18	3.5E-02	97.8		
MW-44	900 feet downgradient	Aug. 2004	Partially	10.0	20.26	4.2E-03	12.0		
MW-54	400 feet downgradient	Aug. 2004	Partially	15.0	17.26	4.0E-03	11.4		
MW-76	200 feet sidegradient	Aug. 2004	Fully	20.0	9.63	7.8E-03	22.1		
MW-76	200 feet sidegradient	June 2006	Fully	20.0	9.60	1.7E-02	48.2	118%	
MW-77	250 feet upgradient	June 2006	Fully	20.0	7.27	1.2E-03	3.3		
MW-79 (Test1)	1,000 feet downgradient	Aug. 2004	Partially	20.0	32.36	3.7E-03	10.3		
MW-79 (Test2)	1,000 feet downgradient	Aug. 2004	Partially	20.0	32.36	1.1E-03	3.2		
MW-144*	30 feet downgradient	Aug. 2004	Fully	20.0	2.71	4.3E-02	121.9		
MW-144	30 feet downgradient	June 2006	Fully	20.0	3.05	2.3E-02	65.1	-47%	
MW-145 (Test1)	700 feet sidegradient	Aug. 2004	Partially	20.0	38.72	2.7E-03	7.5		
MW-145 (Test2)	700 feet sidegradient	Aug. 2004	Partially	20.0	38.72	5.2E-03	14.6		
MW-147	350 feet sidegradient	Aug. 2004	Fully	8.9	8.85	4.4E-02	123.9		
MW-148	250 feet sidegradient	Aug. 2004	Fully	11.5	11.49	1.9E-02	54.7		
MW-149	600 feet downgradient	Aug. 2004	Partially	20.0	30.93	5.3E-03	14.9		
MW-150	300 feet downgradient	Aug. 2004	Fully	10.6	10.60	4.5E-02	127.6		
MW-157	225 feet sidegradient	June 2006	Fully	20.0	0.10	2.3E-02	63.9		
MW-161 (Test 1)*	30 feet upgradient	Mar. 2006	Fully	20.0	4.92	4.4E-02	124.7		
MW-161 (Test 2)*	30 feet upgradient	Mar. 2006	Fully	20.0	4.92	5.1E-02	144.6		
MW-161	30 feet upgradient	June 2006	Fully	20.0	4.27	2.4E-02	68.4	-49%	
MW-162*	50 feet sidegradient	Mar. 2006	Fully	20.0	5.13	5.6E-02	158.7		
MW-162	50 feet sidegradient	June 2006	Fully	20.0	5.60	1.6E-02	46.7	-71%	
MW-163*	70 feet downgradient	Mar. 2006	Fully	20.0	3.32	1.4E-02	40.0		
MW-163	70 feet downgradient	June 2006	Fully	20.0	4.19	1.8E-02	50.8	27%	
MW-164*	175 feet downgradient	Mar. 2006	Fully	20.0	2.96	1.4E-02	39.7		
MW-164	175 feet sidegradient	June 2006	Fully	20.0	5.80	6.0E-04	1.7	-96%	
MW-184*	250 feet sidegradient	Mar. 2006	Fully	10.0	3.29	5.4E-03	15.3		
MW-189*	15 feet upgradient	May 2006	Fully	10.0	9.64	1.4E-02	40.1		
MW-189*	15 feet upgradient	June 2006	Fully	10.0	9.67	1.2E-02	34.6	-14%	
MW-190*	15 feet upgradient	May 2006	Fully	10.0	9.64	1.4E-02	40.7		
MW-190*	15 feet downgradient	June 2006	Fully	10.0	9.48	1.3E-02	37.2	-9%	
MW-191*	15 feet downgradient	May 2006	Fully	10.0	3.78				
MW-191*	15 feet downgradient	June 2006	Fully	10.0	3.93	1.9E-02	54.9		
MW-192*	15 feet downgradient	May 2006	Fully	10.0	3.51	1.1E-02	29.9		
MW-192*	15 feet downgradient	June 2006	Fully	10.0	3.33	1.1E-02	32.4	8%	

TABLE 2

Summary of Off-Depot Slug Test Results
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Well ID	Location Relative to Pilot-Scale ZVI PRB	Test Date	Penetration ¹	Well Screen within the saturated zone (L, ft) ²	Saturated Thickness (D, ft) ³	K (cm/s)	K (ft/day)	% Change	GW Velocity (ft/d)
MW-193*	30 feet downgradient	May 2006	Fully	10.0	7.95	9.5E-03	26.9	—	—
MW-193*	30 feet downgradient	June 2006	Fully	10.0	6.09	1.3E-02	36.7	36%	—
MW-194*	in ZVI PRB column 3	June 2006	Fully	10.0	9.88	5.0E-03	14.2	—	—
MW-195*	in ZVI PRB column 8	June 2006	Fully	10.0	5.07	3.6E-03	10.2	—	—
MW-196*	in ZVI PRB column 12	June 2006		Slug test not conducted - dry well					
				Geometric Mean (Overall)	1.1E-02		32.4		1.9
				Before (August 2004, March and May 2006)	2.0E-02		55.7		3.3
				After (June 2006)	1.1E-02		32.5		1.9
				Geometric Mean of wells within 50 feet of pilot-scale ZVI PRB	2.0E-02		55.4		3.3
				Before (August 2004, March and May 2006)	2.1E-02		60.3		3.6
				After (June 2006)	1.6E-02		45.2		2.7
				Geometric Mean (Saturated thickness < 12 feet)	1.5E-02		43.5		2.6
				Geometric Mean (Saturated thickness > 17 feet)	3.4E-03		9.6		0.6
				Overall minimum	6.0E-04		1.7		0.1
				Overall maximum	5.6E-02		158.7		9.4
				Iron only	7.0E-02		198.4		11.8
				Iron and sand (column slug tests)	4.3E-03		12.2		0.7
				Iron and sand (column 14) laboratory result	1.0E-01		283.5		16.8

Notes:

1. Fully penetrating means the entire aquifer thickness was screened and partially penetrating means only part of the saturated aquifer was screened.
2. Well screen within the saturated zone is always less or equal saturated aquifer thickness ($L \leq D$).
3. Saturated Aquifer Thickness = groundwater elevation - clay elevation

Well ID - slug testing conducted before pilot-scale PRB constructed
 Well ID - slug testing conducted after pilot-scale PRB constructed
 Wells installed in ZVI PRB columns

-- Pressure heads was measured using a MiniTroll Pro, manufactured by In-Situ Inc, during the slug tests.
 -- AquiferTest software (developed by Waterloo Hydrogeologic, Inc.) and Bouwer & Rice method was used to determine the hydraulic conductivity in each test well. Note that the effective radius was used if the stagnant water level was below the top of the screen; $r_{eff} = \sqrt{r^2 \cdot (1-n) + n \cdot R^2}$; r : piezometer radius; n : porosity; and R : bore hole radius.

-- Results based on slug out tests.
 -- Hydraulic gradient (0.0178 ft/ft in PRB study area) based on March 2005 potentiometric surface and $n = 0.3$ were used for groundwater velocity calculations
 -- Iron and sand (column 14) conductivity based on constant head permeability test performed by Kemron in June 2006.

TABLE 3
ZVI PRB Test Column Summary
Memphis Depot Dunn Field ZVI PRB Implementation Study

Test Column	Depth	Jetting Fluid	PRB Material	Discussion
1	77-85 ft bgs	Guar/water	Grout mix of 25 gallons water, four 94-lb bags Portland Type I/II cement. Measured density of 12.8 lbs/gal	In order to verify the geometry of the concrete/grout test column, the drill rods were placed approximately one foot from the center of the column. Drilling was completed to 83 feet bgs but no grout was detected in the drilling spoils. As such, the drill rig was repositioned closer to the center of the column. Drilling was completed to 83 feet bgs; based on the drilling spoils, grout was detected around 78-feet bgs.
2	70-75 ft bgs	60 pounds of guar to 1,000 gallons of water	Gravel E (relatively coarse sandy gravel material) mixed with 70 pounds of guar to 1,000 gallons of water followed by "concrete" sand (relatively fine-grained sand - similar to fluvial materials), water, and guar mixture because the gravel clogged the pump	Approximately 5.26 yd ³ (206 strokes at 0.69 ft ³ per stroke) of mixture was placed in the test column.
3	69-75 ft bgs	60 pounds of guar to 1,000 gallons of water	Sand and iron mixed with 70 pounds of guar to 1,000 gallons of water. The iron and sand hopper gates on the concrete batch plant were initially set at 1.5 and 3.5 inches, respectively. It was changed to 1 and 3.75 inches during the injection. Used one bag of ZVI (1.5 tons).	Installed 9.5 feet from test column 2. Approximately 6.14 yd ³ (240 strokes at 0.69 ft ³ per stroke) of mixture was placed in the test column at a pressure ranging from 100 to 150 psi. A magnetic test was performed on a sample of the iron and sand material (32.8% ZVI). The iron, sand, and guar mix displaced all the guar mixture from the jetting process; black filings were apparent in the returns at the end of the injection. Testing complete.

TABLE 4
ZVI PRB Production Column Summary
Memphis Depa Dunn Field ZVI PRB Implementation Study

Column Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Average
Sequence	5	1	12	8	5	2	13	10	7	3	14	11	8	4	15	
Date of Installation	5/24/06	5/22/06	5/23/06	5/25/06	5/25/06	5/23/06	5/31/06	5/25/06	5/25/06	5/23/06	5/31/06	5/30/06	5/25/06	5/24/06	5/31/06	
Jetting Parameters																
Start Drilling Time	1247	1440	1158	756	752	803	718	1117	1122	1401	1144	754	1551	852	1506	—
Start Depth (ft)	77.4	78.4	77.4	78.7	77.4	78.7	77.4	78.7	77.4	78.7	77.4	78.7	77.4	78.7	77.4	78.0
Stop Depth (ft)	69.2	70.5	69.2	70.5	69.2	70.5	69.2	70.5	69.2	70.5	69.2	70.5	69.2	70.5	69.2	69.8
Length Treated (ft)	8.2	7.9	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
Drilling Fluid (gal)	676	860	724	852	742	1050	981	822	834	1246	925	820	829	810	944	874
Jetting Fluid (gal)	1,978	1,314	1,517	1,959	1,301	1,856	1,085	1,717	1,769	1,555	1,698	1,744	1,656	1,239	1,699	1,606
Total Fluid (gal)	2,654	2,174	2,241	2,811	2,043	2,906	2,068	2,539	2,503	2,801	2,623	2,564	2,485	2,049	2,643	2,480
Fluid Mixture (gallons backwater gal)	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000	70/1000
Cutting Pressure (psi)	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Dispenser Gate (sand/ZVI)	3.5/1.34	3.5/1	3.5/1.63	3.5/1.34	3.5/1.34	3.5/1.25	3.5/1.63	3.5/1.34	3.5/1.34	3.5/1.5	3.5/1.63	3.5/1.75	3.5/1.75	3.5/1.5	3.5/1.63	—
Strokes for 1st appearance of ZVI	NA	NA	258	312	NA	NA	284	305	283	NA	327	280	NA	NA	264	289.1
Volume for 1st appearance of ZVI (ft ³)	NA	NA	178.02	215.28	NA	NA	195.96	210.45	195.27	NA	225.63	193.2	NA	NA	182.16	199.5
Total Strokes	314	317	286	377	304	293	290	335	315	289	364	324	331	287	348	318
Column Dimensions																
Design Column Diameter (ft)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6.0
Calculated Column Diameter (ft)	5.8	5.9	5.5	6.4	5.7	5.6	5.6	6.0	5.8	5.6	6.2	5.9	6.0	5.5	6.1	5.8
Total Volume (ft ³)	216.7	218.7	197.3	260.1	209.8	202.2	200.1	231.2	217.4	199.4	251.2	223.6	228.4	188.0	240.1	220
Iron																
Density (lb/ft ³)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	—
Volume (ft ³) (work plan - 4.5 tons per column)	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6
Volume (ft ³) (field plan - 4.5 tons per column)	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5
Volume (%) (based on MST)	34.2	15.3	30.6	28.1	33.7	22.5	38.6	32.2	44.0	28.4	42.1	39.8	33.6	29.5	37.3	32.7
Volume (%) (based on 4.5 tons per column)	27.7	27.4	30.4	23.1	28.6	29.7	30.0	26.0	27.6	30.1	23.9	26.8	26.3	30.3	25.0	27.5
Volume (ft ³) (based on MST)	74.1	33.5	60.4	73.0	70.7	45.6	77.3	74.4	95.7	56.7	105.6	89.0	76.6	58.4	89.5	72.0
Volume (ft ³) (based on 4.5 tons per column)	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Mass % (based on MST)	42.7	20.6	38.7	35.9	42.2	29.5	47.4	40.5	53.0	36.3	51.0	48.7	42.0	37.5	46.0	40.8
Mass % (based on 4.5 tons per column)	35.5	35.2	38.5	30.1	36.5	37.7	38.0	33.5	35.4	38.2	31.0	34.5	33.8	38.4	32.3	35.2
Mass (tons) (based on MST)	5.6	2.5	4.5	5.5	5.3	3.4	5.8	5.6	7.2	4.2	7.9	6.7	5.7	4.4	6.7	5.4
Mass (tons) (based on 4.5 tons per column)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Sand																
Density (lb/ft ³)	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6	—
Volume (ft ³) (work plan)	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4
Volume (ft ³) (field plan)	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5	73.5
Volume (%) (based on MST)	65.8	64.7	69.4	71.9	66.3	77.5	61.4	67.8	56.0	71.6	57.9	60.2	66.4	70.5	62.7	67.3
Volume (%) (based on 4.5 tons per column)	72.3	72.6	69.6	76.9	71.4	70.3	70.0	74.0	72.4	69.9	76.1	73.2	73.7	69.7	75.0	72.5
Volume (ft ³) (based on MST)	142.6	185.2	136.9	187.1	139.1	156.6	122.8	156.7	121.7	142.8	145.5	134.5	151.8	139.6	150.6	147.6
Volume (ft ³) (based on 4.5 tons per column)	156.7	158.7	137.3	200.1	149.8	142.2	140.1	171.2	157.4	139.4	191.2	163.6	168.4	138.0	180.1	159.6
Mass % (based on MST)	57.3	79.4	61.3	64.1	57.9	70.6	52.6	59.5	47.0	63.7	49.0	51.3	58.0	62.5	54.0	59.2
Mass % (based on 4.5 tons per column)	64.5	64.8	61.5	69.9	63.5	62.3	62.0	66.5	64.6	61.8	69.0	65.5	68.2	61.6	67.7	64.8
Mass (tons) (based on MST)	7.5	9.7	7.2	9.8	7.3	8.2	6.4	8.2	6.4	7.5	7.6	7.0	7.9	7.3	7.9	7.7
Mass (tons) (based on 4.5 tons per column)	8.2	8.3	7.2	10.5	7.8	7.4	7.3	9.0	8.2	7.3	10.0	8.6	8.8	7.2	9.4	8.3
Confirmation Borings and Monitoring Wells																
Monitoring wells			CB-5 MW-194	CB-2	CB-9	CB-4 MW-195	CB-8	CB-3 MW-196	CB-6 MW-198	CB-7	CB-1	CB-6 MW-198	CB-7	CB-6 MW-198	CB-7	CB-6 MW-198

Notes:
Red text denotes calculated value based on field data
MST = magnetic separation test
ZVI volume percentages above design target

TABLE 5

Summary of ZVI PRB Column Metals Analysis
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Sample ID	Sample Date	Sample Type	Al	Sb	As	Ba	Be	Cd	Ca	Cr
C1-F150-052406	5/24/06	Reactive media	1180 =	0.109 U	2.02 =	5.63 =	0.296 J	0.0807 U	233 =	6.22 =
C1-SRTD-052406	5/24/06	Slurry return	4780 =	0.241 U	4.77 =	17.7 =	0.658 J	0.174 U	647 =	13.0 =
C2-DB-052206	5/22/06	Reactive media	859 =	0.0636 U	1.52 =	4.51 =	0.178 J	0.0525 U	146 =	3.31 =
C2-SRTD-052206	5/22/06	Slurry return	409 =	0.0601 U	0.354 J	4.28 =	0.0932 J	0.0444 U	89.4 =	4.19 =
C4-F150-052606	5/26/06	Reactive media	982 =	0.0627 U	1.20 =	4.91 =	0.226 J	0.0442 U	172 =	3.89 =
C4-F312-052606	5/26/06	Reactive media	972 =	0.0610 U	1.76 =	4.43 =	0.206 J	0.0499 U	184 =	5.60 =
C4-SRTD-052606	5/26/06	Slurry return	744 =	0.0575 U	0.610 =	2.55 =	0.124 J	0.0441 U	119 =	3.13 =
C5-F200-052506	5/25/06	Reactive media	1120 =	0.0581 U	2.09 =	5.04 =	0.173 J	0.0487 U	193 =	7.80 =
C5-SRTD-052506	5/25/06	Slurry return	1230 =	0.0628 U	1.11 =	4.55 =	0.134 J	0.0500 U	163 =	3.46 =
C6-SRTD-052306	5/23/06	Slurry return	721 =	0.0528 U	0.213 J	4.47 =	0.0392 J	0.0431 U	61.9 =	1.49 =
C8-F150-052606	5/26/06	Reactive media	881 =	0.0682 U	0.971 =	4.14 =	0.192 J	0.0484 U	157 =	2.86 =
C8-F30S-052606	5/26/06	Reactive media	1690 =	0.0610 U	1.14 =	6.86 =	0.180 J	0.0510 U	258 =	12.3 =
C8-SRTD-052606	5/26/06	Slurry return	1380 =	0.0679 U	0.707 =	4.35 =	0.482 J	0.0485 U	358 =	20.4 =
C9-F150-052506	5/25/06	Reactive media	733 =	0.0595 U	1.24 =	3.32 =	0.204 J	0.0486 U	160 =	2.88 =
C9-SRTD-052506	5/25/06	Slurry return	1390 =	0.0585 U	0.629 =	28.7 =	0.426 J	0.0468 U	326 =	28.3 =
C10-SRTD-052306	5/23/06	Slurry return	969 =	0.0612 U	0.663 =	4.44 =	0.131 J	0.0479 U	128 =	3.31 =
C13-F150-052506	5/25/06	Reactive media	726 =	0.0681 U	1.43 =	3.35 =	0.226 J	0.0498 U	156 =	2.94 =
C13-SRTD-052506	5/25/06	Slurry return	479 =	0.0731 J	0.834 =	2.29 =	0.140 J	0.0474 U	95.6 =	2.16 =
C14-F150-052406	5/24/06	Reactive media	1180 =	0.0650 U	2.07 =	5.11 =	0.334 J	0.0477 U	217 =	4.20 =
C14-SRTD-052406	5/24/06	Slurry return	3110 =	0.107 U	2.17 =	15.5 =	0.416 J	0.0812 U	434 =	9.11 =

TABLE 5

Summary of ZVI PRB Column Metals Analysis
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Sample ID	Sample Date	Sample Type	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni
C1-F150-052406	5/24/06	Reactive media	2.10 =	2.59 =	10900 =	1.09 =	46.6 =	25.4 =	0.0227 U	2.43 J
C1-SRTD-052406	5/24/06	Slurry return	8.84 =	3.75 =	21700 =	4.80 =	252 =	106 =	0.0490 U	4.71 J
C2-DB-052206	5/22/06	Reactive media	1.17 =	0.573 J	6250 =	1.18 =	45.2 =	14.7 =	0.0129 U	0.980 J
C2-SRTD-052206	5/22/06	Slurry return	2.02 =	2.24 =	4390 =	0.919 =	19.9 J	49.2 =	0.0116 U	0.947 J
C4-F150-052606	5/26/06	Reactive media	1.53 =	1.01 =	8140 =	0.950 =	42.0 =	17.1 =	0.0120 U	1.36 J
C4-F312-052606	5/26/06	Reactive media	1.50 =	3.96 =	8840 =	1.07 =	41.3 =	24.7 =	0.0125 U	2.66 =
C4-SRTD-052606	5/26/06	Slurry return	1.15 =	0.528 J	4500 =	0.682 =	39.1 =	15.8 =	0.0125 U	0.985 J
C5-F200-052506	5/25/06	Reactive media	1.40 =	10.0 =	9590 =	1.23 =	37.7 =	30.0 =	0.0130 U	5.46 =
C5-SRTD-052506	5/25/06	Slurry return	1.35 =	0.985 J	4570 =	0.971 =	74.8 =	22.0 =	0.0130 U	1.00 J
C6-SRTD-052306	5/23/06	Slurry return	0.639 J	0.431 U	1220 =	0.755 =	41.6 =	9.89 =	0.0119 U	0.431 U
C8-F150-052606	5/26/06	Reactive media	1.30 =	0.792 J	6920 =	0.506 =	38.8 =	13.0 =	0.0136 U	1.05 J
C8-F30S-052606	5/26/06	Reactive media	2.16 =	19.4 =	12900 =	0.671 =	55.5 =	52.2 =	0.0133 U	7.72 =
C8-SRTD-052606	5/26/06	Slurry return	4.83 =	1.27 =	18600 =	0.635 =	64.0 =	97.0 =	0.0126 U	6.92 =
C9-F150-052506	5/25/06	Reactive media	1.17 =	0.764 J	7120 =	0.614 =	31.8 =	13.0 =	0.0136 U	1.05 J
C9-SRTD-052506	5/25/06	Slurry return	6.52 =	1.86 =	17400 =	0.496 =	58.7 =	242 =	0.0119 U	4.59 =
C10-SRTD-052306	5/23/06	Slurry return	1.38 =	0.986 =	4580 =	0.654 =	58.1 =	25.6 =	0.0131 U	0.888 J
C13-F150-052506	5/25/06	Reactive media	1.92 =	0.732 J	7730 =	0.866 =	26.8 =	18.6 =	0.0136 U	0.964 J
C13-SRTD-052506	5/25/06	Slurry return	0.894 J	1.62 =	4520 =	0.537 =	22.6 J	9.05 =	0.0121 U	0.727 J
C14-F150-052406	5/24/06	Reactive media	2.39 =	0.947 J	10300 =	1.37 =	48.3 =	22.8 =	0.0133 U	1.52 J
C14-SRTD-052406	5/24/06	Slurry return	10.5 =	2.83 =	15600 =	2.34 =	187 =	105 =	0.0214 U	2.41 J

TABLE 5

Summary of ZVI PRB Column Metals Analysis
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Sample ID	Sample Date	Sample Type	K	Se	Ag	Na	Ti	V	Zn
C1-F150-052406	5/24/06	Reactive media	109 =	0.217 U	0.404 U	19.3 J	0.0217 U	7.79 =	12.0 =
C1-SRTD-052406	5/24/06	Slurry return	504 =	0.482 U	0.869 U	60.5 J	0.0482 U	19.5 =	21.8 =
C2-DB-052206	5/22/06	Reactive media	102 =	0.139 J	0.262 U	11.4 J	0.0131 U	4.88 =	7.96 =
C2-SRTD-052206	5/22/06	Slurry return	22.2 U	0.120 U	0.222 U	4.44 U	0.0120 U	3.33 =	4.88 =
C4-F150-052606	5/26/06	Reactive media	92.0 =	0.125 U	0.225 J	10.2 J	0.0125 U	5.51 =	9.94 =
C4-F312-052606	5/26/06	Reactive media	83.0 =	0.122 U	0.250 U	20.7 J	0.0122 U	5.45 =	9.52 =
C4-SRTD-052606	5/26/06	Slurry return	76.2 =	0.115 U	0.220 U	11.3 J	0.0115 U	4.03 =	4.83 =
C5-F200-052506	5/25/06	Reactive media	69.4 =	0.116 U	0.332 J	23.6 J	0.0116 U	5.18 =	7.80 =
C5-SRTD-052506	5/25/06	Slurry return	159 =	0.126 U	0.250 U	19.4 J	0.0126 U	4.70 =	4.86 =
C6-SRTD-052306	5/23/06	Slurry return	96.9 =	0.106 U	0.215 U	7.76 J	0.0106 U	1.59 =	1.98 =
C8-F150-052606	5/26/06	Reactive media	87.5 =	0.136 U	0.242 U	13.8 J	0.0136 U	4.77 =	7.84 =
C8-F30S-052606	5/26/06	Reactive media	93.8 =	0.122 U	0.410 J	34.9 =	0.0122 U	6.44 =	10.2 =
C8-SRTD-052606	5/26/06	Slurry return	98.3 =	0.136 U	0.763 J	23.0 J	0.0136 U	13.6 =	20.3 =
C9-F150-052506	5/25/06	Reactive media	72.4 =	0.119 U	0.246 J	15.2 J	0.0119 U	4.65 =	7.62 =
C9-SRTD-052506	5/25/06	Slurry return	97.7 =	0.117 U	0.637 J	15.2 J	0.0117 U	16.8 =	17.2 =
C10-SRTD-052306	5/23/06	Slurry return	89.6 =	0.122 U	0.240 U	10.0 J	0.0122 U	4.35 =	4.58 =
C13-F150-052506	5/25/06	Reactive media	52.0 =	0.204 J	0.249 U	7.54 J	0.0504 =	4.36 =	7.26 =
C13-SRTD-052506	5/25/06	Slurry return	36.0 J	0.116 U	0.237 U	8.19 J	0.0116 U	2.89 =	4.63 =
C14-F150-052406	5/24/06	Reactive media	104 =	0.206 J	0.294 J	14.7 J	0.0130 U	6.68 =	10.7 =
C14-SRTD-052406	5/24/06	Slurry return	338 =	0.313 J	0.406 U	34.0 J	0.0213 U	12.3 =	14.3 =

TABLE 6
ZVI PRB Confirmation Boring Summary
Memphis Depot Dunn Field ZVI PRB Implementation Study

Boring ID	Location	Interval (ft bgs)	Total Weight (g)	Total Dry Weight (g)	Total Fe Weight (g)	% Sand	% Iron	Notes
CB-1	30-inches N of #12	N/A	N/A	N/A	N/A	N/A	N/A	No magnetic separation test performed. Fe not present in sample.
CB-2	34-inches NW of #5	68-69 70-71 72-73 73-74 6 feet	1,000 611 833 960 3,404	942 611 833 960 3,346	2 529 825 759 2,115	99.8% 13.4% 1.0% 20.9% 36.8%	0.2% 86.6% 99.0% 79.1% 63.2%	
CB-3 (MW-196)	18-inches W of #11	70-71 71-72 72-73 73-74	1,000 799 1,000 921	1,000 799 913 811	912 789 131 213	8.8% 1.3% 85.7% 73.7%	91.2% 98.7% 14.3% 26.3%	High aggregate results are consistent with the relatively high percentage of iron in the reactive media injected into Column 11 (see Table 4). Second highest percentage.
CB-4 (MW-195)	28-inches WNW #8	4 feet 71-72 72-73 76-77 77-78 7 feet	3,720 971 679 1,000 935 3,585	3,523 965 679 1,000 935 3,579	2,045 2 423 825 59 1,309	42.0% 99.8% 37.7% 17.5% 93.7% 63.4%	58.0% 0.2% 62.3% 82.5% 6.3% 36.6%	No magnetic separation test performed. Fe not present in sample - may be just outside the diameter of the column.
CB-5 (MW-194)	37-inches S of #3 and 41 inches N of #1	N/A	N/A	N/A	N/A	N/A	N/A	
CB-6	12 inches SW of # 13	70-71 71-72 72-73 73-74 74-75 5 feet	Unknown Unknown Unknown Unknown Unknown --	913 511 514 485 344 2,767	446 135 16 77 0 674	51.2% 73.6% 96.9% 84.1% 100.0% 75.6%	48.8% 26.4% 3.1% 15.9% 0.0% 24.4%	Boring drilled through Hayward Baker's initial boring. No magnetic separation test performed. Approximately two feet of sand without iron observed between reactive zone and top of clay.
CB-7 (MW-196B)	Center of #13	N/A	N/A	N/A	N/A	N/A	N/A	
CB-8	13 inches SE of #9	N/A	N/A	N/A	N/A	N/A	N/A	Boring drilled through Hayward Baker's initial boring. No magnetic separation test performed.
CB-9	27 inches S of #6	76-77 79-80 81-82 82-83.4 7 feet	1,000 1,000 1,000 1,000 4,000	948 962 940 922 3,772	4 42 332 448 826	99.6% 95.6% 64.7% 51.4% 78.1%	0.4% 4.4% 35.3% 48.6% 21.9%	Low aggregate results are consistent with the relatively low percentage of iron in the reactive media injected into Column 6 (see Table 4). Second lowest percentage.
Aggregate Results				16,987	6,969	59.0%	41.0%	

TABLE 7
 Jetted ZVI PRB Construction Considerations
Memphis Depot Dunn Field ZVI PRB Implementation Study

Possible Construction Issue	Implication(s)	Potential Solution(s)
Incomplete formation sediments removal during jetting process	• Accumulation of formation materials at the bottom of the column. • Iron/sand mix does not adequately interface with top of uppermost clay.	• During jetting process, use guar with higher specific gravity to facilitate removal of formation sediments. Larger formation materials will remain suspended during jetting process and will be removed when the iron/sand/guar mix is pumped into the column. • Lower bottom elevation of tremie pipe to improve guar displacement.
Sidewall sloughing	• Periodic column sidewall sloughing may have resulted in column material stratification, particularly on column perimeter. • Resulted in formation sand lenses within the iron/sand column.	• During jetting process, use guar with higher specific gravity to minimize sidewall sloughing. • Remix column contents after iron/sand/guar pumped into column.
Iron/sand segregation	• Iron and sand separates during the tremie process.	• Not observed. No expected change to mix design (e.g., guar concentration).
Fingering on column perimeter	• Iron and formation sand stratification is exacerbated on perimeter. • Potential for CVOC plume to pass through PRB with insufficient contact time with iron.	• During jetting process, use guar with higher specific gravity, and adjust rotation and extraction rate and the jetting pressure to make cutting radius more consistent top to bottom. • Remix column contents after iron/sand/guar pumped into column.

TABLE 8

Groundwater Depth-to-Water Information
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Well	Date	Time	Sample Event	Water Level (ft btoc)	Water Elevation (ft msl)
MW-77 304.42	26-Apr-2006	13:20	Baseline - ZVI PRB	81.78	222.64
	14-Jun-2006	15:55	Post Injection - 1	81.91	222.51
	07-Jul-2006	17:00	Post Injection - 2	81.86	222.56
	28-Jul-2006	7:40	Post Injection - 3	82.04	222.38
	31-Aug-2006	7:50	Post Injection - 4	82.16	222.26
	28-Sep-2006	15:16	Post Injection - 5	82.74	221.68
	18-Dec-2006	15:14	Post Injection - 6	83.09	221.33
MW-161 296.40	27-Apr-2006	8:30	Baseline - ZVI PRB	77.42	218.98
	24-May-2006	10:32	ZVI Injection Event	77.34	219.06
	26-May-2006	12:14	ZVI Injection Event	77.04	219.36
	30-May-2006	15:21	ZVI Injection Event	77.13	219.27
	31-May-2006	15:21	ZVI Injection Event	77.14	219.26
	14-Jun-2006	8:20	Post Injection - 1	77.43	218.97
	07-Jul-2006	11:17	Post Injection - 2	77.52	218.88
	27-Jul-2006	13:40	Post Injection - 3	77.58	218.82
	30-Aug-2006	11:35	Post Injection - 4	77.70	218.70
	28-Sep-2006	11:08	Post Injection - 5	78.00	218.40
	20-Dec-2006	12:52	Post Injection - 6	78.35	218.05
	26-Apr-2006	18:18	Baseline - ZVI PRB	77.45	218.91
	24-May-2006	10:25	ZVI Injection Event	77.36	219.00
MW-189 296.36	26-May-2006	11:27	ZVI Injection Event	77.13	219.23
	30-May-2006	15:17	ZVI Injection Event	77.13	219.23
	31-May-2006	15:16	ZVI Injection Event	77.17	219.19
	13-Jun-2006	17:45	Post Injection - 1	77.43	218.93
	07-Jul-2006	10:20	Post Injection - 2	77.60	218.76
	27-Jul-2006	12:40	Post Injection - 3	77.68	218.68
	30-Aug-2006	8:15	Post Injection - 4	77.70	218.66
	28-Sep-2006	9:40	Post Injection - 5	84.05	212.31
	20-Dec-2006	10:36	Post Injection - 6	78.42	217.94
	26-Apr-2006	16:50	Baseline - ZVI PRB	78.45	218.87
	24-May-2006	10:19	ZVI Injection Event	78.38	218.94
	26-May-2006	11:19	ZVI Injection Event	78.23	219.09
	30-May-2006	15:13	ZVI Injection Event	78.23	219.09
MW-190 297.32	31-May-2006	15:09	ZVI Injection Event	78.19	219.13
	14-Jun-2006	10:15	Post Injection - 1	78.48	218.84
	07-Jul-2006	14:20	Post Injection - 2	78.56	218.76
	27-Jul-2006	14:55	Post Injection - 3	78.65	218.67
	30-Aug-2006	13:25	Post Injection - 4	78.67	218.65
	28-Sep-2006	12:17	Post Injection - 5	79.15	218.17
	20-Dec-2006	15:52	Post Injection - 6	79.49	217.83
	N/A	N/A	Baseline - ZVI PRB	N/A	N/A
	13-Jun-2006	16:15	Post Injection - 1	74.12	219.14
	07-Jul-2006	9:19	Post Injection - 2	74.30	218.96
	27-Jul-2006	11:35	Post Injection - 3	74.39	218.87
	29-Aug-2006	15:47	Post Injection - 4	74.30	218.96
	28-Sep-2006	7:34	Post Injection - 5	74.80	218.46
MW-194 293.26	20-Dec-2006	10:15	Post Injection - 6	75.12	218.14
	N/A	N/A	Baseline - ZVI PRB	N/A	N/A
	14-Jun-2006	14:15	Post Injection - 1	74.68	220.27
	07-Jul-2006	8:10	Post Injection - 2	>75.18	dry
	27-Jul-2006	11:20	Post Injection - 3	>75.18	dry
	29-Aug-2006	15:00	Post Injection - 4	>75.18	dry
	27-Sep-2006	16:45	Post Injection - 5	>75.18	dry
MW-196 294.95	20-Dec-2006	9:34	Post Injection - 6	74.95	220.00
	N/A	N/A	Baseline - ZVI PRB	N/A	N/A
	13-Jun-2006	14:35	Post Injection - 1	74.93	218.96
	07-Jul-2006	8:18	Post Injection - 2	75.09	218.80
	27-Jul-2006	10:20	Post Injection - 3	75.16	218.73
	29-Aug-2006	14:25	Post Injection - 4	75.10	218.79
	27-Sep-2006	16:51	Post Injection - 5	75.10	218.79
MW-195 293.89	20-Dec-2006	10:03	Post Injection - 6	75.93	217.96

TABLE 8

Groundwater Depth-to-Water Information
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Well	Date	Time	Sample Event	Water Level (ft btoc)	Water Elevation (ft msl)
MW-196B 294.83	09-Sep-2006	9:00	Post Injection - 4	76.70	218.13
	27-Sep-2006	15:40	Post Injection - 5	76.70	218.13
	20-Dec-2006	9:30	Post Injection - 6	77.13	217.70
MW-191 291.67 292.10	27-Apr-2006	10:20	Baseline - ZVI PRB	73.32	218.35
	24-May-2006	10:06	ZVI Injection Event	73.22	218.45
	26-May-2006	11:12	ZVI Injection Event	73.03	218.64
	30-May-2006	14:55	ZVI Injection Event	73.24	218.43
	31-May-2006	15:04	ZVI Injection Event	73.22	218.45
	14-Jun-2006	14:00	Post Injection - 1	73.35	218.32
	06-Jul-2006	17:54	Post Injection - 2	73.46	218.64
	27-Jul-2006	9:26	Post Injection - 3	74.02	218.08
	29-Aug-2006	13:50	Post Injection - 4	73.96	218.14
	27-Sep-2006	14:35	Post Injection - 5	74.30	217.80
	20-Dec-2006	9:00	Post Injection - 6	74.77	217.33
MW-192 293.08	27-Apr-2006	11:20	Baseline - ZVI PRB	75.70	217.38
	24-May-2006	9:58	ZVI Injection Event	74.49	218.59
	26-May-2006	11:05	ZVI Injection Event	74.42	218.66
	30-May-2006	14:50	ZVI Injection Event	74.52	218.56
	31-May-2006	15:00	ZVI Injection Event	74.50	218.58
	13-Jun-2006	13:00	Post Injection - 1	74.67	218.41
	06-Jul-2006	16:35	Post Injection - 2	74.76	218.32
	27-Jul-2006	8:45	Post Injection - 3	74.90	218.18
	29-Aug-2006	11:00	Post Injection - 4	74.86	218.22
	27-Sep-2006	10:50	Post Injection - 5	75.21	217.87
	19-Dec-2006	16:03	Post Injection - 6	75.66	217.42
MW-144 291.603	27-Apr-2006	15:10	Baseline - ZVI PRB	73.37	218.23
	24-May-2006	9:30	ZVI Injection Event	73.35	218.25
	26-May-2006	10:35	ZVI Injection Event	73.21	218.39
	30-May-2006	14:38	ZVI Injection Event	73.32	218.28
	31-May-2006	14:43	ZVI Injection Event	73.31	218.29
	13-Jun-2006	10:20	Post Injection - 1	73.45	218.15
	06-Jul-2006	14:20	Post Injection - 2	73.56	218.04
	26-Jul-2006	16:55	Post Injection - 3	73.58	218.02
	28-Aug-2006	15:35	Post Injection - 4	73.56	218.04
	27-Sep-2006	11:54	Post Injection - 5	74.00	217.60
	19-Dec-2006	13:55	Post Injection - 6	74.75	216.85
MW-193 293.28	27-Apr-2006	13:55	Baseline - ZVI PRB	75.12	218.16
	24-May-2006	9:47	ZVI Injection Event	73.05	220.23
	26-May-2006	10:44	ZVI Injection Event	75.03	218.25
	30-May-2006	14:45	ZVI Injection Event	75.08	218.20
	31-May-2006	14:52	ZVI Injection Event	75.08	218.20
	13-Jun-2006	11:30	Post Injection - 1	75.22	218.06
	06-Jul-2006	15:23	Post Injection - 2	75.31	217.97
	27-Jul-2006	7:52	Post Injection - 3	75.45	217.83
	28-Aug-2006	18:30	Post Injection - 4	75.32	217.96
	27-Sep-2006	9:35	Post Injection - 5	75.80	217.48
	19-Dec-2006	15:02	Post Injection - 6	76.22	217.06
MW-163 290.63	27-Apr-2006	15:23	Baseline - ZVI PRB	72.79	217.84
	24-May-2006	9:23	ZVI Injection Event	72.79	217.84
	26-May-2006	12:14	ZVI Injection Event	72.74	217.89
	30-May-2006	14:29	ZVI Injection Event	73.79	216.84
	31-May-2006	14:36	ZVI Injection Event	72.79	217.84
	13-Jun-2006	8:45	Post Injection - 1	72.91	217.72
	06-Jul-2006	13:20	Post Injection - 2	72.98	217.65
	26-Jul-2006	15:52	Post Injection - 3	73.05	217.58
	28-Aug-2006	14:05	Post Injection - 4	73.00	217.63
	27-Sep-2006	7:20	Post Injection - 5	73.39	217.24
	19-Dec-2006	10:30	Post Injection - 6	73.92	216.71

TABLE 8

Groundwater Depth-to-Water Information
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Well	Date	Time	Sample Event	Water Level (ft btoc)	Water Elevation (ft msl)
MW-150 296.81	26-Apr-2006	9:35	Baseline - ZVI PRB	80.92	215.89
	12-Jun-2006	16:45	Post Injection - 1	80.93	215.88
	06-Jul-2006	11:54	Post Injection - 2	81.05	215.76
	26-Jul-2006	13:48	Post Injection - 3	81.11	215.70
	28-Aug-2006	11:35	Post Injection - 4	81.04	215.77
	26-Sep-2006	14:34	Post Injection - 5	81.36	215.45
	19-Dec-2006	9:20	Post Injection - 6	81.93	214.88
MW-54 295.35	26-Apr-2006	7:00	Baseline - ZVI PRB	79.75	215.60
	12-Jun-2006	14:05	Post Injection - 1	79.81	215.54
	06-Jul-2006	9:35	Post Injection - 2	79.92	215.43
	26-Jul-2006	12:35	Post Injection - 3	80.02	215.33
	28-Aug-2006	9:45	Post Injection - 4	79.89	215.46
	26-Sep-2006	9:30	Post Injection - 5	80.30	215.05
	19-Dec-2006	7:45	Post Injection - 6	80.71	214.64
MW-162 299.70	26-Apr-2006	15:30	Baseline - ZVI PRB	80.97	218.73
	14-Jun-2006	11:50	Post Injection - 1	81.03	218.67
	07-Jul-2006	15:47	Post Injection - 2	81.12	218.58
	27-Jul-2006	16:27	Post Injection - 3	81.22	218.48
	30-Aug-2006	15:40	Post Injection - 4	82.22	217.48
	28-Sep-2006	14:00	Post Injection - 5	81.70	218.00
	20-Dec-2006	15:32	Post Injection - 6	82.05	217.65
MW-196C 292.90	09-Sep-2006	9:00	Post Injection - 4	75.10	217.80
	27-Sep-2006	13:20	Post Injection - 5	75.00	217.90
	20-Dec-2006	7:45	Post Injection - 6	75.44	217.46

	Wells upgradient to the PRB Study Area
	Wells within the PRB Study Area
	Wells downgradient to the PRB Study Area

Measurement believed to be erroneous.

TABLE 9
Geochemical and VOC Data Summary
Memphis Depot Dunn Field ZVI PRB Implementation Study

Well	Sample Identification	Sample	Sample Date	Sample Event	Fe(II) (mg/L)	Total Iron (mg/L)	DO (mg/L)	pH	Conductivity (µS/cm)	Temp. (°C)	ORP (mV)	Turbidity (NTU)	TCR	5-12-OCF	1-2-OCF	VC	1,1,2,2-PCA	1,1,2,2-TCA	PS	PS	Other Field Observation(s)
MW-77	MW-77-85	26-Apr-2006	Baseline - ZVI PRB	0.16	0.92	3.40	6.3	0.453	16.2	176	341.1	22.2	5,170	154	36.3	ND	16,700	14.6	1.05	5.05	
	MW-77-86	14-Jun-2006	Post In Jection - 1	NC	0.38	4.35	5.9	0.402	17.5	403	32.4	ND	4,530	122	26.2 J	ND	9,160	ND	ND	ND	
	MW-77-86	07-Jul-2006	Post In Jection - 2	NC	0.67	3.71	6.2	0.429	17.8	322	38.7	27.2 J	4,060	105	20.5 J	ND	11,400	ND	ND	ND	
	MW-77-86	28-Jul-2006	Post In Jection - 3	0.00	0.14	3.81	6.4	0.425	19.0	334	23.1	ND	4,990	129	ND	ND	10,700	ND	ND	ND	
	MW-77-86	31-Aug-2006	Post In Jection - 4	0.00	0.05	1.84	6.3	0.423	17.6	318	9.3	38.2 J	6,980	150	30.6 J	ND	16,700	ND	ND	ND	
	MW-77-86	28-Sep-2006	Post In Jection - 5	0.00	2.58	4.86	6.4	0.499	17.7	336	96.0	37.7 J	7,420	172	30.1 J	ND	15,600	ND	ND	ND	
	MW-77-86	18-Dec-2006	Post In Jection - 6	0.00	0.00	3.53	6.3	0.331	16.8	498	11.1	6.25 U	1,710	53.3	12.5 U	6.25 U	6,250	6.25 U	6.25 U	3.13 U	
MW-161	MW-161-80	27-Apr-2006	Baseline - ZVI PRB	0.06	0.14	1.49	6.3	0.335	17.9	165	39.0	7.79	1,400	51.8	5.43	ND	1,790	6.36	0.454 J	1.47	
	MW-161-80	14-Jun-2006	Post In Jection - 1	NC	0.78	1.20	6.0	0.470	20.0	187	15.2	8.49 J	2,170	52.2	4.56 J	ND	3,260	6.72 J	ND	1.35 J	
	MW-161-80	07-Jul-2006	Post In Jection - 2	NC	0.21	0.76	6.2	0.382	19.8	109	12.1	ND	1,970	51.4	ND	ND	2,740	ND	ND	ND	
	MW-161-80	27-Jul-2006	Post In Jection - 3	0.00	0.22	0.32	5.6	0.363	19.9	247	1.3	9.60 J	2,190	57	ND	ND	2,830	ND	ND	ND	
	MW-161-80	30-Aug-2006	Post In Jection - 4	0.00	0.26	0.38	5.7	0.370	19.0	371	5.7	16.1	3,290	75.5	4.33	ND	3,960	7.07	1.11	2.57	
	MW-161-80	28-Sep-2006	Post In Jection - 5	0.00	0.21	2.72	6.3	0.356	19.8	102	0.0	7.63 J	1,920	37	ND	ND	2,310	ND	ND	1.25 U	
	MW161-80D	20-Dec-2006	Post In Jection - 6	0.20	0.20	3.28	6.2	0.333	17.6	143	5.3	7.77 J	1,690	40	2.50 U	5.00 U	1,560	2.55 J	2.50 U	1.25 U	
MW-189	MW-189-85	26-Apr-2006	Baseline - ZVI PRB	0.04	0.08	0.49	6.3	0.354	17.3	116	7.0	7.55	1,430	51.6	5.11	ND	1,790	6.28	0.458 J	1.58	
	MW-189-84	13-Jun-2006	Post In Jection - 1	NC	0.30	0.86	5.6	0.347	19.4	180	0.0	5.05 J	1,620	40.9	3.32 J	ND	2,680	5.72 J	ND	1.64 J	
	MW-189-84	07-Jul-2006	Post In Jection - 2	NC	0.26	0.90	6.2	0.367	18.9	59	5.7	5.44 J	1,750	47.8	ND	ND	2,480	ND	ND	ND	
	MW-189-84	27-Jul-2006	Post In Jection - 3	0.60	0.31	0.42	5.8	0.349	19.3	126	0.0	8.58 J	2,050	53	ND	ND	2,840	ND	ND	ND	
	MW-189-84	30-Aug-2006	Post In Jection - 4	0.20	0.97	0.25	6.1	0.349	19.5	95	8.3	9.77	2,630	61.8	4.2	ND	3,130	5.98	0.769 J	1.97	
	MW-189-86	28-Sep-2006	Post In Jection - 5	0.20	0.31	3.17	6.2	0.356	19.4	129	6.6	6.94 J	1,680	37.7	ND	ND	2,240	ND	ND	1.28 J	
	MW189-86	20-Dec-2006	Post In Jection - 6	0.00	0.80	1.75	6.2	0.331	17.7	113	1.3	7.54 J	1,640	40.2	2.50 U	5.00 U	1,480	3.12 J	2.50 U	1.28 J	
MW-190	MW-190-86	26-Apr-2006	Baseline - ZVI PRB	0.04	0.06	0.60	6.3	0.381	17.3	116	4.8	12.5	2,720	80.5	6.48	ND	4,410	8.84	0.632 J	2.73	
	MW-190-84	14-Jun-2006	Post In Jection - 1	NC	0.06	1.33	5.8	0.502	18.8	204	13.5	8.50 J	2,890	61.2	5.37 J	ND	7,300	8.35 J	ND	2.58 J	
	MW-190-84	07-Jul-2006	Post In Jection - 2	NC	0.15	1.34	6.2	0.395	20.4	113	16.2	ND	1,650	45.6 J	ND	ND	5,120	ND	ND	ND	
	MW-190-84	27-Jul-2006	Post In Jection - 3	0.00	0.16	1.27	5.7	0.364	19.9	220	0.0	ND	2,420	54.1	ND	ND	5,390	ND	ND	ND	
	MW-190-84	30-Aug-2006	Post In Jection - 4	0.00	0.00	0.53	5.8	0.351	19.4	432	10	13.9	3,680	73.5	5.48	ND	6,120	7.6	1.02	2.62	
	MW-190-84	28-Sep-2006	Post In Jection - 5	0.00	2.05	3.35	6.3	0.375	19.9	176	0.0	ND	3,630	52.9	ND	ND	7,950	ND	ND	ND	
	MW190-84	20-Dec-2006	Post In Jection - 6	0.00	0.00	1.60	6.3	0.346	17.5	123	1.0	12.5 U	3,100	59.1	12.5 U	25.0 U	7,970	12.5 U	12.5 U	6.25 U	Strong G Uar Odor
MW-194	Not installed								Not installed							Not installed					
	MW-194-81	13-Jun-2006	Post In Jection - 1	NC	3.22	0.72	5.5	0.398	20.1	32	12.3	11.8	2,700	141	32.2	ND	3,960	8.86 J	ND	2.34 J	
	MW-194-81	07-Jul-2006	Post In Jection - 2	NC	2.16	0.90	NC	0.452	20.8	-74	10.8	6.69 J	2,300	79	ND	ND	3,360	12.5 J	ND	ND	
	MW-194-81	27-Jul-2006	Post In Jection - 3	2.50	1.69	0.25	6.0	0.421	19.6	2	2.6	ND	2,960	93.7	ND	ND	4,000	16.7 J	ND	ND	
	MW-194-81	29-Aug-2006	Post In Jection - 4	3.40	3.13	6.11	6.2	0.400	22.9	-6	13.8	ND	1,660	65.9	ND	ND	2,660	15.6 J	ND	ND	
	MW-194-81	28-Sep-2006	Post In Jection - 5	3.40	3.14	3.96	6.3	0.366	19.0	9	1.3	7.43 J	1,830	54.8	6.31 J	ND	2,160	18.0 J	ND	ND	
	MW194-80	20-Dec-2006	Post In Jection - 6	3.00	2.20	1.42	6.2	0.335	19.5	46	4.9	4.03 J	1,500	59.6	5.46 J	5.00 U	1,610	16.1	2.50 U	1.25 U	
MW-196	Not installed								Not installed							Not installed					
	Not sampled	14-Jun-2006	Post In Jection - 1	NC	3.15	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	Strong G Uar Odor
	Not sampled	07-Jul-2006	Post In Jection - 2	NC	0.37	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.5' of water
	Not sampled	27-Jul-2006	Post In Jection - 3	1.10	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	Dry
	Not sampled	29-Aug-2006	Post In Jection - 4	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	Dry
	Not sampled	27-Sep-2006	Post In Jection - 5	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	Dry
	Not sampled	20-Dec-2006	Post In Jection - 6	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.15' of water
MW-198B	Not installed								Not installed							Not installed					
	Not installed	Baseline - ZVI PRB							Not installed							Not installed					
	Not installed	Post In Jection - 1							Not installed							Not installed					
	Not installed	Post In Jection - 2							Not installed							Not installed					
	Not installed	Post In Jection - 3							Not installed							Not installed					
	Not installed	Post In Jection - 4							Not installed							Not installed					
	MW-198B-77	27-Sep-2006	Post In Jection - 5	1.80	8.2	0.55	7.1	0.431	22.2	-181	5.66 J	1730	468	126	ND	8.31 J	4930	24.8	ND	ND	Well Installed 8/31/2006
Not sampled	20-Dec-2006	Post In Jection - 6	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.37' of water	

Well	Sample Identification	Sample Date	Sample Event	Fe(II) (mg/L)	Total Iron (mg/L)	DO (mg/L)	pH	Conductivity (mS/cm)	Temp. (°C)	ORP (mV)	Turbidity (NTU)	TCR	1,2-DCR	1,1-DCR	1,1,2,2-PCA	1,2-TCA	CT	Other Field Observation(s)		
MW-195	Not installed		Baseline - ZVI PRB					Not installed												
	MW-195-78	13-Jun-2006	Post In Jection - 1	NC	3.32	0.31	5.5	1.308	21.8	-127	55.3	2.45	0.427 J	ND	6.71	ND	ND	ND	Strong G Uar Odor	
	MW-195-78	07-Jul-2006	Post In Jection - 2	NC	5.30	0.56	6.7	0.439	20.5	-132	2.7	ND	ND	ND	ND	ND	ND	ND	Minimal G Uar Odor	
	MW-195-78	27-Jul-2006	Post In Jection - 3	4.20	3.76	0.79	6.6	0.327	20.8	-134	10.1	0.289 J	ND	ND	0.138 J	ND	ND	ND	Strong Methane-like Odor	
	MW-195-78	29-Aug-2006	Post In Jection - 4	1.40	1.44	2.05	9.0	0.233	20.0	-358	4.2	ND	4.89	ND	ND	0.522 J	ND	ND	Strong Methane-like Odor	
	MW-195-78	27-Sep-2006	Post In Jection - 5	0.00	0.46	0.64	9.4	0.234	20.2	-222	8.3	3.08	21.7	3.11	ND	3.3	0.623 J	ND	Strong Methane-like Odor	
	MW-195-78	20-Dec-2006	Post In Jection - 6	0.00	0.00	0.79	9.7	0.226	18.4	-233	0.5	0.250 U	38.9	3.52	0.500 U	2.1	16.4	0.125 U	Strong Methane-like Odor	
MW-191	MW-191-75	27-Apr-2006	Baseline - ZVI PRB	0.10	0.15	0.44	6.2	0.337	17.9	71	6.4	7.89	41.9	6.78	1.900	5.44	ND	1.17	G Uar Odor	
	MW-191-BLR	14-Jun-2006	Post In Jection - 1	NC	3.80	6.54	4.1	0.419	19.3	128	28.7	7.42 J	1.560	39.5	2.400	4.46 J	ND	ND	Strong G Uar Odor	
	MW-191-BLR	06-Jul-2006	Post In Jection - 2	NC	4.30	6.33	6.4	0.418	19.7	-75	102.5	3.87 J	901	38.1	1.490	7.20 J	ND	ND	Strong G Uar Odor	
	MW-191-77	27-Jul-2006	Post In Jection - 3	4.10	2.52	0.61	6.3	0.367	19.9	-46	2.7	3.86 J	870	40.6	1.740	4.81 J	ND	ND	Strong G Uar Odor	
	MW-191-77	29-Aug-2006	Post In Jection - 4	5.50	4.28	5.02	6.2	0.355	20.0	-46	12.4	3.86 J	989	32.3	1.41 J	ND	ND	ND	Strong G Uar Odor	
	MW-191-77	27-Sep-2006	Post In Jection - 5	3.80	9.32	1.20	6.1	0.337	20.4	-22	22.5	1.99 J	491	20.2	3.35 J	ND	ND	ND	Strong G Uar Odor	
	MW-191-77	20-Dec-2006	Post In Jection - 6	4.60	5.30	0.66	6.4	0.367	17.8	-23	4.9	11.8	2.550	68.3	3.150	6.2	1.25 U	1.83 J	Strong G Uar Odor	
MW-196C	Not installed		Baseline - ZVI PRB					Not installed												
	Not installed		Post In Jection - 1					Not installed												
	Not installed		Post In Jection - 2					Not installed												
	Not installed		Post In Jection - 3					Not installed												
	Not installed		Post In Jection - 4					Not installed												
	Not installed		Post In Jection - 5					Not installed												
	Not installed		Post In Jection - 6					Not installed												
MW-192	MW-196C-79	27-Sep-2006	Post In Jection - 6	4.40	10.6	0.82	6.1	0.328	20.5	-13	14.4	3.49 J	729	30.3	1.270	5.80 J	ND	ND	Well Installed 8/31/2006	
	MW-196C-79	20-Dec-2006	Post In Jection - 6	2.00	2.0	0.56	6.3	0.307	17.6	12	0.9	3.17 J	904	24.8	1.720	2.84 J	2.50 U	1.25 U		
	MW-192-76	27-Apr-2006	Baseline - ZVI PRB	0.50	0.75	0.74	6.3	0.399	19.0	41	8.0	5.09 J	2.430	76.2	5.420	8.88 J	ND	2.58 J		
	MW-192-77	13-Jun-2006	Post In Jection - 1	NC	0.89	0.93	5.5	0.488	20.1	24	4.1	6.96 J	2.920	82.9	7.840	8.04 J	ND	2.54 J		
	MW-192-77	06-Jul-2006	Post In Jection - 2	NC	2.51	0.73	6.3	0.448	19.7	8	0.8	ND	4.150	86.9	ND	9.260	ND	ND	Minimal G Uar Odor	
	MW-192-77	27-Jul-2006	Post In Jection - 3	3.40	3.08	1.78	6.2	0.401	19.9	31	7.4	ND	3.830	76.7 J	ND	8.140	ND	ND		
	MW-192-77	29-Aug-2006	Post In Jection - 4	2.50	2.12	0.67	6.3	0.394	20.0	28	3.0	ND	3.590	68.6 J	ND	8.140	ND	ND		
MW-144	MW-192-77	27-Sep-2006	Post In Jection - 5	3.80	8.84	0.83	6.4	0.410	19.9	15	0.0	6.25 U	2.660	66.2	ND	4.760	6.25 U	3.13 U		
	MW-192-77	19-Dec-2006	Post In Jection - 6	4.60	9.00	0.44	6.6	0.360	17.7	-80	0.4	3.625 U	2.040	118	13.9 J	3.660	7.62 J	6.25 U		
	MW-144-75	27-Apr-2006	Baseline - ZVI PRB	0.02	0.60	1.61	6.3	0.406	17.7	203	7.5	16.9	2.790	88.9	7.04	8.94	0.901 J	3.13		
	MW-144-75	13-Jun-2006	Post In Jection - 1	NC	1.01	1.29	6.0	0.529	19.9	75	25.6	ND	1.790	51.6	ND	3.760	6.01 J	ND	G Uar Odor	
	MW-144-75	06-Jul-2006	Post In Jection - 2	NC	2.20	2.19	5.0	0.550	19.7	41	16.7	8.48 J	1.870	73.6	ND	3.650	7.20 J	ND	Strong Methane-like Odor	
	MW-144-75	26-Jul-2006	Post In Jection - 3	NC	3.84	0.29	5.0	0.558	20.0	-34	0.0	ND	2.670	121	ND	5.030	17.9 J	ND		
	MW-144-75	28-Aug-2006	Post In Jection - 4	6.20	4.10	2.25	6.3	0.445	19.1	-121	5.9	ND	2.540	79.8	ND	4.890	21.8 J	ND		
MW-193	MW-144-75	27-Sep-2006	Post In Jection - 5	4.60	4.92	1.43	6.1	0.408	21.9	-27	0.0	6.49 J	2.120	103	18.6 J	ND	2.960	51.1		
	MW-144-75	19-Dec-2006	Post In Jection - 6	5.00	9.60	0.74	6.4	0.395	17.9	-51	1.0	11.0 J	2.780	97.5	9.75 J	10.0 U	5.00 U	2.50 U		
	MW-193-80	27-Apr-2006	Baseline - ZVI PRB	0.44	0.40	0.44	6.1	0.300	18.0	99	7.5	6.75	1.250	33.5	5.63	2.150	4.43	ND	1.05	
	MW-193-80	13-Jun-2006	Post In Jection - 1	NC	1.08	0.88	5.6	0.376	20.1	105	27.1	3.04 J	1.210	29.2	2.80 J	ND	2.750	4.57 J	ND	
	MW-193-80	06-Jul-2006	Post In Jection - 2	NC	0.75	0.89	6.2	0.333	20.4	39	2.4	ND	1.370	33.6	ND	2.970	ND	ND	Minimal G Uar Odor	
	MW-193-80	27-Jul-2006	Post In Jection - 3	1.40	0.88	0.42	6.0	0.315	19.2	73	0.5	ND	1.420	29.7	ND	3.010	ND	ND		
	MW-193-80	28-Aug-2006	Post In Jection - 4	0.80	1.64	1.05	6.1	0.328	19.1	40	4.4	6.18 J	2.110	40.4	ND	4.570	ND	ND		
MW-163	MW-193-80	27-Sep-2006	Post In Jection - 5	2.40	2.05	1.36	6.1	0.317	20.1	95	1.3	ND	1.170	35	7.14 J	ND	2.270	ND		
	MW-193-80	19-Dec-2006	Post In Jection - 6	0.10	0.92	0.62	6.4	0.308	17.7	80	11.3	5.00 U	787	23.2	5.00 U	2.000	5.00 U	2.90 U		
	MW-163-75	27-Apr-2006	Baseline - ZVI PRB	0.03	2.00	0.80	6.2	0.358	17.5	174	9.9	12.6	2.030	61.6	5.75	2.420	6.6	0.831 J	2.14	
	MW-163-75	13-Jun-2006	Post In Jection - 1	NC	1.16	1.27	6.0	0.382	19.5	121	49.5	5.56 J	1.530	41.4	2.79 J	ND	1.950	5.74 J	ND	1.42 J
	MW-163-75	06-Jul-2006	Post In Jection - 2	NC	3.16	1.30	5.1	1.149	21.2	-317	24.8	2.52 J	591	20.2	1.58 J	ND	725	2.02 J	ND	
	MW-163-75	26-Jul-2006	Post In Jection - 3	NC	6.08	0.23	4.8	0.761	19.4	50	5.2	2.44 J	594	45.6	10.4	810	6.48	ND	ND	Strong G Uar Odor
	MW-163-75	28-Aug-2006	Post In Jection - 4	6.80	4.24	2.52	5.8	0.345	19.2	99	65.7	2.43 J	600	53.7	9.09	976	11.3	ND	ND	Methane-like Odor
MW-163-75	MW-163-75	27-Sep-2006	Post In Jection - 5	4.40	8.92	0.65	6.7	0.313	18.4	-55	25.1	3.44 J	732	70.7	9.98	ND	845	11.6	ND	
	MW-163-75	19-Dec-2006	Post In Jection - 6	4.40	8.20	0.49	6.8	0.257	17.3	-97	9.7	1.65 J	411	131	18.9	1.00 U	3.74	28.2	0.500 U	0.480 J

TABLE 9
Geochemical and VOC Data S Urinary
Memphis Depot Data Field ZVI PRB Implementation Study

Well	Sample Identification	Sample Date	Sample Event	Fe(II) (mg/L)	Total Iron (mg/L)	DO (mg/L)	pH	Conductivity (mS/cm)	Temp. (°C)	ORP (mV)	Turbidity (NTU)	PCr	TCr	C-1,2-DCE	H-1,2-DCE	VC	1,1,2,2-PCA	1,1,2,2-TCA	ST	TS	Other Field Observation(s)	
MW-150	MW-150-86	26-Apr-2006	Baseline - ZVI PRB	3.44	4.88	0.68	6.1	0.270	16.0	28	16.1	4.02	1,120	54	10.3	ND	0.377 J	2,590	6	0.315 J	2	
	MW-150-85	12-Jun-2006	Post In Jection - 1	NC	1.05	0.94	5.3	0.292	19.3	50	0.9	4.90 J	1,940	49.6	8.18 J	ND	ND	4,620	9.58 J	ND	1.81 J	
	MW-150-85	06-Jul-2006	Post In Jection - 2	NC	3.62	0.97	6.1	0.297	19.8	10	30.8	ND	2,040	51.3	7.39 J	ND	ND	4,820	7.72 J	ND	ND	
	MW-150-85	26-Jul-2006	Post In Jection - 3	NC	3.19	0.88	5.7	0.282	24.3	56	0.0	ND	1,920	54.8	ND	ND	5,990	ND	ND	ND	ND	
	MW-150-85	28-Aug-2006	Post In Jection - 4	4.60	3.92	5.52	5.9	0.304	20.3	-33	42.4	ND	2,590	61.3	ND	ND	ND	7,900	16.9 J	ND	ND	
	MW-150-85	26-Sep-2006	Post In Jection - 5	2.40	7.68	0.55	6.1	0.327	18.6	24	89.3	ND	2,790	62.1	ND	ND	ND	6,050	14.4 J	ND	ND	
MW-54	MW-150-85	19-Dec-2006	Post In Jection - 6	4.20	7.80	0.78	6.5	0.536	16.4	-77	21.3	12.5 U	3,190	112	21.4 J	25.0 U	12.5 U	7,770	24.6 J	12.5 U	6.25 U	
	MW-54-90	26-Apr-2006	Baseline - ZVI PRB	0.13	2.10	1.67	6.0	0.245	16.1	129	16.7	1.63	493	26.3	5.65	ND	ND	572	4.54	1.08	1.68	
	MW-54-92	12-Jun-2006	Post In Jection - 1	NC	1.40	2.02	5.1	0.262	19.9	161	12.6	1.73 J	608	21.3	4.4	ND	ND	959	3.84	0.721 J	1.20 J	
	MW-54-92	06-Jul-2006	Post In Jection - 2	NC	1.79	2.18	5.9	0.256	21.0	143	16.1	1.78 J	498	20.2	3.95 J	ND	ND	642	3.85 J	ND	1.38 J	
	MW-54-92	26-Jul-2006	Post In Jection - 3	NC	1.93	1.44	5.5	0.229	21.3	139	3.0	ND	489	17.9	3.40 J	ND	ND	680	3.50 J	ND	0.876 J	
	MW-54-92	28-Aug-2006	Post In Jection - 4	0.20	0.46	3.13	5.7	0.253	18.0	160	12.1	2.91 J	719	24.9	4.77 J	ND	ND	731	3.30 J	3.39 J	1.82 J	
MW-162	MW-54-92	26-Sep-2006	Post In Jection - 5	0.00	0.53	2.63	5.8	0.253	20.5	176	0.0	3.13	617	25	5.3	ND	ND	625	2.7	1.83	1.84	
	MW-54-92	19-Dec-2006	Post In Jection - 6	0.00	0.20	2.44	6.1	0.269	16.6	148	18.3	2.19 J	571	16.9	3.31 J	2.50 U	1.25 U	452	1.46 J	4.31 J	1.93 J	
	MW-162-84	26-Apr-2006	Baseline - ZVI PRB	0.03	0.17	4.63	6.1	0.299	16.9	193	27.0	11.4	1,150	66.6	15.9	ND	ND	983	1.98	0.498 J	3.36	
	MW-162-85	14-Jun-2006	Post In Jection - 1	NC	0.66	5.11	4.9	0.351	18.7	352	18.4	9.04 J	971	45.3	10.2	ND	ND	803	ND	ND	2.09 J	
	MW-162-85	07-Jul-2006	Post In Jection - 2	NC	0.46	4.42	5.9	0.306	18.9	279	10.8	9.4	857	44.8	10.9	ND	ND	640	ND	ND	2.03 J	
	MW-162-85	27-Jul-2006	Post In Jection - 3	NC	NC	4.37	5.6	0.278	18.4	506	26.0	6.07	575	30.1	7.6	ND	ND	385	ND	ND	1.67 J	
ZVI PRB in Jections - 05/10/06 through 06/10/06	MW-162-85	30-Aug-2006	Post In Jection - 4	0.00	0.04	2.48	5.7	0.272	18.5	473	6.9	9.25	996	34.6	9.1	ND	ND	433	0.862 J	0.369 J	2.14	
	MW-162-85	28-Sep-2006	Post In Jection - 5	0.00	2.86	6.37	5.9	0.267	21.3	292	100.0	6.59	487	18.6	4.47 J	ND	ND	168	ND	ND	ND	
	MW162-85	20-Dec-2006	Post In Jection - 6	0.00	0.00	5.03	6.0	0.277	17.0	257	36.9	3.57	354	13.4	3.47	1.25 U	0.625 U	434	0.625 U	0.625 U	0.606 J	
	Red dissolved oxygen readings are suspect due to a bad DO membrane																					

Note: all VOCs are reported in Ugl

Note: all VOCs are reported in Ugl.

ND not detected above minimal detection limit

NC not collected

Wells Upgradient to the PRB
Wells within the PRB
Wells downgradient to the PRB

TABLE 10

Comparison of April (Baseline) and Sept/Oct and December 2006 TCE and 1,1,2,2-PCA Results
 Memphis Depot Dunn Field ZVI PRB Implementation Study

Monitoring Well ID			Baseline - April 2006		5th Event - Sept/Oct 2006		Delta from Baseline		6th Event - Dec 2006		Delta from Baseline	
	Northing	Easting	TCE	1,1,2,2-PCA	TCE	1,1,2,2-PCA	TCE	1,1,2,2-PCA	TCE	1,1,2,2-PCA	TCE	1,1,2,2-PCA
Far Upgradient												
MW-77	281142.96	801815.29	5,170	16,700	7,390	15,600	43%	-7%	1,710	3,260	-67%	-80%
Upgradient												
MW-161	281120.29	801596.82	1,400	1,790	1,920	2,310	37%	29%	1,640	1,560	17%	-13%
MW-189	281115.99	801587.43	1,430	1,790	1,680	2,240	17%	25%	1,640	1,480	15%	-17%
MW-190	281138.88	801595.73	2,720	4,410	3,630	6,120	33%	39%	3,100	7,970	14%	81%
PRB												
MW-194	281115.71	801567.74	not installed	not installed	1,830	2,160	n/a	n/a	1,500	1,610	n/a	n/a
MW-195	281139.31	801566.63	not installed	not installed	3	3	n/a	n/a	6	16	n/a	n/a
MW-196	281145.94	801576.20	not installed	not installed	dry	dry	n/a	n/a	dry	dry	n/a	n/a
MW-196B	281152.42	801579.89	not installed	not installed	1,730	4,930	n/a	n/a	dry	dry	n/a	n/a
Downgradient												
MW-144	281138.63	801528.84	2,790	4,080	2,120	2,960	-24%	-27%	2,780	3,500	0%	-14%
MW-163	281152.59	801487.27	2,030	2,420	732	845	-64%	-65%	396	461	-80%	-81%
MW-191	281133.68	801546.91	1,240	1,900	491	569	-60%	-70%	2,550	3,150	106%	66%
MW-192	281156.67	801555.48	2,430	5,420	2,660	4,760	9%	-12%	2,040	3,660	-16%	-32%
MW-193	281167.35	801531.90	1,250	2,150	1,170	2,270	-6%	6%	787	2,000	-37%	-7%
MW-196C	281146.15	801552.09	not installed	not installed	729	1,270	n/a	n/a	904	1,720	n/a	n/a
Far Downgradient												
MW-54	281160.10	801183.32	493	572	631	513	28%	-10%	571	452	16%	-21%
MW-150	281238.66	801283.61	1,120	2,590	2,790	6,050	149%	134%	7,770	3,190	594%	23%
Side-gradient												
MW-162	281244.22	801596.06	1,150	983	487	168	-58%	-83%	354	434	-69%	-56%

ATTACHMENT A

Boring Logs and MW Construction Diagrams

Monitoring Well Boring Logs

- MW-189
- MW-190
- MW-191
- MW-192
- MW-193
- MW-196C



PROJECT NUMBER 334469	BORING NUMBER MW-189
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION : Memphis Depot
 ELEVATION : DRILLING CONTRACTOR : Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START : 3/23/2006 END : 3/23/2006 LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (%)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-8"-6"-8" (N)	SOIL DESCRIPTION	COMMENTS
					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION Corrected FID (ppm)
					Silt, yellowish-brown, grass, damp, stiff	1.9
					Silt, brown, fine grain loess, dry	-
						2.6
						6.0
					Silt, brown, loess fine grain, damp, stiff	
						22.1
						1.7
						2.0
						15
						2.6
						46.4
					Silty sand, tannish orange, fine grain, sticky, damp, gravel up to 1/4"	
					Gravelly silty sand, orangish red, fine grain, loose, damp, gravel pea size up to 2" diameter, less silt after 36'	
						33.9



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PROJECT NUMBER 334469	BORING NUMBER MW-189
SOIL BORING LOG	

PROJECT : PRB Implementation Study

LOCATION : Memphis Depot

ELEVATION :

DRILLING CONTRACTOR : Prosonic

DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)

WATER LEVELS :

START

3/23/2006

END

3/23/2006

LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)		START	3/23/2006	END	3/23/2006	LOGGER :	Mike Karafa
INTERVAL (FT)	RECOVERY (%)	#/TYPE	STANDARD	SOIL DESCRIPTION		COMMENTS	
			PENETRATION				
			TEST	SOIL NAME, USCS GROUP SYMBOL, COLOR,		DEPTH OF CASING, DRILLING RATE,	
			RESULTS	MOISTURE CONTENT, RELATIVE DENSITY,		DRILLING FLUID LOSS,	
			6"-6"-6"-6" (N)	OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.		TESTS, AND INSTRUMENTATION	
							Corrected FID (ppm)
40	100						
45					Sand, light tan, fine grain, loose, dry gravel up to 1/5"		0.0
							7.1
50	100						
					sand, orangsh brown, fine to regular coarse grain, loose, damp, gravel pea size up to 1/2" diameter		10.5
55							4.5
					sand, orange and tan, fine grain, loose, dry		12.1
60	100						
					sand, orange, fine to coarse grain, loose, dry, gravel up to 1/4"		
					sand, light tan, fine grain, loose, dry, pea size gravel		0.0
65							
					silty gravelly sand, fine to very coarse grain, damp, loose, fluvial deposits		
					sand, orange to tan, fine grain, loose, damp		0.0
70	100						



CH2MHILL

PROJECT NUMBER 334469	BORING NUMBER MW-189
SOIL BORING LOG	

PROJECT PRB Implementation Study LOCATION : Memphis Depot
 ELEVATION : DRILLING CONTRACTOR : Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START 3/23/2006 END 3/23/2006 LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)		INTERVAL (FT)		STANDARD PENETRATION TEST RESULTS		SOIL DESCRIPTION		COMMENTS	
		RECOVERY (%)		6"-8"-6"-6" (N)		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	
		#/TYPE						Corrected FID (ppm)	
75									
80		100					gravelly sand, orangish tan, fine to medium grain, loose, damp, gravel up to 3/4"		0.0
85							sand, orange, fine to coarse grain, loose, damp, gravel up to 1" diameter		
							silty sand, dark grey, loose, damp to wet, fine grain		
							silty clay, orange, stiff, damp		
90		100					silty clay, dark grey		
95									0.0
100							Boring terminated at 97-feet		



PROJECT NUMBER 334469	BORING NUMBER MW-190
SOIL BORING LOG	

PROJECT : PRB Implementation Study

LOCATION : Memphis Depot

ELEVATION : DRILLING CONTRACTOR : Prosonic

DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)

WATER LEVELS : START 3/23/2006 END: 3/24/2006 LOGGER Mike Karafa

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (%)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION Corrected FID (ppm)
5	100				Silt, brown, roots, grass, dry	0.0
					Silt brown, loess, loose, dry	
10	100				silt brown, loess, stiff, damp to wet	3.4
15						0.0
20	100					0.0
25						
30	100				Silty sand, brown with grey and red and yellow sand, fine grain, stiff, gravel up to 1/2"	
35						
					silty sand, reddish orange, fine to coarse grain, loose to sticky, gravel up to 1/2"	0.0



PROJECT NUMBER 334469	BORING NUMBER MW-190
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION : Memphis Depot
 ELEVATION : DRILLING CONTRACTOR : Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START : 3/23/2006 END : 3/24/2006 LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)		STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
	RECOVERY (%)	#/TYPE			
40	100			gravely sand, reddish orange, loose, damp, fine to coarse grain, gravel up to 3/4"	0.0
45					
50	100			gravely sand, tan, loose, dry, fine to medium grain, gravel up to 1.5"	0.0
55					
60	100			sand, tan, fine grain, loose, dry, gravel pea size up to 1/2" diameter	0.0
65					
				sand, light grey, fine grain, loose, dry, gravel up to 1/2"	
				sand, orange, fine to medium grain, loose, dry, gravel up to 3/4" diameter	0.0
70	100				
				clay, red, stiff, dry	
				sand, reddish brown, fine to coarse grain, loose, gravel and cobbles up to 5"	
				sand, orangish tan, fine grain, loose dry	



PROJECT NUMBER 334469	BORING NUMBER MW-190
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION : Memphis Depot
 ELEVATION : DRILLING CONTRACTOR : Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START : 3/23/2006 END : 3/24/2006 LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)		STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION Corrected FID (ppm)
	RECOVERY (%)	#/TYPE			
75					
80				sandy clay, orange, stiff, fine grain, dry to damp sand orange, fine to medium grain, loose, damp to we	0.0
85				sand, orange, fine to coarse grain, loose, saturated	
90				clayey sand, orange, fine to coarse grain, sticky, saturated	
95				silty clay, orange with grey, stiff, damp	0.0
100				clay sand, orange, fine to medium grain, wet with grey cla	
105				silty clay, dark grey, massive damp	
110				Boring terminated at 97-feet	



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PROJECT NUMBER 334469	BORING NUMBER MW-191
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION Memphis Depot
 ELEVATION DRILLING CONTRACTOR Prosonic
 DRILLING METHOD AND EQUIPMENT USED Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START 3/22/2006 END 3/22/2006 LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (%)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION Corrected FID (ppm)
5	100				silt, brown, roots, wet	0.0
					Silt, brown, fine grain loess, stiff, damp	
					silt brown, fine grain, dry loess	
					silt brown, fine grain, stiff, damp	
10	100					
15						
20	100					
25					silt, some sand, brown, fine grain, damp	1.4
					silt, sand, brown with grey sand, stiff, damp, fine grain, gravel up to 1/4"	54.0
30	100				sand, some silt, reddish orange, loose, damp fine to coarse grain gravel up to 1/2"	
35					sand, orange, fine to coarse grain, loose, dry, some pea size gravel	



CH2MHILL

PROJECT NUMBER 334469	BORING NUMBER MW-191
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION : Memphis Depot
 ELEVATION : DRILLING CONTRACTOR Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START 3/22/2006 END 3/22/2006 LOGGER Mike Karafa

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (%)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION Corrected FID (ppm)
40	100				sand, fine to coarse grain, loose, dry, gravel from 46 to 47, pea size to 1/2"	10.1
45						6.8
50	50				gravelly sand, very coarse grain, loose, pea size to 1/2", fine grain sand tan loose sand, reddish orange, fine grain, loose, damp	0.0
55						
60	100				sand, reddish orange, fine to medium grain, loose, damp	
65					sand, some silt, tan, very fine grain, loose, dry, some pea size gravel	0.0
70	100				sand, orangish tan, fine to medium grain, loose, damp, up to 1/2" gravel	0.0
					sand, light tan, loose, fine grain, dry	
					sand, orange, fine grain, loose, damp	



PROJECT NUMBER
334469

BORING NUMBER MW-191

SOIL BORING LOG

PROJECT PRB Implementation Study

LOCATION : Memphis Depot

ELEVATION .

DRILLING CONTRACTOR : Prosonic

DRILLING METHOD AND EQUIPMENT USED	Rotasonic rig (4 inch sample casing / 6 inch outer casing)

WATER LEVELS:

START 3/22/2006

END 3/22/2006

LOGGER

Mike Karafa

DEPTH BELOW SURFACE (FT)				START		END		LOGGER		
INTERVAL (FT)				STANDARD PENETRATION TEST RESULTS		SOIL DESCRIPTION				
RECOVERY (%)				TEST RESULTS		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY				
#/TYPE				6"-6'-6"-6" (N)		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.				
						Corrected FID (ppm)				
75						sand, orange to tan, fine to medium grain, loose, damp to wet				1.2
						silty clay, orange with grey, stiff, damp				9.9
80			100							0.0
85										
						silty clay, dark grey, massive, damp Boring terminated at 87-feet				
90										
95										
100										
105										
110										



PROJECT NUMBER 334469	BORING NUMBER MW-192
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION Memphis Depot
 ELEVATION : DRILLING CONTRACTOR : Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START : 3/21/2006 END : 3/22/2006 LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
INTERVAL (FT)	RECOVERY (%)	#/TYPE	PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION	
			TEST			
			RESULTS			
			6"-6"-6"-6" (N)		Corrected FID (ppm)	
5	100			silt brown, grass, roots, saturated	0.0	
				silt brown, stiff saturated		
				silt brown, stiff, dry, loess		
				silt brown, stiff, damp, loess with orange and grey silt		
	10	100				5.0
20	100			12.1		
25				17.8		
30	100		silt, sand, brown with grey sand, stiff, damp, fine grain, gravel up to 1/4"	0.0		
			gravelly sand, reddish orange, some silt, loose, fine to coarse grain, damp to wet			
35			gravelly sand, orange, fine to coarse grain, loose damp gravel up to 1.5" diameter			



CH2MHILL

PROJECT NUMBER 334469	BORING NUMBER MW-192
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION : Memphis Depot
 ELEVATION : DRILLING CONTRACTOR : Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START : 3/21/2006 END : 3/22/2006 LOGGER : Mike Karafa

DEPTH BELOW SURFACE (FT)		INTERVAL (FT)		STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. Corrected FID (ppm)
		RECOVERY (%)	#/TYPE			
40		100				0.0
45					sand, reddish orange, fine to medium grain, loose damp sand, light tan, fine grain, loose, dry	
					gravelly sand, fine grain, loose, gravel up to 1/5" diameter	
50		100			gravelly sand, orangish tan, fine to coarse grain, loose dry, gravel pea size up to 3/8"	
55					sand, light tan, fine grain, loose, dry	0.0
60		75			sand, tannish brown, fine grain, loose, dry	
					sand, orangish brown, fine to medium grain, loose damp gravel	0.0
65					sand, light tan, fine grain, loose, dry, gravel	
70		75				10.1



CH2MHILL

PROJECT NUMBER 334469	BORING NUMBER MW-192
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION Memphis Depot
 ELEVATION : DRILLING CONTRACTOR Prosonic
 DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START 3/21/2006 END 3/22/2006 LOGGER Mike Karafa

DEPTH BELOW SURFACE (FT)		STANDARD PENETRATION TEST RESULTS		SOIL DESCRIPTION	COMMENTS
INTERVAL (FT)	RECOVERY (%)	#/TYPE		6"-6"-6"-6" (N)	
				SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
					Corrected FID (ppm)
75					
				sand, orange, fine to coarse grain, loose, wet, some gravel	
				silty clay, orange, stiff, damp, grey	0.0
80		100			
85				clay, dark grey, massive, damp	
				Boring terminated at 87-feet	

BORING NUMBER MW-193

SOIL BORING LOG

LOCATION · Memphis Depot

DRILLING CONTRACTOR • Prosonic

DRILLING METHOD AND EQUIPMENT USED : Rotasonic rig (4 inch sample casing / 6 inch outer casing)

WATER LEVELS :

START

3/16/2006

END.

3/20/2006

LOGGE

Mike Karpis

DEPTH BELOW SURFACE (FT)			STANDARD PENETRATION TEST RESULTS		SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	RECOVERY (%)	#/TYPE	6"-8"-8"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0					grass, roots, soil, silty	Corrected FID (ppm) 0.0
5	100				silt, brown, loose, dry, fine grain loess	The original location was abandoned. Therefore the soil boring information will be used from the first attempt up to 57-feet bgs and from the second attempt on from there. This is due to the second location being 5-feet from the first and nothing was logged up to 57-feet during the second attempt.
10	100				silt, brown, loess, stiff, damp	0.0
15						0.0
20	100					
25						
30	100				silty sand, orangish brown, stiff, damp, fine grain	
35					silty sand, orangish red, loose to sticky, coarse grain, gravel up to 1/2"	3.5
					sand, tan, fine to coarse grain, loose, damp, gravel up to 3/4"	



CH2MHILL

PROJECT NUMBER 334469	BORING NUMBER MW-193
SOIL BORING LOG	

PROJECT : PRB Implementation Study LOCATION Memphis Depot
 ELEVATION : DRILLING CONTRACTOR Prosonic
 DRILLING METHOD AND EQUIPMENT USED Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS : START : 3/16/2006 END 3/20/2006 LOGGER Mike Karafa

DEPTH BELOW SURFACE (FT)				STANDARD		SOIL DESCRIPTION		LOGGERS		COMMENTS	
INTERVAL (FT)				PENETRATION		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION		Corrected FID (ppm)	
RECOVERY (%)				TEST RESULTS							
#/TYPE				6"-6"-6"-6" (N)							
40		85					sand, tan, fine to medium grain, loose, dry, pea size gravel			0.0	
45											
							sand, light tan, very fine grain, loose, dry				
							sand, orangish tan, dry loose, fine to coarse grain, gravel up to 3/4				
50		100									
							sand, light tan, very fine grain, loose, dry, pea size gravel			0.0	
55											
							sand, orangish tan, fine to medium grain, loose, dry, gravel pea size up to 1/2			0.0	
60		100									
65											
70		100					sand, orange, damp, fine grain, loose			0.0	



CH2MHILL

PROJECT NUMBER 334469	BORING NUMBER MW-193
SOIL BORING LOG	

PROJECT PRB Implementation Study LOCATION Memphis Depot
 ELEVATION DRILLING CONTRACTOR Prosonic
 DRILLING METHOD AND EQUIPMENT USED Rotasonic rig (4 inch sample casing / 6 inch outer casing)
 WATER LEVELS: START 3/16/2006 END 3/20/2006 LOGGER Mike Karafa

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (%)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
75					sand, orange, fine to coarse grain, loose, damp to wet, gravel up to 1/2"	
80					sand, orange, fine to coarse grain, loose, pea size gravel, saturate	0.0
85					silty clay, orange, stiff, damp, grey silty clay mottles	
90					Boring terminated at 88-feet	
95						
100						
105						
110						



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

MW-196C

SHEET 1 of 1

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A Marshall

DRILLING METHOD/EQUIPMENT : Rotasonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK N/A

TOTAL DEPTH OF BORING : 80 ft-bgs

WATER LEVELS : START 8/31/2006 END 8/31/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)	STANDARD			SOIL DESCRIPTION	COMMENTS
	SAMPLE INTERVAL (FT)		PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	RECOVERY (FT)	#/TYPE			
0 1 <					

TD @ 80 FT-BGS

Confirmation Boring Logs

- CB-1
- CB-2
- CB-3 (MW-196)
- CB-4 (MW-195)
- CB-5 (MW-194)
- CB-6
- CB-7 (MW-196B)
- CB-8
- CB-9

**CH2MHILL**
 PROJECT NUMBER
 334469.TS.PB

 BORING NUMBER
 CB-1

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION:
 DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : D. Wilcox
 DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6"
 OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A TOTAL DEPTH OF BORING : 86 ft-bgs
 WATER LEVELS : START : 6/5/2006 END : 6/5/2006 LOGGER Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)			STANDARD	SOIL DESCRIPTION	COMMENTS
	RECOVERY (FT)	#/TYPE	PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	
			TEST RESULTS			
			6"-6"-6" (N)			
0-6	6/6	N/A	N/A	0-6: Silt brown, moist, moderately stiff, yellowish tint	FID = 0.0	
6-16	10/10	N/A	N/A	6-24: Yellow brown, silt, moist, stiff	FID = 0.0	
16-26	10/10	N/A	N/A	24-26: Sandy clay	FID = 0.0	



CH2MHILL

 PROJECT NUMBER
 334469.TS.PB

 BORING NUMBER
 CB-1

SHEET 2 of 3

SOIL BORING LOG

PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION :
 DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : D. Wilcox
 DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6"
 OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A TOTAL DEPTH OF BORING : 86 ft-bgs
 WATER LEVELS : START : 6/5/2006 END : 6/5/2006 LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)		PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
			#/TYPE	TEST RESULTS 6"-6'-6" (N)		
26-36	10/10	N/A	N/A	N/A		
36-46	10/10	N/A	N/A	N/A	40-45: Orange/yellow, brown, clayey sand, slightly moist, fairly soft 45-46: Orange, yellow, sand, dry, very soft	FID = 0.0
46-56	10/10	N/A	N/A	N/A	46-56: Orange, yellow, clayey sand with gravel, dry	FID @ 50': 0 FID @ 53': 27.1



CH2MHILL

 PROJECT NUMBER
 334469.TS.PB

 BORING NUMBER
 CB-1

SHEET 3 of 3

SOIL BORING LOG

PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION :
 DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : D. Wilcox
 DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6"
 OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A TOTAL DEPTH OF BORING : 86 ft-bgs
 WATER LEVELS : START : 6/5/2006 END : 6/5/2006 LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST		
#/TYPE				RESULTS		
				6"-6"-6" (N)		
65	56-66	10/10	N/A	N/A		
70	66-76	5/10	N/A	N/A	66-68 Orange, clayey sand, dry 68-69: Yellow, orange, clayey sand with dark deposits 70-74: Orange, clayey sand, dry	FID = 0.0
75						
80	76-86	10/10	N/A	N/A	75-86: Yellow, clay, stiff	FID = 0.0



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-2

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : D. Wilcox

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 86 ft-bgs

WATER LEVELS : START : 6/5/2006 END : 6/5/2006

LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)		PENETRATION		
			#/TYPE	TEST RESULTS	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
				6"-6"-6" (N)		
0-6	6/6	N/A	N/A	N/A	0-6: Silt, brown, moist, moderately stiff	FID @ 3'= 10.0 FID @ 6'= 0.0
6-16	10/10	N/A	N/A	N/A	6-16: Silt brown w/ clay, moist, stiff	FID @ 10'= 0.0 FID @ 16'= 0.0
16-26	10/10	N/A	N/A	N/A	16-26: Yellowish brown, silty clay, moist, stiff	FID @ 20'= 0.0 FID @ 24'= 0.0



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-2

SHEET 2 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : D. Wilcox

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 86 ft-bgs

WATER LEVELS : START : 6/5/2006 END : 6/5/2006

LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)		PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
				TEST RESULTS		
				6"-8"-6" (N)		
35	26-36	10/10	N/A	N/A		
40	36-46	9/10	N/A	N/A	36-43: Orange/grey, clayey sand with gravel, fairly dry 43-46: Yellow/grey, sand, very dry, soft, little gravel	FID = 0.0
45						
50	46-56	9/10	N/A	N/A	46-47: Yellow/orange, clayey sand w/ gravel 47-48: Orange/yellow, grey clayey sand 48-55: Orange/yellow, clayey sand with gravel 55-56: Orange clayey sand, dry, soft	FID = 0.0



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-2

SHEET 3 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : D. Wilcox

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 86 ft-bgs

WATER LEVELS :

START : 6/5/2006

END :

6/5/2006

LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST RESULTS		
#/TYPE				6"-6"-6" (N)		
65	56-66	10/10	N/A	N/A		
70					66-68: SEE ABOVE 68-74: black iron fillings with few sand fines 75-78: orange/yellow, sandy clay with gravel 78-86: stiff orange-brown clay, slightly moist	saving 66- ~80 of this run
75	66-86	20/20	N/A	N/A		
80						

 CH2MHILL	PROJECT NUMBER 334469.TS.PB	BORING NUMBER CB-3	SHEET 1 of 3
	SOIL BORING LOG		

PROJECT : Memphis Depot	LOCATION : Memphis, Tennessee	ELEVATION:
DRILLING CONTRACTOR : Prosonic / MEM		NAME OF DRILLER : D Wilcox
DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)		SIZE/TYPE OF BIT : 4 X 6"
OVERBURDEN THICKNESS :	DEPTH DRILLED INTO ROCK : N/A	TOTAL DEPTH OF BORING : 86 ft-bgs
WATER LEVELS :	START : 6/6/2006	END : 6/6/2006
		LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
5	0-6	6/6	N/A	N/A	0-28: brown silt, slightly moist, moderately stiff, yellowish tint, orange/yellow tint	
10	6-16	10/10	N/A	N/A		
15						
20	16-26	10/10	N/A	N/A		

**CH2MHILL**

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-3

SHEET 2 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : D. Wilcox

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 86 ft-bgs

WATER LEVELS :

START : 6/6/2006

END : 6/6/2006

LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION		COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)		PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
			#/TYPE	TEST RESULTS 6"-6"-6" (N)			
26-36	10/10	N/A	N/A	N/A			
36-46	9/10	N/A	N/A	N/A	44-46: orange/yellow sand, very soft, dry		
46-56	6/10	N/A	N/A	N/A	46-56: orange clayey sand, with lots of grey gravel, dry, soft		

**CH2MHILL**

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-3

SHEET 3 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : D. Wilcox

DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 86 ft-bgs

WATER LEVELS :

START : 6/6/2006

END :

6/6/2006

LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST RESULTS		
#/TYPE				6"-6"-6" (N)		
56-66	5/10	N/A	N/A	N/A	66-67: layer of stiffer dark orange, sandy clay 67-70: orange, yellow grey sand, dry, soft 70-73: orange/grey sand with iron intermingled, 50/50 to solid 73-76: orange, silty sand 76-86: orange brown clay []	[] - word is illegible
66-86	20/20	N/A	N/A	N/A		



CH2MHILL

 PROJECT NUMBER
 334469.TS.PB

 BORING NUMBER
 CB-4

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION :
 DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : D. Wilcox
 DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6"
 OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A TOTAL DEPTH OF BORING : 86 ft-bgs
 WATER LEVELS : START : 6/6/2006 END : 6/6/2006 LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)		PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
				TEST RESULTS		
				6"-6"-6" (N)		
0-6	6/6	N/A	N/A	N/A	0-27: brown silt, slightly moist, moderately stiff, yellowish tint, orange tint	
6-16	10/10	N/A	N/A	N/A		
16-26	10/10	N/A	N/A	N/A		

 CH2MHILL	PROJECT NUMBER 334469.TS.PB	BORING NUMBER CB-4	SHEET 2 of 3			
	SOIL BORING LOG					
PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION: _____ DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : D Wilcox DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6" OVERBURDEN THICKNESS : _____ DEPTH DRILLED INTO ROCK : N/A TOTAL DEPTH OF BORING : 86 ft-bgs WATER LEVELS : _____ START : 6/6/2006 END : 6/6/2006 LOGGER : Katherine Clarke/ATL						
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
35	26-36	10/10	N/A	N/A		
40	36-46	10/10	N/A	N/A	40-44: more grey 44-46: yellow grey, sand, very soft, dry	
45						
50	46-56	8/10	N/A	N/A	46-54: orange grey, sand, gravel, dry, very soft 54-56: yellow orange sand, few greavel, dry, very soft	

 CH2MHILL	PROJECT NUMBER 334469.TS.PB	BORING NUMBER CB-4	SHEET 3 of 3			
	SOIL BORING LOG					
PROJECT : Memphis Depot		LOCATION : Memphis, Tennessee				
DRILLING CONTRACTOR : Prosonic / MEM		ELEVATION: _____				
DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)		NAME OF DRILLER : D. Wilcox				
OVERBURDEN THICKNESS : _____		SIZE/TYPE OF BIT : 4 X 6"				
WATER LEVELS : _____		TOTAL DEPTH OF BORING : 86 ft-bgs				
START : 6/6/2006		END : 6/6/2006				
LOGGER : Katherine Clarke/ATL						
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
65	56-66	10/10	N/A	N/A		
70					66-72: orange grey sand with little gravel 72-77: iron/black material (driller lost about 3 ft during bag loading) 77-82: orange, clayey sand, dry, somewhat soft 82-86: orange, brown, clay, stiff	
75	66-86	20/20	N/A	N/A		
80						

**CH2MHILL**

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-5

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : D. Wilcox

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 86 ft-bgs

WATER LEVELS : START : 6/7/2006 END : 6/7/2006

LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST RESULTS		
#/TYPE				6"-6"-6" (N)		
0-6	6/6	N/A	N/A	N/A	0-26: brown silt, slightly moist, moderately stiff	
6-16	10/10	N/A	N/A	N/A		
16-26	10/10	N/A	N/A	N/A		



CH2MHILL

PROJECT NUMBER
334469.TS.PBBORING NUMBER
CB-5

SHEET 2 of 3

SOIL BORING LOG

PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION:
 DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : D. Wilcox
 DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6"
 OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A TOTAL DEPTH OF BORING : 86 ft-bgs
 WATER LEVELS : START : 6/7/2006 END : 6/7/2006 LOGGER : Katherine Clarke/ATL

DEPTH BELOW SURFACE (FT)		STANDARD PENETRATION TEST RESULTS		SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)	RECOVERY (FT)	#/TYPE	TEST RESULTS	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
			6"-6"-6" (N)		
26-36	10/10	N/A	N/A		
36-46	10/10	N/A	N/A	36-40: orange/grey, gravelly sand, dry 40-42: orange/yellow gravelly sand, very dry 42-44: orange clayey, sand w/ bits of grey, dry, soft 44-46: yellow to yellow-white sand with small gravel pieces	
46-56	10/10	N/A	N/A	46-47: orange/grey, clayey sand with gravel 47: 1/4 foot of grey-white sand with gravel, very soft, dry 47-50: orange, yellow, grey, sand with gravel 50-54: orange w/ yellow, clayey sand with gravel 54-55: yellow w/ little orange, dry sand 55: 1/4 foot of black sand 55-66: orange sand, few gravel, dry bits of grey sand	

SHEET 3 of 3

PROJECT : Memphis Depot	LOCATION : Memphis, Tennessee	ELEVATION :
DRILLING CONTRACTOR : Prosonic / MEM		NAME OF DRILLER : D. Wilcox
DRILLING METHOD/EQUIPMENT. Prosonic (4" Corebarrel and 6" Outer casing)		SIZE/TYPE OF BIT : 4 X 6"
OVERBURDEN THICKNESS :	DEPTH DRILLED INTO ROCK : N/A	TOTAL DEPTH OF BORING : 86 ft-bgs
WATER LEVELS :	START : 6/7/2006	LOGGER : Katherine Clarke/ATL
	END : 6/7/2006	

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
	SAMPLE INTERVAL (FT)	RECOVERY (FT)	#/TYPE			
65	56-66	10/10	N/A	N/A		
70	66-76	5/10	N/A	N/A	66-72. orange/yellow/grey sand 72-74: dark orange sand	
75						
80	76-86	10/10	N/A	N/A	76-84. wet orange/yellow sandy clay, soft with gravel 84-86. orange/brown clay, moist, very stiff	



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-6

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A. Marshall

DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 85 ft-bgs

WATER LEVELS :

START : 9/1/2006

END :

9/1/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST RESULTS		
#/TYPE				6"-6'-6" (N)		
5	0-15	15 / 15	C-1	N/A	0.0-0.5' ROUNDED GRAVEL (GP), reddish brown, dry, hard 0.5-6.5: CLAY (CL), strong brown, dry, firm to somewhat brittle, common distinct medium light brown mottling 6.5-15.0: CLAY (CL), strong brown, slightly moist, soft	
15						
20	15-25	10 / 10	C-2	N/A	15.0-16.2: AS ABOVE 16.2-20.5: SLIGHTLY SILTY CLAY (CL), brown to light brown, slightly moist, firm, common distinct medium orange mottles 20.5-25.0: AS ABOVE, no orange mottles, silt content increasing with depth	



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-6

SHEET 2 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A. Marshall

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 85 ft-bgs

WATER LEVELS : START : 9/1/2006 END 9/1/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)	#/TYPE	PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
				TEST RESULTS		
				6"-6'-6" (N)		
25-35	10 / 10	C-3	N/A			
35-45	10 / 10	C-4	N/A		35.0-40.6: AS ABOVE, ~75% sand 40.6-44.0: Well sorted sand (F-M) w/ some gravel (SP), reddish brown, slightly moist, loose, gravel up to 1", sub-rounded, chert, ~10% 44.0-45.0: FINE SAND (--), well sorted, pale brown to yellow, slightly moist, loose	
45-55	10 / 10	C-5	N/A		45.0-50.7: SILTY SAND (SM), medium, reddish brown to pale yellow, slightly moist, loose, some gravel, ~10%, sub-rounded, chert 50.7-52.5: FINE SAND (SP), well sorted, pale yellowish brown, slightly moist, loose 52.5-55.0: POORLY SORTED SAND W/ SOME GRAVEL (SW), coarse to medium grain, pale brown, slightly moist, loose, gravel up to 2", subangular	



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-6

SHEET 3 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A. Marshall

DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 85 ft-bgs

WATER LEVELS :

START : 9/1/2006

END :

9/1/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST RESULTS		
#/TYPE				6"-6"-6" (N)		
55-65	10 / 10	C-6	N/A			
65-80	5 / 15	C-7	N/A		65.0-67.8: AS ABOVE 67.8-68.6: IRON/SAND MIX, black, slightly moist, loose, clear contact 68.6-69.3: SAND (SP), pale reddish brown, moist, loose, trace gravel up to 1/2", subrounded 69.3-70.2: AS 67.8-68.6 70.2-72.0: AS 68.6-69.3, wet 72.0-73.0: AS 67.8-68.6, wet 73.0-75.5: AS 68.6-69.3, wet 75.5-85: CLAY (CL), reddish brown, firm, slightly moist, common fine distinct mottles	65-80: Lost bottom 10/15' of core going down to retrieve
80-85	5 / 5	C-8	N/A			80-85: Retrieved 70-80' from previous run



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-7

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A. Marshall

DRILLING METHOD/EQUIPMENT : Rotasonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 85 ft-bgs

WATER LEVELS :

START : 8/30/2006

END : 8/30/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION		COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST RESULTS			
#/TYPE				6"-6"-6" (N)			
0-15	5 / 15	C-1		N/A	0.0-2.5. CONCRETE GROUT, gray, v. hard to powdered, slightly moist (from extraction) 2.3-2.5. SOLID GROUT FRAG 2.5-5.0: CLAY/SAND/GRAVEL MIX, light brown to strong brown, slightly moist, soft to loose, see comments		0 0-15.0: Sampled through ~3-5-ft of grout abandonment from previous contractor. (Hayward Baker jet-grout hole #13) 2.3-2.5: This frag more than likely responsible for poor recovery, as it did not allow sample into corebarrel.
15-25	9 / 10	C-2		N/A	15 0-17.5: GROUT FRAG AND CLAY (GC), dark gray to brown, wet, firm to loose 17.5-24.0: SAND (SW), coarse to fine grain, poorly sorted, light reddish brown, dry, loose		

 CH2MHILL	PROJECT NUMBER 334469.TS.PB	BORING NUMBER CB-7	SHEET 2 of 3			
	SOIL BORING LOG					
PROJECT : Memphis Depot		LOCATION : Memphis, Tennessee				
DRILLING CONTRACTOR : Prosonic / MEM		ELEVATION:				
DRILLING METHOD/EQUIPMENT: Rotasonic (4" Corebarrel and 6" Outer casing)		NAME OF DRILLER : A. Marshall				
OVERBURDEN THICKNESS :		SIZE/TYPE OF BIT : 4 X 6"				
WATER LEVELS :		TOTAL DEPTH OF BORING : 85 ft-bgs				
START : 8/30/2006		END : 8/30/2006				
		LOGGER : Derek Miller/ORO				
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
35	25-35	8 1 / 10	C-3	N/A		
40	35-45	9.9 / 10	C-4	N/A	35.0-36.0. AS ABOVE 36.0-44.9: SAND W/ FEW IRON FILINGS. dark brown, dry, loose, sand coarse, fining down to medium w/ depth, iron content increasing w/ depth	35-45: Sample hot FIELD FE PARTICLE REACTIVITY RESULTS 36.0-36.5: (-) 36.5-37.0: (-) 37.0-37.5: (-) 37.5-38.0: (-) 38.0-38.5: (-) 38.5-39.0: (-) 39.0-39.5: (-) 39.5-40.0: (+) 40.0-40.5: (+) 40.5-41.0: (+) 41.0-41.5: (+) 41.5-42.0: (+) 42.0-42.5: (+) 42.5-43.0: (+) 43.0-43.5: (+) 43.5-44.0: (+) 44.0-44.5: (+) 44.5-45.0: (+)
45	45-55	10 / 10	C-5	N/A	45.0-55.0: AS ABOVE, coarsening down w/ increasing iron content, positive particle response for entire run	



CH2MHILL

PROJECT NUMBER
334469.TS.PBBORING NUMBER
CB-7

SHEET 3 of 3

SOIL BORING LOG

PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION :
 DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : A. Marshall
 DRILLING METHOD/EQUIPMENT : Rotasonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6"
 OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A TOTAL DEPTH OF BORING : 85 ft-bgs
 WATER LEVELS : START : 8/30/2006 END : 8/30/2006 LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST RESULTS		
#/TYPE				6"-6"-6" (N)		
55-65	10 / 10	C-6	N/A			
65-75	10 / 10	C-7	N/A		65.0-75.0: SAND (SP), coarse to medium grain, black, moist, loose, iron filings throughout, many little clay pockets throughout, ~10% up to 1" thick	
75-85	10 / 10	C-8	N/A		75.0-77.0: SAND (SP), medium grain, reddish brown to very dark grayish brown, wet, loose, does not react w/ magnet 77.0-81.7: CLAY (CL), reddish brown, slightly moist, firm 81.7-85.0: CLAY (CL), reddish brown, slightly moist, firm, common dark brown medium mottles throughout	



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-8

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A Marshall

DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 85 ft-bgs

WATER LEVELS : START : 8/30/2006 END : 8/30/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
RECOVERY (FT)				TEST		
#/TYPE				RESULTS		
				6"-6"-6" (N)		
5	0-15	13 / 15	C-1	N/A	0.0-13.0: SILTY CLAY (CL), strong brown, slightly moist, soft, surface gravel 0 0-0.5, rounded, up to 2", ~30%	
10						
15						
					15.0-18.2: AS ABOVE, no gravel	
20	15-25	10 / 10	C-2	N/A	18.2-25.0: SILTY CLAY (CL), strong brown, dry, firm, somewhat crumbly, common distinct coarse pale brown mottles throughout	



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-8

SHEET 2 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A. Marshall

DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 85 ft-bgs

WATER LEVELS : START : 8/30/2006 END : 8/30/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)		PENETRATION		
				TEST RESULTS	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
				6"-6"-6" (N)		
25-35	10 / 10	C-3	N/A			
35-45	10-Oct	C-4	N/A		35.0-37.4: SILTY CLAY WITH SOME GRAVEL (CL), reddish brown, firm, moist, gravel up to 1/2", subangular, ~20% 37.4-42.4: SILTY TO SL. CLAYEY SAND (SM), medium grain, firm, moist, gravel present, round, up to 1", ~10% 42.4-45.0: SAND W/ LITTLE GRAVEL (SW), medium grain, black to reddish brown, dry, loose, iron present throughout	
45-55	10 / 10	C-5	N/A		45.0-55.0: AS ABOVE, iron increasing w/ depth	



CH2MHILL

 PROJECT NUMBER
 334469.TS.PB

 BORING NUMBER
 CB-8

SHEET 3 of 3

SOIL BORING LOG

PROJECT : Memphis Depot LOCATION : Memphis, Tennessee ELEVATION :
 DRILLING CONTRACTOR : Prosonic / MEM NAME OF DRILLER : A. Marshall
 DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing) SIZE/TYPE OF BIT : 4 X 6"
 OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK N/A TOTAL DEPTH OF BORING : 85 ft-bgs
 WATER LEVELS : START : 8/30/2006 END : 8/30/2006 LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)		RECOVERY (FT)	#/TYPE	PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
				TEST RESULTS		
				6"-6"-6" (N)		
55-65	10 / 10	C-6	N/A			
65-80	15 / 15	C-7	N/A	65.0-77.5: AS ABOVE 77.5-80.0: SAND (SP), light brown, wet, loose, medium grain, NO IRON		
80-85	5 / 5	C-8	N/A	80-82.0: AS ABOVE 82.0-85.0: CLAY (CL), reddish brown, slightly moist, firm, many prominent medium gray mottles throughout		

**CH2MHILL**

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-9

SHEET 1 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A. Marshall

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK N/A

TOTAL DEPTH OF BORING : 95 ft-bgs

WATER LEVELS : START 9/1/2006 END 9/1/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)				STANDARD	SOIL DESCRIPTION	COMMENTS
SAMPLE INTERVAL (FT)				PENETRATION	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
RECOVERY (FT)				TEST RESULTS		
#/TYPE				6"-6"-6" (N)		
5	0-15	14.4 / 15	C-1	N/A	0.0-11.0. SILTY CLAY (CL), strong brown, moist, soft to firm w/ depth 11 0-14.4. AS ABOVE, slightly moist, firm to crumbly	
15	15-25	10 / 10	C-2	N/A	15 0-25.0. AS ABOVE, common distinct medium pale brown mottles	
20						

 CH2MHILL	PROJECT NUMBER 334469.TS.PB	BORING NUMBER CB-9	SHEET 2 of 3			
	SOIL BORING LOG					
PROJECT : Memphis Depot		LOCATION : Memphis, Tennessee				
DRILLING CONTRACTOR : Prosonic / MEM		ELEVATION:				
DRILLING METHOD/EQUIPMENT : Prosonic (4" Corebarrel and 6" Outer casing)		NAME OF DRILLER : A. Marshall				
OVERBURDEN THICKNESS : N/A		SIZE/TYPE OF BIT : 4 X 6"				
WATER LEVELS : START : 9/1/2006 END : 9/1/2006		TOTAL DEPTH OF BORING : 95 ft-bgs				
		LOGGER : Derek Miller/ORO				
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
35	25-35	10 / 10	C-3	N/A		
40	35-45	10 / 10	C-4	N/A	35.0-37.3: AS ABOVE 37.3-41.6: SAND (SW), medium grain, slightly moist, loose, gravel up to 1/2", angular, ~20% 41.6-45.0: SAND (SP), fine grain, pale brown to pale reddish brown, dry, loose	
45					45.0-45.8: SILTY SAND (SM), reddish brown to grayish brown, slightly moist, loose, falls apart w/ slight finger pressure 45.8-53.0: SAND W/ SOME GRAVEL (SW), medium to fine grain, pale brown to reddish brown, slightly moist, loose, gravel up to 1/2-1", subangular, ~20% 53.0-55.0: SAND (SP), medium grain, reddish brown, slightly moist, loose, trace gravel up to 1/2", sub-rounded	
50	45-55	10 / 10	C-5	N/A		



CH2MHILL

PROJECT NUMBER

334469.TS.PB

BORING NUMBER

CB-9

SHEET 3 of 3

SOIL BORING LOG

PROJECT : Memphis Depot

LOCATION : Memphis, Tennessee

ELEVATION:

DRILLING CONTRACTOR : Prosonic / MEM

NAME OF DRILLER : A. Marshall

DRILLING METHOD/EQUIPMENT: Prosonic (4" Corebarrel and 6" Outer casing)

SIZE/TYPE OF BIT : 4 X 6"

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : N/A

TOTAL DEPTH OF BORING : 95 ft-bgs

WATER LEVELS :

START : 9/1/2006

END :

9/1/2006

LOGGER : Derek Miller/ORO

DEPTH BELOW SURFACE (FT)

STANDARD

SOIL DESCRIPTION

COMMENTS

SAMPLE INTERVAL (FT)

PENETRATION

RECOVERY (FT)

TEST

RESULTS

6"-6"-6"

(N)

SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.

DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.

55-65

10 / 10

C-6

N/A

65

65-75

10 / 10

C-7

N/A

70

75

75-85

8.4 / 10

C-8

N/A

80

65.0-71.0: SLIGHTLY SILTY SAND (SM), reddish brown to slightly greenish brown, moist, loose, gravel up to 2", sub-rounded, ~20%, medium grain sand

71.0-75.0: SAND (SP), reddish brown, slightly moist, loose

75.0-81.3: AS ABOVE, trace iron from 77.0-80.0

81.3-83.4: SAND AND IRON MIX, (SP), medium grain, black, moist, loose, clay nodules present, up to 1/4-1/2", ~5-10%

Monitoring Well Construction Diagrams

- MW-189
- MW-190
- MW-191
- MW-192
- MW-193
- MW-194
- MW-195
- MW-196
- MW-196B
- MW-196C

**CH2MHILL**

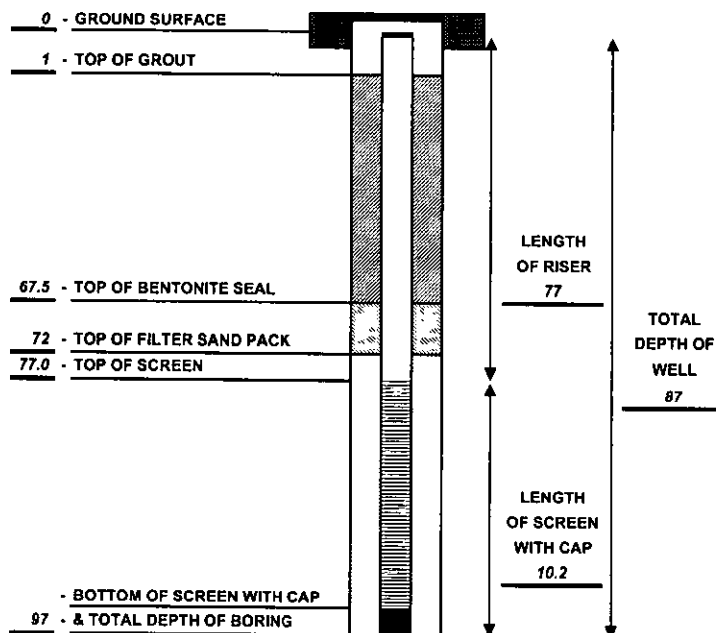
Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469.TS.PB	Northing	281115 989
Project Location	Memphis, TN	Start Date / Time	3/23/2006	Easting	801587 428
Well / Piezometer ID	MW-189	End Date / Time	3/23/2006		

Ground Surface Elevation		Static Water Level (ft btoc)	
Top of Casing Elevation	296.364	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	6.5 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	8'
		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Screen		Cement Type	Portland Type I/II
Diameter	2"	Manufacturer	Commercial Grade Quickrete
Material	Schedule 40 PVC	Amount Cement Used (Grout)	94-lb bag(s)
Slot Size	0.01	Density of Grout	Not measured
Drilling Technique	Rotosonic		
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	Drilling Contractor	Prosonic Corporation
Borehole Diameter	6"	CH2M HILL Field Representative	Michael Karafa

Remarks Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel



All measurements in feet
All depths in feet below ground surface

QA / QC

DRILLER: Mike Coleman

DISCREPANCIES: N/A

INSPECTOR: Michael Karafa

CHECKED BY: DATE:

**CH2MHILL**

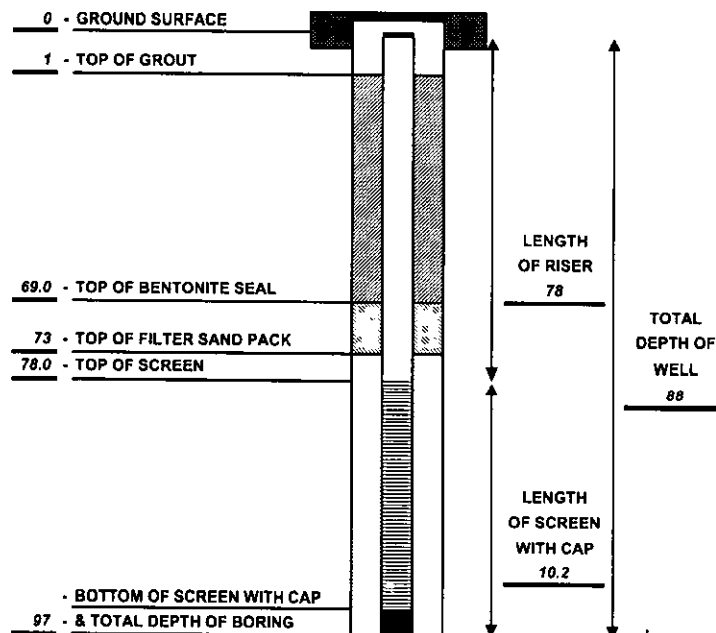
Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469.TS.PB	Northing	281138.875
Project Location	Memphis, TN	Start Date / Time	3/24/2006 0730	Easting	801595.732
Well / Piezometer ID	MW-190	End Date / Time	3/24/2006 1140		

Ground Surface Elevation	297.576	Static Water Level (ft btoc)	
Top of Casing Elevation	297.316	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	6.5 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	8'
		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Screen		Cement Type	Portland Type I/II
Diameter	2"	Manufacturer	Commercial Grade Quickrete
Material	Schedule 40 PVC	Amount Cement Used (Grout)	X 94-lb bag(s)
Slot Size	0.01	Density of Grout	Not measured
Drilling Technique	Rotosonic		
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	Drilling Contractor	Prosonic Corporation
Borehole Diameter	6"	CH2M HILL Field Representative	Michael Karafa

Remarks Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel



All measurements in feet
All depths in feet below ground surface

QA / QC

DRILLER: Mike Coleman

DISCREPANCIES: N/A

INSPECTOR: Michael Karafa

CHECKED BY: DATE:

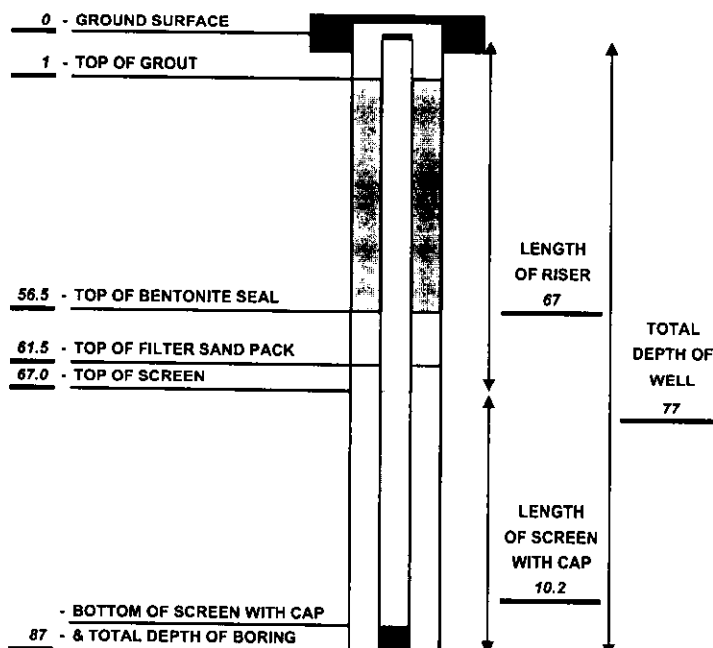
**CH2MHILL**

Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469 TS.PB	Northing	281133.678
Project Location	Memphis, TN	Start Date / Time	3/22/2006 1140	Easting	801546 91
Well / Piezometer ID	MW-191	End Date / Time	3/22/2006 1710		

Ground Surface Elevation	292.042	Static Water Level (ft btoc)	
Top of Casing Elevation	291.67	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	5 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	9'
Screen		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Diameter	2"	Cement Type	Portland Type I/II
Material	Schedule 40 PVC	Manufacturer	Commercial Grade Quickrete
Slot Size	0.01	Amount Cement Used (Grout)	X 94-lb bag(s)
Drilling Technique	Rotosonic	Density of Grout	Not measured
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	Drilling Contractor	Prosonic Corporation
Borehole Diameter	6"	CH2M HILL Field Representative	Michael Karafa
Remarks	Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel		



All measurements in feet
All depths in feet below ground surface

QA / QC

DRILLER: Mike Coleman

DISCREPANCIES: N/A

INSPECTOR: Michael Karafa

CHECKED BY:

DATE:

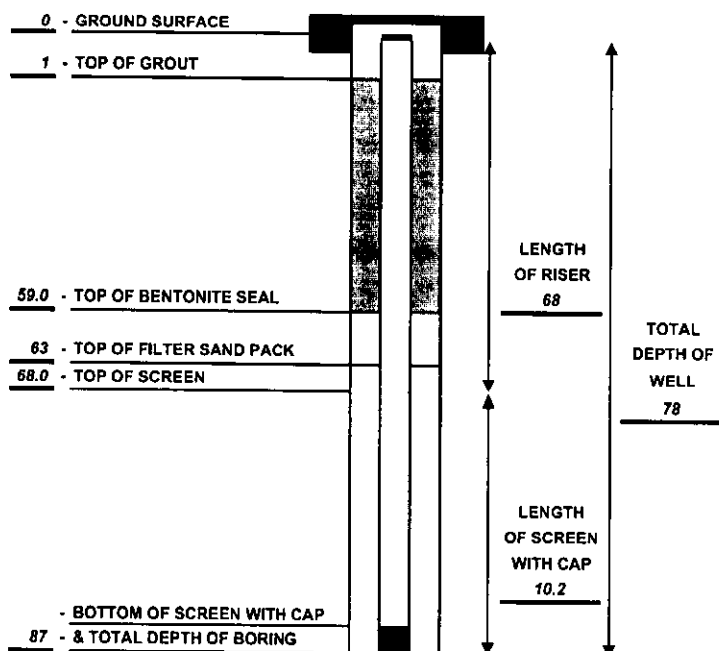
**CH2MHILL**

Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469.TS PB	Northing	281156.668
Project Location	Memphis, TN	Start Date / Time	3/21/2006 1340	Easting	801555.475
Well / Piezometer ID	MW-192	End Date / Time	3/22/2006 1055		

Ground Surface Elevation	293.558	Static Water Level (ft btoe)	
Top of Casing Elevation	293.075	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	1 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	8'
		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Screen		Cement Type	Portland Type I/II
Diameter	2"	Manufacturer	Commercial Grade Quickrete
Material	Schedule 40 PVC	Amount Cement Used (Grout)	1 X 94-lb bag(s)
Slot Size	0.01	Density of Grout	Not measured
Drilling Technique	Rotosonic	Drilling Contractor	Prosonic Corporation
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	CH2M HILL Field Representative	Michael Karafa
Borehole Diameter	6"		
Remarks	Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel		



All measurements in feet
All depths in feet below ground surface

QA / QC

DRILLER: Mike Coleman

DISCREPANCIES: N/A

INSPECTOR: Michael Karafa

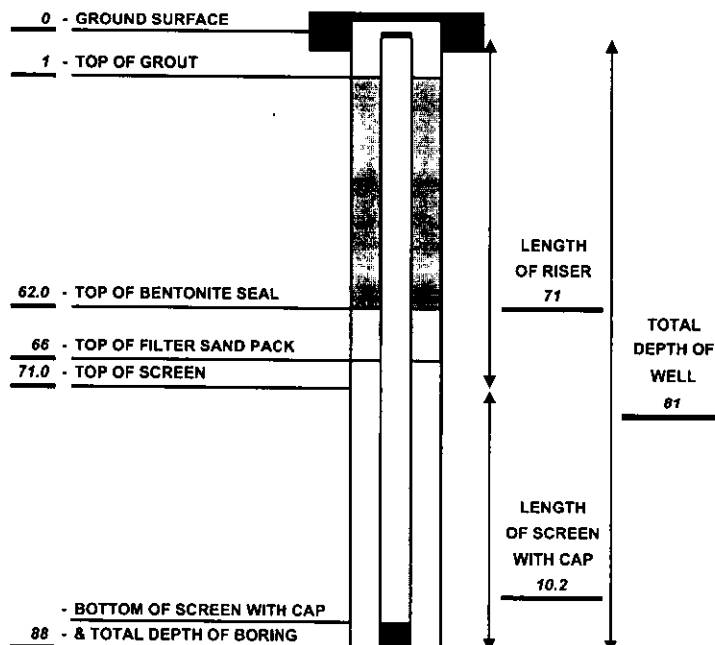
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DATE:

**CH2MHILL****Monitoring Well / Piezometer Completion Diagram***Flush Mount*

Project Name	Memphis Depot	Project Number	334469 TS.PB	Northing	281167 351
Project Location	Memphis, TN	Start Date / Time	3/20/2006 12:15	Easting	801531.899
Well / Piezometer ID	MW-193	End Date / Time	3/21/2006 11:12		

Ground Surface Elevation	293.644	Static Water Level (ft btoc)	
Top of Casing Elevation	293.281	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	5 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	6"
Screen		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Diameter	2"	Cement Type	Portland Type I/II
Material	Schedule 40 PVC	Manufacturer	Commercial Grade Quickrete
Slot Size	0.01	Amount Cement Used (Grout)	X 94-lb bag(s)
Drilling Technique	Rotosonic	Density of Grout	Not measured
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	Drilling Contractor	Prosonic Corporation
Borehole Diameter	6"	CH2M HILL Field Representative	Michael Karafa
Remarks	Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel		



All measurements in feet
All depths in feet below ground surface

QA / QC

DRILLER: Mike Coleman

DISCREPANCIES: N/A

INSPECTOR: Michael Karafa

CHECKED BY: DATE:

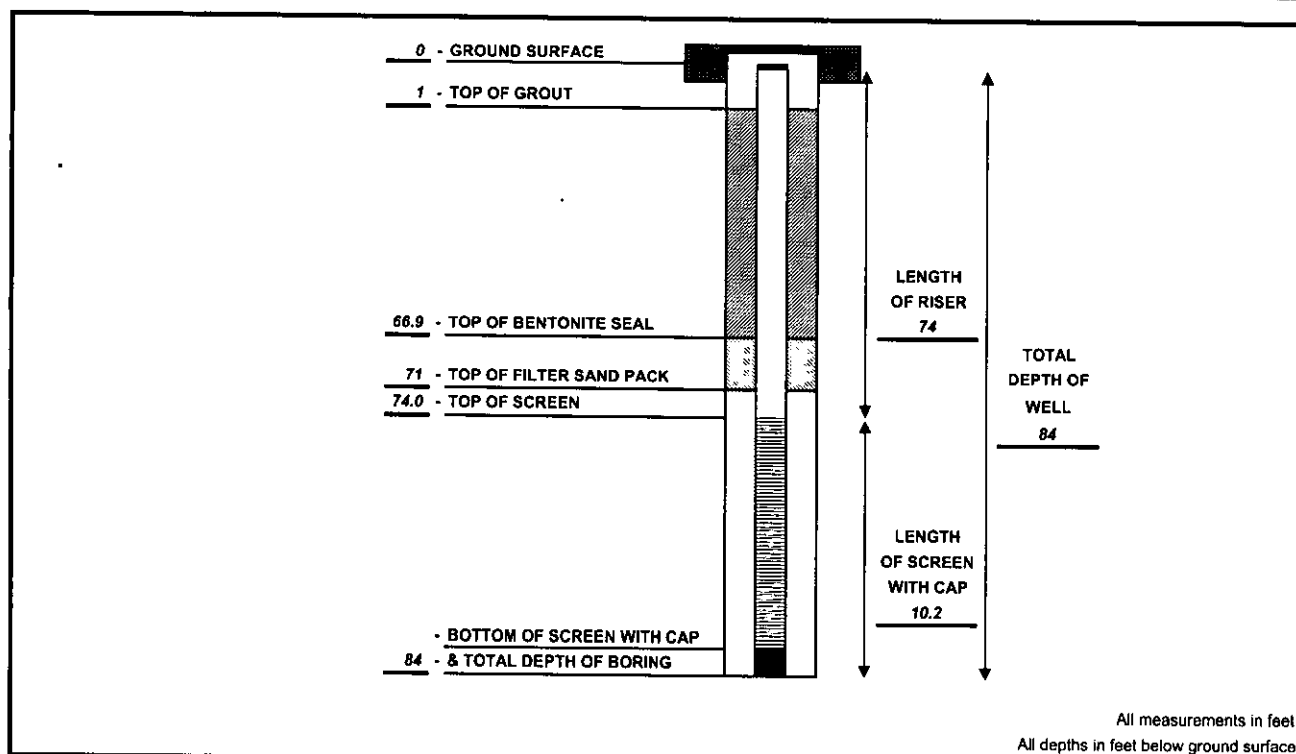
**CH2MHILL**

Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469.TS.PB	Northing	281115.71
Project Location	Memphis, TN	Start Date / Time	6/7/2006 1030	Easting	801567.74
Well / Piezometer ID	MW-194	End Date / Time	6/7/2006 1540		

Ground Surface Elevation	293.64	Static Water Level (ft btoc)	
Top of Casing Elevation	293.26	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	4 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	N/A
		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Screen		Cement Type	Portland Type I/II
Diameter	2"	Manufacturer	Commercial Grade Quickrete
Material	Schedule 40 PVC	Amount Cement Used (Grout)	X 94-lb bag(s)
Slot Size	0.01	Density of Grout	Not measured
Drilling Technique	Rotosonic		
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	Drilling Contractor	Prosonic Corporation
Borehole Diameter	6"	CH2M HILL Field Representative	Katherine Clarke
Remarks	Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel		



QA / QC

DRILLER: David Wilcox

DISCREPANCIES: N/A

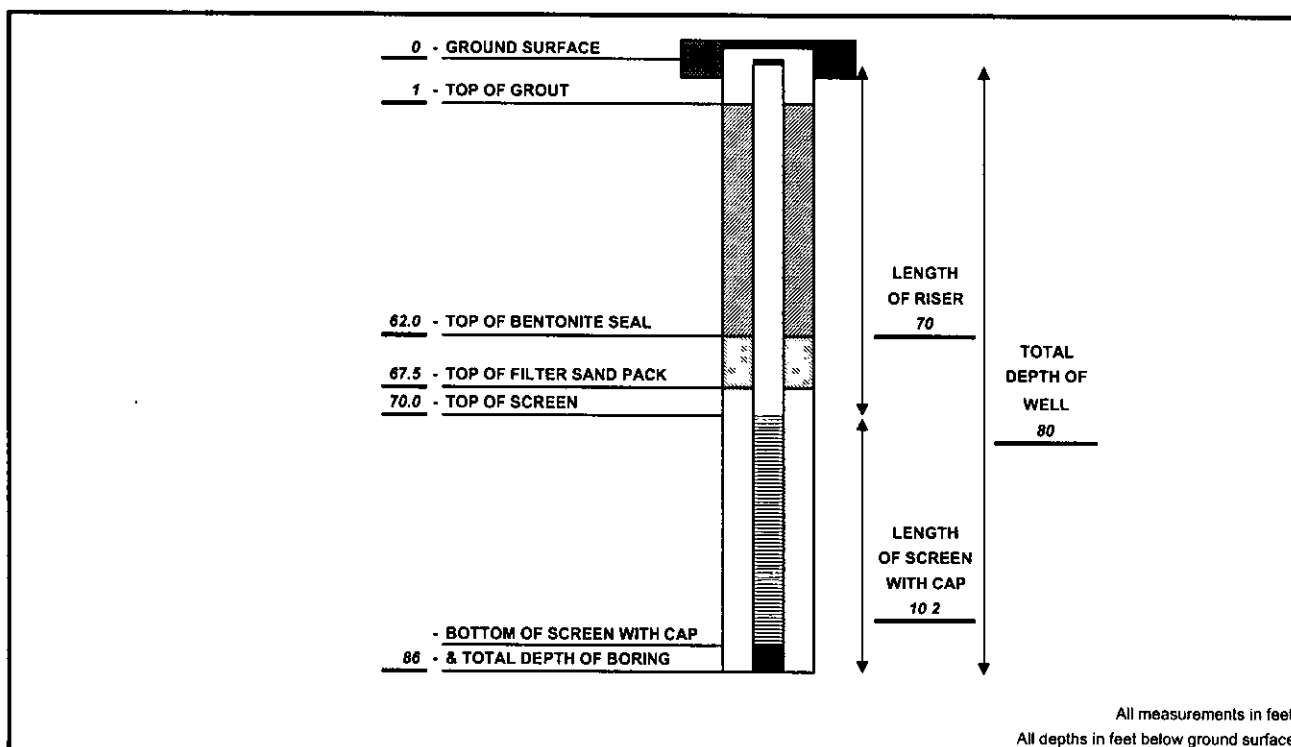
INSPECTOR: Katherine Clarke

CHECKED BY: DATE:

**CH2MHILL****Monitoring Well / Piezometer Completion Diagram***Flush Mount*

Project Name	Memphis Depot	Project Number	334469 TS PB	Northing	281139.31
Project Location	Memphis, TN	Start Date / Time	6/6/2006 1545	Easting	801566.63
Well / Piezometer ID	MW-195	End Date / Time	6/7/2006 0930		

Ground Surface Elevation	294.3	Static Water Level (ft btoc)	
Top of Casing Elevation	293.89	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	5 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	N/A
Screen		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Diameter	2"	Cement Type	Portland Type I/II
Material	Schedule 40 PVC	Manufacturer	Commercial Grade Quickcrete
Slot Size	0.01	Amount Cement Used (Grout)	X 94-lb bag(s)
Drilling Technique	Rotosonic	Density of Grout	Not measured
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	Drilling Contractor	Prosonic Corporation
Borehole Diameter	6"	CH2M HILL Field Representative	Katherine Clarke
Remarks	Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel		



QA / QC

DRILLER: David Wilcox

DISCREPANCIES: N/A

INSPECTOR: Katherine Clarke

CHECKED BY: DATE:

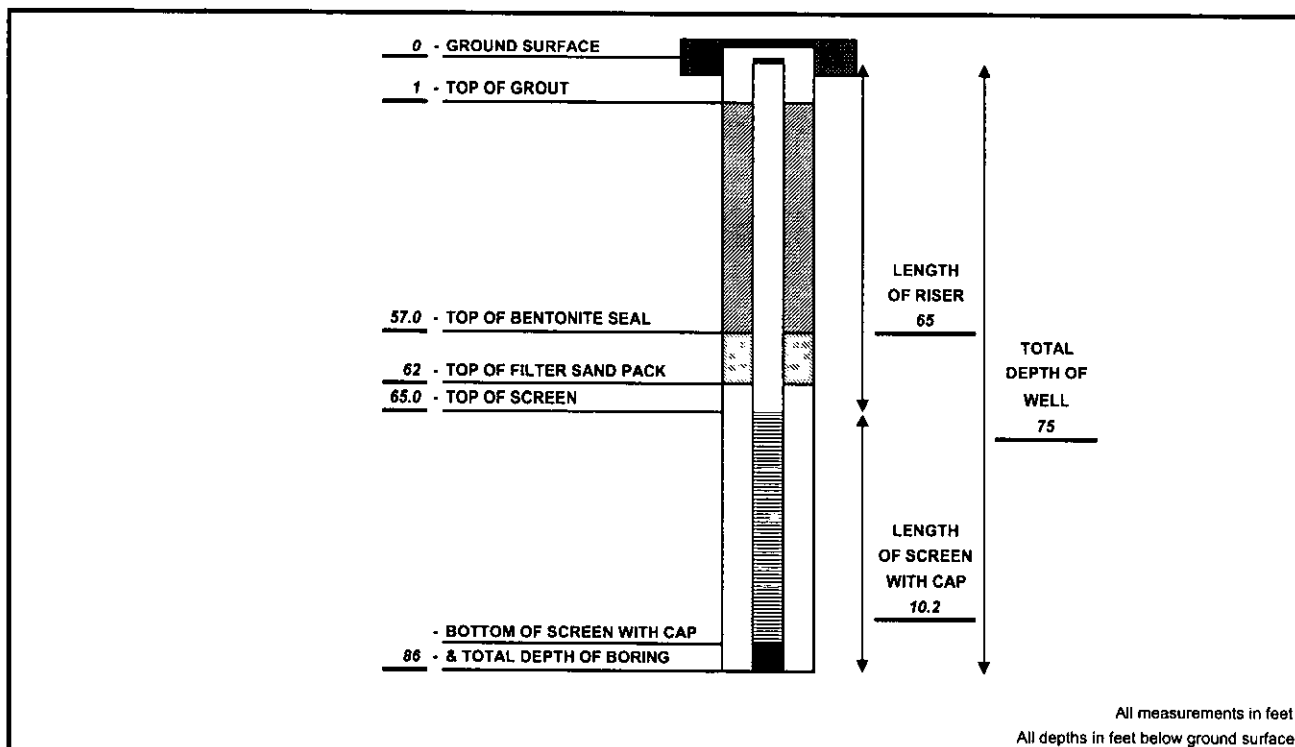
**CH2MHILL**

Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469.TS PB	Northing	281145.94
Project Location	Memphis, TN	Start Date / Time	6/6/2006 0840	Easting	801576.2
Well / Piezometer ID	MW-196	End Date / Time	6/6/2006 1505		

Ground Surface Elevation	294.95	Static Water Level (ft btoc)	
Top of Casing Elevation	295.3	Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	Regal Fill
Drain Tube	N	Amount Sand Used	4 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	Hole Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	N/A
		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Screen		Cement Type	Portland Type I/II
Diameter	2"	Manufacturer	Commercial Grade Quickrete
Material	Schedule 40 PVC	Amount Cement Used (Grout)	X 94-lb bag(s)
Slot Size	0.01	Density of Grout	Not measured
Drilling Technique	Rotosonic	Drilling Contractor	Prosonic Corporation
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	CH2M HILL Field Representative	Katherine Clarke
Borehole Diameter	6"		
Remarks	Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel		



QA / QC	DRILLER:	David Wilcox	INSPECTOR:	Katherine Clarke
	DISCREPANCIES:	N/A	CHECKED BY:	DATE:

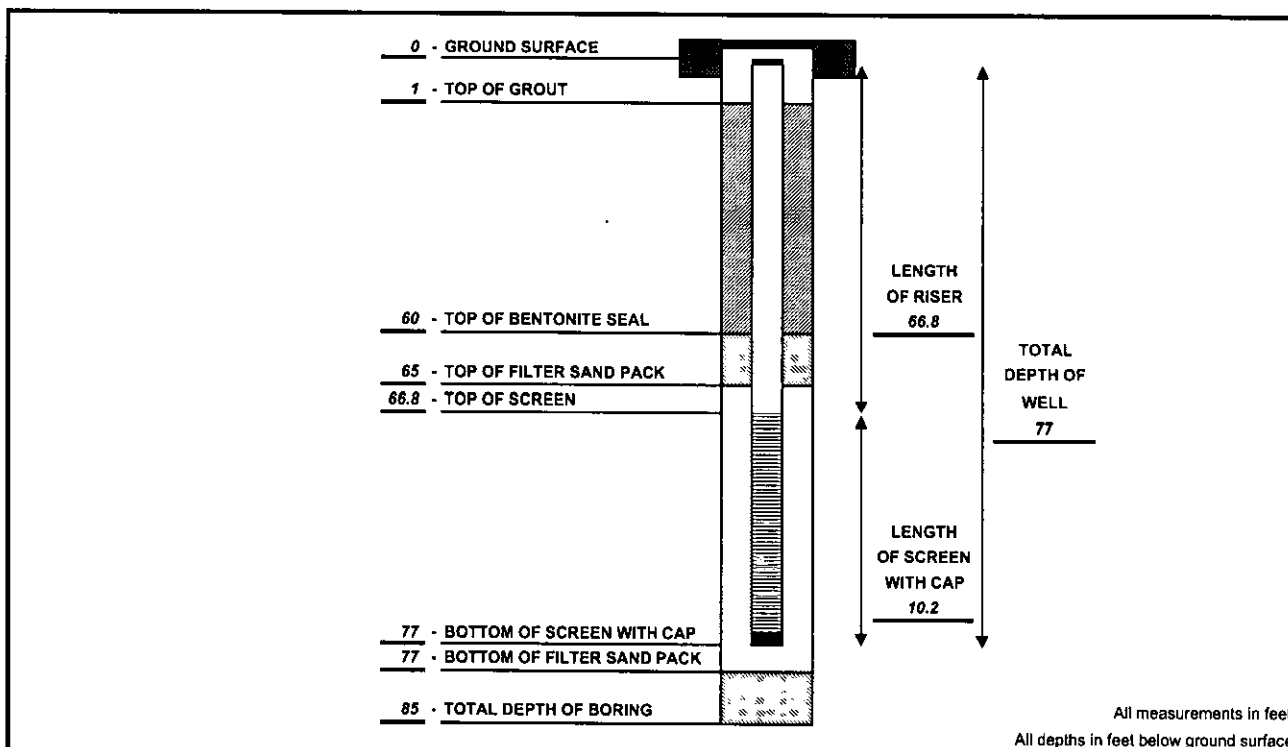
**CH2MHILL**

Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469.TS.PB	Northing	
Project Location	Memphis, TN	Start Date / Time	8/30/2006 15:40	Easting	
Well / Piezometer ID	MW-196B	End Date / Time	8/30/2006 17:00		

Ground Surface Elevation		Static Water Level (ft btoc)	
Top of Casing Elevation		Measured On	
Concrete Pad		Filter Pack Type	Filter Sand
Dimensions	3 x 3 ft	Manufacturer	FilterSil Industrial Quartz
Drain Tube	N	Amount Sand Used	5 X 50-lb bag(s)
Well Casing		Bentonite Type	3/8" chips
Diameter	2"	Manufacturer	DSI Shur-Plug
Material	Schedule 40 PVC	Amount Bentonite Below Screen	1 X 50-lb bag(s)
Screen		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Diameter	2"	Cement Type	Portland Type I/II
Material	Schedule 40 PVC	Manufacturer	Commercial Grade Quickrete
Slot Size	0.01	Amount Cement Used (Grout)	6 X 94-lb bag(s)
Drilling Technique	Rotosonic	Density of Grout	Not measured
Auger/Bit Size and Type	4" Core Barrel / 6" Casing	Drilling Contractor	Prosonic Corporation
Borehole Diameter	6"	CH2M HILL Field Representative	Derek Miller
Remarks	Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel		



QA / QC

 DRILLER: A. Marshall
 DISCREPANCIES: N/A

 INSPECTOR: Derek Miller
 CHECKED BY: D. Nelson
 DATE: 9/1/2006

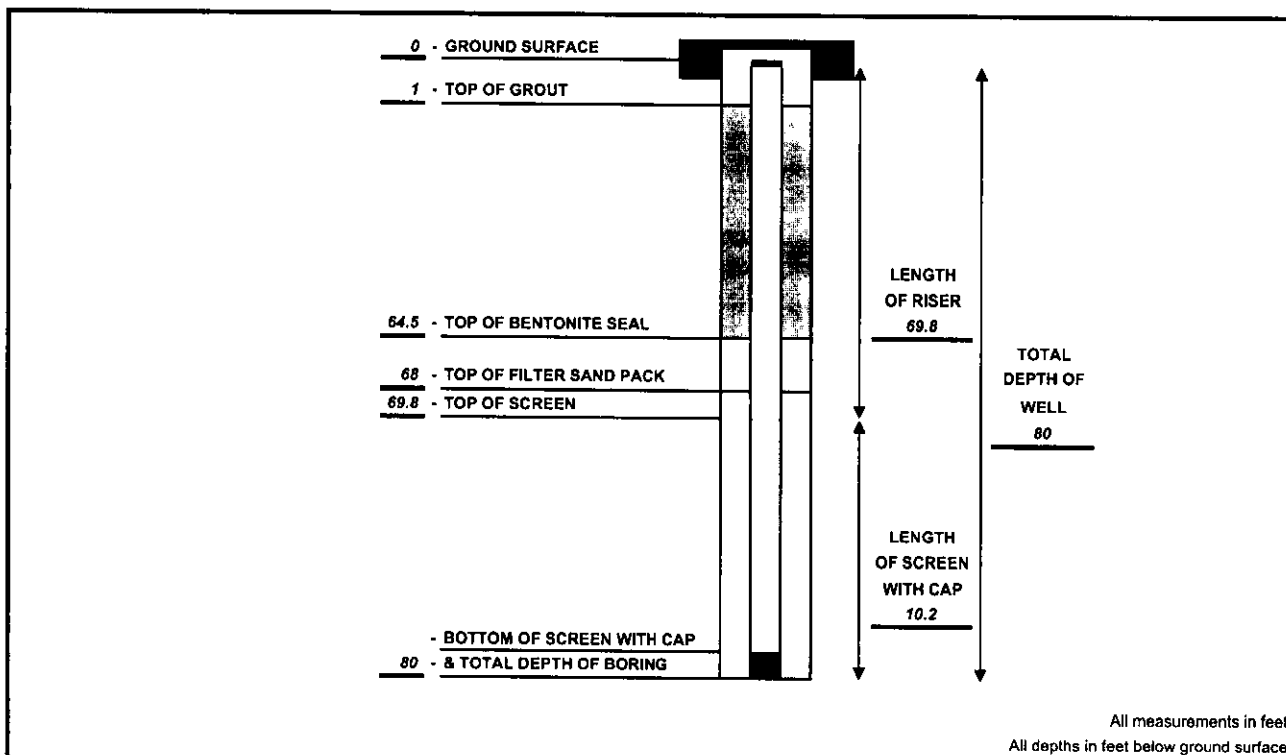
**CH2MHILL**

Monitoring Well / Piezometer Completion Diagram

Flush Mount

Project Name	Memphis Depot	Project Number	334469 TS.PB	Northing	281146 15
Project Location	Memphis, TN	Start Date / Time	8/31/2006 11:00	Easting	801552.09
Well / Piezometer ID	MW-196C	End Date / Time	8/31/2006 12.40		

Ground Surface Elevation		Static Water Level (ft btoc)	
Top of Casing Elevation		Measured On	
292.895			
Concrete Pad		Filter Pack Type	
Dimensions	3 x 3 ft	Filter Sand	
Drain Tube	N	Manufacturer	FilterSil Industrial Quartz
		Amount Sand Used	4 5 X 50-lb bag(s)
Well Casing		Bentonite Type	
Diameter	2"	3/8" chips	
Material	Schedule 40 PVC	Manufacturer	DSI Shur-Plug
		Amount Bentonite Below Screen	N/A
		Amount Bentonite Used (Seal)	1 X 50-lb bag(s)
Screen		Cement Type	
Diameter	2"	Portland Type I/II	
Material	Schedule 40 PVC	Manufacturer	Commercial Grade Quickrete
Slot Size	0.01	Amount Cement Used (Grout)	6 X 94-lb bag(s)
		Density of Grout	Not measured
Drilling Technique		Drilling Contractor	
Auger/Bit Size and Type		CH2M HILL Field Representative	
Borehole Diameter		Prosonic Corporation	
		Derek Miller	
Remarks Grout Mix Ratio: 1 X 94-lb cement, 7 gals water, 6% bentonite gel			



QA / QC

DRILLER: A. Marshall

DISCREPANCIES: N/A

INSPECTOR: Derek Miller

CHECKED BY: D. Nelson

DATE: 9/1/2006

ATTACHMENT B

Slug and Conductivity Testing Results

Reactive Media Permeability Test Results

CONSTANT HEAD PERMEABILITY

ASTM D 2434

PROJECT: CH2MHILL
 PROJECT No.: SE-0171
 SAMPLE No.: Mix 2, Boring 4, column 14
 TEST DATE: 6/16/2006

TESTED BY: kfs
 TRACKING CODE: 3750_ch
 EQUIPMENT No.: 1

MOISTURE CONTENT (Dry Basis)		
1. MOISTURE TIN NO.	SE0171	
2. WT MOISTURE TIN (tare weight)	88.33	g
3. WT WET SOIL + TARE	198.72	g
4. WT DRY SOIL + TARE	193.70	g
5. WT WATER, W _w	5.02	g
6. WT DRY SOIL, W _s	105.37	g
7. MOISTURE CONTENT, W	4.76	%

SOIL SPECIMEN DIMENSIONS		
TRIPLICATE ANALYSES	SPECIMEN	
	DIAMETER	HEIGHT
No. 1	4.50	7.21 in.
No. 2	4.50	7.25 in.
No. 3	4.50	7.21 in.
Average	4.50 in.	7.22 in.

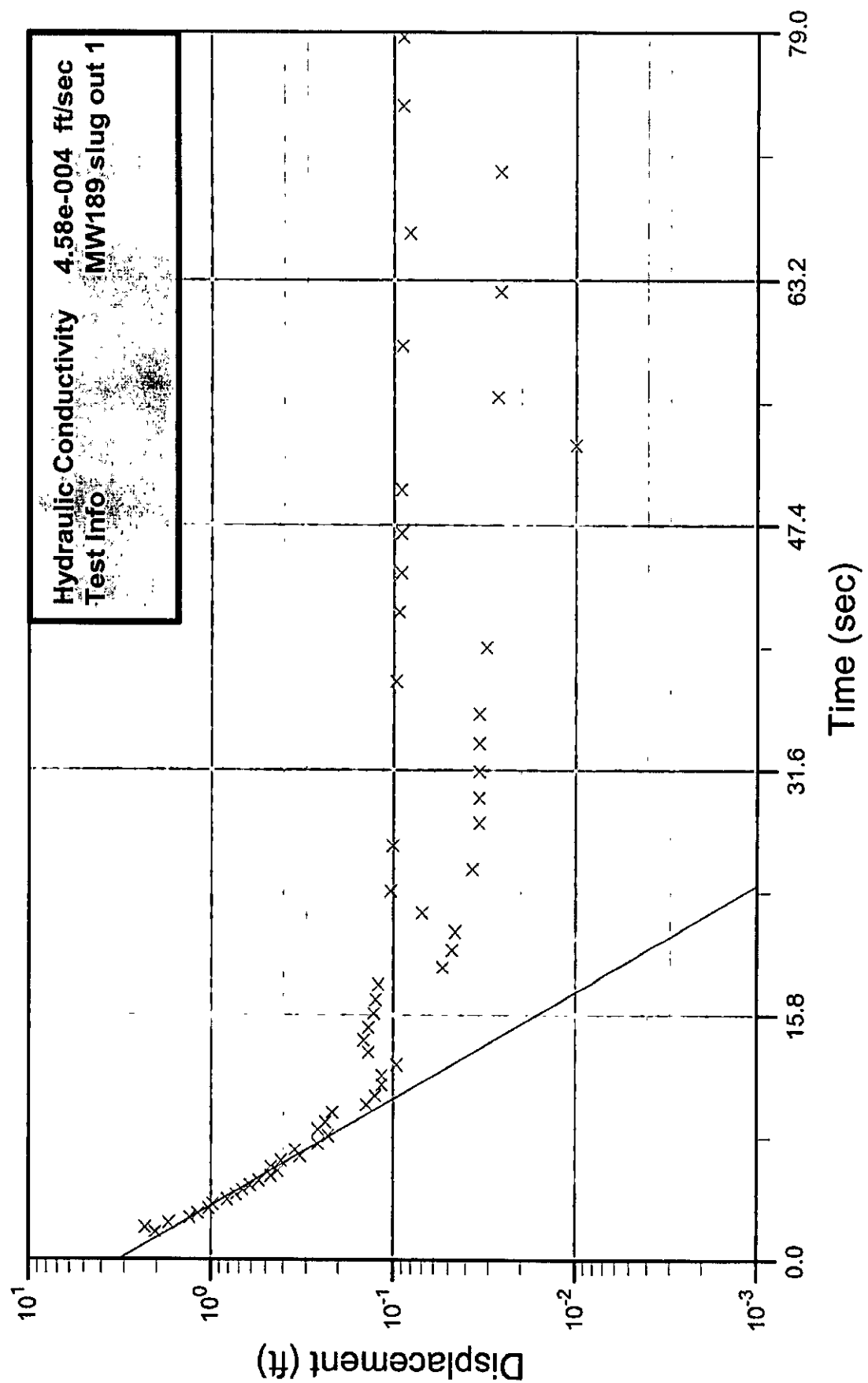
SPECIMEN CONDITIONS	
Specimen WT, W _o	3651.50 g
Area, A _o	15.90 in ²
Volume, V _o	114.85 in ³
Bulk Unit Weight	121.1 pcf
Dry Unit Weight	115.6 pcf

FLOW DATA				
Time (sec.)	L (cm)	Q (cm ³)	H (cm)	K (cm/sec)
30.00	11.43	108.26	3.9	1.0E-01
60.00	11.43	214.38	3.9	1.0E-01
30.00	11.43	95.86	3.3	1.1E-01
60.00	11.43	180.95	3.3	1.0E-01
30.00	11.43	58.08	2.0	1.1E-01
60.00	11.43	109.27	2.0	1.0E-01
Average:				1.0E-01

May 2006 Slug Test Analysis Results

- MW-189
- MW-190
- MW-191
- MW-192
- MW-193

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW189 slug out 1

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 60

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 9.64 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 3.20399 ft
Hydraulic Conductivity Calculated Value	= 0.000457676 ft/sec
Aquifer Thickness Fixed Value	= 9.64 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 4.6873
B	
Calculated Value	= 0.794107
C	
Calculated Value	= 4.6134
Linear Regression Slope	
Fixed Value	= -0.333646 ft/sec
Linear Regression Intercept	
Fixed Value	= 3.20399 ft

ANALYSIS STATISTICS

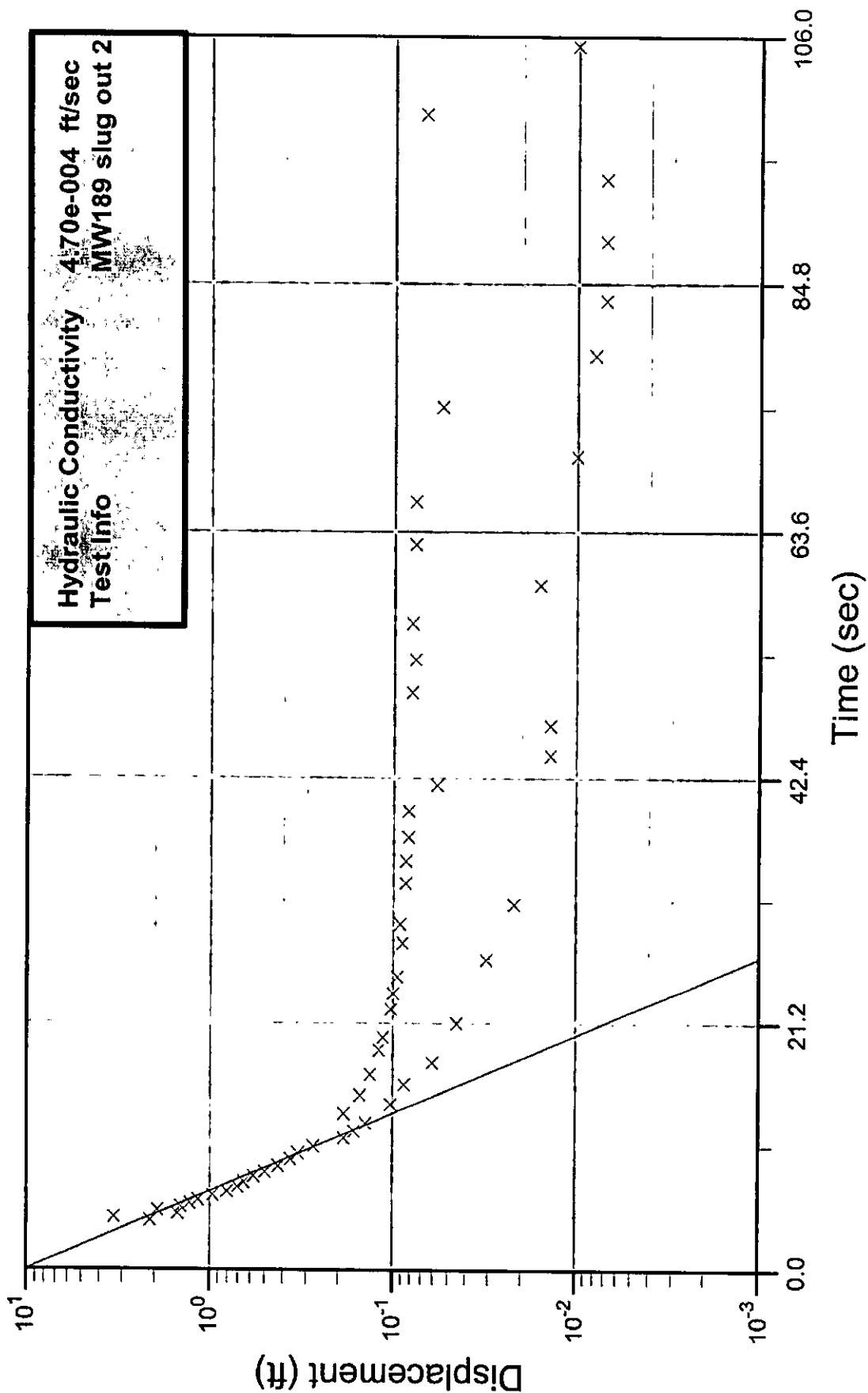
Regression Line	
Slope:	-0.333646 ft/sec
Intercept:	3.203989 ft
Residual Mean	= 0.060437
Residual Standard Dev.	= 0.107239
Residual Sum of Squares	= 0.909168
Absolute Residual Mean	= 0.074319
Minimum Residual	= -0.062057
Maximum Residual	= 0.721991

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.800000e+000	2.029000e+000	1.757397e+000	2.716033e-001
1	2.100000e+000	2.312000e+000	1.590009e+000	7.219909e-001
2	2.400000e+000	1.709000e+000	1.438565e+000	2.704353e-001
3	2.700000e+000	1.307000e+000	1.301545e+000	5.454979e-003
4	3.000000e+000	1.174000e+000	1.177576e+000	-3.576115e-003
5	3.300000e+000	1.027000e+000	1.065415e+000	-3.841494e-002
6	3.600000e+000	9.770000e-001	9.639368e-001	1.306317e-002
7	3.900000e+000	8.130000e-001	8.721243e-001	-5.912426e-002

8	4.200000e+000	7.270000e-001	7.890566e-001	-6.205661e-002
9	4.500000e+000	6.690000e-001	7.139009e-001	-4.490094e-002
10	4.800000e+000	6.080000e-001	6.459037e-001	-3.790366e-002
11	5.100000e+000	5.440000e-001	5.843830e-001	-4.038296e-002
12	5.400000e+000	4.690000e-001	5.287219e-001	-5.972194e-002
13	5.700000e+000	4.300000e-001	4.783625e-001	-4.836250e-002
14	6.000000e+000	4.660000e-001	4.327997e-001	3.320033e-002
15	6.400000e+000	4.110000e-001	3.787273e-001	3.227267e-002
16	6.700000e+000	3.250000e-001	3.426545e-001	-1.765450e-002
17	7.100000e+000	3.440000e-001	2.998446e-001	4.415545e-002
18	7.500000e+000	2.580000e-001	2.623831e-001	-4.383116e-003
19	8.000000e+000	2.270000e-001	2.220678e-001	4.932225e-003
20	8.400000e+000	2.580000e-001	1.943235e-001	6.367653e-002
21	8.900000e+000	2.360000e-001	1.644655e-001	7.153446e-002
22	9.500000e+000	2.160000e-001	1.346277e-001	8.137228e-002
23	1.000000e+001	1.410000e-001	1.139421e-001	2.705792e-002
24	1.060000e+001	1.270000e-001	9.327038e-002	3.372962e-002
25	1.130000e+001	1.160000e-001	7.384367e-002	4.215633e-002
26	1.190000e+001	1.160000e-001	6.044674e-002	5.555326e-002
27	1.260000e+001	9.600000e-002	4.785666e-002	4.814334e-002
28	1.340000e+001	1.380000e-001	3.664560e-002	1.013544e-001
29	1.420000e+001	1.460000e-001	2.806088e-002	1.179391e-001
30	1.500000e+001	1.380000e-001	2.148724e-002	1.165128e-001
31	1.590000e+001	1.290000e-001	1.591366e-002	1.130863e-001
32	1.680000e+001	1.260000e-001	1.178581e-002	1.142142e-001
33	1.780000e+001	1.210000e-001	8.442261e-003	1.125577e-001
34	1.890000e+001	5.400000e-002	5.848817e-003	4.815118e-002
35	2.000000e+001	4.800000e-002	4.052073e-003	4.394793e-002
36	2.120000e+001	4.600000e-002	2.715166e-003	4.328483e-002
37	2.240000e+001	7.000000e-002	1.819347e-003	6.818065e-002
38	2.380000e+001	1.040000e-001	1.140393e-003	1.028596e-001
39	2.520000e+001	3.700000e-002	7.148150e-004	3.628518e-002
40	2.670000e+001	1.010000e-001	4.333538e-004	1.005666e-001
41	2.820000e+001	3.400000e-002	2.627191e-004	3.373728e-002
42	2.980000e+001	3.400000e-002	1.540460e-004	3.384595e-002
43	3.150000e+001	3.400000e-002	8.736135e-005	3.391264e-002
44	3.330000e+001	3.400000e-002	4.791794e-005	3.395208e-002
45	3.520000e+001	3.400000e-002	2.542066e-005	3.397458e-002
46	3.730000e+001	9.700000e-002	1.261523e-005	9.698738e-002
47	3.950000e+001	3.100000e-002	6.054995e-006	3.099395e-002
48	4.180000e+001	9.400000e-002	2.810880e-006	9.399719e-002
49	4.430000e+001	9.100000e-002	1.220648e-006	9.099878e-002
50	4.690000e+001	9.100000e-002	5.126828e-007	9.099949e-002
51	4.970000e+001	9.100000e-002	2.014312e-007	9.099980e-002
52	5.260000e+001	1.000000e-002	7.654464e-008	9.999923e-003
53	5.570000e+001	2.700000e-002	2.720963e-008	2.699997e-002
54	5.900000e+001	9.000000e-002	9.047954e-009	8.999999e-002
55	6.250000e+001	2.600000e-002	2.814479e-009	2.600000e-002
56	6.620000e+001	8.200000e-002	8.189651e-010	8.200000e-002
57	7.010000e+001	2.600000e-002	2.229219e-010	2.600000e-002
58	7.430000e+001	8.900000e-002	5.489968e-011	8.900000e-002
59	7.870000e+001	8.900000e-002	1.264756e-011	8.900000e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW189 slug out 2

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 57

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 9.64 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 10.0403 ft
Hydraulic Conductivity	
Calculated Value	= 0.000469989 ft/sec
Aquifer Thickness	
Fixed Value	= 9.64 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 4.6873
B	
Calculated Value	= 0.794107
C	
Calculated Value	= 4.6134
Linear Regression Slope	
Fixed Value	= -0.342622 ft/sec
Linear Regression Intercept	
Fixed Value	= 10.0403 ft

ANALYSIS STATISTICS

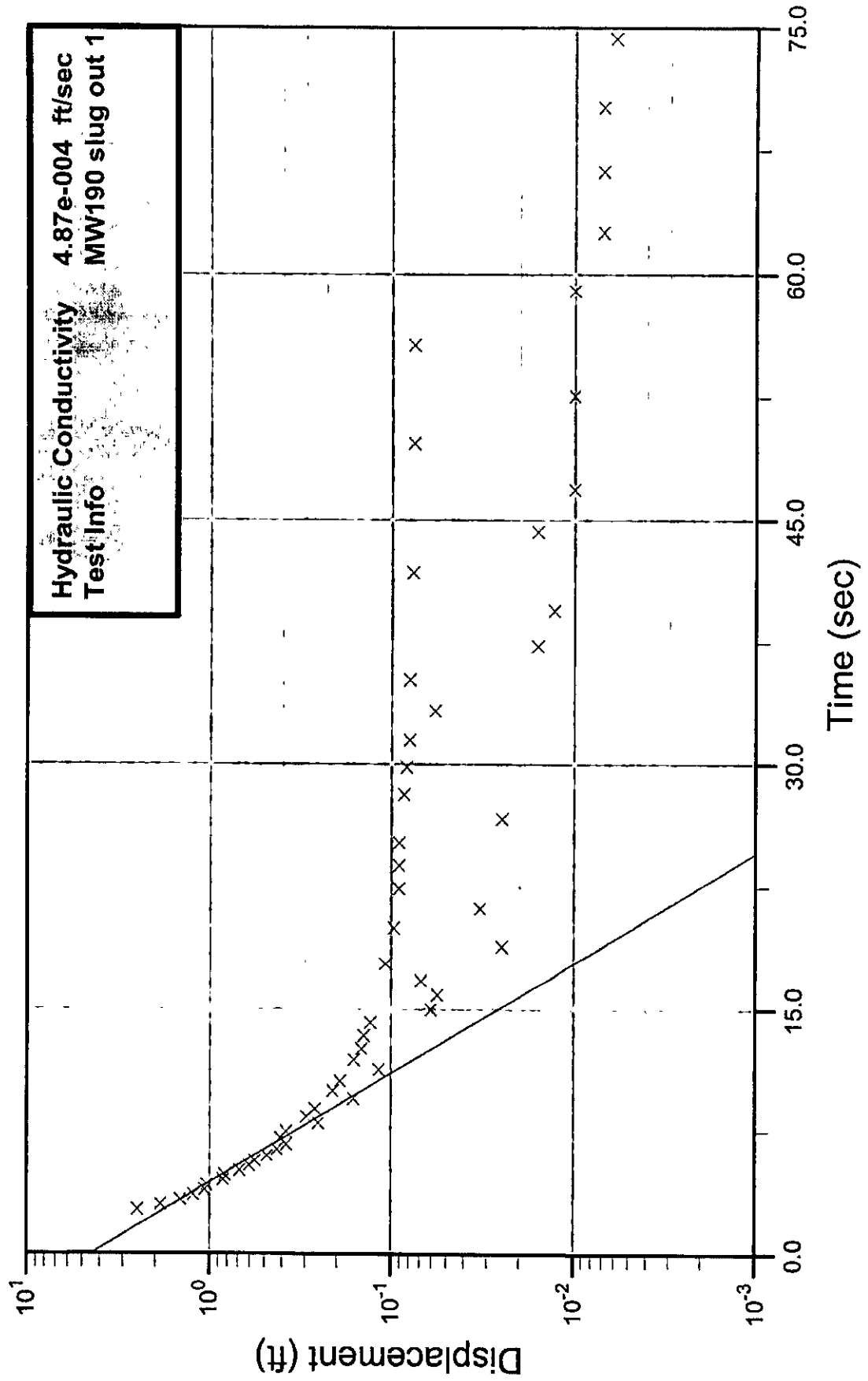
Regression Line	
Slope:	-0.342622 ft/sec
Intercept:	10.040345 ft
Residual Mean	= 0.026222
Residual Standard Dev.	= 0.186511
Residual Sum of Squares	= 2.022013
Absolute Residual Mean	= 0.097335
Minimum Residual	= -0.447716
Maximum Residual	= 1.168409

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	4.200000e+000	2.110000e+000	2.381187e+000	-2.711869e-001
1	4.500000e+000	3.317000e+000	2.148591e+000	1.168409e+000
2	4.800000e+000	1.491000e+000	1.938716e+000	-4.477159e-001
3	5.100000e+000	1.924000e+000	1.749341e+000	1.746588e-001
4	5.400000e+000	1.441000e+000	1.578465e+000	-1.374647e-001
5	5.700000e+000	1.283000e+000	1.424279e+000	-1.412795e-001
6	6.000000e+000	1.158000e+000	1.285155e+000	-1.271552e-001
7	6.400000e+000	9.640000e-001	1.120562e+000	-1.565623e-001

8	6.700000e+000	8.030000e-001	1.011105e+000	-2.081053e-001
9	7.100000e+000	7.030000e-001	8.816107e-001	-1.786107e-001
10	7.500000e+000	6.500000e-001	7.687007e-001	-1.187007e-001
11	8.000000e+000	5.750000e-001	6.476761e-001	-7.267610e-002
12	8.400000e+000	5.000000e-001	5.647267e-001	-6.472672e-002
13	8.900000e+000	4.250000e-001	4.758159e-001	-5.081586e-002
14	9.500000e+000	3.640000e-001	3.874000e-001	-2.339999e-002
15	1.000000e+001	3.310000e-001	3.264075e-001	4.592461e-003
16	1.060000e+001	2.730000e-001	2.657547e-001	7.245349e-003
17	1.130000e+001	1.870000e-001	2.090844e-001	-2.208442e-002
18	1.190000e+001	1.640000e-001	1.702325e-001	-6.232460e-003
19	1.260000e+001	1.420000e-001	1.339316e-001	8.068361e-003
20	1.340000e+001	1.870000e-001	1.018226e-001	8.517742e-002
21	1.420000e+001	1.030000e-001	7.741142e-002	2.558858e-002
22	1.500000e+001	1.530000e-001	5.885264e-002	9.414736e-002
23	1.590000e+001	8.700000e-002	4.323615e-002	4.376385e-002
24	1.680000e+001	1.340000e-001	3.176348e-002	1.022365e-001
25	1.780000e+001	6.100000e-002	2.254910e-002	3.845090e-002
26	1.890000e+001	1.200000e-001	1.546858e-002	1.045314e-001
27	2.000000e+001	1.140000e-001	1.061138e-002	1.033886e-001
28	2.120000e+001	4.500000e-002	7.034174e-003	3.796583e-002
29	2.240000e+001	1.030000e-001	4.662883e-003	9.833712e-002
30	2.380000e+001	1.000000e-001	2.886264e-003	9.711374e-002
31	2.520000e+001	9.500000e-002	1.786561e-003	9.321344e-002
32	2.670000e+001	3.100000e-002	1.068611e-003	2.993139e-002
33	2.820000e+001	8.900000e-002	6.391771e-004	8.836082e-002
34	2.980000e+001	9.200000e-002	3.694393e-004	9.163056e-002
35	3.150000e+001	2.200000e-002	2.063408e-004	2.179366e-002
36	3.330000e+001	8.600000e-002	1.113646e-004	8.588864e-002
37	3.520000e+001	8.600000e-002	5.808036e-005	8.594192e-002
38	3.730000e+001	8.300000e-002	2.828471e-005	8.297172e-002
39	3.950000e+001	8.300000e-002	1.331050e-005	8.298669e-002
40	4.180000e+001	5.800000e-002	6.052808e-006	5.799395e-002
41	4.430000e+001	1.400000e-002	2.570158e-006	1.399743e-002
42	4.690000e+001	1.400000e-002	1.054588e-006	1.399895e-002
43	4.970000e+001	8.000000e-002	4.040602e-007	7.999960e-002
44	5.260000e+001	7.700000e-002	1.495992e-007	7.699985e-002
45	5.570000e+001	8.000000e-002	5.171934e-008	7.999995e-002
46	5.900000e+001	1.600000e-002	1.669617e-008	1.599998e-002
47	6.250000e+001	7.700000e-002	5.032929e-009	7.699999e-002
48	6.620000e+001	7.700000e-002	1.416658e-009	7.700000e-002
49	7.010000e+001	1.000000e-002	3.723485e-010	1.000000e-002
50	7.430000e+001	5.500000e-002	8.830686e-011	5.500000e-002
51	7.870000e+001	8.000000e-003	1.955598e-011	8.000000e-003
52	8.340000e+001	7.000000e-003	3.907734e-012	7.000000e-003
53	8.840000e+001	7.000000e-003	7.045807e-013	7.000000e-003
54	9.370000e+001	7.000000e-003	1.146296e-013	7.000000e-003
55	9.930000e+001	6.800000e-002	1.682764e-014	6.800000e-002
56	1.052000e+002	1.000000e-002	2.229000e-015	1.000000e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW190 slug out 1

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 56

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 9.62 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 4.45917 ft
Hydraulic Conductivity Calculated Value	= 0.000487207 ft/sec
Aquifer Thickness Fixed Value	= 9.64 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	.
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 4.6821
B	
Calculated Value	= 0.793086
C	
Calculated Value	= 4.6061
Linear Regression Slope	
Fixed Value	= -0.342312 ft/sec
Linear Regression Intercept	
Fixed Value	= 4.45917 ft

ANALYSIS STATISTICS

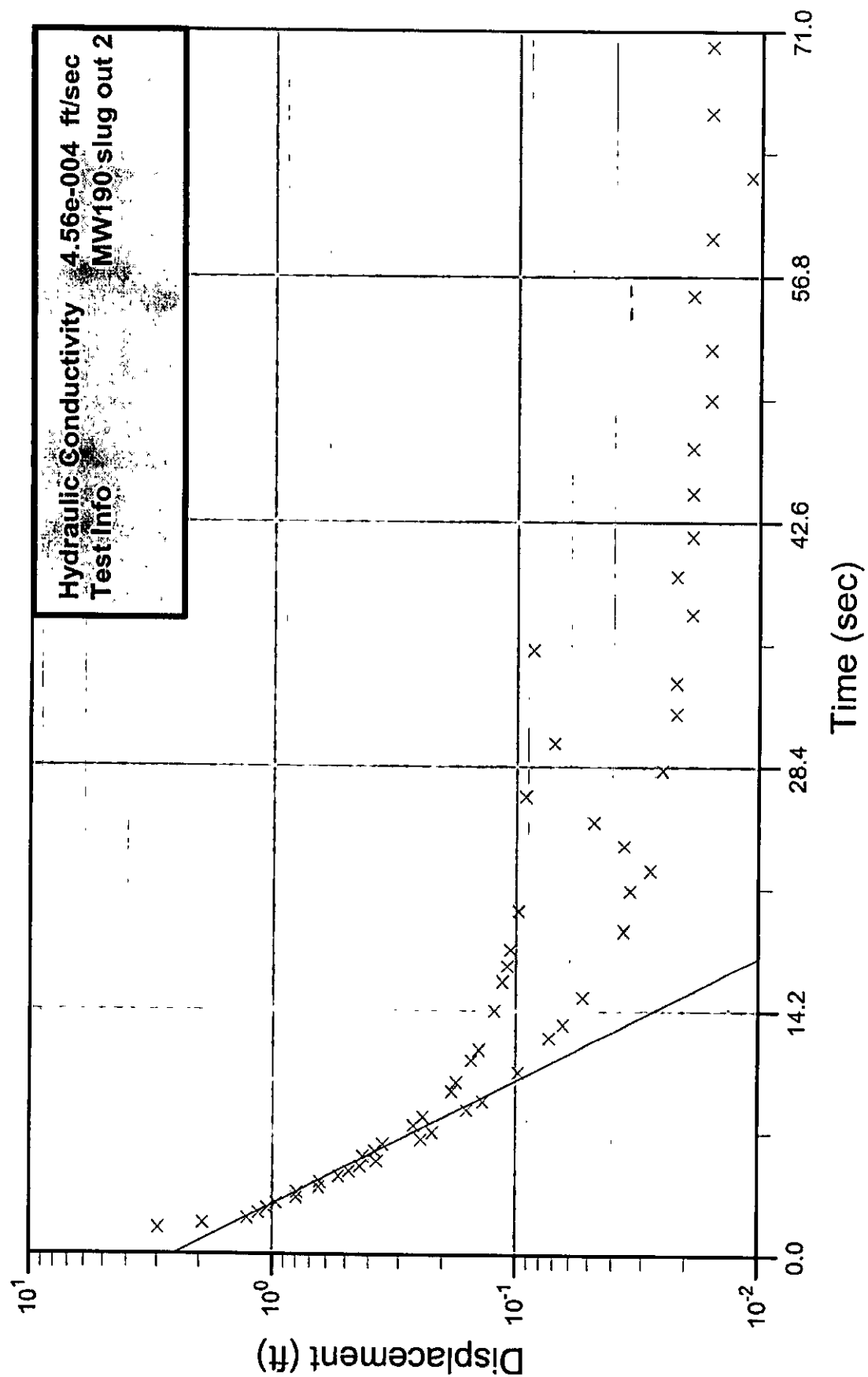
Regression Line	
Slope:	-0.342312 ft/sec
Intercept:	4.459173 ft
Residual Mean	= 0.038824
Residual Standard Dev.	= 0.113778
Residual Sum of Squares	= 0.809353
Absolute Residual Mean	= 0.070290
Minimum Residual	= -0.108575
Maximum Residual	= 0.720459

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	2.700000e+000	2.490000e+000	1.769541e+000	7.204590e-001
1	3.000000e+000	1.860000e+000	1.596840e+000	2.631603e-001
2	3.300000e+000	1.458000e+000	1.440993e+000	1.700650e-002
3	3.600000e+000	1.225000e+000	1.300357e+000	-7.535735e-002
4	3.900000e+000	1.066000e+000	1.173447e+000	-1.074468e-001
5	4.200000e+000	1.036000e+000	1.058922e+000	-2.292234e-002
6	4.500000e+000	8.470000e-001	9.555751e-001	-1.085751e-001
7	4.800000e+000	8.250000e-001	8.623141e-001	-3.731414e-002

8	5.100000e+000	6.860000e-001	7.781552e-001	-9.215516e-002
9	5.400000e+000	6.060000e-001	7.022098e-001	-9.620982e-002
10	5.700000e+000	5.640000e-001	6.336765e-001	-6.967649e-002
11	6.000000e+000	4.860000e-001	5.718318e-001	-8.583179e-002
12	6.400000e+000	4.280000e-001	4.986577e-001	-7.065773e-002
13	6.700000e+000	3.810000e-001	4.499904e-001	-6.899040e-002
14	7.100000e+000	4.090000e-001	3.924077e-001	1.659231e-002
15	7.500000e+000	3.810000e-001	3.421935e-001	3.880648e-002
16	8.000000e+000	2.530000e-001	2.883630e-001	-3.536305e-002
17	8.400000e+000	2.950000e-001	2.514629e-001	4.353713e-002
18	8.900000e+000	2.640000e-001	2.119052e-001	5.209476e-002
19	9.500000e+000	1.620000e-001	1.725612e-001	-1.056118e-002
20	1.000000e+001	2.110000e-001	1.454156e-001	6.558443e-002
21	1.060000e+001	1.920000e-001	1.184165e-001	7.358348e-002
22	1.130000e+001	1.170000e-001	9.318527e-002	2.381473e-002
23	1.190000e+001	1.610000e-001	7.588373e-002	8.511627e-002
24	1.260000e+001	1.470000e-001	5.971503e-002	8.728497e-002
25	1.340000e+001	1.420000e-001	4.541007e-002	9.658993e-002
26	1.420000e+001	1.310000e-001	3.453192e-002	9.646808e-002
27	1.500000e+001	6.100000e-002	2.625967e-002	3.474033e-002
28	1.590000e+001	5.600000e-002	1.929707e-002	3.670293e-002
29	1.680000e+001	6.900000e-002	1.418056e-002	5.481944e-002
30	1.780000e+001	1.080000e-001	1.006999e-002	9.793001e-002
31	1.890000e+001	2.500000e-002	6.910322e-003	1.808968e-002
32	2.000000e+001	9.700000e-002	4.742065e-003	9.225794e-002
33	2.120000e+001	3.300000e-002	3.144635e-003	2.985536e-002
34	2.240000e+001	9.100000e-002	2.085322e-003	8.891468e-002
35	2.380000e+001	9.100000e-002	1.291347e-003	8.970865e-002
36	2.520000e+001	9.100000e-002	7.996738e-004	9.020033e-002
37	2.670000e+001	2.500000e-002	4.785379e-004	2.452146e-002
38	2.820000e+001	8.600000e-002	2.863649e-004	8.571364e-002
39	2.980000e+001	8.300000e-002	1.655987e-004	8.283440e-002
40	3.150000e+001	8.000000e-002	9.253958e-005	7.990746e-002
41	3.330000e+001	5.800000e-002	4.997257e-005	5.795003e-002
42	3.520000e+001	8.000000e-002	2.607771e-005	7.997392e-002
43	3.730000e+001	1.600000e-002	1.270792e-005	1.598729e-002
44	3.950000e+001	1.300000e-002	5.984292e-006	1.299402e-002
45	4.180000e+001	7.700000e-002	2.723233e-006	7.699728e-002
46	4.430000e+001	1.600000e-002	1.157241e-006	1.599884e-002
47	4.690000e+001	1.000000e-002	4.752221e-007	9.999525e-003
48	4.970000e+001	7.600000e-002	1.822370e-007	7.599982e-002
49	5.260000e+001	1.000000e-002	6.753204e-008	9.999932e-003
50	5.570000e+001	7.600000e-002	2.336955e-008	7.599998e-002
51	5.900000e+001	1.000000e-002	7.551932e-009	9.999992e-003
52	6.250000e+001	7.000000e-003	2.278940e-009	6.999998e-003
53	6.620000e+001	7.000000e-003	6.422066e-010	6.999999e-003
54	7.010000e+001	7.000000e-003	1.689989e-010	7.000000e-003
55	7.430000e+001	6.000000e-003	4.013226e-011	6.000000e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW190 slug out 2

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 59

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 9.62 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 2.55495 ft
Hydraulic Conductivity	
Calculated Value	= 0.000455879 ft/sec
Aquifer Thickness	
Fixed Value	= 9.64 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 4.6821
B	
Calculated Value	= 0.793086
C	
Calculated Value	= 4.6061
Linear Regression Slope	
Fixed Value	= -0.320301 ft/sec
Linear Regression Intercept	
Fixed Value	= 2.55495 ft

ANALYSIS STATISTICS

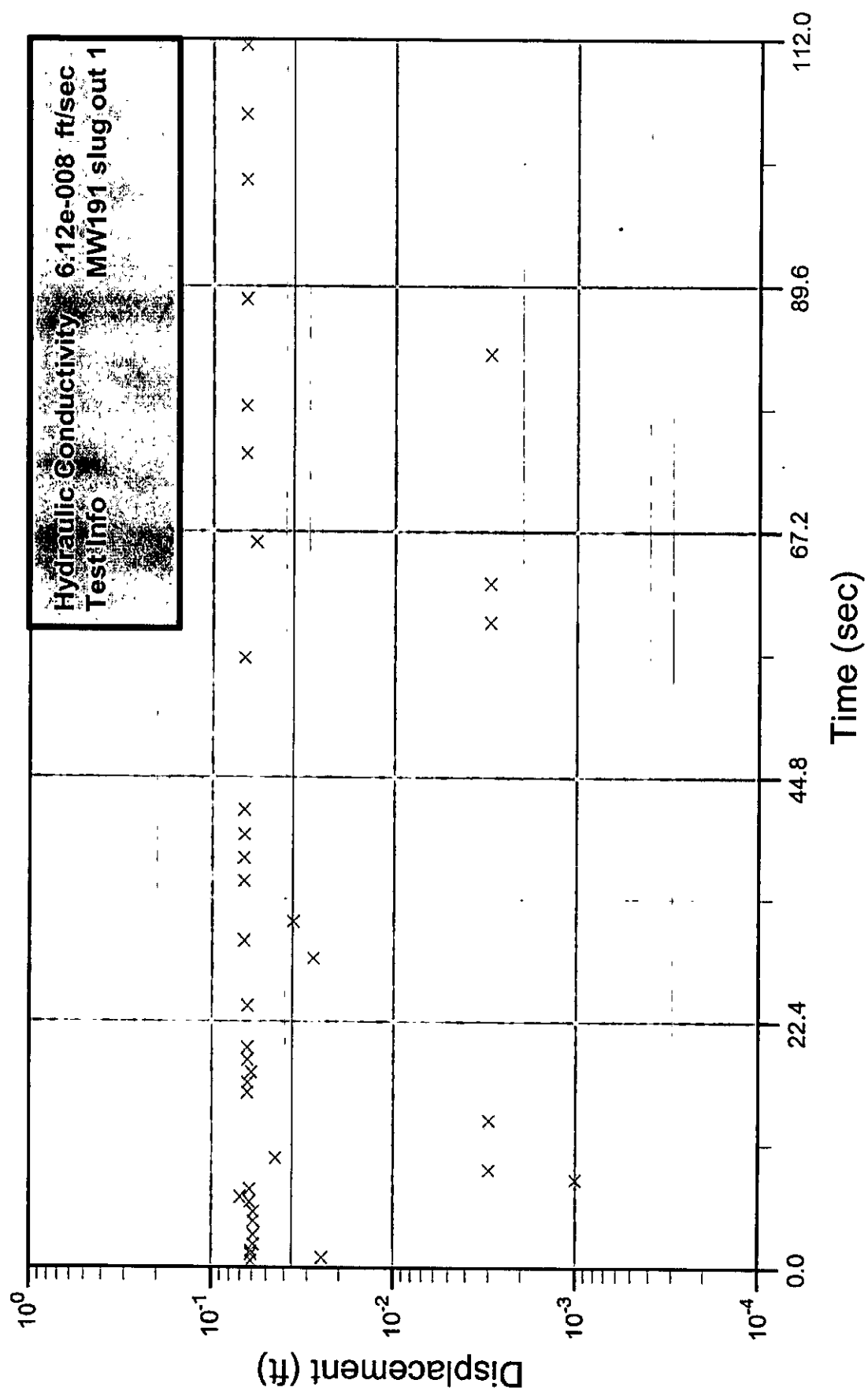
Regression Line	
Slope:	-0.320301 ft/sec
Intercept:	2.554949 ft
Residual Mean	= 0.048581
Residual Standard Dev.	= 0.193375
Residual Sum of Squares	= 2.345494
Absolute Residual Mean	= 0.073108
Minimum Residual	= -0.090843
Maximum Residual	= 1.392753

DATA DETAIL

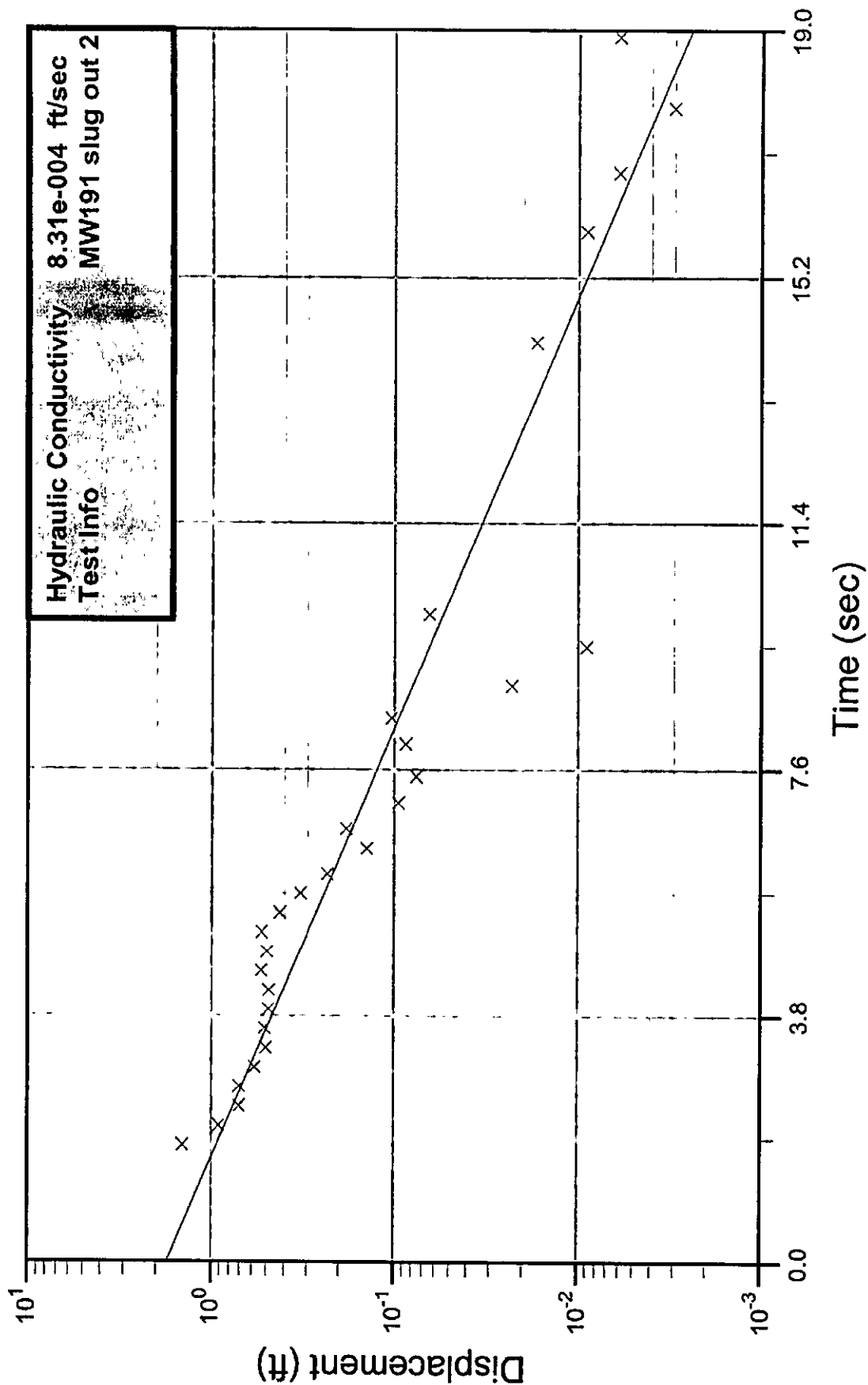
Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	2.973000e+000	1.580247e+000	1.392753e+000
1	1.800000e+000	1.938000e+000	1.435468e+000	5.025318e-001
2	2.100000e+000	1.269000e+000	1.303954e+000	-3.495363e-002
3	2.400000e+000	1.141000e+000	1.184488e+000	-4.348813e-002
4	2.700000e+000	1.055000e+000	1.075968e+000	-2.096781e-002
5	3.000000e+000	9.690000e-001	9.773899e-001	-8.389888e-003
6	3.300000e+000	7.970000e-001	8.878435e-001	-9.084347e-002
7	3.600000e+000	7.950000e-001	8.065011e-001	-1.150111e-002

8	3.900000e+000	6.450000e-001	7.326112e-001	-8.761117e-002
9	4.200000e+000	6.390000e-001	6.654909e-001	-2.649087e-002
10	4.500000e+000	5.340000e-001	6.045200e-001	-7.051999e-002
11	4.800000e+000	4.840000e-001	5.491351e-001	-6.513513e-002
12	5.100000e+000	4.370000e-001	4.988245e-001	-6.182452e-002
13	5.400000e+000	3.730000e-001	4.531233e-001	-8.012326e-002
14	5.700000e+000	4.250000e-001	4.116091e-001	1.339095e-002
15	6.000000e+000	3.780000e-001	3.738983e-001	4.101705e-003
16	6.400000e+000	3.510000e-001	3.289361e-001	2.206388e-002
17	6.700000e+000	2.450000e-001	2.987997e-001	-5.379968e-002
18	7.100000e+000	2.200000e-001	2.628683e-001	-4.286830e-002
19	7.500000e+000	2.620000e-001	2.312578e-001	3.074224e-002
20	8.000000e+000	2.400000e-001	1.970352e-001	4.296476e-002
21	8.400000e+000	1.590000e-001	1.733413e-001	-1.434128e-002
22	8.900000e+000	1.370000e-001	1.476895e-001	-1.068949e-002
23	9.500000e+000	1.840000e-001	1.218672e-001	6.213283e-002
24	1.000000e+001	1.760000e-001	1.038327e-001	7.216725e-002
25	1.060000e+001	9.800000e-002	8.567842e-002	1.232158e-002
26	1.130000e+001	1.530000e-001	6.846965e-002	8.453035e-002
27	1.190000e+001	1.420000e-001	5.649828e-002	8.550172e-002
28	1.260000e+001	7.300000e-002	4.515043e-002	2.784957e-002
29	1.340000e+001	6.400000e-002	3.494444e-002	2.905556e-002
30	1.420000e+001	1.230000e-001	2.704545e-002	9.595455e-002
31	1.500000e+001	5.300000e-002	2.093198e-002	3.206802e-002
32	1.590000e+001	1.140000e-001	1.568975e-002	9.831025e-002
33	1.680000e+001	1.090000e-001	1.176039e-002	9.723961e-002
34	1.780000e+001	1.060000e-001	8.537231e-003	9.746277e-002
35	1.890000e+001	3.600000e-002	6.002080e-003	2.999792e-002
36	2.000000e+001	9.800000e-002	4.219748e-003	9.378025e-002
37	2.120000e+001	3.400000e-002	2.873166e-003	3.112683e-002
38	2.240000e+001	2.800000e-002	1.956298e-003	2.604370e-002
39	2.380000e+001	3.600000e-002	1.249362e-003	3.475064e-002
40	2.520000e+001	4.800000e-002	7.978874e-004	4.720211e-002
41	2.670000e+001	9.200000e-002	4.934969e-004	9.150650e-002
42	2.820000e+001	2.500000e-002	3.052300e-004	2.469477e-002
43	2.980000e+001	7.000000e-002	1.828351e-004	6.981716e-002
44	3.150000e+001	2.200000e-002	1.060673e-004	2.189393e-002
45	3.330000e+001	2.200000e-002	5.959267e-005	2.194041e-002
46	3.520000e+001	8.600000e-002	3.242603e-005	8.596757e-002
47	3.730000e+001	1.900000e-002	1.654907e-005	1.898345e-002
48	3.950000e+001	2.200000e-002	8.179809e-006	2.199182e-002
49	4.180000e+001	1.900000e-002	3.915635e-006	1.899608e-002
50	4.430000e+001	1.900000e-002	1.758086e-006	1.899824e-002
51	4.690000e+001	1.900000e-002	7.644828e-007	1.899924e-002
52	4.970000e+001	1.600000e-002	3.117987e-007	1.599969e-002
53	5.260000e+001	1.600000e-002	1.231602e-007	1.599988e-002
54	5.570000e+001	1.900000e-002	4.562949e-008	1.899995e-002
55	5.900000e+001	1.600000e-002	1.585623e-008	1.599998e-002
56	6.250000e+001	1.100000e-002	5.168126e-009	1.099999e-002
57	6.620000e+001	1.600000e-002	1.579957e-009	1.600000e-002
58	7.010000e+001	1.600000e-002	4.530402e-010	1.600000e-002

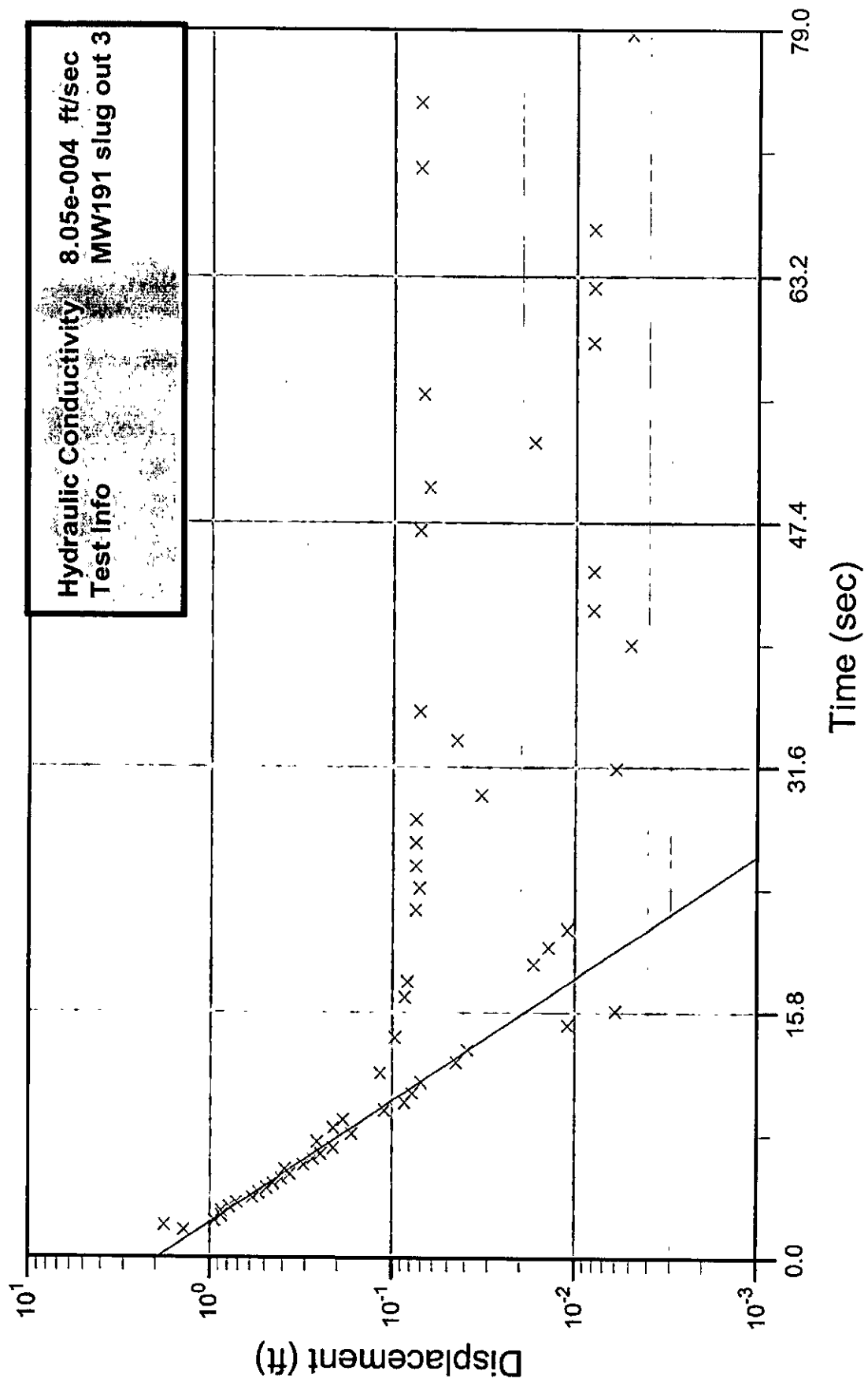
Bouwer & Rice



Bouwer & Rice



Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW191 slug out 3

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 60

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 3.78 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.94089 ft
Hydraulic Conductivity	
Calculated Value	= 0.000805138 ft/sec
Aquifer Thickness	
Fixed Value	= 3.78 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 2.87296
B	
Calculated Value	= 0.460273
C	
Calculated Value	= 2.53451
Linear Regression Slope	
Fixed Value	= -0.29222 ft/sec
Linear Regression Intercept	
Fixed Value	= 1.94089 ft

ANALYSIS STATISTICS

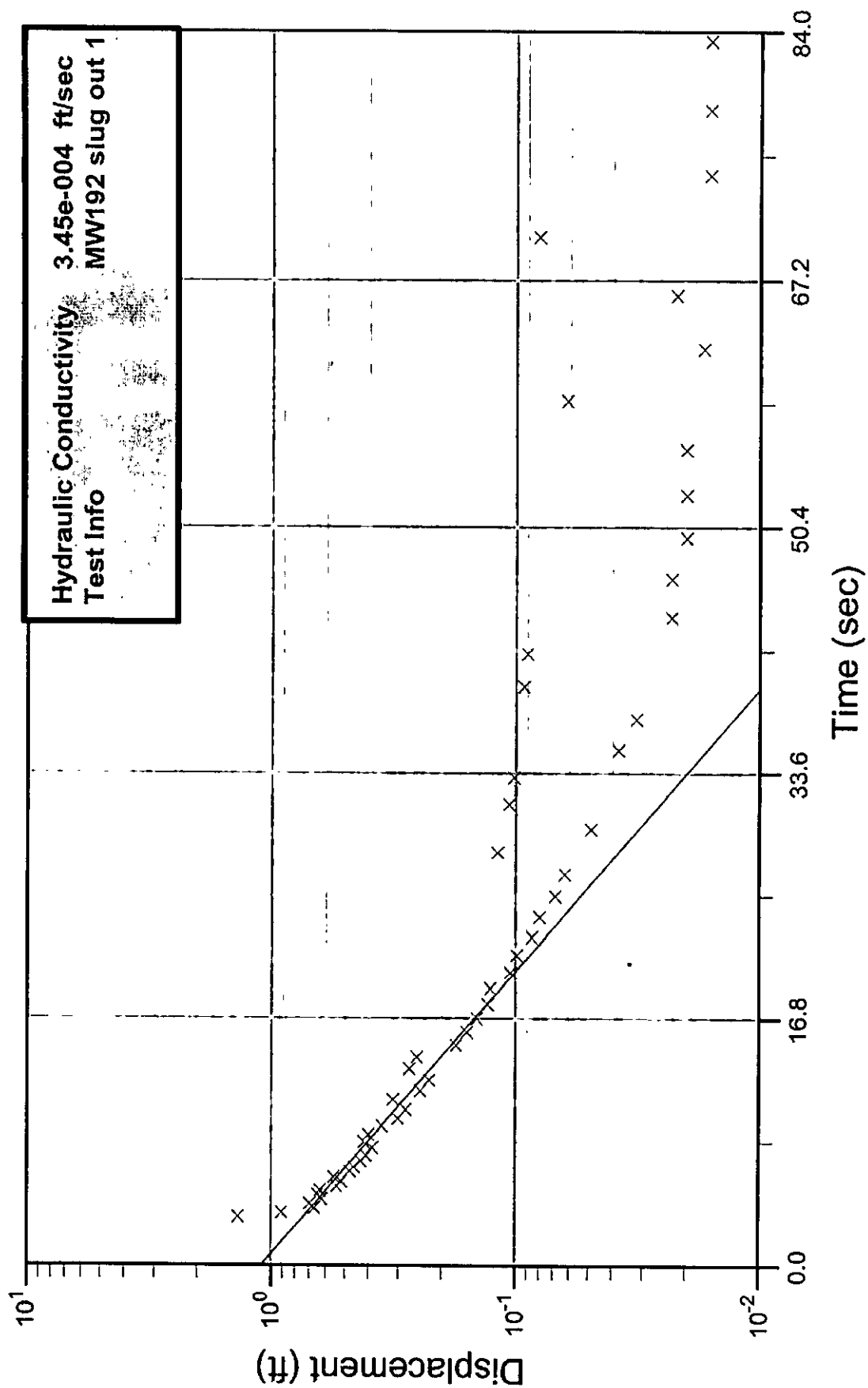
Regression Line	
Slope:	-0.292220 ft/sec
Intercept:	1.940886 ft
Residual Mean	= 0.034081
Residual Standard Dev.	= 0.103164
Residual Sum of Squares	= 0.708257
Absolute Residual Mean	= 0.049242
Minimum Residual	= -0.037944
Maximum Residual	= 0.737273

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.800000e+000	1.396000e+000	1.146998e+000	2.490017e-001
1	2.100000e+000	1.788000e+000	1.050727e+000	7.372729e-001
2	2.400000e+000	9.380000e-001	9.625361e-001	-2.453615e-002
3	2.700000e+000	8.610000e-001	8.817474e-001	-2.074738e-002
4	3.000000e+000	8.630000e-001	8.077395e-001	5.526052e-002
5	3.300000e+000	7.830000e-001	7.399433e-001	4.305670e-002
6	3.600000e+000	7.140000e-001	6.778375e-001	3.616253e-002
7	3.900000e+000	5.830000e-001	6.209444e-001	-3.794438e-002

8	4.200000e+000	5.390000e-001	5.688265e-001	-2.982652e-002
9	4.500000e+000	4.890000e-001	5.210831e-001	-3.208307e-002
10	4.800000e+000	4.500000e-001	4.773469e-001	-2.734689e-002
11	5.100000e+000	4.060000e-001	4.372816e-001	-3.128162e-002
12	5.400000e+000	3.640000e-001	4.005792e-001	-3.657917e-002
13	5.700000e+000	3.890000e-001	3.669573e-001	2.204274e-002
14	6.000000e+000	3.060000e-001	3.361574e-001	-3.015736e-002
15	6.400000e+000	2.720000e-001	2.990741e-001	-2.707409e-002
16	6.700000e+000	2.470000e-001	2.739718e-001	-2.697184e-002
17	7.100000e+000	2.110000e-001	2.437486e-001	-3.274858e-002
18	7.500000e+000	2.590000e-001	2.168594e-001	4.214059e-002
19	8.000000e+000	1.670000e-001	1.873801e-001	-2.038011e-002
20	8.400000e+000	2.110000e-001	1.667092e-001	4.429076e-002
21	8.900000e+000	1.860000e-001	1.440472e-001	4.195278e-002
22	9.500000e+000	1.110000e-001	1.208813e-001	-9.881307e-003
23	1.000000e+001	8.600000e-002	1.044490e-001	-1.844902e-002
24	1.060000e+001	7.800000e-002	8.765135e-002	-9.651354e-003
25	1.130000e+001	7.000000e-002	7.143679e-002	-1.436790e-003
26	1.190000e+001	1.170000e-001	5.994821e-002	5.705179e-002
27	1.260000e+001	4.500000e-002	4.885843e-002	-3.858429e-003
28	1.340000e+001	3.900000e-002	3.867335e-002	3.266450e-004
29	1.420000e+001	9.700000e-002	3.061147e-002	6.638853e-002
30	1.500000e+001	1.100000e-002	2.423017e-002	-1.323017e-002
31	1.590000e+001	6.000000e-003	1.862679e-002	-1.262679e-002
32	1.680000e+001	8.600000e-002	1.431922e-002	7.168078e-002
33	1.780000e+001	8.300000e-002	1.069079e-002	7.230921e-002
34	1.890000e+001	1.700000e-002	7.751919e-003	9.248081e-003
35	2.000000e+001	1.400000e-002	5.620937e-003	8.379063e-003
36	2.120000e+001	1.100000e-002	3.958378e-003	7.041622e-003
37	2.240000e+001	7.500000e-002	2.787570e-003	7.221243e-002
38	2.380000e+001	7.200000e-002	1.851622e-003	7.014838e-002
39	2.520000e+001	7.500000e-002	1.229926e-003	7.377007e-002
40	2.670000e+001	7.500000e-002	7.934410e-004	7.420656e-002
41	2.820000e+001	7.500000e-002	5.118590e-004	7.448814e-002
42	2.980000e+001	3.300000e-002	3.206971e-004	3.267930e-002
43	3.150000e+001	6.000000e-003	1.951411e-004	5.804859e-003
44	3.330000e+001	4.500000e-002	1.153218e-004	4.488468e-002
45	3.520000e+001	7.200000e-002	6.618863e-005	7.193381e-002
46	3.730000e+001	-8.000000e-003	3.583218e-005	-8.035832e-
003				
47	3.950000e+001	5.000000e-003	1.883962e-005	4.981160e-003
48	4.180000e+001	8.000000e-003	9.620115e-006	7.990380e-003
49	4.430000e+001	8.000000e-003	4.633470e-006	7.995367e-003
50	4.690000e+001	7.200000e-002	2.167412e-006	7.199783e-002
51	4.970000e+001	6.400000e-002	9.563012e-007	6.399904e-002
52	5.260000e+001	1.700000e-002	4.097859e-007	1.699959e-002
53	5.570000e+001	6.900000e-002	1.656294e-007	6.899983e-002
54	5.900000e+001	8.000000e-003	6.314453e-008	7.999937e-003
55	6.250000e+001	8.000000e-003	2.270661e-008	7.999977e-003
56	6.620000e+001	8.000000e-003	7.701705e-009	7.999992e-003
57	7.010000e+001	7.200000e-002	2.463994e-009	7.200000e-002
58	7.430000e+001	7.200000e-002	7.221367e-010	7.200000e-002
59	7.870000e+001	5.000000e-003	1.996261e-010	5.000000e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW192 slug out 1

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 56

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 3.51 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.09362 ft
Hydraulic Conductivity Calculated Value	= 0.000345459 ft/sec
Aquifer Thickness Fixed Value	= 3.51 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type	

Selected Value = Isotropic
 Correction Type
 Selected Value = None
 Kz/Kr
 Fixed Value = 1
 Effective Casing Inner Diameter
 Calculated Value = 0.17 ft
 Effective Screen Inner Diameter
 Calculated Value = 0.17 ft
 A
 Calculated Value = 2.78815
 B
 Calculated Value = 0.443311
 C
 Calculated Value = 2.4518
 Linear Regression Slope
 Fixed Value = -0.119163 ft/sec
 Linear Regression Intercept
 Fixed Value = 1.09362 ft

ANALYSIS STATISTICS

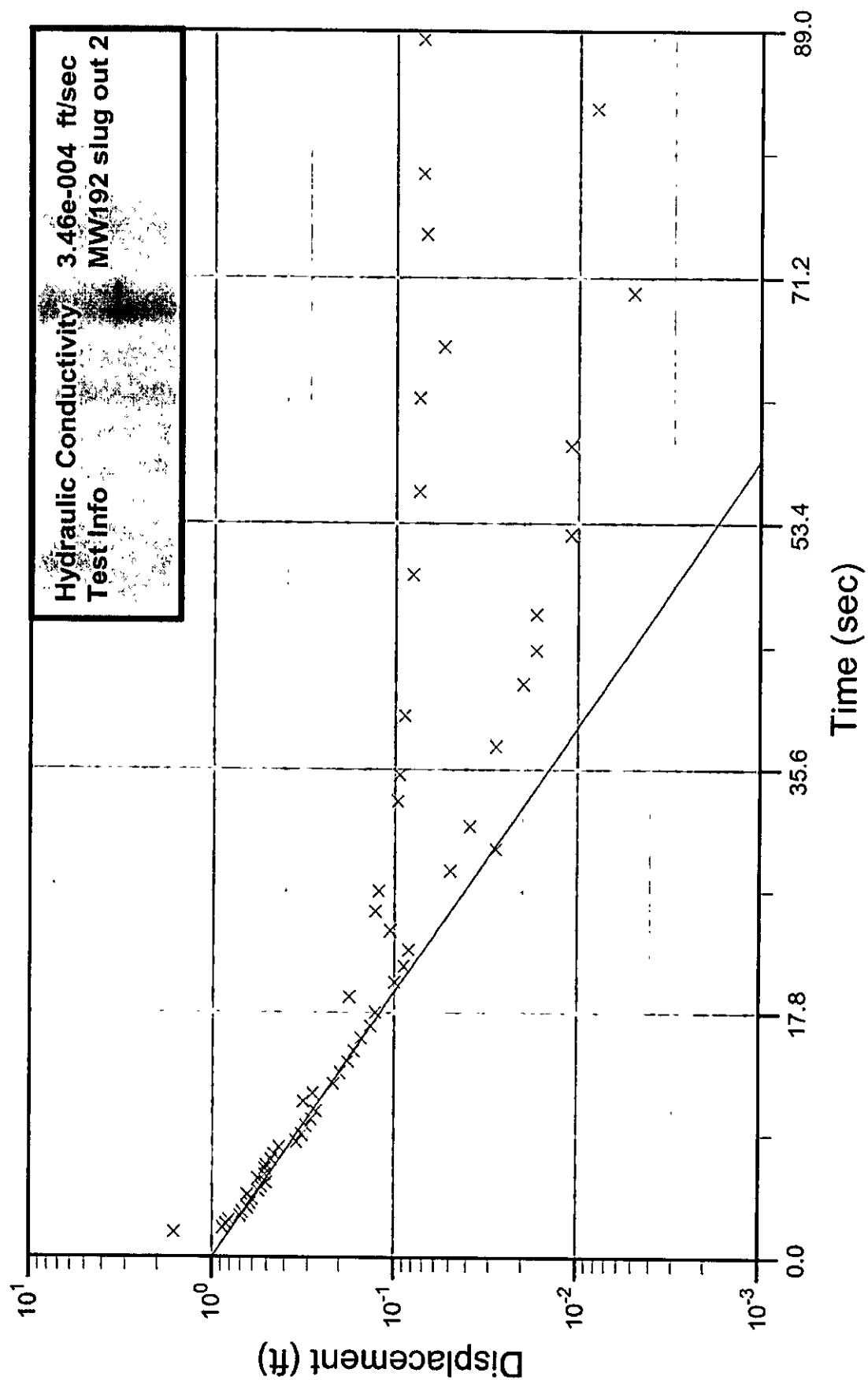
Regression Line
 Slope: -0.119163 ft/sec
 Intercept: 1.093624 ft
 Residual Mean = 0.028583
 Residual Standard Dev. = 0.090639
 Residual Sum of Squares = 0.505821
 Absolute Residual Mean = 0.042647
 Minimum Residual = -0.038276
 Maximum Residual = 0.627949

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	3.300000e+000	1.366000e+000	7.380508e-001	6.279492e-001
1	3.600000e+000	9.110000e-001	7.121322e-001	1.988678e-001
2	3.900000e+000	6.690000e-001	6.871239e-001	-1.812388e-002
3	4.200000e+000	7.000000e-001	6.629937e-001	3.700625e-002
4	4.500000e+000	6.250000e-001	6.397110e-001	-1.471101e-002
5	4.800000e+000	6.470000e-001	6.172459e-001	2.975409e-002
6	5.100000e+000	6.330000e-001	5.955697e-001	3.743027e-002
7	5.400000e+000	5.420000e-001	5.746548e-001	-3.265476e-002

8	5.700000e+000	5.170000e-001	5.544743e-001	-3.747427e-002
9	6.000000e+000	5.560000e-001	5.350025e-001	2.099752e-002
10	6.400000e+000	4.780000e-001	5.100996e-001	-3.209960e-002
11	6.700000e+000	4.590000e-001	4.921861e-001	-3.318614e-002
12	7.100000e+000	4.310000e-001	4.692762e-001	-3.827625e-002
13	7.500000e+000	4.110000e-001	4.474327e-001	-3.643274e-002
14	8.000000e+000	3.860000e-001	4.215526e-001	-3.555258e-002
15	8.400000e+000	4.170000e-001	4.019305e-001	1.506952e-002
16	8.900000e+000	4.000000e-001	3.786822e-001	2.131776e-002
17	9.500000e+000	3.530000e-001	3.525524e-001	4.475641e-004
18	1.000000e+001	3.030000e-001	3.321603e-001	-2.916029e-002
19	1.060000e+001	2.810000e-001	3.092406e-001	-2.824059e-002
20	1.130000e+001	3.170000e-001	2.844920e-001	3.250799e-002
21	1.190000e+001	2.450000e-001	2.648615e-001	-1.986152e-002
22	1.260000e+001	2.250000e-001	2.436646e-001	-1.866461e-002
23	1.340000e+001	2.720000e-001	2.215087e-001	5.049128e-002
24	1.420000e+001	2.530000e-001	2.013674e-001	5.163257e-002
25	1.500000e+001	1.750000e-001	1.830575e-001	-8.057531e-003
26	1.590000e+001	1.580000e-001	1.644413e-001	-6.441255e-003
27	1.680000e+001	1.440000e-001	1.477182e-001	-3.718185e-003
28	1.780000e+001	1.300000e-001	1.311239e-001	-1.123925e-003
29	1.890000e+001	1.270000e-001	1.150151e-001	1.198494e-002
30	2.000000e+001	1.050000e-001	1.008852e-001	4.114792e-003
31	2.120000e+001	9.900000e-002	8.744300e-002	1.155700e-002
32	2.240000e+001	8.600000e-002	7.579187e-002	1.020813e-002
33	2.380000e+001	8.000000e-002	6.414603e-002	1.585397e-002
34	2.520000e+001	6.900000e-002	5.428964e-002	1.471036e-002
35	2.670000e+001	6.300000e-002	4.540346e-002	1.759654e-002
36	2.820000e+001	1.190000e-001	3.797178e-002	8.102822e-002
37	2.980000e+001	4.900000e-002	3.138034e-002	1.761966e-002
38	3.150000e+001	1.070000e-001	2.562591e-002	8.137409e-002
39	3.330000e+001	1.020000e-001	2.067881e-002	8.132119e-002
40	3.520000e+001	3.800000e-002	1.648909e-002	2.151091e-002
41	3.730000e+001	3.200000e-002	1.283860e-002	1.916140e-002
42	3.950000e+001	9.300000e-002	9.877865e-003	8.312214e-002
43	4.180000e+001	9.000000e-002	7.509887e-003	8.249011e-002
44	4.430000e+001	2.300000e-002	5.575109e-003	1.742489e-002
45	4.690000e+001	2.300000e-002	4.089763e-003	1.891024e-002
46	4.970000e+001	2.000000e-002	2.929493e-003	1.707051e-002
47	5.260000e+001	2.000000e-002	2.073536e-003	1.792646e-002
48	5.570000e+001	2.000000e-002	1.433113e-003	1.856689e-002
49	5.900000e+001	6.200000e-002	9.671607e-004	6.103284e-002
50	6.250000e+001	1.700000e-002	6.373333e-004	1.636267e-002
51	6.620000e+001	2.200000e-002	4.100946e-004	2.158991e-002
52	7.010000e+001	8.100000e-002	2.576625e-004	8.074234e-002
53	7.430000e+001	1.600000e-002	1.562042e-004	1.584380e-002
54	7.870000e+001	1.600000e-002	9.246637e-005	1.590753e-002
55	8.340000e+001	1.600000e-002	5.281403e-005	1.594719e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW192 slug out 2

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 62

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 3.51 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1 ft
Hydraulic Conductivity	
Calculated Value	= 0.000345651 ft/sec
Aquifer Thickness	
Fixed Value	= 3.51 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 2.78815
B	
Calculated Value	= 0.443311
C	
Calculated Value	= 2.4518
Linear Regression Slope	
Fixed Value	= -0.11923 ft/sec
Linear Regression Intercept	
Fixed Value	= 1 ft

ANALYSIS STATISTICS

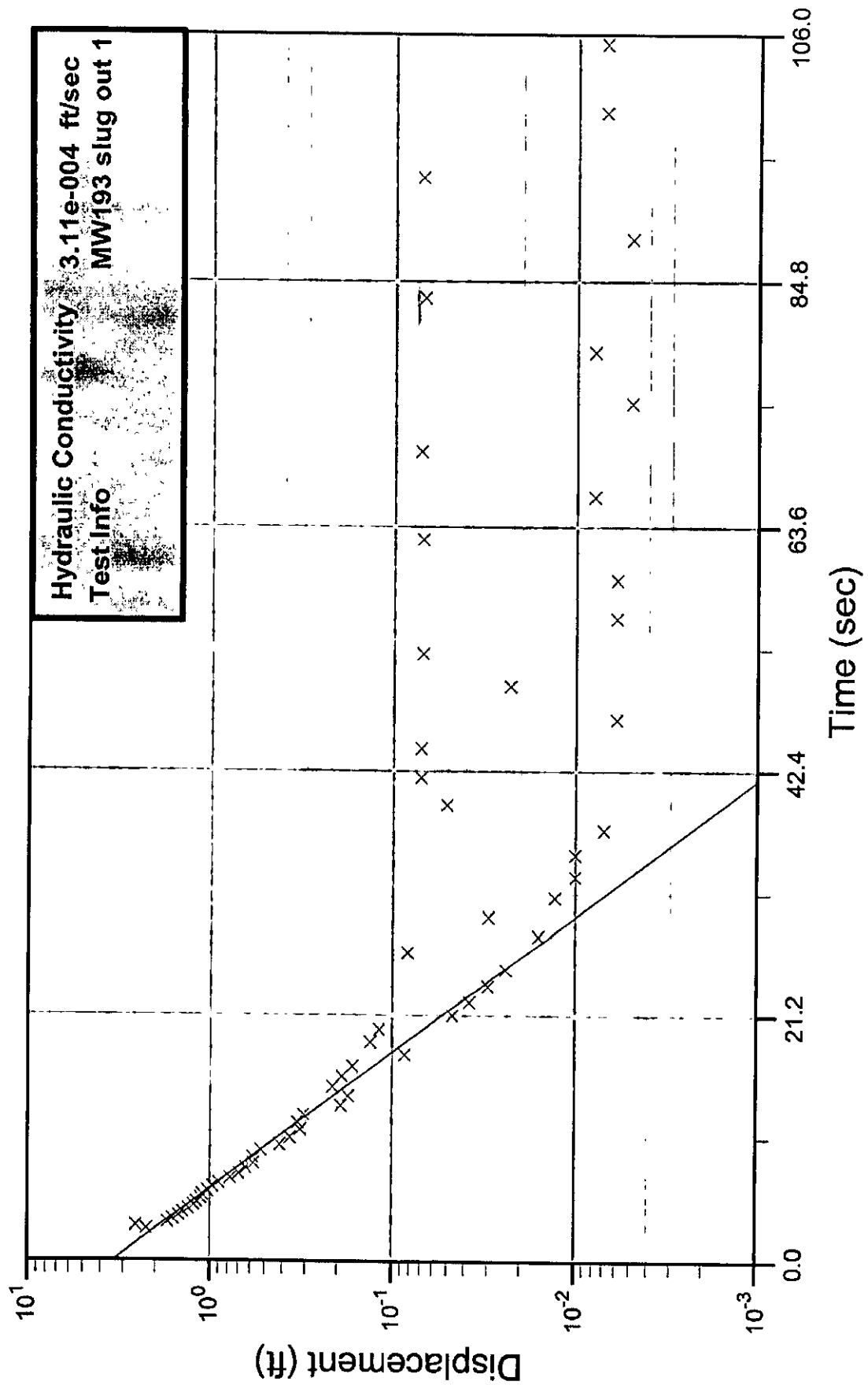
Regression Line	
Slope:	-0.119230 ft/sec
Intercept:	1.000000 ft
Residual Mean	= 0.041924
Residual Standard Dev.	= 0.105136
Residual Sum of Squares	= 0.794298
Absolute Residual Mean	= 0.046844
Minimum Residual	= -0.022317
Maximum Residual	= 0.817147

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.800000e+000	1.624000e+000	8.068532e-001	8.171468e-001
1	2.100000e+000	8.750000e-001	7.785029e-001	9.649707e-002
2	2.400000e+000	8.390000e-001	7.511488e-001	8.785116e-002
3	2.700000e+000	8.080000e-001	7.247559e-001	8.324412e-002
4	3.000000e+000	7.030000e-001	6.992903e-001	3.709709e-003
5	3.300000e+000	6.860000e-001	6.747195e-001	1.128052e-002
6	3.600000e+000	6.440000e-001	6.510120e-001	-7.012007e-003
7	3.900000e+000	6.190000e-001	6.281375e-001	-9.137538e-003

8	4.200000e+000	6.030000e-001	6.060668e-001	-3.066805e-003
9	4.500000e+000	6.420000e-001	5.847716e-001	5.722843e-002
10	4.800000e+000	5.560000e-001	5.642246e-001	-8.224575e-003
11	5.100000e+000	5.390000e-001	5.443995e-001	-5.399538e-003
12	5.400000e+000	5.060000e-001	5.252711e-001	-1.927109e-002
13	5.700000e+000	5.610000e-001	5.068148e-001	5.418525e-002
14	6.000000e+000	5.140000e-001	4.890069e-001	2.499309e-002
15	6.400000e+000	5.140000e-001	4.662326e-001	4.776737e-002
16	6.700000e+000	5.060000e-001	4.498507e-001	5.614929e-002
17	7.100000e+000	4.750000e-001	4.289000e-001	4.609997e-002
18	7.500000e+000	4.590000e-001	4.089251e-001	5.007492e-002
19	8.000000e+000	4.310000e-001	3.852595e-001	4.574052e-002
20	8.400000e+000	3.450000e-001	3.673170e-001	-2.231697e-002
21	8.900000e+000	3.250000e-001	3.460593e-001	-2.105934e-002
22	9.500000e+000	3.060000e-001	3.221678e-001	-1.616776e-002
23	1.000000e+001	2.870000e-001	3.035230e-001	-1.652304e-002
24	1.060000e+001	2.700000e-001	2.825681e-001	-1.256812e-002
25	1.130000e+001	3.170000e-001	2.599421e-001	5.705793e-002
26	1.190000e+001	2.810000e-001	2.419959e-001	3.900406e-002
27	1.260000e+001	2.170000e-001	2.226186e-001	-5.618624e-003
28	1.340000e+001	2.000000e-001	2.023657e-001	-2.365664e-003
29	1.420000e+001	1.810000e-001	1.839552e-001	-2.955239e-003
30	1.500000e+001	1.670000e-001	1.672197e-001	-2.197204e-004
31	1.590000e+001	1.530000e-001	1.502051e-001	2.794878e-003
32	1.680000e+001	1.360000e-001	1.349218e-001	1.078242e-003
33	1.780000e+001	1.280000e-001	1.197571e-001	8.242931e-003
34	1.890000e+001	1.780000e-001	1.050370e-001	7.296302e-002
35	2.000000e+001	1.000000e-001	9.212624e-002	7.873765e-003
36	2.120000e+001	8.900000e-002	7.984474e-002	9.155258e-003
37	2.240000e+001	8.400000e-002	6.920051e-002	1.479949e-002
38	2.380000e+001	1.060000e-001	5.856203e-002	4.743797e-002
39	2.520000e+001	1.280000e-001	4.955905e-002	7.844095e-002
40	2.670000e+001	1.230000e-001	4.144305e-002	8.155695e-002
41	2.820000e+001	5.000000e-002	3.465616e-002	1.534384e-002
42	2.980000e+001	2.800000e-002	2.863724e-002	-6.372396e-004
43	3.150000e+001	3.900000e-002	2.338319e-002	1.561681e-002
44	3.330000e+001	9.700000e-002	1.886680e-002	7.813320e-002
45	3.520000e+001	9.500000e-002	1.504231e-002	7.995769e-002
46	3.730000e+001	2.800000e-002	1.171049e-002	1.628951e-002
47	3.950000e+001	8.900000e-002	9.008595e-003	7.999140e-002
48	4.180000e+001	2.000000e-002	6.847959e-003	1.315204e-002
49	4.430000e+001	1.700000e-002	5.082871e-003	1.191713e-002
50	4.690000e+001	1.700000e-002	3.728026e-003	1.327197e-002
51	4.970000e+001	8.100000e-002	2.669885e-003	7.833011e-002
52	5.260000e+001	1.100000e-002	1.889418e-003	9.110582e-003
53	5.570000e+001	7.500000e-002	1.305592e-003	7.369441e-002
54	5.900000e+001	1.100000e-002	8.809085e-004	1.011909e-002
55	6.250000e+001	7.500000e-002	5.803606e-004	7.441964e-002
56	6.620000e+001	5.500000e-002	3.733437e-004	5.462666e-002
57	7.010000e+001	5.000000e-003	2.345112e-004	4.765489e-003
58	7.430000e+001	6.900000e-002	1.421294e-004	6.885787e-002
59	7.870000e+001	7.200000e-002	8.411014e-005	7.191589e-002
60	8.340000e+001	8.000000e-003	4.802623e-005	7.951974e-003
61	8.840000e+001	7.200000e-002	2.645905e-005	7.197354e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW193 slug out 1

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 62

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 7.95 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 3.348 ft
Hydraulic Conductivity	
Calculated Value	= 0.000310523 ft/sec
Aquifer Thickness	
Fixed Value	= 7.95 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 4.23735
B	
Calculated Value	= 0.703547
C	
Calculated Value	= 4.00492
Linear Regression Slope	
Fixed Value	= -0.194898 ft/sec
Linear Regression Intercept	
Fixed Value	= 3.348 ft

ANALYSIS STATISTICS

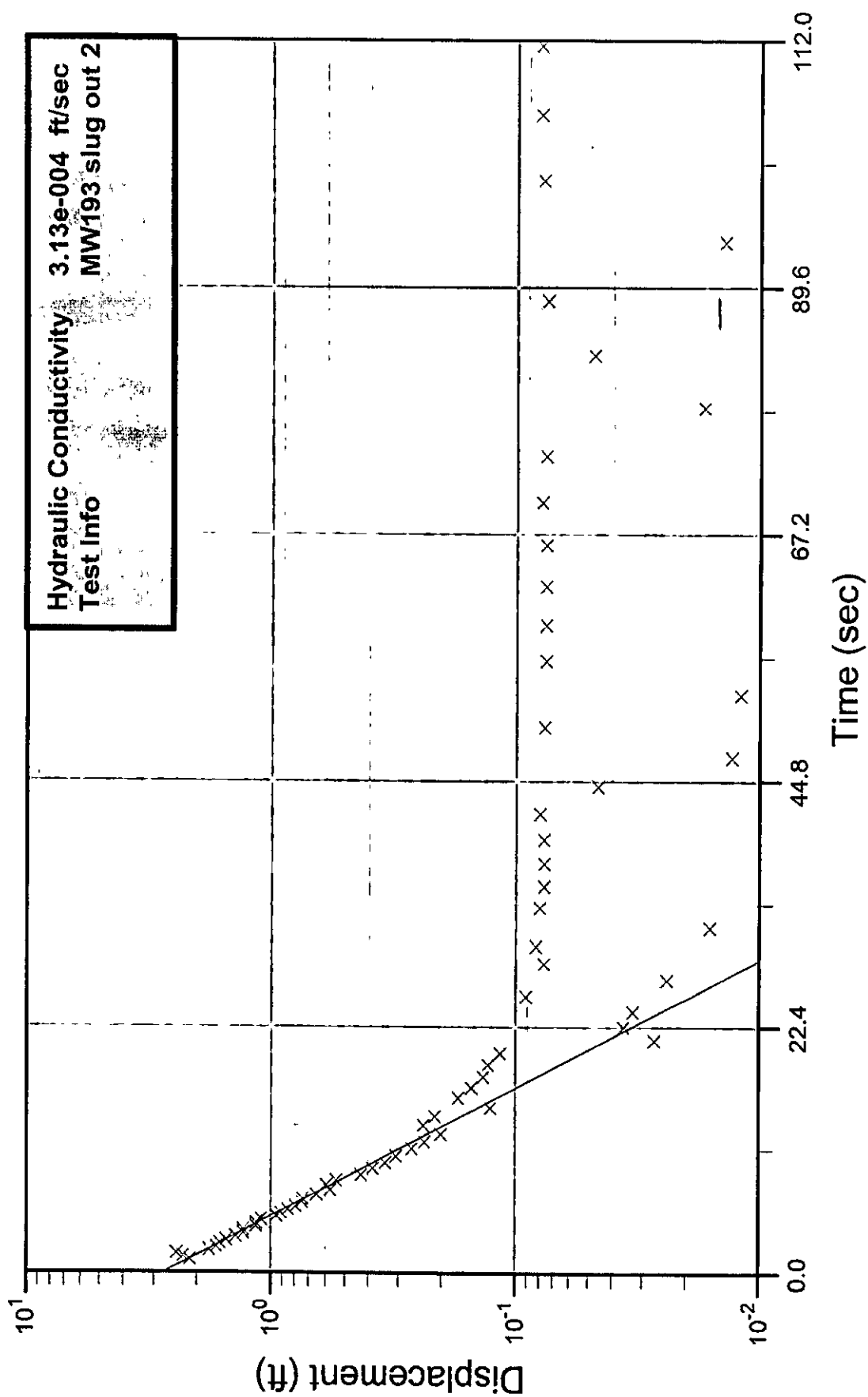
Regression Line	
Slope:	-0.194898 ft/sec
Intercept:	3.347995 ft
Residual Mean	= 0.012394
Residual Standard Dev.	= 0.102435
Residual Sum of Squares	= 0.660089
Absolute Residual Mean	= 0.049248
Minimum Residual	= -0.085708
Maximum Residual	= 0.686239

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	2.700000e+000	2.235000e+000	1.978103e+000	2.568972e-001
1	3.000000e+000	2.552000e+000	1.865761e+000	6.862391e-001
2	3.300000e+000	1.711000e+000	1.759799e+000	-4.879914e-002
3	3.600000e+000	1.600000e+000	1.659855e+000	-5.985525e-002
4	3.900000e+000	1.486000e+000	1.565587e+000	-7.958746e-002
5	4.200000e+000	1.414000e+000	1.476673e+000	-6.267340e-002
6	4.500000e+000	1.316000e+000	1.392809e+000	-7.680902e-002
7	4.800000e+000	1.228000e+000	1.313708e+000	-8.570752e-002

8	5.100000e+000	1.180000e+000	1.239098e+000	-5.909842e-002
9	5.400000e+000	1.119000e+000	1.168727e+000	-4.972658e-002
10	5.700000e+000	1.100000e+000	1.102351e+000	-2.351350e-003
11	6.000000e+000	1.025000e+000	1.039746e+000	-1.474575e-002
12	6.400000e+000	9.670000e-001	9.617672e-001	5.232763e-003
13	6.700000e+000	8.920000e-001	9.071458e-001	-1.514580e-002
14	7.100000e+000	7.750000e-001	8.391120e-001	-6.411197e-002
15	7.500000e+000	6.970000e-001	7.761805e-001	-7.918053e-002
16	8.000000e+000	6.360000e-001	7.041112e-001	-6.811123e-002
17	8.400000e+000	5.780000e-001	6.513045e-001	-7.330452e-002
18	8.900000e+000	5.830000e-001	5.908301e-001	-7.830114e-003
19	9.500000e+000	5.250000e-001	5.256260e-001	-6.260212e-004
20	1.000000e+001	4.140000e-001	4.768210e-001	-6.282101e-002
21	1.060000e+001	3.640000e-001	4.241990e-001	-6.019898e-002
22	1.130000e+001	3.200000e-001	3.701004e-001	-5.010041e-002
23	1.190000e+001	3.310000e-001	3.292561e-001	1.743926e-003
24	1.260000e+001	3.060000e-001	2.872657e-001	1.873433e-002
25	1.340000e+001	1.920000e-001	2.457929e-001	-5.379293e-002
26	1.420000e+001	1.750000e-001	2.103076e-001	-3.530763e-002
27	1.500000e+001	2.140000e-001	1.799454e-001	3.405463e-002
28	1.590000e+001	1.890000e-001	1.509948e-001	3.800519e-002
29	1.680000e+001	1.660000e-001	1.267020e-001	3.929803e-002
30	1.780000e+001	8.600000e-002	1.042655e-001	-1.826545e-002
31	1.890000e+001	1.330000e-001	8.414595e-002	4.885405e-002
32	2.000000e+001	1.190000e-001	6.790879e-002	5.109121e-002
33	2.120000e+001	4.700000e-002	5.374703e-002	-6.747025e-003
34	2.240000e+001	3.800000e-002	4.253857e-002	-4.538571e-003
35	2.380000e+001	3.000000e-002	3.238044e-002	-2.380443e-003
36	2.520000e+001	2.400000e-002	2.464806e-002	-6.480554e-004
37	2.670000e+001	8.300000e-002	1.840002e-002	6.459998e-002
38	2.820000e+001	1.600000e-002	1.373580e-002	2.264204e-003
39	2.980000e+001	3.000000e-002	1.005600e-002	1.994400e-002
40	3.150000e+001	1.300000e-002	7.219916e-003	5.780084e-003
41	3.330000e+001	1.000000e-002	5.083640e-003	4.916360e-003
42	3.520000e+001	1.000000e-002	3.510373e-003	6.489627e-003
43	3.730000e+001	7.000000e-003	2.331326e-003	4.668674e-003
44	3.950000e+001	5.100000e-002	1.518408e-003	4.948159e-002
45	4.180000e+001	7.100000e-002	9.698617e-004	7.003014e-002
46	4.430000e+001	7.100000e-002	5.958027e-004	7.040420e-002
47	4.690000e+001	6.000000e-003	3.589474e-004	5.641053e-003
48	4.970000e+001	2.300000e-002	2.079843e-004	2.279202e-002
49	5.260000e+001	7.000000e-002	1.181860e-004	6.988181e-002
50	5.570000e+001	6.000000e-003	6.459114e-005	5.935409e-003
51	5.900000e+001	6.000000e-003	3.395089e-005	5.966049e-003
52	6.250000e+001	7.000000e-002	1.716330e-005	6.998284e-002
53	6.620000e+001	8.000000e-003	8.344917e-006	7.991655e-003
54	7.010000e+001	7.200000e-002	3.902245e-006	7.199610e-002
55	7.430000e+001	5.000000e-003	1.721132e-006	4.998279e-003
56	7.870000e+001	8.000000e-003	7.301049e-007	7.999270e-003
57	8.340000e+001	6.900000e-002	2.921214e-007	6.899971e-002
58	8.840000e+001	5.000000e-003	1.102424e-007	4.999890e-003
59	9.370000e+001	7.100000e-002	3.924109e-008	7.099996e-002
60	9.930000e+001	7.000000e-003	1.317470e-008	6.999987e-003
61	1.052000e+002	7.000000e-003	4.172028e-009	6.999996e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number: 334469
Date: May 18, 2006
Area Name: Memphis Depot
Additional Info:
MW193 slug out 2

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 68

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 7.95 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 2.72971 ft
Hydraulic Conductivity Calculated Value	= 0.000312927 ft/sec
Aquifer Thickness Fixed Value	= 7.95 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type	

Selected Value	= Isotropic
Correction Type	
Selected Value	= None
Kz/Kr	
Fixed Value	= 1
Effective Casing Inner Diameter	
Calculated Value	= 0.17 ft
Effective Screen Inner Diameter	
Calculated Value	= 0.17 ft
A	
Calculated Value	= 4.23735
B	
Calculated Value	= 0.703547
C	
Calculated Value	= 4.00492
Linear Regression Slope	
Fixed Value	= -0.196406 ft/sec
Linear Regression Intercept	
Fixed Value	= 2.72971 ft

ANALYSIS STATISTICS

Regression Line	
Slope:	-0.196406 ft/sec
Intercept:	2.729710 ft
Residual Mean	= 0.031562
Residual Standard Dev.	= 0.078882
Residual Sum of Squares	= 0.490861
Absolute Residual Mean	= 0.054021
Minimum Residual	= -0.052994
Maximum Residual	= 0.512187

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	2.140000e+000	2.156546e+000	-1.654571e-002
1	1.500000e+000	2.279000e+000	2.033149e+000	2.458510e-001
2	1.800000e+000	2.429000e+000	1.916813e+000	5.121870e-001
3	2.100000e+000	1.785000e+000	1.807134e+000	-2.213373e-002
4	2.400000e+000	1.665000e+000	1.703730e+000	-3.873024e-002
5	2.700000e+000	1.618000e+000	1.606243e+000	1.175654e-002
6	3.000000e+000	1.524000e+000	1.514335e+000	9.665161e-003
7	3.300000e+000	1.393000e+000	1.427685e+000	-3.468519e-002

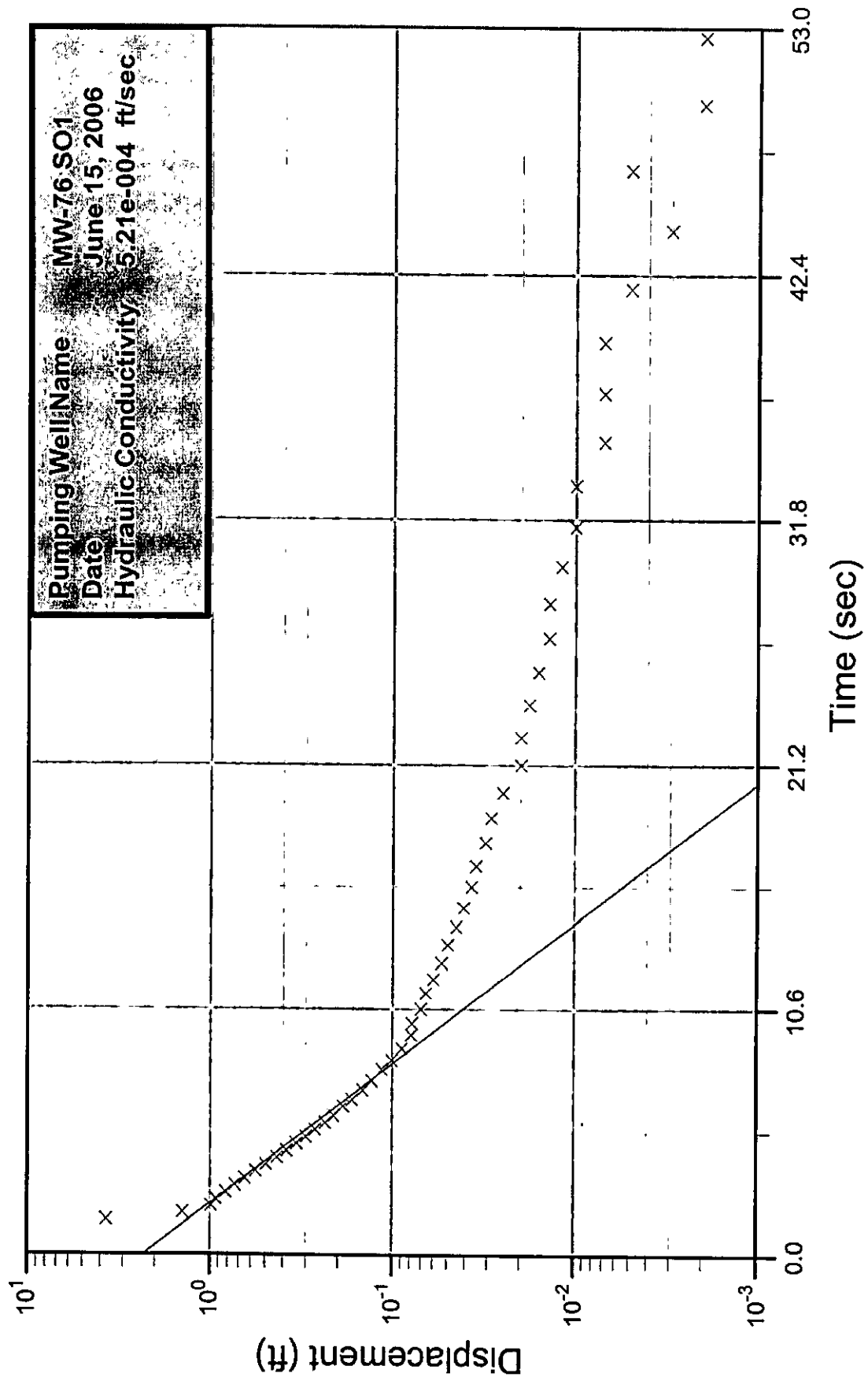
8	3.600000e+000	1.293000e+000	1.345994e+000	-5.299360e-002
9	3.900000e+000	1.296000e+000	1.268976e+000	2.702362e-002
10	4.200000e+000	1.149000e+000	1.196366e+000	-4.736604e-002
11	4.500000e+000	1.146000e+000	1.127910e+000	1.808955e-002
12	4.800000e+000	1.096000e+000	1.063372e+000	3.262815e-002
13	5.100000e+000	9.520000e-001	1.002526e+000	-5.052613e-002
14	5.400000e+000	9.080000e-001	9.451620e-001	-3.716198e-002
15	5.700000e+000	8.520000e-001	8.910802e-001	-3.908018e-002
16	6.000000e+000	7.940000e-001	8.400929e-001	-4.609292e-002
17	6.400000e+000	7.470000e-001	7.766191e-001	-2.961906e-002
18	6.700000e+000	7.440000e-001	7.321812e-001	1.181878e-002
19	7.100000e+000	6.530000e-001	6.768607e-001	-2.386071e-002
20	7.500000e+000	5.750000e-001	6.257200e-001	-5.071999e-002
21	8.000000e+000	5.970000e-001	5.671931e-001	2.980691e-002
22	8.400000e+000	5.440000e-001	5.243384e-001	1.966162e-002
23	8.900000e+000	4.300000e-001	4.752942e-001	-4.529424e-002
24	9.500000e+000	3.860000e-001	4.224581e-001	-3.645809e-002
25	1.000000e+001	3.410000e-001	3.829434e-001	-4.194335e-002
26	1.060000e+001	3.080000e-001	3.403734e-001	-3.237340e-002
27	1.130000e+001	2.660000e-001	2.966517e-001	-3.065173e-002
28	1.190000e+001	2.360000e-001	2.636744e-001	-2.767440e-002
29	1.260000e+001	2.020000e-001	2.298049e-001	-2.780487e-002
30	1.340000e+001	2.380000e-001	1.963906e-001	4.160941e-002
31	1.420000e+001	2.140000e-001	1.678348e-001	4.616516e-002
32	1.500000e+001	1.270000e-001	1.434312e-001	-1.643117e-002
33	1.590000e+001	1.720000e-001	1.201919e-001	5.180811e-002
34	1.680000e+001	1.520000e-001	1.007179e-001	5.128207e-002
35	1.780000e+001	1.360000e-001	8.275774e-002	5.324226e-002
36	1.890000e+001	1.300000e-001	6.667770e-002	6.332230e-002
37	2.000000e+001	1.160000e-001	5.372205e-002	6.227795e-002
38	2.120000e+001	2.700000e-002	4.244189e-002	-1.544189e-002
39	2.240000e+001	3.600000e-002	3.353026e-002	2.469742e-003
40	2.380000e+001	3.300000e-002	2.546944e-002	7.530559e-003
41	2.520000e+001	9.100000e-002	1.934648e-002	7.165352e-002
42	2.670000e+001	2.400000e-002	1.440969e-002	9.590310e-003
43	2.820000e+001	7.700000e-002	1.073266e-002	6.626734e-002
44	2.980000e+001	8.300000e-002	7.838451e-003	7.516155e-002
45	3.150000e+001	1.600000e-002	5.613365e-003	1.038663e-002
46	3.330000e+001	8.000000e-002	3.941727e-003	7.605827e-002
47	3.520000e+001	7.700000e-002	2.714063e-003	7.428594e-002
48	3.730000e+001	7.700000e-002	1.796775e-003	7.520322e-002
49	3.950000e+001	7.700000e-002	1.166374e-003	7.583363e-002
50	4.180000e+001	8.000000e-002	7.424238e-004	7.925758e-002
51	4.430000e+001	4.600000e-002	4.543666e-004	4.554563e-002
52	4.690000e+001	1.300000e-002	2.726661e-004	1.272733e-002
53	4.970000e+001	7.700000e-002	1.573244e-004	7.684268e-002
54	5.260000e+001	1.200000e-002	8.900847e-005	1.191099e-002
55	5.570000e+001	7.600000e-002	4.841801e-005	7.595158e-002
56	5.900000e+001	7.600000e-002	2.532345e-005	7.597468e-002
57	6.250000e+001	7.600000e-002	1.273442e-005	7.598727e-002
58	6.620000e+001	7.600000e-002	6.157095e-006	7.599384e-002
59	7.010000e+001	7.900000e-002	2.862285e-006	7.899714e-002
60	7.430000e+001	7.600000e-002	1.254471e-006	7.599875e-002
61	7.870000e+001	1.700000e-002	5.286259e-007	1.699947e-002
62	8.340000e+001	4.800000e-002	2.100133e-007	4.799979e-002
63	8.840000e+001	7.500000e-002	7.866035e-008	7.499992e-002
64	9.370000e+001	1.400000e-002	2.777637e-008	1.399997e-002

65	9.930000e+001	7.800000e-002	9.247100e-009	7.799999e-002
66	1.052000e+002	8.000000e-002	2.902326e-009	8.000000e-002
67	1.115000e+002	8.000000e-002	8.421075e-010	8.000000e-002

June 2006 Slug Test Analysis Results

- MW-076
- MW-077
- MW-144
- MW-157
- MW-161
- MW-162
- MW-163
- MW-164
- MW-189
- MW-190
- MW-191
- MW-192
- MW-193
- MW-194
- MW-195

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 54

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 9.6 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 2.27567 ft
Hydraulic Conductivity Calculated Value	= 0.000520907 ft/sec
Aquifer Thickness Fixed Value	= 9.6 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.67689

B
 Calculated Value = 0.792065

C
 Calculated Value = 4.59879

Linear Regression Slope
 Fixed Value = -0.378504 ft/sec

Linear Regression Intercept
 Fixed Value = 2.27567 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.378504 ft/sec
 Intercept: 2.275672 ft

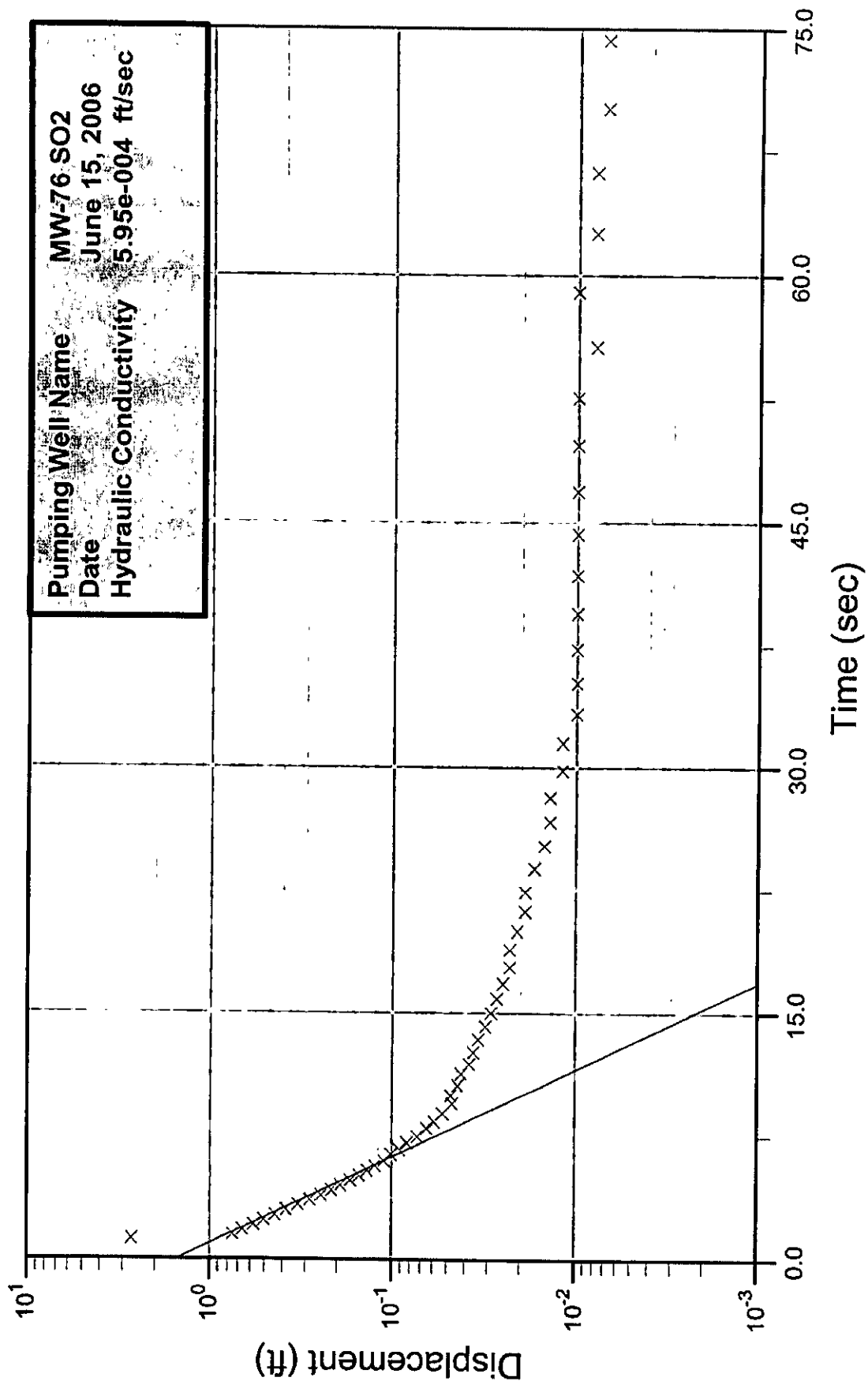
Residual Mean = 0.054994
 Residual Standard Dev. = 0.327707
 Residual Sum of Squares = 5.962478
 Absolute Residual Mean = 0.067490
 Minimum Residual = -0.040796
 Maximum Residual = 2.423159

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	3.713000e+000	1.289841e+000	2.423159e+000
1	1.800000e+000	1.408000e+000	1.151388e+000	2.566121e-001
2	2.100000e+000	9.870000e-001	1.027796e+000	-4.079618e-002
3	2.400000e+000	9.270000e-001	9.174710e-001	9.529031e-003
4	2.700000e+000	8.220000e-001	8.189882e-001	3.011765e-003
5	3.000000e+000	7.330000e-001	7.310768e-001	1.923213e-003
6	3.300000e+000	6.440000e-001	6.526019e-001	-8.601889e-003
7	3.600000e+000	5.620000e-001	5.825506e-001	-2.055061e-002
8	3.900000e+000	4.950000e-001	5.200187e-001	-2.501873e-002

9	4.200000e+000	4.320000e-001	4.641991e-001	-3.219913e-002
10	4.500000e+000	3.820000e-001	4.143713e-001	-3.237129e-002
11	4.800000e+000	3.370000e-001	3.698920e-001	-3.289204e-002
12	5.100000e+000	2.990000e-001	3.301873e-001	-3.118726e-002
13	5.400000e+000	2.670000e-001	2.947445e-001	-2.774446e-002
14	5.700000e+000	2.360000e-001	2.631061e-001	-2.710614e-002
15	6.000000e+000	2.120000e-001	2.348639e-001	-2.286392e-002
16	6.400000e+000	1.880000e-001	2.018661e-001	-1.386611e-002
17	6.700000e+000	1.680000e-001	1.801975e-001	-1.219750e-002
18	7.100000e+000	1.470000e-001	1.548802e-001	-7.880186e-003
19	7.500000e+000	1.310000e-001	1.331199e-001	-2.119896e-003
20	8.000000e+000	1.150000e-001	1.101671e-001	4.832915e-003
21	8.400000e+000	1.010000e-001	9.468888e-002	6.311123e-003
22	8.900000e+000	8.900000e-002	7.836242e-002	1.063758e-002
23	9.500000e+000	7.900000e-002	6.244225e-002	1.655775e-002
24	1.000000e+001	7.800000e-002	5.167582e-002	2.632418e-002
25	1.060000e+001	7.000000e-002	4.117732e-002	2.882268e-002
26	1.130000e+001	6.600000e-002	3.159297e-002	3.440703e-002
27	1.190000e+001	6.000000e-002	2.517452e-002	3.482548e-002
28	1.260000e+001	5.400000e-002	1.931495e-002	3.468505e-002
29	1.340000e+001	5.000000e-002	1.426881e-002	3.573119e-002
30	1.420000e+001	4.500000e-002	1.054101e-002	3.445899e-002
31	1.500000e+001	4.100000e-002	7.787109e-003	3.321289e-002
32	1.590000e+001	3.700000e-002	5.539011e-003	3.146099e-002
33	1.680000e+001	3.500000e-002	3.939928e-003	3.106007e-002
34	1.780000e+001	3.100000e-002	2.698398e-003	2.830160e-002
35	1.890000e+001	2.900000e-002	1.779449e-003	2.722055e-002
36	2.000000e+001	2.500000e-002	1.173451e-003	2.382655e-002
37	2.120000e+001	2.000000e-002	7.450861e-004	1.925491e-002
38	2.240000e+001	2.000000e-002	4.730944e-004	1.952691e-002
39	2.380000e+001	1.800000e-002	2.784920e-004	1.772151e-002
40	2.520000e+001	1.600000e-002	1.639372e-004	1.583606e-002
41	2.670000e+001	1.400000e-002	9.291893e-005	1.390708e-002
42	2.820000e+001	1.400000e-002	5.266606e-005	1.394733e-002
43	2.980000e+001	1.200000e-002	2.874215e-005	1.197126e-002
44	3.150000e+001	1.000000e-002	1.510322e-005	9.984897e-003
45	3.330000e+001	1.000000e-002	7.641551e-006	9.992358e-003
46	3.520000e+001	7.000000e-003	3.722676e-006	6.996277e-003
47	3.730000e+001	7.000000e-003	1.681329e-006	6.998319e-003
48	3.950000e+001	7.000000e-003	7.311588e-007	6.999269e-003
49	4.180000e+001	5.000000e-003	3.061488e-007	4.999694e-003
50	4.430000e+001	3.000000e-003	1.188439e-007	2.999881e-003
51	4.690000e+001	5.000000e-003	4.442048e-008	4.999956e-003
52	4.970000e+001	2.000000e-003	1.539263e-008	1.999985e-003
53	5.260000e+001	2.000000e-003	5.135757e-009	1.999995e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 61

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 9.6 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.48842 ft
Hydraulic Conductivity Calculated Value	= 0.000594587 ft/sec
Aquifer Thickness Fixed Value	= 9.6 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.67689

B
 Calculated Value = 0.792065

C
 Calculated Value = 4.59879

Linear Regression Slope
 Fixed Value = -0.432042 ft/sec

Linear Regression Intercept
 Fixed Value = 1.48842 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.432042 ft/sec
 Intercept: 1.488419 ft

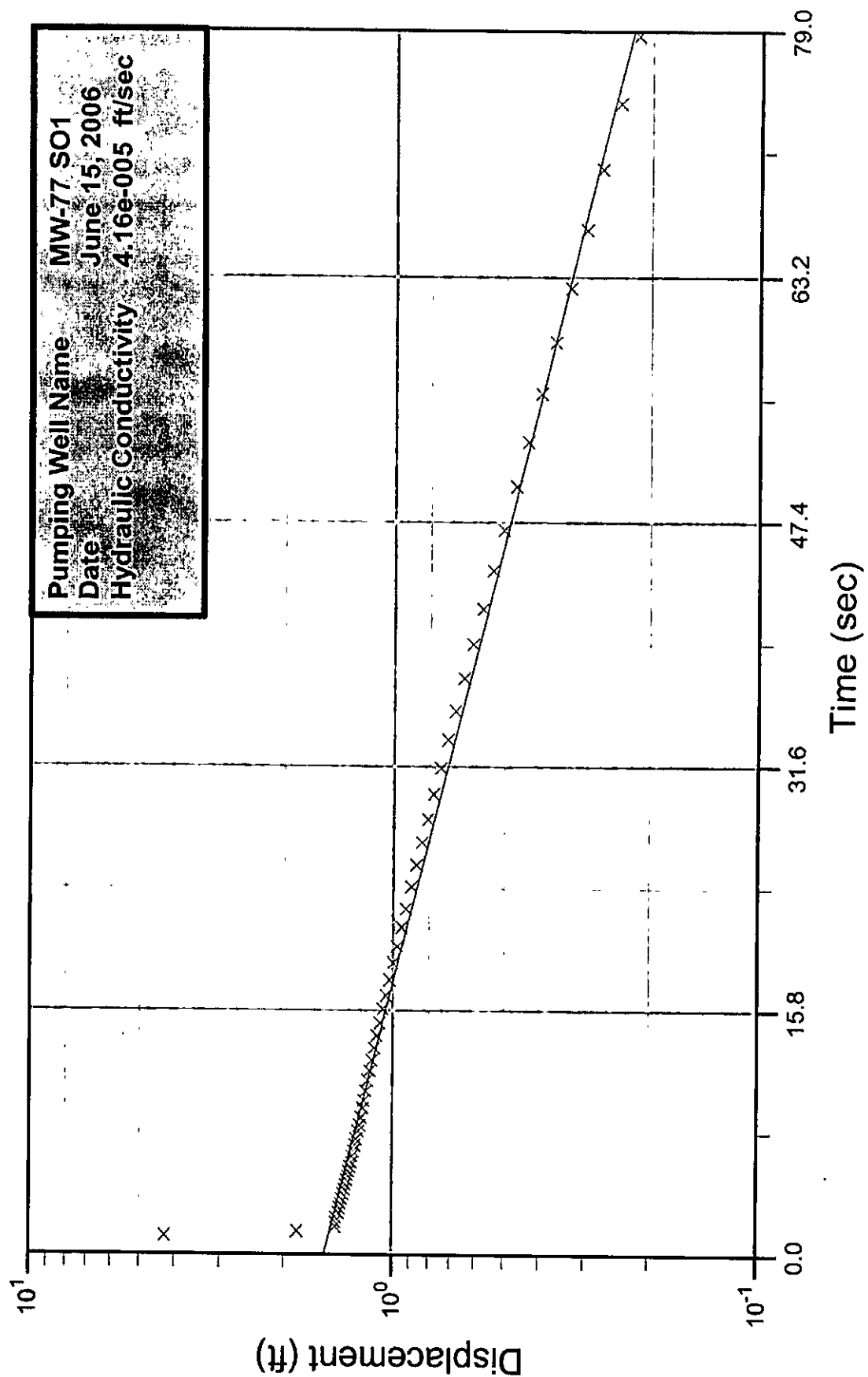
Residual Mean = 0.035987
 Residual Standard Dev. = 0.226869
 Residual Sum of Squares = 3.218652
 Absolute Residual Mean = 0.046584
 Minimum Residual = -0.031228
 Maximum Residual = 1.787732

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	2.674000e+000	8.862677e-001	1.787732e+000
1	1.500000e+000	7.490000e-001	7.785291e-001	-2.952911e-002
2	1.800000e+000	6.620000e-001	6.838877e-001	-2.188770e-002
3	2.100000e+000	5.750000e-001	6.007513e-001	-2.575132e-002
4	2.400000e+000	5.070000e-001	5.277214e-001	-2.072137e-002
5	2.700000e+000	4.400000e-001	4.635692e-001	-2.356925e-002
6	3.000000e+000	3.820000e-001	4.072157e-001	-2.521574e-002
7	3.300000e+000	3.290000e-001	3.577128e-001	-2.871282e-002
8	3.600000e+000	2.830000e-001	3.142277e-001	-3.122768e-002

9	3.900000e+000	2.460000e-001	2.760288e-001	-3.002879e-002
10	4.200000e+000	2.160000e-001	2.424735e-001	-2.647353e-002
11	4.500000e+000	1.920000e-001	2.129974e-001	-2.099738e-002
12	4.800000e+000	1.700000e-001	1.871045e-001	-1.710449e-002
13	5.100000e+000	1.520000e-001	1.643593e-001	-1.235925e-002
14	5.400000e+000	1.380000e-001	1.443790e-001	-6.379021e-003
15	5.700000e+000	1.240000e-001	1.268277e-001	-2.827676e-003
16	6.000000e+000	1.110000e-001	1.114099e-001	-4.099493e-004
17	6.400000e+000	1.010000e-001	9.372826e-002	7.271738e-003
18	6.700000e+000	9.100000e-002	8.233424e-002	8.665755e-003
19	7.100000e+000	8.300000e-002	6.926711e-002	1.373289e-002
20	7.500000e+000	7.300000e-002	5.827385e-002	1.472615e-002
21	8.000000e+000	6.500000e-002	4.695231e-002	1.804769e-002
22	8.400000e+000	5.900000e-002	3.950058e-002	1.949942e-002
23	8.900000e+000	5.300000e-002	3.182634e-002	2.117366e-002
24	9.500000e+000	4.700000e-002	2.455877e-002	2.244123e-002
25	1.000000e+001	4.800000e-002	1.978745e-002	2.821255e-002
26	1.060000e+001	4.400000e-002	1.526897e-002	2.873103e-002
27	1.130000e+001	4.200000e-002	1.128408e-002	3.071592e-002
28	1.190000e+001	3.800000e-002	8.707353e-003	2.929265e-002
29	1.260000e+001	3.600000e-002	6.434913e-003	2.956509e-002
30	1.340000e+001	3.400000e-002	4.554449e-003	2.944555e-002
31	1.420000e+001	3.100000e-002	3.223510e-003	2.777649e-002
32	1.500000e+001	2.900000e-002	2.281509e-003	2.671849e-002
33	1.590000e+001	2.700000e-002	1.546508e-003	2.545349e-002
34	1.680000e+001	2.500000e-002	1.048291e-003	2.395171e-002
35	1.780000e+001	2.300000e-002	6.805317e-004	2.231947e-002
36	1.890000e+001	2.300000e-002	4.231082e-004	2.257689e-002
37	2.000000e+001	2.100000e-002	2.630599e-004	2.073694e-002
38	2.120000e+001	1.900000e-002	1.566370e-004	1.884336e-002
39	2.240000e+001	1.900000e-002	9.326831e-005	1.890673e-002
40	2.380000e+001	1.700000e-002	5.093862e-005	1.694906e-002
41	2.520000e+001	1.500000e-002	2.782020e-005	1.497218e-002
42	2.670000e+001	1.400000e-002	1.455157e-005	1.398545e-002
43	2.820000e+001	1.400000e-002	7.611314e-006	1.399239e-002
44	2.980000e+001	1.200000e-002	3.812817e-006	1.199619e-002
45	3.150000e+001	1.200000e-002	1.829233e-006	1.199817e-002
46	3.330000e+001	1.000000e-002	8.404825e-007	9.999160e-003
47	3.520000e+001	1.000000e-002	3.698494e-007	9.999630e-003
48	3.730000e+001	1.000000e-002	1.492776e-007	9.999851e-003
49	3.950000e+001	1.000000e-002	5.770332e-008	9.999942e-003
50	4.180000e+001	1.000000e-002	2.136209e-008	9.999979e-003
51	4.430000e+001	1.000000e-002	7.253704e-009	9.999993e-003
52	4.690000e+001	1.000000e-002	2.358917e-009	9.999998e-003
53	4.970000e+001	1.000000e-002	7.036210e-010	9.999999e-003
54	5.260000e+001	1.000000e-002	2.010025e-010	1.000000e-002
55	5.570000e+001	8.000000e-003	5.266688e-011	8.000000e-003
56	5.900000e+001	1.000000e-002	1.265747e-011	1.000000e-002
57	6.250000e+001	8.000000e-003	2.790163e-012	8.000000e-003
58	6.620000e+001	8.000000e-003	5.641383e-013	8.000000e-003
59	7.010000e+001	7.000000e-003	1.046200e-013	7.000000e-003
60	7.430000e+001	7.000000e-003	1.704331e-014	7.000000e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 62

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.6875 ft
Screen Length	
Fixed Value	= 7.27 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.5417 ft
Hydraulic Conductivity	
Calculated Value	= 4.15661e-005 ft/sec
Aquifer Thickness	
Fixed Value	= 7.27 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
Selected Value = None

Kz/Kr
Fixed Value = 1

Effective Casing Inner Diameter
Calculated Value = 0.17 ft

Effective Screen Inner Diameter
Calculated Value = 0.17 ft

A
Calculated Value = 4.03881

B
Calculated Value = 0.66614

C
Calculated Value = 3.76652

Linear Regression Slope
Fixed Value = -0.0243666 ft/sec

Linear Regression Intercept
Fixed Value = 1.5417 ft

ANALYSIS STATISTICS

Regression Line

Slope: -0.024367 ft/sec
Intercept: 1.541700 ft

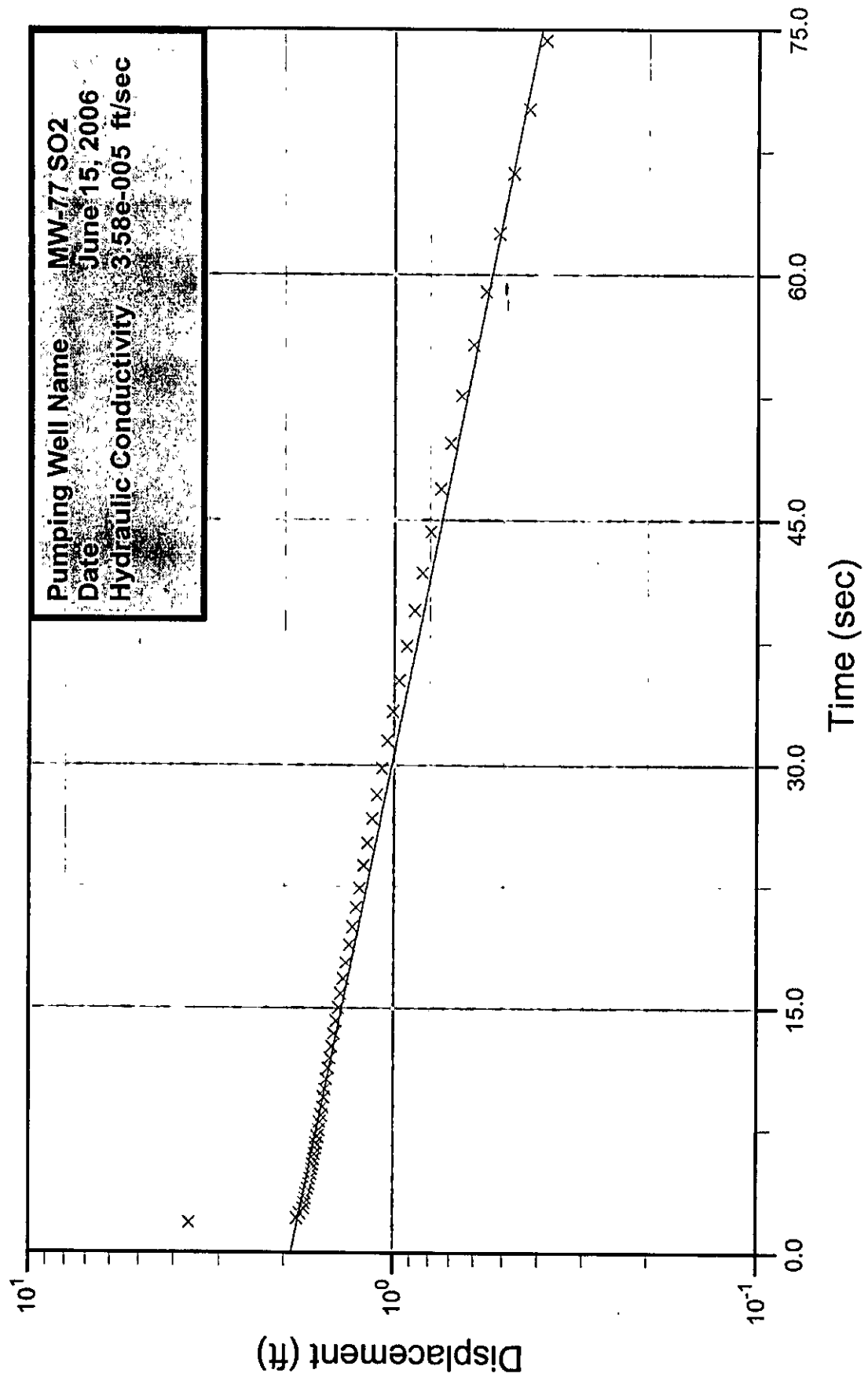
Residual Mean = 0.049209
Residual Standard Dev. = 0.349718
Residual Sum of Squares = 7.732920
Absolute Residual Mean = 0.071632
Minimum Residual = -0.038543
Maximum Residual = 2.752726

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	4.250000e+000	1.497274e+000	2.752726e+000
1	1.500000e+000	1.830000e+000	1.486369e+000	3.436312e-001
2	1.800000e+000	1.437000e+000	1.475543e+000	-3.854310e-002
3	2.100000e+000	1.437000e+000	1.464796e+000	-2.779624e-002
4	2.400000e+000	1.431000e+000	1.454128e+000	-2.312765e-002
5	2.700000e+000	1.410000e+000	1.443537e+000	-3.353676e-002
6	3.000000e+000	1.401000e+000	1.433023e+000	-3.202301e-002
7	3.300000e+000	1.393000e+000	1.422586e+000	-2.958584e-002
8	3.600000e+000	1.379000e+000	1.412225e+000	-3.322468e-002

9	3.900000e+000	1.368000e+000	1.401939e+000	-3.393899e-002
10	4.200000e+000	1.356000e+000	1.391728e+000	-3.572821e-002
11	4.500000e+000	1.348000e+000	1.381592e+000	-3.359180e-002
12	4.800000e+000	1.338000e+000	1.371529e+000	-3.352922e-002
13	5.100000e+000	1.328000e+000	1.361540e+000	-3.353992e-002
14	5.400000e+000	1.322000e+000	1.351623e+000	-2.962338e-002
15	5.700000e+000	1.312000e+000	1.341779e+000	-2.977907e-002
16	6.000000e+000	1.302000e+000	1.332006e+000	-3.000645e-002
17	6.400000e+000	1.294000e+000	1.319087e+000	-2.508693e-002
18	6.700000e+000	1.282000e+000	1.309480e+000	-2.747959e-002
19	7.100000e+000	1.269000e+000	1.296779e+000	-2.777856e-002
20	7.500000e+000	1.259000e+000	1.284201e+000	-2.520073e-002
21	8.000000e+000	1.247000e+000	1.268650e+000	-2.164985e-002
22	8.400000e+000	1.235000e+000	1.256345e+000	-2.134484e-002
23	8.900000e+000	1.223000e+000	1.241131e+000	-1.813128e-002
24	9.500000e+000	1.211000e+000	1.223118e+000	-1.211799e-002
25	1.000000e+001	1.203000e+000	1.208307e+000	-5.306788e-003
26	1.060000e+001	1.190000e+000	1.190770e+000	-7.698999e-004
27	1.130000e+001	1.174000e+000	1.170632e+000	3.368373e-003
28	1.190000e+001	1.160000e+000	1.153642e+000	6.358459e-003
29	1.260000e+001	1.144000e+000	1.134131e+000	9.868818e-003
30	1.340000e+001	1.126000e+000	1.112237e+000	1.376267e-002
31	1.420000e+001	1.109000e+000	1.090766e+000	1.823387e-002
32	1.500000e+001	1.089000e+000	1.069709e+000	1.929057e-002
33	1.590000e+001	1.069000e+000	1.046506e+000	2.249388e-002
34	1.680000e+001	1.046000e+000	1.023806e+000	2.219388e-002
35	1.780000e+001	1.024000e+000	9.991609e-001	2.483907e-002
36	1.890000e+001	1.001000e+000	9.727359e-001	2.826412e-002
37	2.000000e+001	9.770000e-001	9.470097e-001	2.999029e-002
38	2.120000e+001	9.510000e-001	9.197201e-001	3.127986e-002
39	2.240000e+001	9.250000e-001	8.932170e-001	3.178304e-002
40	2.380000e+001	8.960000e-001	8.632603e-001	3.273969e-002
41	2.520000e+001	8.680000e-001	8.343083e-001	3.369167e-002
42	2.670000e+001	8.400000e-001	8.043650e-001	3.563500e-002
43	2.820000e+001	8.090000e-001	7.754963e-001	3.350367e-002
44	2.980000e+001	7.810000e-001	7.458442e-001	3.515583e-002
45	3.150000e+001	7.480000e-001	7.155801e-001	3.241994e-002
46	3.330000e+001	7.160000e-001	6.848731e-001	3.112687e-002
47	3.520000e+001	6.840000e-001	6.538886e-001	3.011135e-002
48	3.730000e+001	6.470000e-001	6.212709e-001	2.572910e-002
49	3.950000e+001	6.130000e-001	5.888437e-001	2.415634e-002
50	4.180000e+001	5.780000e-001	5.567507e-001	2.124932e-002
51	4.430000e+001	5.420000e-001	5.238477e-001	1.815227e-002
52	4.690000e+001	5.060000e-001	4.916897e-001	1.431027e-002
53	4.970000e+001	4.690000e-001	4.592623e-001	9.737739e-003
54	5.260000e+001	4.350000e-001	4.279294e-001	7.070573e-003
55	5.570000e+001	4.000000e-001	3.967958e-001	3.204180e-003
56	5.900000e+001	3.660000e-001	3.661386e-001	-1.386447e-004
57	6.250000e+001	3.330000e-001	3.362077e-001	-3.207653e-003
58	6.620000e+001	3.010000e-001	3.072226e-001	-6.222603e-003
59	7.010000e+001	2.730000e-001	2.793716e-001	-6.371615e-003
60	7.430000e+001	2.440000e-001	2.521951e-001	-8.195138e-003
61	7.870000e+001	2.180000e-001	2.265555e-001	-8.555538e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 59

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.6875 ft
Screen Length Fixed Value	= 7.27 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.90171 ft
Hydraulic Conductivity Calculated Value	= 3.58225e-005 ft/sec
Aquifer Thickness Fixed Value	= 7.27 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.03881

B
 Calculated Value = 0.66614

C
 Calculated Value = 3.76652

Linear Regression Slope
 Fixed Value = -0.0209996 ft/sec

Linear Regression Intercept
 Fixed Value = 1.90171 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.021000 ft/sec
 Intercept: 1.901713 ft

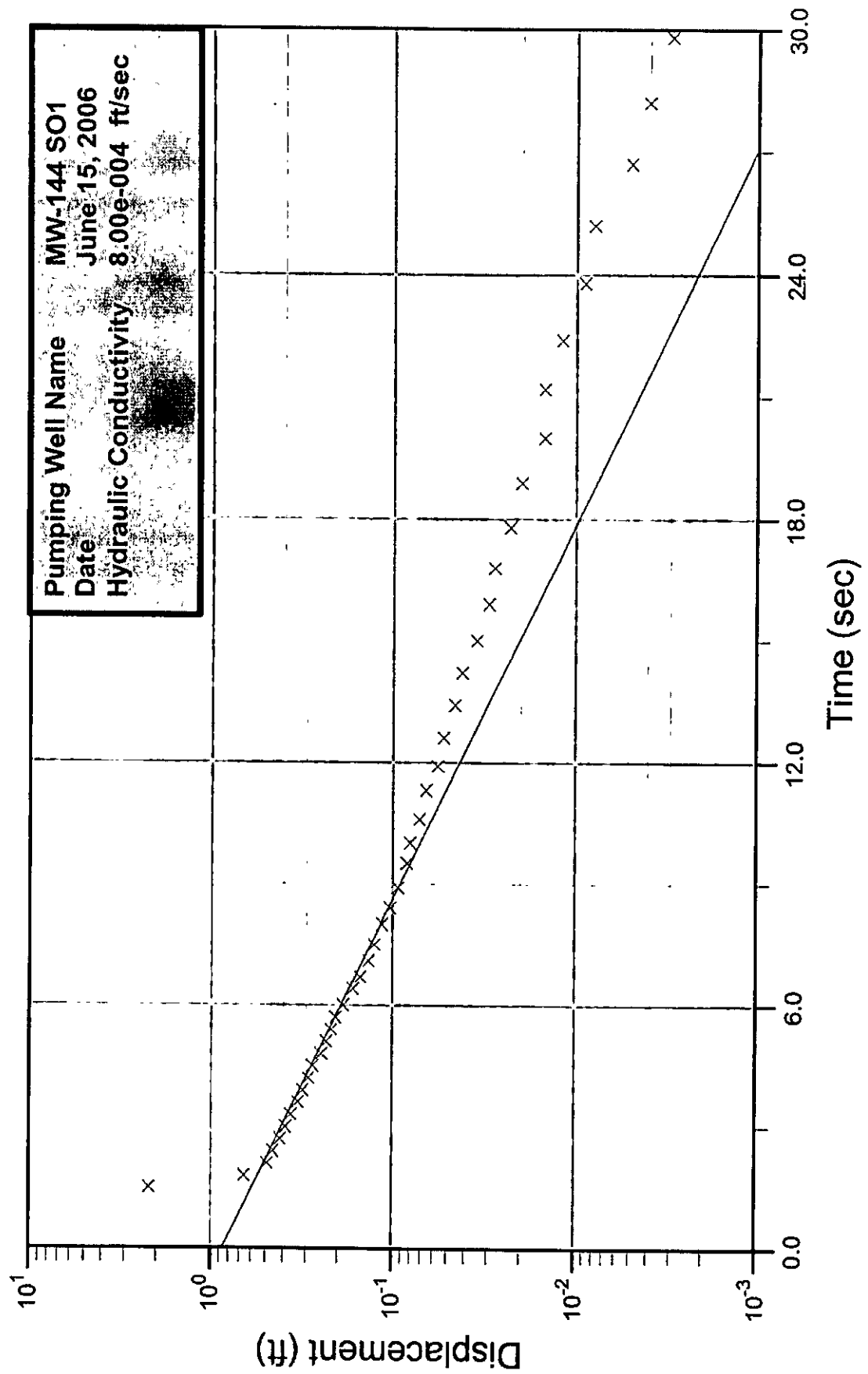
Residual Mean = 0.044972
 Residual Standard Dev. = 0.232967
 Residual Sum of Squares = 3.321484
 Absolute Residual Mean = 0.062451
 Minimum Residual = -0.034369
 Maximum Residual = 1.799829

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.800000e+000	3.631000e+000	1.831171e+000	1.799829e+000
1	2.100000e+000	1.842000e+000	1.819672e+000	2.232847e-002
2	2.400000e+000	1.808000e+000	1.808244e+000	-2.438638e-004
3	2.700000e+000	1.765000e+000	1.796888e+000	-3.188797e-002
4	3.000000e+000	1.757000e+000	1.785603e+000	-2.860338e-002
5	3.300000e+000	1.745000e+000	1.774390e+000	-2.938967e-002
6	3.600000e+000	1.737000e+000	1.763246e+000	-2.624638e-002
7	3.900000e+000	1.721000e+000	1.752173e+000	-3.117307e-002
8	4.200000e+000	1.707000e+000	1.741169e+000	-3.416930e-002

9	4.500000e+000	1.697000e+000	1.730235e+000	-3.323463e-002
10	4.800000e+000	1.685000e+000	1.719369e+000	-3.436863e-002
11	5.100000e+000	1.675000e+000	1.708571e+000	-3.357088e-002
12	5.400000e+000	1.669000e+000	1.697841e+000	-2.884093e-002
13	5.700000e+000	1.659000e+000	1.687178e+000	-2.817837e-002
14	6.000000e+000	1.649000e+000	1.676583e+000	-2.758278e-002
15	6.400000e+000	1.639000e+000	1.662559e+000	-2.355875e-002
16	6.700000e+000	1.628000e+000	1.652118e+000	-2.411776e-002
17	7.100000e+000	1.618000e+000	1.638298e+000	-2.029837e-002
18	7.500000e+000	1.604000e+000	1.624595e+000	-2.059458e-002
19	8.000000e+000	1.596000e+000	1.607626e+000	-1.162592e-002
20	8.400000e+000	1.582000e+000	1.594179e+000	-1.217869e-002
21	8.900000e+000	1.568000e+000	1.577528e+000	-9.527722e-003
22	9.500000e+000	1.556000e+000	1.557776e+000	-1.775969e-003
23	1.000000e+001	1.545000e+000	1.541505e+000	3.494779e-003
24	1.060000e+001	1.531000e+000	1.522204e+000	8.795505e-003
25	1.130000e+001	1.515000e+000	1.499992e+000	1.500780e-002
26	1.190000e+001	1.498000e+000	1.481211e+000	1.678876e-002
27	1.260000e+001	1.480000e+000	1.459597e+000	2.040287e-002
28	1.340000e+001	1.462000e+000	1.435281e+000	2.671879e-002
29	1.420000e+001	1.444000e+000	1.411370e+000	3.262962e-002
30	1.500000e+001	1.421000e+000	1.387858e+000	3.314211e-002
31	1.590000e+001	1.401000e+000	1.361874e+000	3.912578e-002
32	1.680000e+001	1.379000e+000	1.336377e+000	4.262298e-002
33	1.780000e+001	1.354000e+000	1.308606e+000	4.539372e-002
34	1.890000e+001	1.328000e+000	1.278725e+000	4.927546e-002
35	2.000000e+001	1.302000e+000	1.249525e+000	5.247486e-002
36	2.120000e+001	1.274000e+000	1.218431e+000	5.556883e-002
37	2.240000e+001	1.245000e+000	1.188111e+000	5.688905e-002
38	2.380000e+001	1.215000e+000	1.153690e+000	6.131034e-002
39	2.520000e+001	1.184000e+000	1.120266e+000	6.373440e-002
40	2.670000e+001	1.150000e+000	1.085528e+000	6.447208e-002
41	2.820000e+001	1.118000e+000	1.051867e+000	6.613259e-002
42	2.980000e+001	1.081000e+000	1.017113e+000	6.388748e-002
43	3.150000e+001	1.045000e+000	9.814428e-001	6.355718e-002
44	3.330000e+001	1.008000e+000	9.450374e-001	6.296259e-002
45	3.520000e+001	9.700000e-001	9.080735e-001	6.192650e-002
46	3.730000e+001	9.270000e-001	8.688984e-001	5.810160e-002
47	3.950000e+001	8.830000e-001	8.296693e-001	5.333074e-002
48	4.180000e+001	8.400000e-001	7.905494e-001	4.945062e-002
49	4.430000e+001	7.960000e-001	7.501170e-001	4.588301e-002
50	4.690000e+001	7.490000e-001	7.102594e-001	3.874058e-002
51	4.970000e+001	7.030000e-001	6.697011e-001	3.329892e-002
52	5.260000e+001	6.560000e-001	6.301341e-001	2.586587e-002
53	5.570000e+001	6.090000e-001	5.904199e-001	1.858008e-002
54	5.900000e+001	5.630000e-001	5.508901e-001	1.210986e-002
55	6.250000e+001	5.170000e-001	5.118527e-001	5.147298e-003
56	6.620000e+001	4.720000e-001	4.735883e-001	-1.588339e-003
57	7.010000e+001	4.280000e-001	4.363480e-001	-8.348010e-003
58	7.430000e+001	3.850000e-001	3.995112e-001	-1.451124e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 53

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 3.05 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 0.862979 ft
Hydraulic Conductivity Calculated Value	= 0.000800086 ft/sec
Aquifer Thickness Fixed Value	= 3.05 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 2.61615

B
 Calculated Value = 0.409553

C
 Calculated Value = 2.23948

Linear Regression Slope
 Fixed Value = -0.249703 ft/sec

Linear Regression Intercept
 Fixed Value = 0.862979 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.249703 ft/sec
 Intercept: 0.862979 ft

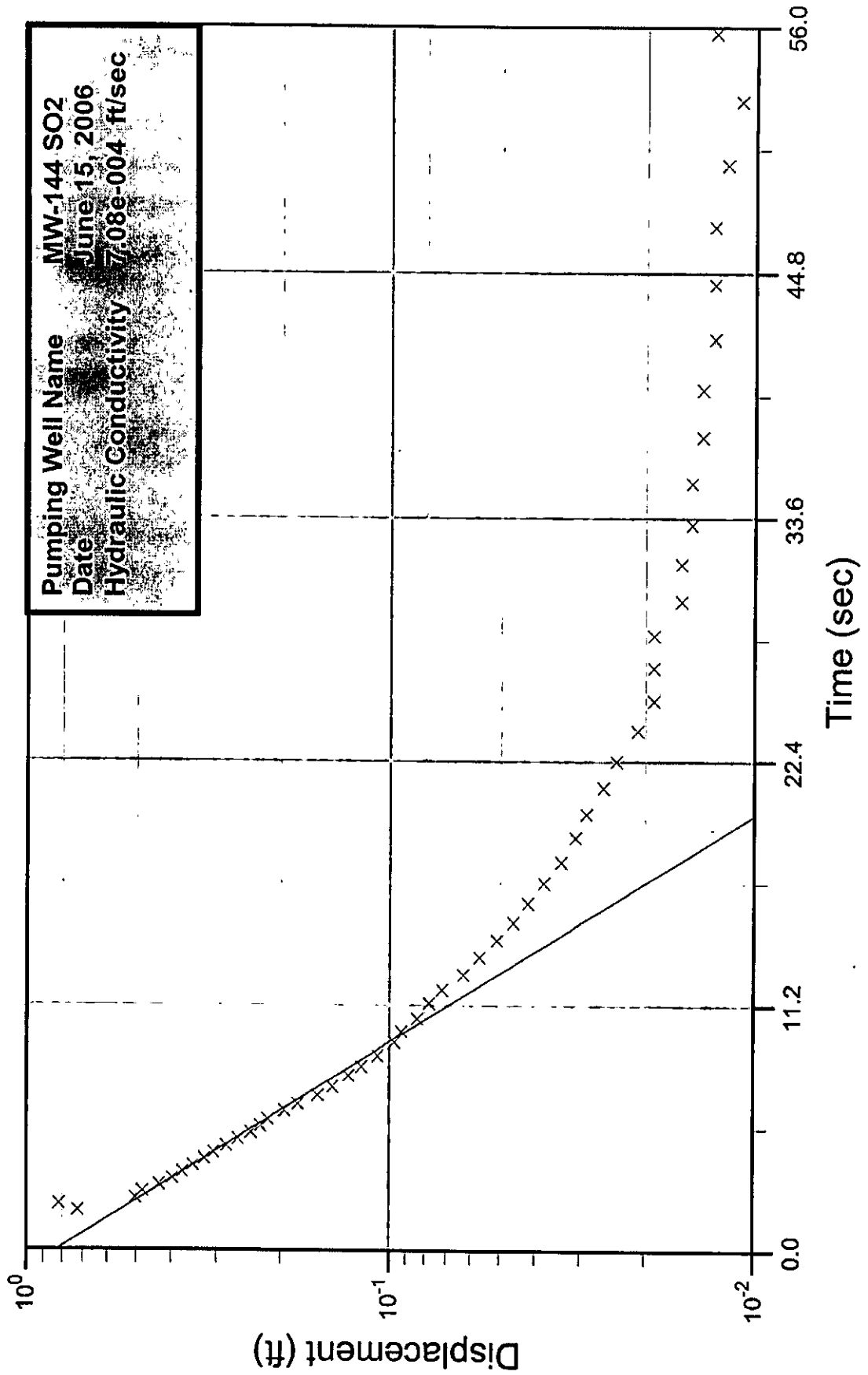
Residual Mean = 0.031799
 Residual Standard Dev. = 0.217585
 Residual Sum of Squares = 2.562793
 Absolute Residual Mean = 0.040682
 Minimum Residual = -0.023744
 Maximum Residual = 1.595619

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	2.189000e+000	5.933806e-001	1.595619e+000
1	1.800000e+000	6.550000e-001	5.505541e-001	1.044459e-001
2	2.100000e+000	4.930000e-001	5.108186e-001	-1.781856e-002
3	2.400000e+000	4.570000e-001	4.739509e-001	-1.695088e-002
4	2.700000e+000	4.160000e-001	4.397441e-001	-2.374408e-002
5	3.000000e+000	3.880000e-001	4.080061e-001	-2.000611e-002
6	3.300000e+000	3.620000e-001	3.785588e-001	-1.655879e-002
7	3.600000e+000	3.330000e-001	3.512368e-001	-1.823679e-002
8	3.900000e+000	3.130000e-001	3.258867e-001	-1.288672e-002

9	4.200000e+000	2.910000e-001	3.023663e-001	-1.136626e-002
10	4.500000e+000	2.760000e-001	2.805434e-001	-4.543364e-003
11	4.800000e+000	2.480000e-001	2.602955e-001	-1.229550e-002
12	5.100000e+000	2.330000e-001	2.415090e-001	-8.509008e-003
13	5.400000e+000	2.190000e-001	2.240784e-001	-5.078403e-003
14	5.700000e+000	2.070000e-001	2.079058e-001	-9.058295e-004
15	6.000000e+000	1.880000e-001	1.929005e-001	-4.900491e-003
16	6.400000e+000	1.660000e-001	1.745643e-001	-8.564350e-003
17	6.700000e+000	1.520000e-001	1.619654e-001	-9.965390e-003
18	7.100000e+000	1.370000e-001	1.465698e-001	-9.569783e-003
19	7.500000e+000	1.270000e-001	1.326376e-001	-5.637604e-003
20	8.000000e+000	1.150000e-001	1.170697e-001	-2.069684e-003
21	8.400000e+000	1.040000e-001	1.059416e-001	-1.941634e-003
22	8.900000e+000	9.400000e-002	9.350707e-002	4.929309e-004
23	9.500000e+000	8.400000e-002	8.049664e-002	3.503355e-003
24	1.000000e+001	8.100000e-002	7.104861e-002	9.951395e-003
25	1.060000e+001	7.200000e-002	6.116302e-002	1.083698e-002
26	1.130000e+001	6.600000e-002	5.135441e-002	1.464559e-002
27	1.190000e+001	5.700000e-002	4.420904e-002	1.279096e-002
28	1.260000e+001	5.300000e-002	3.711932e-002	1.588068e-002
29	1.340000e+001	4.600000e-002	3.039796e-002	1.560204e-002
30	1.420000e+001	4.200000e-002	2.489367e-002	1.710633e-002
31	1.500000e+001	3.500000e-002	2.038606e-002	1.461394e-002
32	1.590000e+001	3.000000e-002	1.628296e-002	1.371704e-002
33	1.680000e+001	2.800000e-002	1.300569e-002	1.499431e-002
34	1.780000e+001	2.300000e-002	1.013185e-002	1.286815e-002
35	1.890000e+001	2.000000e-002	7.698392e-003	1.230161e-002
36	2.000000e+001	1.500000e-002	5.849397e-003	9.150603e-003
37	2.120000e+001	1.500000e-002	4.334887e-003	1.066511e-002
38	2.240000e+001	1.200000e-002	3.212510e-003	8.787490e-003
39	2.380000e+001	9.000000e-003	2.264760e-003	6.735240e-003
40	2.520000e+001	8.000000e-003	1.596614e-003	6.403386e-003
41	2.670000e+001	5.000000e-003	1.097826e-003	3.902174e-003
42	2.820000e+001	4.000000e-003	7.548604e-004	3.245140e-003
43	2.980000e+001	3.000000e-003	5.062389e-004	2.493761e-003
44	3.150000e+001	0.000000e+000	3.311311e-004	-3.311311e-004
45	3.330000e+001	0.000000e+000	2.112516e-004	-2.112516e-004
46	3.520000e+001	-2.000000e-003	1.314485e-004	-2.131448e-
003				
47	3.730000e+001	-3.000000e-003	7.780764e-005	-3.077808e-
003				
48	3.950000e+001	-4.000000e-003	4.492049e-005	-4.044920e-
003				
49	4.180000e+001	-3.000000e-003	2.529427e-005	-3.025294e-
003				
50	4.430000e+001	-4.000000e-003	1.354912e-005	-4.013549e-
003				
51	4.690000e+001	-3.000000e-003	7.078733e-006	-3.007079e-
003				
52	4.970000e+001	-4.000000e-003	3.518124e-006	-4.003518e-
003				

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 54

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 3.05 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 0.823847 ft
Hydraulic Conductivity Calculated Value	= 0.000708038 ft/sec
Aquifer Thickness Fixed Value	= 3.05 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 2.61615

B
 Calculated Value = 0.409553

C
 Calculated Value = 2.23948

Linear Regression Slope
 Fixed Value = -0.220975 ft/sec

Linear Regression Intercept
 Fixed Value = 0.823847 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.220975 ft/sec
 Intercept: 0.823847 ft

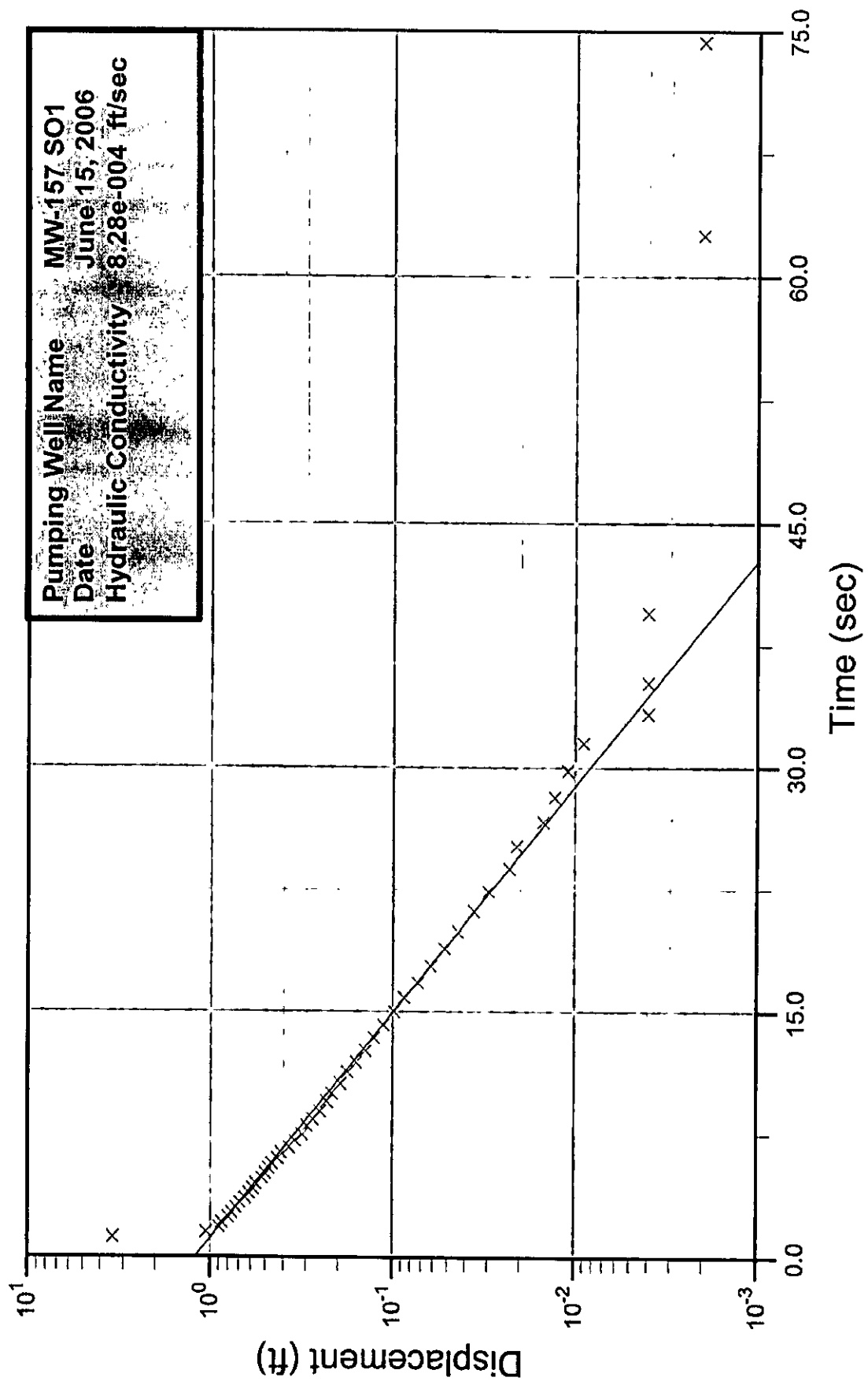
Residual Mean = 0.016073
 Residual Standard Dev. = 0.045600
 Residual Sum of Squares = 0.126234
 Absolute Residual Mean = 0.019686
 Minimum Residual = -0.013582
 Maximum Residual = 0.298019

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.800000e+000	7.230000e-001	5.534827e-001	1.695173e-001
1	2.100000e+000	8.160000e-001	5.179807e-001	2.980193e-001
2	2.400000e+000	5.020000e-001	4.847559e-001	1.724405e-002
3	2.700000e+000	4.800000e-001	4.536623e-001	2.633769e-002
4	3.000000e+000	4.320000e-001	4.245631e-001	7.436886e-003
5	3.300000e+000	3.970000e-001	3.973304e-001	-3.304204e-004
6	3.600000e+000	3.730000e-001	3.718445e-001	1.155490e-003
7	3.900000e+000	3.490000e-001	3.479933e-001	1.006661e-003
8	4.200000e+000	3.250000e-001	3.256720e-001	-6.720499e-004

9	4.500000e+000	3.060000e-001	3.047825e-001	1.217488e-003
10	4.800000e+000	2.820000e-001	2.852329e-001	-3.232890e-003
11	5.100000e+000	2.620000e-001	2.669372e-001	-4.937236e-003
12	5.400000e+000	2.410000e-001	2.498151e-001	-8.815117e-003
13	5.700000e+000	2.270000e-001	2.337913e-001	-6.791261e-003
14	6.000000e+000	2.170000e-001	2.187952e-001	-1.795220e-003
15	6.400000e+000	1.950000e-001	2.002860e-001	-5.285990e-003
16	6.700000e+000	1.790000e-001	1.874391e-001	-8.439074e-003
17	7.100000e+000	1.580000e-001	1.715825e-001	-1.358245e-002
18	7.500000e+000	1.440000e-001	1.570672e-001	-1.306724e-002
19	8.000000e+000	1.300000e-001	1.406376e-001	-1.063763e-002
20	8.400000e+000	1.200000e-001	1.287402e-001	-8.740231e-003
21	8.900000e+000	1.080000e-001	1.152737e-001	-7.273695e-003
22	9.500000e+000	9.700000e-002	1.009600e-001	-3.959997e-003
23	1.000000e+001	9.300000e-002	9.039934e-002	2.600661e-003
24	1.060000e+001	8.400000e-002	7.917433e-002	4.825675e-003
25	1.130000e+001	7.800000e-002	6.782763e-002	1.017237e-002
26	1.190000e+001	7.200000e-002	5.940538e-002	1.259462e-002
27	1.260000e+001	6.300000e-002	5.089183e-002	1.210817e-002
28	1.340000e+001	5.700000e-002	4.264554e-002	1.435446e-002
29	1.420000e+001	5.100000e-002	3.573543e-002	1.526457e-002
30	1.500000e+001	4.600000e-002	2.994502e-002	1.605498e-002
31	1.590000e+001	4.200000e-002	2.454444e-002	1.745556e-002
32	1.680000e+001	3.800000e-002	2.011786e-002	1.788214e-002
33	1.780000e+001	3.400000e-002	1.612923e-002	1.787077e-002
34	1.890000e+001	3.100000e-002	1.264878e-002	1.835122e-002
35	2.000000e+001	2.900000e-002	9.919364e-003	1.908064e-002
36	2.120000e+001	2.600000e-002	7.608903e-003	1.839110e-002
37	2.240000e+001	2.400000e-002	5.836605e-003	1.816340e-002
38	2.380000e+001	2.100000e-002	4.283560e-003	1.671644e-002
39	2.520000e+001	1.900000e-002	3.143761e-003	1.585624e-002
40	2.670000e+001	1.900000e-002	2.256822e-003	1.674318e-002
41	2.820000e+001	1.900000e-002	1.620112e-003	1.737989e-002
42	2.980000e+001	1.600000e-002	1.137617e-003	1.486238e-002
43	3.150000e+001	1.600000e-002	7.813582e-004	1.521864e-002
44	3.330000e+001	1.500000e-002	5.249374e-004	1.447506e-002
45	3.520000e+001	1.500000e-002	3.449594e-004	1.465504e-002
46	3.730000e+001	1.400000e-002	2.168877e-004	1.378311e-002
47	3.950000e+001	1.400000e-002	1.333844e-004	1.386662e-002
48	4.180000e+001	1.300000e-002	8.023767e-005	1.291976e-002
49	4.430000e+001	1.300000e-002	4.618043e-005	1.295382e-002
50	4.690000e+001	1.300000e-002	2.599805e-005	1.297400e-002
51	4.970000e+001	1.200000e-002	1.400329e-005	1.198600e-002
52	5.260000e+001	1.100000e-002	7.377723e-006	1.099262e-002
53	5.570000e+001	1.300000e-002	3.718957e-006	1.299628e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 67

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 0.1 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.19536 ft
Hydraulic Conductivity Calculated Value	= 0.000828182 ft/sec
Aquifer Thickness Fixed Value	= 0.1 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
Selected Value = None

Kz/Kr
Fixed Value = 1

Effective Casing Inner Diameter
Calculated Value = 0.17 ft

Effective Screen Inner Diameter
Calculated Value = 0.17 ft

A
Calculated Value = 1.6955

B
Calculated Value = 0.2386

C
Calculated Value = 0.543418

Linear Regression Slope
Fixed Value = -0.165759 ft/sec

Linear Regression Intercept
Fixed Value = 1.19536 ft

ANALYSIS STATISTICS

Regression Line
Slope: -0.165759 ft/sec
Intercept: 1.195357 ft

Residual Mean = -0.032663
Residual Standard Dev. = 0.404580
Residual Sum of Squares = 11.038397
Absolute Residual Mean = 0.110755
Minimum Residual = -1.195357
Maximum Residual = 2.441258

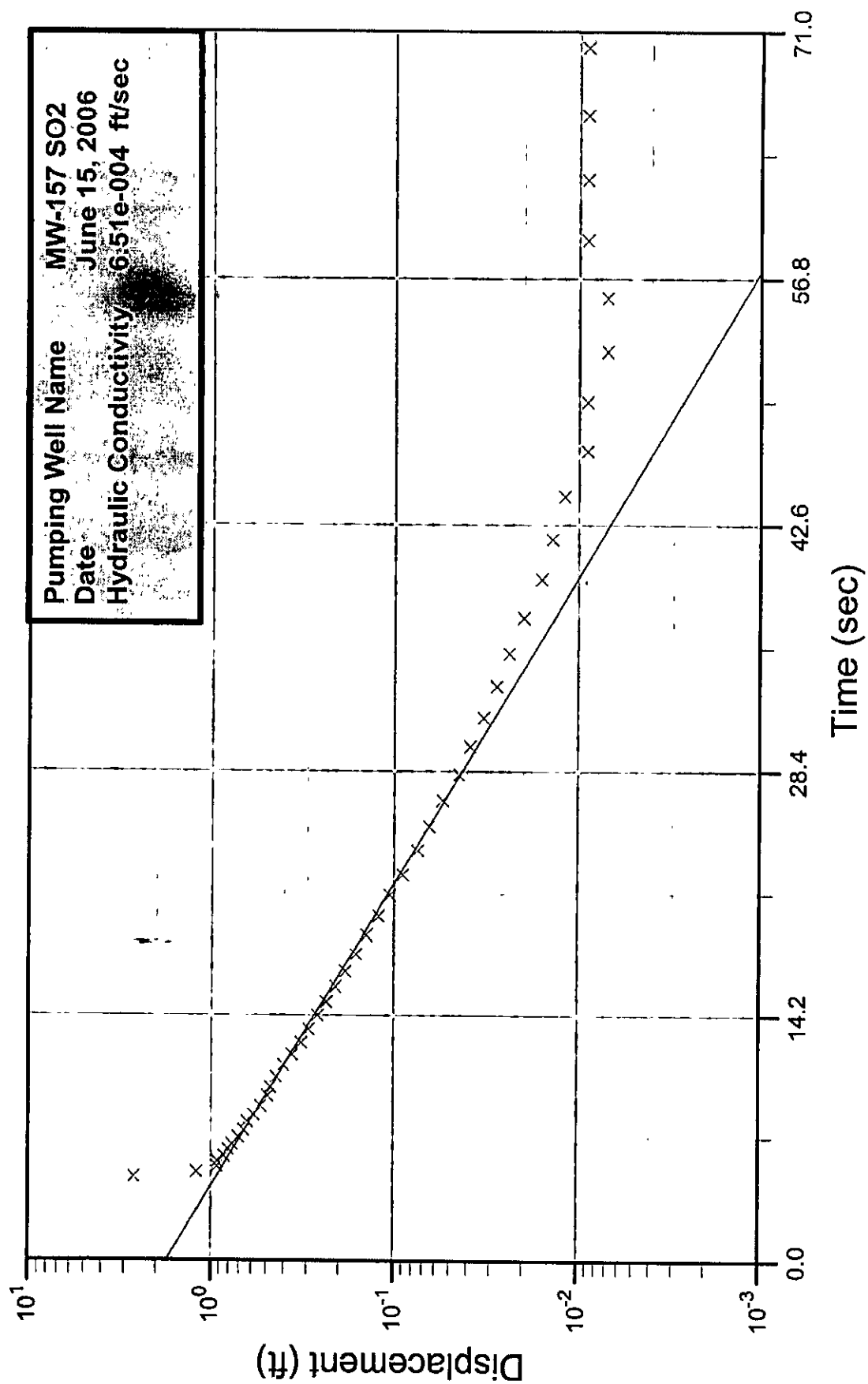
DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	0.000000e+000	0.000000e+000	1.195357e+000	-1.195357e+000
1	3.000000e-001	-1.400000e-002	1.137369e+000	-
1.151369e+000				
2	6.000000e-001	-1.700000e-002	1.082193e+000	-
1.099193e+000				
3	9.000000e-001	-1.700000e-002	1.029694e+000	-
1.046694e+000				
4	1.200000e+000	3.421000e+000	9.797424e-001	2.441258e+000
5	1.500000e+000	1.054000e+000	9.322136e-001	1.217864e-001

6	1.800000e+000	8.970000e-001	8.869904e-001	1.000955e-002
7	2.100000e+000	8.660000e-001	8.439612e-001	2.203883e-002
8	2.400000e+000	7.950000e-001	8.030193e-001	-8.019314e-003
9	2.700000e+000	7.650000e-001	7.640636e-001	9.363911e-004
10	3.000000e+000	7.250000e-001	7.269977e-001	-1.997705e-003
11	3.300000e+000	6.910000e-001	6.917299e-001	-7.299246e-004
12	3.600000e+000	6.440000e-001	6.581730e-001	-1.417304e-002
13	3.900000e+000	6.120000e-001	6.262440e-001	-1.424405e-002
14	4.200000e+000	5.860000e-001	5.958640e-001	-9.863985e-003
15	4.500000e+000	5.660000e-001	5.669577e-001	-9.577037e-004
16	4.800000e+000	5.230000e-001	5.394537e-001	-1.645371e-002
17	5.100000e+000	5.010000e-001	5.132840e-001	-1.228398e-002
18	5.400000e+000	4.810000e-001	4.883838e-001	-7.383782e-003
19	5.700000e+000	4.620000e-001	4.646915e-001	-2.691531e-003
20	6.000000e+000	4.300000e-001	4.421486e-001	-1.214863e-002
21	6.400000e+000	4.120000e-001	4.137833e-001	-1.783321e-003
22	6.700000e+000	3.740000e-001	3.937101e-001	-1.971005e-002
23	7.100000e+000	3.450000e-001	3.684522e-001	-2.345224e-002
24	7.500000e+000	3.170000e-001	3.448148e-001	-2.781480e-002
25	8.000000e+000	2.970000e-001	3.173889e-001	-2.038893e-002
26	8.400000e+000	2.750000e-001	2.970274e-001	-2.202737e-002
27	8.900000e+000	2.520000e-001	2.734024e-001	-2.140242e-002
28	9.500000e+000	2.320000e-001	2.475195e-001	-1.551949e-002
29	1.000000e+001	2.180000e-001	2.278323e-001	-9.832288e-003
30	1.060000e+001	1.950000e-001	2.062635e-001	-1.126347e-002
31	1.130000e+001	1.790000e-001	1.836668e-001	-4.666751e-003
32	1.190000e+001	1.600000e-001	1.662791e-001	-6.279072e-003
33	1.260000e+001	1.420000e-001	1.480628e-001	-6.062751e-003
34	1.340000e+001	1.280000e-001	1.296747e-001	-1.674688e-003
35	1.420000e+001	1.130000e-001	1.135703e-001	-5.702576e-004
36	1.500000e+001	9.900000e-002	9.946585e-002	-4.658524e-004
37	1.590000e+001	8.700000e-002	8.568101e-002	1.318989e-003
38	1.680000e+001	7.300000e-002	7.380659e-002	-8.065923e-004
39	1.780000e+001	6.200000e-002	6.253266e-002	-5.326598e-004
40	1.890000e+001	5.200000e-002	5.210985e-002	-1.098501e-004
41	2.000000e+001	4.400000e-002	4.342429e-002	5.757080e-004
42	2.120000e+001	3.600000e-002	3.559155e-002	4.084548e-004
43	2.240000e+001	3.000000e-002	2.917165e-002	8.283537e-004
44	2.380000e+001	2.300000e-002	2.313009e-002	-1.300934e-004
45	2.520000e+001	2.100000e-002	1.833977e-002	2.660232e-003
46	2.670000e+001	1.500000e-002	1.430248e-002	6.975166e-004
47	2.820000e+001	1.300000e-002	1.115396e-002	1.846040e-003
48	2.980000e+001	1.100000e-002	8.555549e-003	2.444451e-003
49	3.150000e+001	9.000000e-003	6.454578e-003	2.545422e-003
50	3.330000e+001	4.000000e-003	4.789487e-003	-7.894869e-004
51	3.520000e+001	4.000000e-003	3.495516e-003	5.044839e-004
52	3.730000e+001	0.000000e+000	2.467948e-003	-2.467948e-003
53	3.950000e+001	4.000000e-003	1.713807e-003	2.286193e-003
54	4.180000e+001	0.000000e+000	1.170547e-003	-1.170547e-003
55	4.430000e+001	-1.000000e-003	7.734250e-004	-1.773425e-
003				
56	4.690000e+001	-1.000000e-003	5.026304e-004	-1.502630e-
003				
57	4.970000e+001	-3.000000e-003	3.159960e-004	-3.315996e-
003				
58	5.260000e+001	-1.000000e-003	1.953960e-004	-1.195396e-
003				

59	5.570000e+001	0.000000e+000	1.168832e-004	-1.168832e-004
60	5.900000e+001	-2.000000e-003	6.763802e-005	-2.067638e-
003				
61	6.250000e+001	2.000000e-003	3.786448e-005	1.962136e-003
62	6.620000e+001	0.000000e+000	2.050574e-005	-2.050574e-005
63	7.010000e+001	0.000000e+000	1.074289e-005	-1.074289e-005
64	7.430000e+001	2.000000e-003	5.355138e-006	1.994645e-003
65	7.870000e+001	-1.000000e-003	2.582393e-006	-1.002582e-
003				
66	8.340000e+001	-1.000000e-003	1.184889e-006	-1.001185e-
003				

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 48

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 0.1 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.75035 ft
Hydraulic Conductivity	
Calculated Value	= 0.000651288 ft/sec
Aquifer Thickness	
Fixed Value	= 0.1 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 1.6955

B
 Calculated Value = 0.2386

C
 Calculated Value = 0.543418

Linear Regression Slope
 Fixed Value = -0.130354 ft/sec

Linear Regression Intercept
 Fixed Value = 1.75035 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.130354 ft/sec
 Intercept: 1.750348 ft

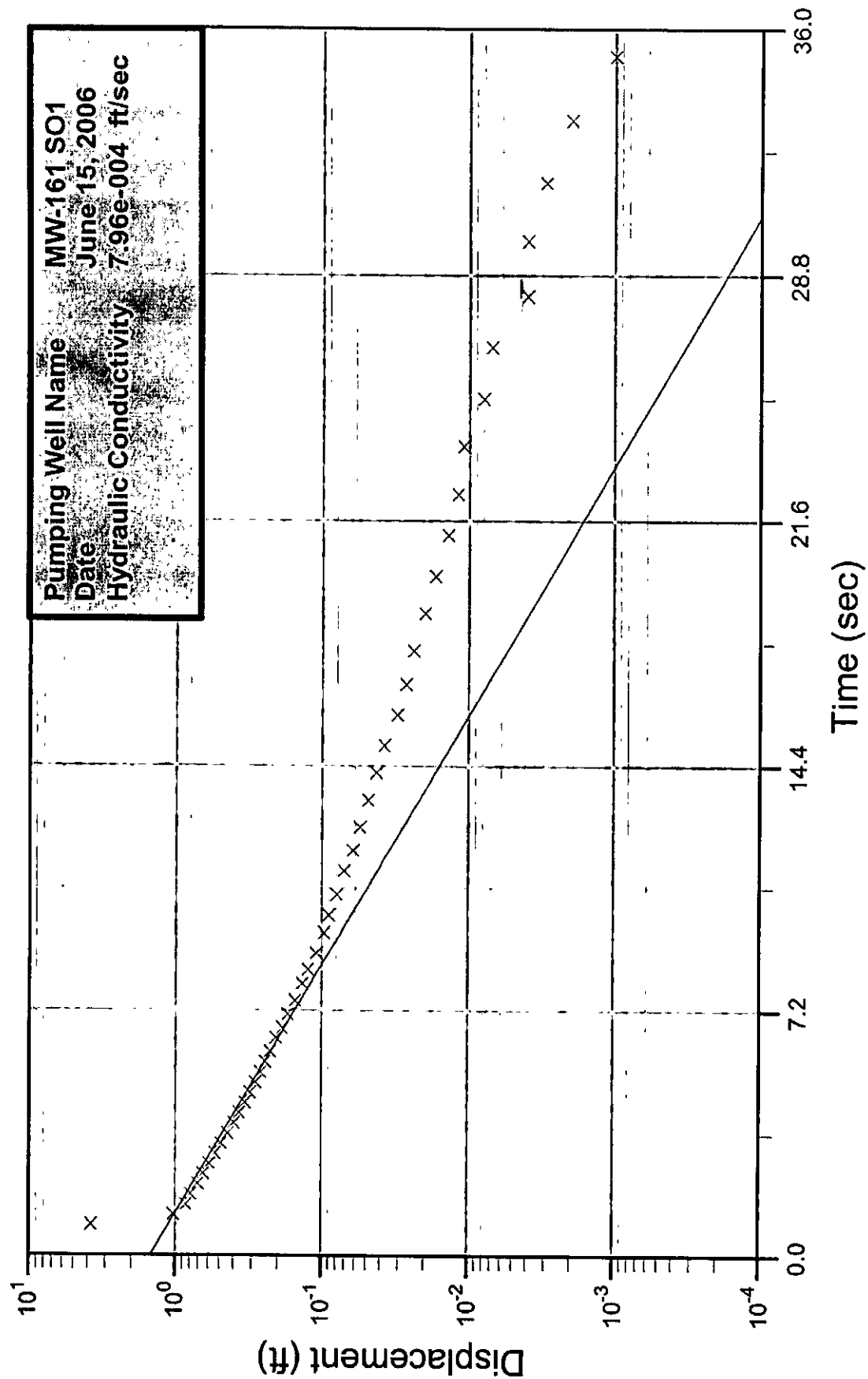
Residual Mean = 0.047504
 Residual Standard Dev. = 0.246782
 Residual Sum of Squares = 3.031576
 Absolute Residual Mean = 0.053800
 Minimum Residual = -0.015698
 Maximum Residual = 1.709761

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	4.800000e+000	2.646000e+000	9.362387e-001	1.709761e+000
1	5.100000e+000	1.196000e+000	9.003325e-001	2.956675e-001
2	5.400000e+000	9.260000e-001	8.658035e-001	6.019651e-002
3	5.700000e+000	9.250000e-001	8.325987e-001	9.240133e-002
4	6.000000e+000	8.490000e-001	8.006673e-001	4.833270e-002
5	6.400000e+000	8.070000e-001	7.599889e-001	4.701106e-002
6	6.700000e+000	7.660000e-001	7.308423e-001	3.515774e-002
7	7.100000e+000	7.100000e-001	6.937114e-001	1.628861e-002
8	7.500000e+000	6.610000e-001	6.584670e-001	2.533019e-003

9	8.000000e+000	6.330000e-001	6.169188e-001	1.608125e-002
10	8.400000e+000	5.860000e-001	5.855758e-001	4.241642e-004
11	8.900000e+000	5.360000e-001	5.486269e-001	-1.262692e-002
12	9.500000e+000	4.930000e-001	5.073526e-001	-1.435259e-002
13	1.000000e+001	4.750000e-001	4.753394e-001	-3.394382e-004
14	1.060000e+001	4.420000e-001	4.395787e-001	2.421329e-003
15	1.130000e+001	4.040000e-001	4.012436e-001	2.756354e-003
16	1.190000e+001	3.610000e-001	3.710573e-001	-1.005726e-002
17	1.260000e+001	3.230000e-001	3.386979e-001	-1.569789e-002
18	1.340000e+001	2.920000e-001	3.051567e-001	-1.315665e-002
19	1.420000e+001	2.620000e-001	2.749370e-001	-1.293700e-002
20	1.500000e+001	2.350000e-001	2.477100e-001	-1.271000e-002
21	1.590000e+001	2.090000e-001	2.202889e-001	-1.128894e-002
22	1.680000e+001	1.850000e-001	1.959033e-001	-1.090334e-002
23	1.780000e+001	1.620000e-001	1.719609e-001	-9.960924e-003
24	1.890000e+001	1.420000e-001	1.489898e-001	-6.989788e-003
25	2.000000e+001	1.220000e-001	1.290872e-001	-7.087216e-003
26	2.120000e+001	1.060000e-001	1.103948e-001	-4.394836e-003
27	2.240000e+001	9.000000e-002	9.440919e-002	-4.409193e-003
28	2.380000e+001	7.500000e-002	7.866063e-002	-3.660626e-003
29	2.520000e+001	6.500000e-002	6.553911e-002	-5.391061e-004
30	2.670000e+001	5.500000e-002	5.389921e-002	1.100787e-003
31	2.820000e+001	4.500000e-002	4.432659e-002	6.734093e-004
32	2.980000e+001	3.900000e-002	3.598198e-002	3.018022e-003
33	3.150000e+001	3.300000e-002	2.882999e-002	4.170008e-003
34	3.330000e+001	2.800000e-002	2.280042e-002	5.199582e-003
35	3.520000e+001	2.400000e-002	1.779836e-002	6.201644e-003
36	3.730000e+001	2.000000e-002	1.353613e-002	6.463868e-003
37	3.950000e+001	1.600000e-002	1.016127e-002	5.838729e-003
38	4.180000e+001	1.400000e-002	7.529052e-003	6.470948e-003
39	4.430000e+001	1.200000e-002	5.435133e-003	6.564867e-003
40	4.690000e+001	9.000000e-003	3.872744e-003	5.127256e-003
41	4.970000e+001	9.000000e-003	2.688469e-003	6.311531e-003
42	5.260000e+001	7.000000e-003	1.842171e-003	5.157829e-003
43	5.570000e+001	7.000000e-003	1.229795e-003	5.770205e-003
44	5.900000e+001	9.000000e-003	7.998579e-004	8.200142e-003
45	6.250000e+001	9.000000e-003	5.068397e-004	8.493160e-003
46	6.620000e+001	9.000000e-003	3.129003e-004	8.687100e-003
47	7.010000e+001	9.000000e-003	1.881997e-004	8.811800e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 52

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 4.27 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.47653 ft
Hydraulic Conductivity	
Calculated Value	= 0.000795904 ft/sec
Aquifer Thickness	
Fixed Value	= 4.27 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
Selected Value = None

Kz/Kr
Fixed Value = 1

Effective Casing Inner Diameter
Calculated Value = 0.17 ft

Effective Screen Inner Diameter
Calculated Value = 0.17 ft

A
Calculated Value = 3.04595

B
Calculated Value = 0.49

C
Calculated Value = 2.69969

Linear Regression Slope
Fixed Value = -0.314769 ft/sec

Linear Regression Intercept
Fixed Value = 1.47653 ft

ANALYSIS STATISTICS

Regression Line

Slope: -0.314769 ft/sec
Intercept: 1.476529 ft

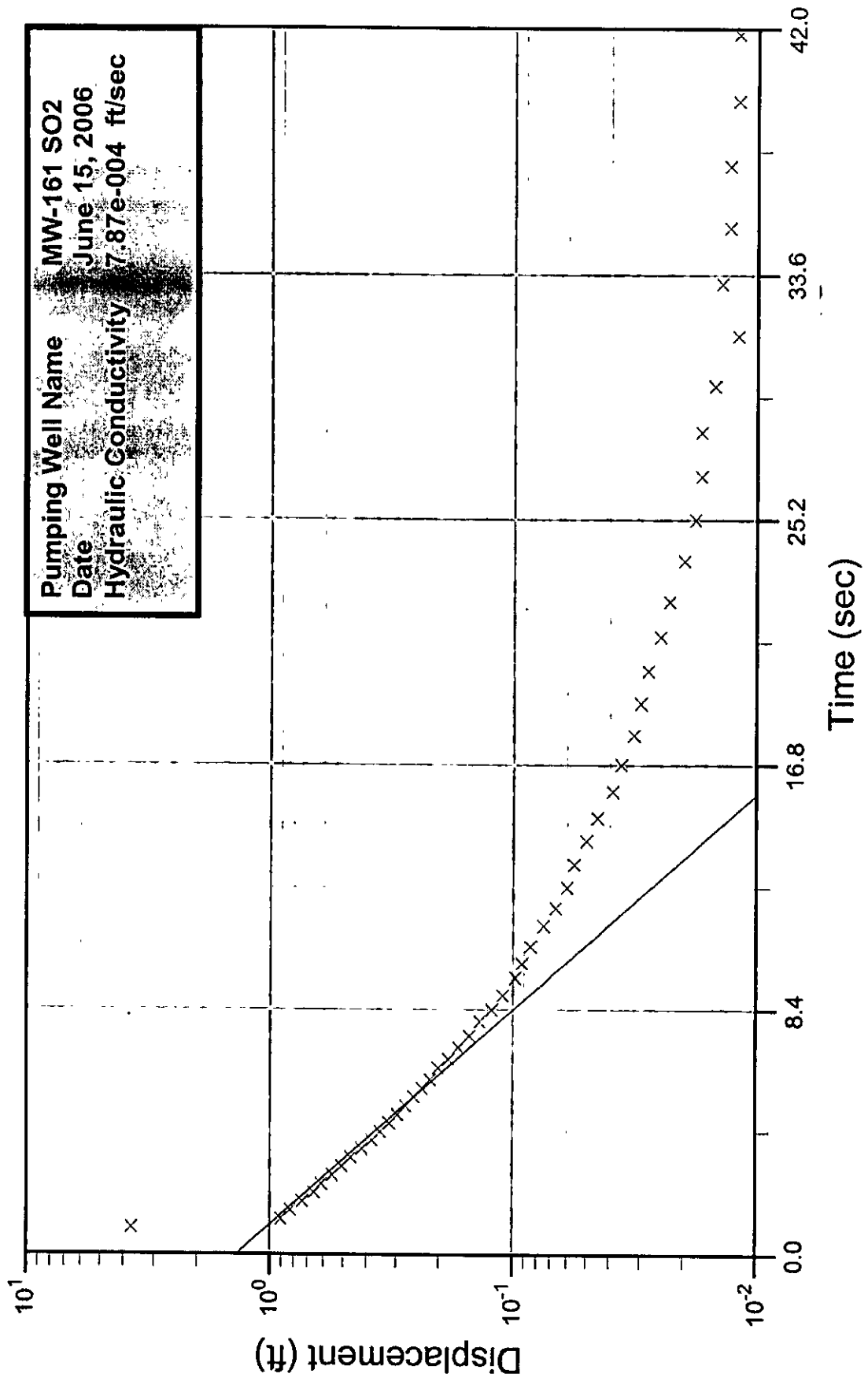
Residual Mean = -0.026445
Residual Standard Dev. = 0.493717
Residual Sum of Squares = 12.711698
Absolute Residual Mean = 0.148970
Minimum Residual = -1.476529
Maximum Residual = 2.672731

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	0.000000e+000	0.000000e+000	1.476529e+000	-1.476529e+000
1	3.000000e-001	-1.000000e-002	1.343480e+000	-
1.353480e+000				
2	6.000000e-001	-1.200000e-002	1.222420e+000	-
1.234420e+000				
3	9.000000e-001	3.785000e+000	1.112269e+000	2.672731e+000
4	1.200000e+000	1.035000e+000	1.012044e+000	2.295640e-002
5	1.500000e+000	8.500000e-001	9.208492e-001	-7.084924e-002
6	1.800000e+000	7.860000e-001	8.378723e-001	-5.187232e-002

7	2.100000e+000	7.030000e-001	7.623724e-001	-5.937238e-002
8	2.400000e+000	6.460000e-001	6.936757e-001	-4.767567e-002
9	2.700000e+000	5.900000e-001	6.311692e-001	-4.116916e-002
10	3.000000e+000	5.350000e-001	5.742951e-001	-3.929506e-002
11	3.300000e+000	4.900000e-001	5.225458e-001	-3.254584e-002
12	3.600000e+000	4.410000e-001	4.754597e-001	-3.445969e-002
13	3.900000e+000	3.990000e-001	4.326164e-001	-3.361643e-002
14	4.200000e+000	3.660000e-001	3.936337e-001	-2.763375e-002
15	4.500000e+000	3.360000e-001	3.581638e-001	-2.216375e-002
16	4.800000e+000	3.100000e-001	3.258899e-001	-1.588993e-002
17	5.100000e+000	2.850000e-001	2.965243e-001	-1.152427e-002
18	5.400000e+000	2.630000e-001	2.698047e-001	-6.804732e-003
19	5.700000e+000	2.440000e-001	2.454929e-001	-1.492864e-003
20	6.000000e+000	2.260000e-001	2.233717e-001	2.628283e-003
21	6.400000e+000	2.060000e-001	1.969460e-001	9.053956e-003
22	6.700000e+000	1.870000e-001	1.791994e-001	7.800591e-003
23	7.100000e+000	1.710000e-001	1.579995e-001	1.300052e-002
24	7.500000e+000	1.520000e-001	1.393076e-001	1.269242e-002
25	8.000000e+000	1.360000e-001	1.190210e-001	1.697900e-002
26	8.400000e+000	1.240000e-001	1.049404e-001	1.905961e-002
27	8.900000e+000	1.090000e-001	8.965851e-002	1.934149e-002
28	9.500000e+000	9.700000e-002	7.422841e-002	2.277159e-002
29	1.000000e+001	9.000000e-002	6.341894e-002	2.658106e-002
30	1.060000e+001	8.000000e-002	5.250463e-002	2.749537e-002
31	1.130000e+001	7.100000e-002	4.212171e-002	2.887829e-002
32	1.190000e+001	6.200000e-002	3.487262e-002	2.712738e-002
33	1.260000e+001	5.600000e-002	2.797648e-002	2.802352e-002
34	1.340000e+001	4.900000e-002	2.174859e-002	2.725141e-002
35	1.420000e+001	4.300000e-002	1.690711e-002	2.609289e-002
36	1.500000e+001	3.800000e-002	1.314339e-002	2.485661e-002
37	1.590000e+001	3.100000e-002	9.900917e-003	2.109908e-002
38	1.680000e+001	2.700000e-002	7.458360e-003	1.954164e-002
39	1.780000e+001	2.400000e-002	5.444287e-003	1.855571e-002
40	1.890000e+001	2.000000e-002	3.850956e-003	1.614904e-002
41	2.000000e+001	1.700000e-002	2.723930e-003	1.427607e-002
42	2.120000e+001	1.400000e-002	1.867038e-003	1.213296e-002
43	2.240000e+001	1.200000e-002	1.279707e-003	1.072029e-002
44	2.380000e+001	1.100000e-002	8.236207e-004	1.017638e-002
45	2.520000e+001	8.000000e-003	5.300832e-004	7.469917e-003
46	2.670000e+001	7.000000e-003	3.305907e-004	6.669409e-003
47	2.820000e+001	4.000000e-003	2.061755e-004	3.793824e-003
48	2.980000e+001	4.000000e-003	1.245987e-004	3.875401e-003
49	3.150000e+001	3.000000e-003	7.296583e-005	2.927034e-003
50	3.330000e+001	2.000000e-003	4.140525e-005	1.958595e-003
51	3.520000e+001	1.000000e-003	2.276780e-005	9.772322e-004

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 52

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 4.27 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.36429 ft
Hydraulic Conductivity	
Calculated Value	= 0.000786571 ft/sec
Aquifer Thickness	
Fixed Value	= 4.27 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.04595

B
 Calculated Value = 0.49

C
 Calculated Value = 2.69969

Linear Regression Slope
 Fixed Value = -0.311078 ft/sec

Linear Regression Intercept
 Fixed Value = 1.36429 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.311078 ft/sec
 Intercept: 1.364292 ft

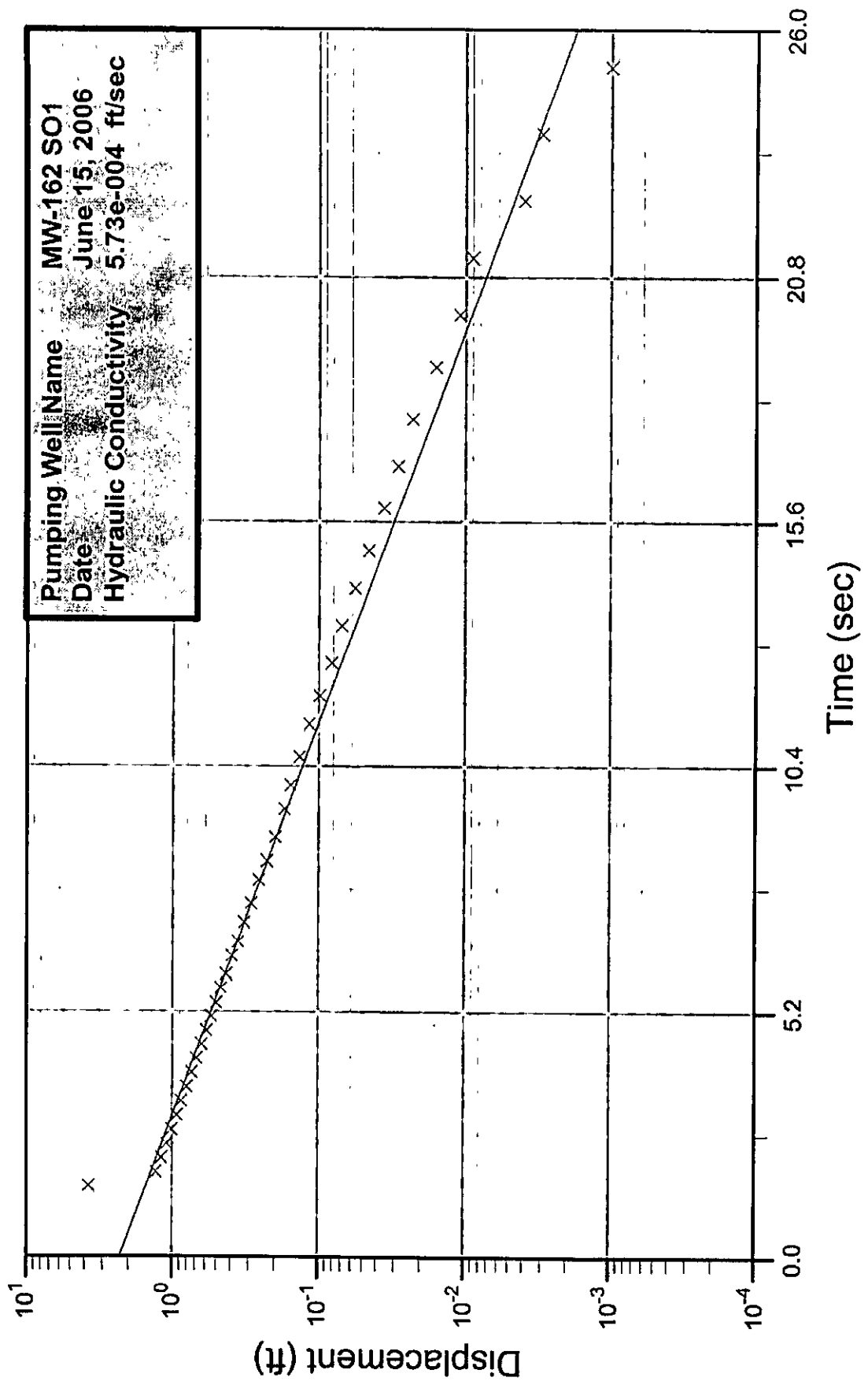
Residual Mean = 0.059213
 Residual Standard Dev. = 0.368153
 Residual Sum of Squares = 7.230236
 Absolute Residual Mean = 0.074111
 Minimum Residual = -0.052902
 Maximum Residual = 2.682859

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	9.000000e-001	3.714000e+000	1.031141e+000	2.682859e+000
1	1.200000e+000	9.020000e-001	9.392649e-001	-3.726487e-002
2	1.500000e+000	8.230000e-001	8.555754e-001	-3.257538e-002
3	1.800000e+000	7.360000e-001	7.793427e-001	-4.334271e-002
4	2.100000e+000	6.570000e-001	7.099025e-001	-5.290245e-002
5	2.400000e+000	6.150000e-001	6.466494e-001	-3.164939e-002
6	2.700000e+000	5.540000e-001	5.890322e-001	-3.503225e-002
7	3.000000e+000	5.060000e-001	5.365489e-001	-3.054885e-002
8	3.300000e+000	4.650000e-001	4.887418e-001	-2.374178e-002

9	3.600000e+000	4.190000e-001	4.451944e-001	-2.619438e-002
10	3.900000e+000	3.800000e-001	4.055271e-001	-2.552709e-002
11	4.200000e+000	3.500000e-001	3.693942e-001	-1.939419e-002
12	4.500000e+000	3.210000e-001	3.364808e-001	-1.548078e-002
13	4.800000e+000	2.970000e-001	3.065000e-001	-9.499989e-003
14	5.100000e+000	2.750000e-001	2.791905e-001	-4.190517e-003
15	5.400000e+000	2.550000e-001	2.543143e-001	6.856532e-004
16	5.700000e+000	2.360000e-001	2.316547e-001	4.345330e-003
17	6.000000e+000	2.180000e-001	2.110140e-001	6.986006e-003
18	6.400000e+000	2.020000e-001	1.863252e-001	1.567483e-002
19	6.700000e+000	1.840000e-001	1.697234e-001	1.427660e-002
20	7.100000e+000	1.670000e-001	1.498656e-001	1.713439e-002
21	7.500000e+000	1.510000e-001	1.323312e-001	1.866880e-002
22	8.000000e+000	1.370000e-001	1.132694e-001	2.373060e-002
23	8.400000e+000	1.220000e-001	1.000168e-001	2.198322e-002
24	8.900000e+000	1.100000e-001	8.560974e-002	2.439026e-002
25	9.500000e+000	9.800000e-002	7.103356e-002	2.696644e-002
26	1.000000e+001	9.200000e-002	6.080145e-002	3.119855e-002
27	1.060000e+001	8.500000e-002	5.044920e-002	3.455080e-002
28	1.130000e+001	7.500000e-002	4.057745e-002	3.442255e-002
29	1.190000e+001	6.700000e-002	3.366861e-002	3.333139e-002
30	1.260000e+001	6.000000e-002	2.708043e-002	3.291957e-002
31	1.340000e+001	5.600000e-002	2.111427e-002	3.488573e-002
32	1.420000e+001	5.000000e-002	1.646253e-002	3.353747e-002
33	1.500000e+001	4.500000e-002	1.283563e-002	3.216437e-002
34	1.590000e+001	3.900000e-002	9.701253e-003	2.929875e-002
35	1.680000e+001	3.600000e-002	7.332269e-003	2.866773e-002
36	1.780000e+001	3.200000e-002	5.372038e-003	2.662796e-002
37	1.890000e+001	3.000000e-002	3.815310e-003	2.618469e-002
38	2.000000e+001	2.800000e-002	2.709696e-003	2.529030e-002
39	2.120000e+001	2.500000e-002	1.865526e-003	2.313447e-002
40	2.240000e+001	2.300000e-002	1.284346e-003	2.171565e-002
41	2.380000e+001	2.000000e-002	8.308891e-004	1.916911e-002
42	2.520000e+001	1.800000e-002	5.375316e-004	1.746247e-002
43	2.670000e+001	1.700000e-002	3.370971e-004	1.666290e-002
44	2.820000e+001	1.700000e-002	2.114005e-004	1.678860e-002
45	2.980000e+001	1.500000e-002	1.285130e-004	1.487149e-002
46	3.150000e+001	1.200000e-002	7.573178e-005	1.192427e-002
47	3.330000e+001	1.400000e-002	4.326128e-005	1.395674e-002
48	3.520000e+001	1.300000e-002	2.395580e-005	1.297604e-002
49	3.730000e+001	1.300000e-002	1.246528e-005	1.298753e-002
50	3.950000e+001	1.200000e-002	6.287579e-006	1.199371e-002
51	4.180000e+001	1.200000e-002	3.074362e-006	1.199693e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 48

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 5.6 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 2.27039 ft
Hydraulic Conductivity	
Calculated Value	= 0.0005727 ft/sec
Aquifer Thickness	
Fixed Value	= 5.6 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.49924

B
 Calculated Value = 0.561912

C
 Calculated Value = 3.20006

Linear Regression Slope
 Fixed Value = -0.27631 ft/sec

Linear Regression Intercept
 Fixed Value = 2.27039 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.276310 ft/sec
 Intercept: 2.270388 ft

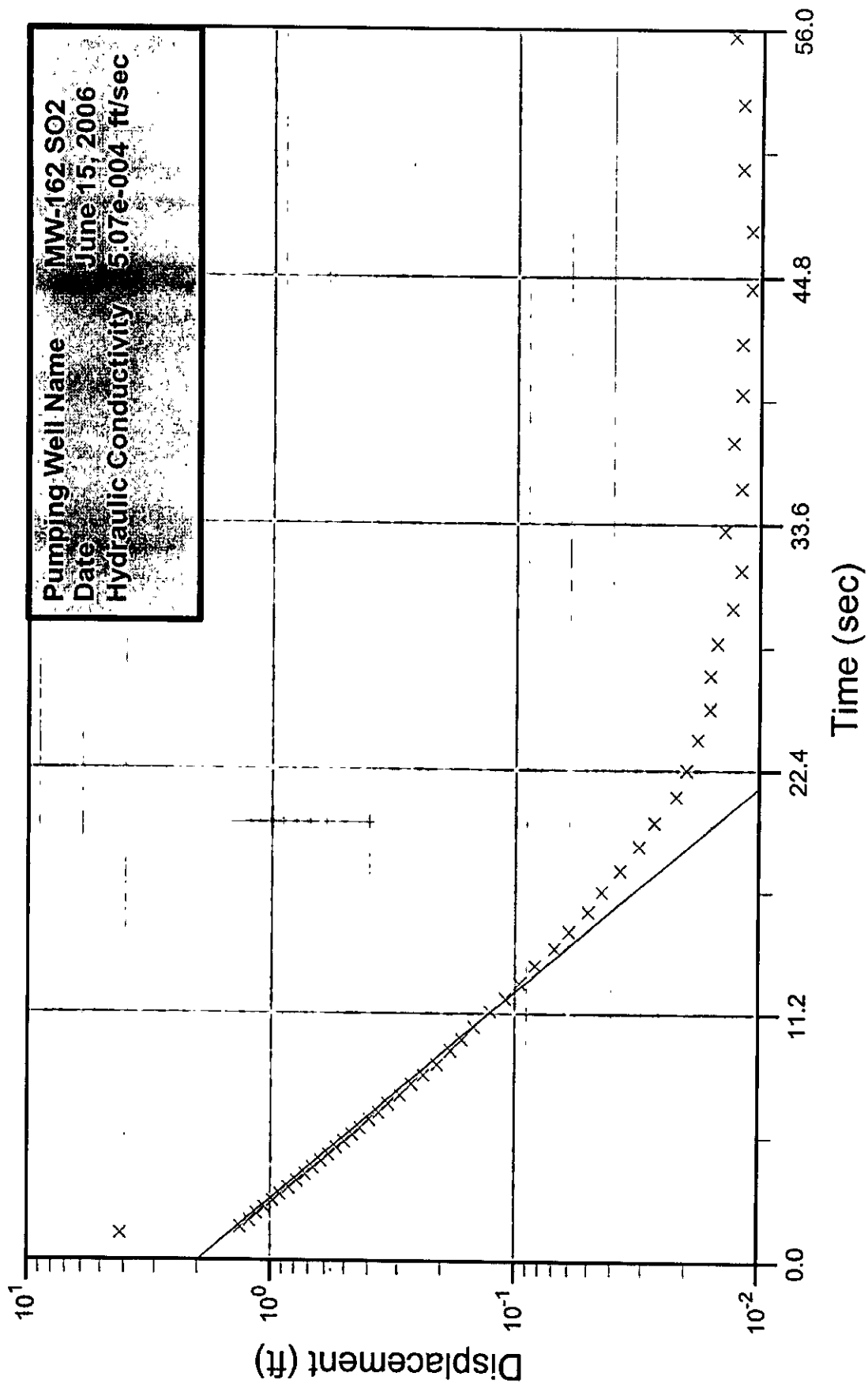
Residual Mean = 0.039016
 Residual Standard Dev. = 0.324510
 Residual Sum of Squares = 5.127778
 Absolute Residual Mean = 0.062784
 Minimum Residual = -0.084702
 Maximum Residual = 2.256970

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	3.757000e+000	1.500030e+000	2.256970e+000
1	1.800000e+000	1.296000e+000	1.380702e+000	-8.470215e-002
2	2.100000e+000	1.189000e+000	1.270867e+000	-8.186670e-002
3	2.400000e+000	1.097000e+000	1.169769e+000	-7.276871e-002
4	2.700000e+000	1.012000e+000	1.076713e+000	-6.471311e-002
5	3.000000e+000	9.400000e-001	9.910601e-001	-5.106012e-002
6	3.300000e+000	8.710000e-001	9.122209e-001	-4.122086e-002
7	3.600000e+000	8.020000e-001	8.396533e-001	-3.765330e-002
8	3.900000e+000	7.390000e-001	7.728585e-001	-3.385852e-002

9	4.200000e+000	6.850000e-001	7.113773e-001	-2.637730e-002
10	4.500000e+000	6.340000e-001	6.547869e-001	-2.078693e-002
11	4.800000e+000	5.850000e-001	6.026983e-001	-1.769835e-002
12	5.100000e+000	5.450000e-001	5.547534e-001	-9.753435e-003
13	5.400000e+000	5.040000e-001	5.106226e-001	-6.622562e-003
14	5.700000e+000	4.680000e-001	4.700023e-001	-2.002318e-003
15	6.000000e+000	4.310000e-001	4.326134e-001	-1.613432e-003
16	6.400000e+000	3.950000e-001	3.873468e-001	7.653175e-003
17	6.700000e+000	3.580000e-001	3.565332e-001	1.466781e-003
18	7.100000e+000	3.240000e-001	3.192273e-001	4.772718e-003
19	7.500000e+000	2.910000e-001	2.858249e-001	5.175140e-003
20	8.000000e+000	2.590000e-001	2.489430e-001	1.005695e-002
21	8.400000e+000	2.280000e-001	2.228948e-001	5.105168e-003
22	8.900000e+000	2.000000e-001	1.941333e-001	5.866717e-003
23	9.500000e+000	1.730000e-001	1.644750e-001	8.524960e-003
24	1.000000e+001	1.570000e-001	1.432518e-001	1.374823e-002
25	1.060000e+001	1.360000e-001	1.213668e-001	1.463317e-002
26	1.130000e+001	1.170000e-001	1.000230e-001	1.697697e-002
27	1.190000e+001	9.900000e-002	8.474225e-002	1.425775e-002
28	1.260000e+001	8.200000e-002	6.983932e-002	1.216068e-002
29	1.340000e+001	7.000000e-002	5.598865e-002	1.401135e-002
30	1.420000e+001	5.700000e-002	4.488487e-002	1.211513e-002
31	1.500000e+001	4.600000e-002	3.598322e-002	1.001678e-002
32	1.590000e+001	3.600000e-002	2.806080e-002	7.939203e-003
33	1.680000e+001	2.900000e-002	2.188265e-002	7.117346e-003
34	1.780000e+001	2.300000e-002	1.659969e-002	6.400309e-003
35	1.890000e+001	1.600000e-002	1.224898e-002	3.751018e-003
36	2.000000e+001	1.100000e-002	9.038576e-003	1.961424e-003
37	2.120000e+001	9.000000e-003	6.487838e-003	2.512162e-003
38	2.240000e+001	4.000000e-003	4.656933e-003	-6.569331e-004
39	2.380000e+001	3.000000e-003	3.163006e-003	-1.630059e-004
40	2.520000e+001	1.000000e-003	2.148325e-003	-1.148325e-003
41	2.670000e+001	0.000000e+000	1.419384e-003	-1.419384e-003
42	2.820000e+001	-1.000000e-003	9.377779e-004	-1.937778e-
003				
43	2.980000e+001	-2.000000e-003	6.026983e-004	-2.602698e-
003				
44	3.150000e+001	-2.000000e-003	3.767905e-004	-2.376791e-
003				
45	3.330000e+001	-2.000000e-003	2.291395e-004	-2.229140e-
003				
46	3.520000e+001	-2.000000e-003	1.355501e-004	-2.135550e-
003				
47	3.730000e+001	-3.000000e-003	7.587523e-005	-3.075875e-
003				

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:

Job Number:

Date: June 15, 2006

Area Name: Memphis Depot

Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 56

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 5.6 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.97956 ft
Hydraulic Conductivity	
Calculated Value	= 0.000506721 ft/sec
Aquifer Thickness	
Fixed Value	= 5.6 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.49924

B
 Calculated Value = 0.561912

C
 Calculated Value = 3.20006

Linear Regression Slope
 Fixed Value = -0.244477 ft/sec

Linear Regression Intercept
 Fixed Value = 1.97956 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.244477 ft/sec
 Intercept: 1.979556 ft

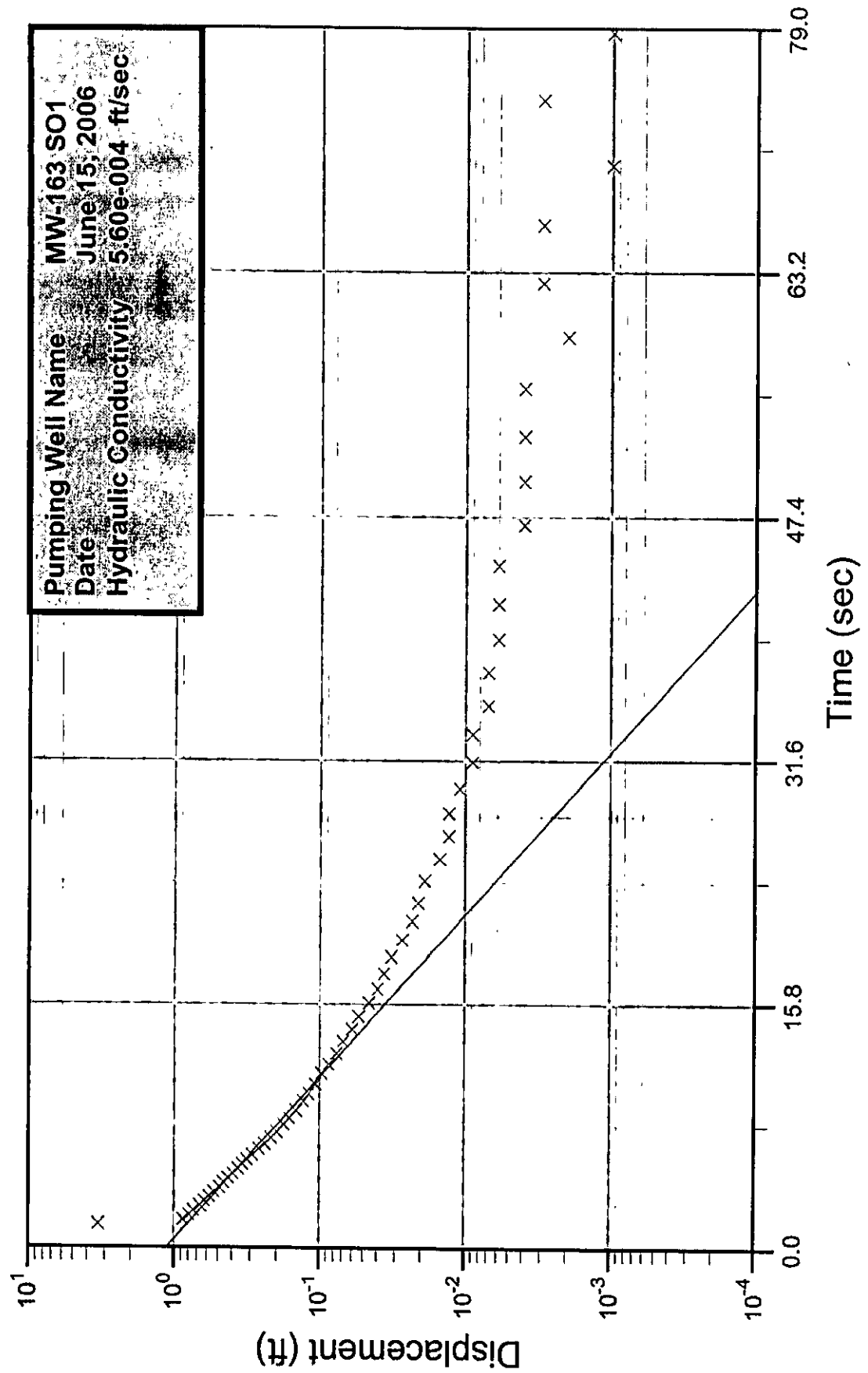
Residual Mean = 0.039949
 Residual Standard Dev. = 0.353338
 Residual Sum of Squares = 7.080834
 Absolute Residual Mean = 0.065800
 Minimum Residual = -0.055831
 Maximum Residual = 2.655758

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	4.132000e+000	1.476242e+000	2.655758e+000
1	1.500000e+000	1.334000e+000	1.371845e+000	-3.784508e-002
2	1.800000e+000	1.219000e+000	1.274831e+000	-5.583076e-002
3	2.100000e+000	1.140000e+000	1.184677e+000	-4.467712e-002
4	2.400000e+000	1.064000e+000	1.100899e+000	-3.689897e-002
5	2.700000e+000	9.810000e-001	1.023045e+000	-4.204546e-002
6	3.000000e+000	9.160000e-001	9.506976e-001	-3.469760e-002
7	3.300000e+000	8.450000e-001	8.834660e-001	-3.846604e-002
8	3.600000e+000	7.830000e-001	8.209890e-001	-3.798898e-002

9	3.900000e+000	7.240000e-001	7.629302e-001	-3.893018e-002
10	4.200000e+000	6.720000e-001	7.089772e-001	-3.697718e-002
11	4.500000e+000	6.230000e-001	6.588396e-001	-3.583964e-002
12	4.800000e+000	5.810000e-001	6.122477e-001	-3.124774e-002
13	5.100000e+000	5.400000e-001	5.689507e-001	-2.895072e-002
14	5.400000e+000	5.020000e-001	5.287156e-001	-2.671559e-002
15	5.700000e+000	4.650000e-001	4.913258e-001	-2.632582e-002
16	6.000000e+000	4.330000e-001	4.565802e-001	-2.358018e-002
17	6.400000e+000	3.970000e-001	4.140445e-001	-1.704449e-002
18	6.700000e+000	3.620000e-001	3.847640e-001	-2.276403e-002
19	7.100000e+000	3.300000e-001	3.489188e-001	-1.891884e-002
20	7.500000e+000	2.950000e-001	3.164130e-001	-2.141304e-002
21	8.000000e+000	2.650000e-001	2.800057e-001	-1.500567e-002
22	8.400000e+000	2.370000e-001	2.539199e-001	-1.691992e-002
23	8.900000e+000	2.080000e-001	2.247032e-001	-1.670318e-002
24	9.500000e+000	1.840000e-001	1.940458e-001	-1.004576e-002
25	1.000000e+001	1.650000e-001	1.717183e-001	-6.718304e-003
26	1.060000e+001	1.470000e-001	1.482899e-001	-1.289882e-003
27	1.130000e+001	1.260000e-001	1.249652e-001	1.034843e-003
28	1.190000e+001	1.100000e-001	1.079155e-001	2.084489e-003
29	1.260000e+001	9.600000e-002	9.094133e-002	5.058672e-003
30	1.340000e+001	8.300000e-002	7.478615e-002	8.213846e-003
31	1.420000e+001	6.900000e-002	6.150085e-002	7.499152e-003
32	1.500000e+001	6.000000e-002	5.057560e-002	9.424403e-003
33	1.590000e+001	5.000000e-002	4.058667e-002	9.413331e-003
34	1.680000e+001	4.400000e-002	3.257060e-002	1.142940e-002
35	1.780000e+001	3.700000e-002	2.550649e-002	1.149351e-002
36	1.890000e+001	3.100000e-002	1.949207e-002	1.150793e-002
37	2.000000e+001	2.700000e-002	1.489586e-002	1.210414e-002
38	2.120000e+001	2.200000e-002	1.110850e-002	1.089150e-002
39	2.240000e+001	2.000000e-002	8.284097e-003	1.171590e-002
40	2.380000e+001	1.800000e-002	5.883016e-003	1.211698e-002
41	2.520000e+001	1.600000e-002	4.177869e-003	1.182213e-002
42	2.670000e+001	1.600000e-002	2.895291e-003	1.310471e-002
43	2.820000e+001	1.500000e-002	2.006455e-003	1.299354e-002
44	2.980000e+001	1.300000e-002	1.356905e-003	1.164310e-002
45	3.150000e+001	1.200000e-002	8.954712e-004	1.110453e-002
46	3.330000e+001	1.400000e-002	5.766820e-004	1.342332e-002
47	3.520000e+001	1.200000e-002	3.624129e-004	1.163759e-002
48	3.730000e+001	1.300000e-002	2.168882e-004	1.278311e-002
49	3.950000e+001	1.200000e-002	1.266633e-004	1.187334e-002
50	4.180000e+001	1.200000e-002	7.218516e-005	1.192781e-002
51	4.430000e+001	1.100000e-002	3.917510e-005	1.096082e-002
52	4.690000e+001	1.100000e-002	2.074698e-005	1.097925e-002
53	4.970000e+001	1.200000e-002	1.046320e-005	1.198954e-002
54	5.260000e+001	1.200000e-002	5.149401e-006	1.199485e-002
55	5.570000e+001	1.300000e-002	2.413314e-006	1.299759e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 61

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 4.19 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.11549 ft
Hydraulic Conductivity Calculated Value	= 0.000560413 ft/sec
Aquifer Thickness Fixed Value	= 4.19 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.01756

B
 Calculated Value = 0.485344

C
 Calculated Value = 2.67154

Linear Regression Slope
 Fixed Value = -0.218665 ft/sec

Linear Regression Intercept
 Fixed Value = 1.11549 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.218665 ft/sec
 Intercept: 1.115493 ft

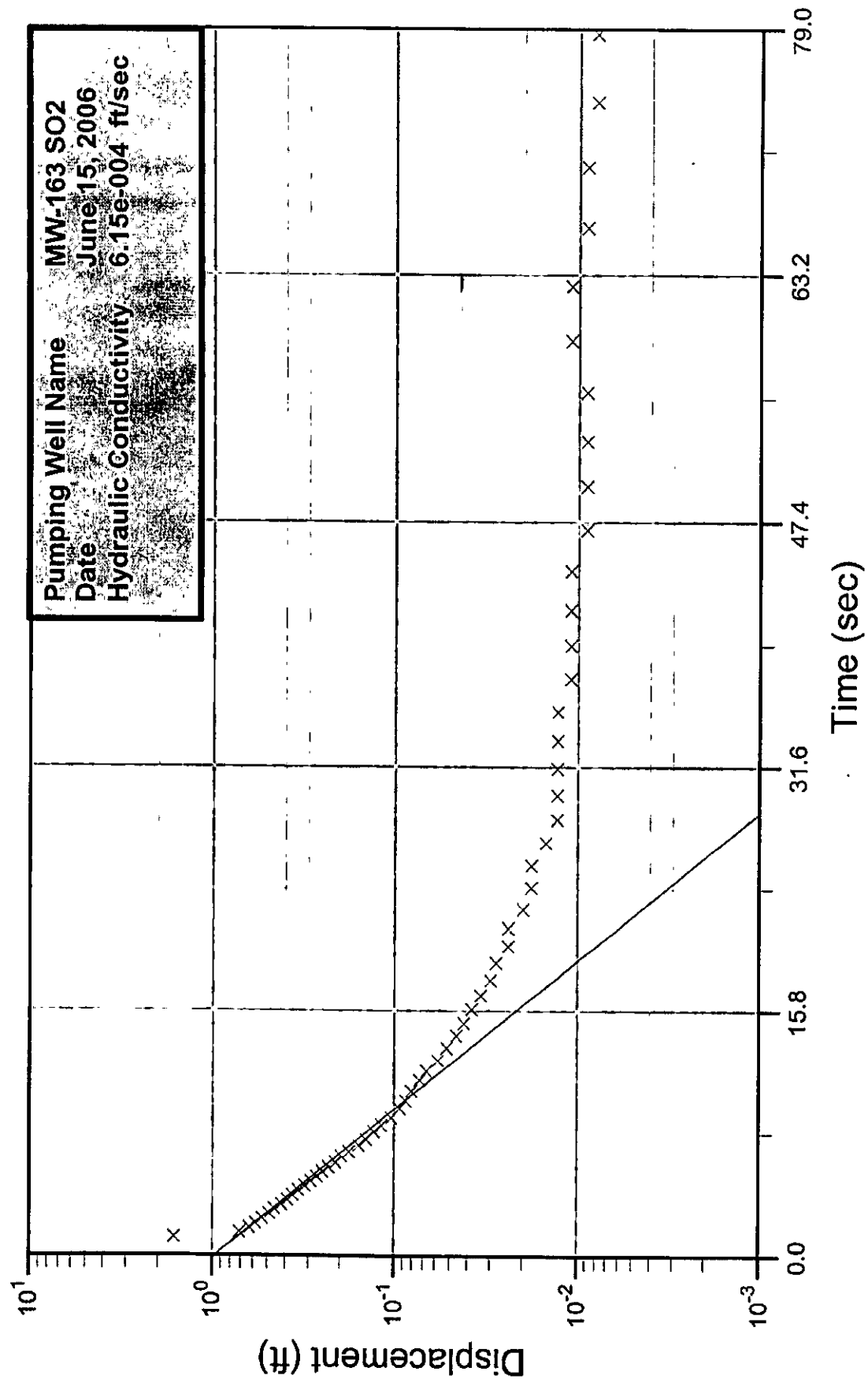
Residual Mean = 0.051299
 Residual Standard Dev. = 0.321172
 Residual Sum of Squares = 6.452785
 Absolute Residual Mean = 0.056242
 Minimum Residual = -0.019165
 Maximum Residual = 2.532438

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	3.336000e+000	8.035620e-001	2.532438e+000
1	1.800000e+000	8.710000e-001	7.525406e-001	1.184594e-001
2	2.100000e+000	7.940000e-001	7.047588e-001	8.924120e-002
3	2.400000e+000	7.360000e-001	6.600108e-001	7.598918e-002
4	2.700000e+000	6.690000e-001	6.181041e-001	5.089593e-002
5	3.000000e+000	6.240000e-001	5.788581e-001	4.514185e-002
6	3.300000e+000	5.780000e-001	5.421041e-001	3.589589e-002
7	3.600000e+000	5.330000e-001	5.076837e-001	2.531627e-002
8	3.900000e+000	4.910000e-001	4.754488e-001	1.555115e-002

9	4.200000e+000	4.590000e-001	4.452607e-001	1.373932e-002
10	4.500000e+000	4.270000e-001	4.169893e-001	1.001072e-002
11	4.800000e+000	3.960000e-001	3.905130e-001	5.487048e-003
12	5.100000e+000	3.640000e-001	3.657177e-001	-1.717710e-003
13	5.400000e+000	3.400000e-001	3.424968e-001	-2.496817e-003
14	5.700000e+000	3.160000e-001	3.207503e-001	-4.750313e-003
15	6.000000e+000	2.910000e-001	3.003846e-001	-9.384582e-003
16	6.400000e+000	2.630000e-001	2.752274e-001	-1.222742e-002
17	6.700000e+000	2.390000e-001	2.577521e-001	-1.875212e-002
18	7.100000e+000	2.170000e-001	2.361654e-001	-1.916542e-002
19	7.500000e+000	1.980000e-001	2.163866e-001	-1.838661e-002
20	8.000000e+000	1.780000e-001	1.939760e-001	-1.597598e-002
21	8.400000e+000	1.620000e-001	1.777305e-001	-1.773053e-002
22	8.900000e+000	1.460000e-001	1.593234e-001	-1.332341e-002
23	9.500000e+000	1.300000e-001	1.397336e-001	-9.733553e-003
24	1.000000e+001	1.190000e-001	1.252617e-001	-6.261695e-003
25	1.060000e+001	1.070000e-001	1.098599e-001	-2.859946e-003
26	1.130000e+001	9.700000e-002	9.426794e-002	2.732065e-003
27	1.190000e+001	8.700000e-002	8.267707e-002	4.322927e-003
28	1.260000e+001	7.700000e-002	7.094303e-002	6.056975e-003
29	1.340000e+001	6.900000e-002	5.955769e-002	9.442311e-003
30	1.420000e+001	6.000000e-002	4.999953e-002	1.000047e-002
31	1.500000e+001	5.400000e-002	4.197533e-002	1.202467e-002
32	1.590000e+001	4.600000e-002	3.447670e-002	1.152330e-002
33	1.680000e+001	4.000000e-002	2.831766e-002	1.168234e-002
34	1.780000e+001	3.600000e-002	2.275582e-002	1.324418e-002
35	1.890000e+001	3.200000e-002	1.789086e-002	1.410914e-002
36	2.000000e+001	2.700000e-002	1.406598e-002	1.293402e-002
37	2.120000e+001	2.300000e-002	1.081962e-002	1.218038e-002
38	2.240000e+001	2.100000e-002	8.322509e-003	1.267749e-002
39	2.380000e+001	1.900000e-002	6.127785e-003	1.287222e-002
40	2.520000e+001	1.500000e-002	4.511830e-003	1.048817e-002
41	2.670000e+001	1.300000e-002	3.250166e-003	9.749834e-003
42	2.820000e+001	1.300000e-002	2.341306e-003	1.065869e-002
43	2.980000e+001	1.100000e-002	1.650116e-003	9.349884e-003
44	3.150000e+001	9.000000e-003	1.137822e-003	7.862178e-003
45	3.330000e+001	9.000000e-003	7.676046e-004	8.232395e-003
46	3.520000e+001	7.000000e-003	5.066457e-004	6.493354e-003
47	3.730000e+001	7.000000e-003	3.200945e-004	6.679906e-003
48	3.950000e+001	6.000000e-003	1.978589e-004	5.802141e-003
49	4.180000e+001	6.000000e-003	1.196565e-004	5.880343e-003
50	4.430000e+001	6.000000e-003	6.926667e-005	5.930733e-003
51	4.690000e+001	4.000000e-003	3.922977e-005	3.960770e-003
52	4.970000e+001	4.000000e-003	2.126739e-005	3.978733e-003
53	5.260000e+001	4.000000e-003	1.128018e-005	3.988720e-003
54	5.570000e+001	4.000000e-003	5.726974e-006	3.994273e-003
55	5.900000e+001	2.000000e-003	2.783179e-006	1.997217e-003
56	6.250000e+001	3.000000e-003	1.294685e-006	2.998705e-003
57	6.620000e+001	3.000000e-003	5.764934e-007	2.999424e-003
58	7.010000e+001	1.000000e-003	2.457149e-007	9.997543e-004
59	7.430000e+001	3.000000e-003	9.807971e-008	2.999902e-003
60	7.870000e+001	1.000000e-003	3.747433e-008	9.999625e-004

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 62

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 4.19 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 0.961111 ft
Hydraulic Conductivity	
Calculated Value	= 0.000615127 ft/sec
Aquifer Thickness	
Fixed Value	= 4.19 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.01756

B
 Calculated Value = 0.485344

C
 Calculated Value = 2.67154

Linear Regression Slope
 Fixed Value = -0.240013 ft/sec

Linear Regression Intercept
 Fixed Value = 0.961111 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.240013 ft/sec
 Intercept: 0.961111 ft

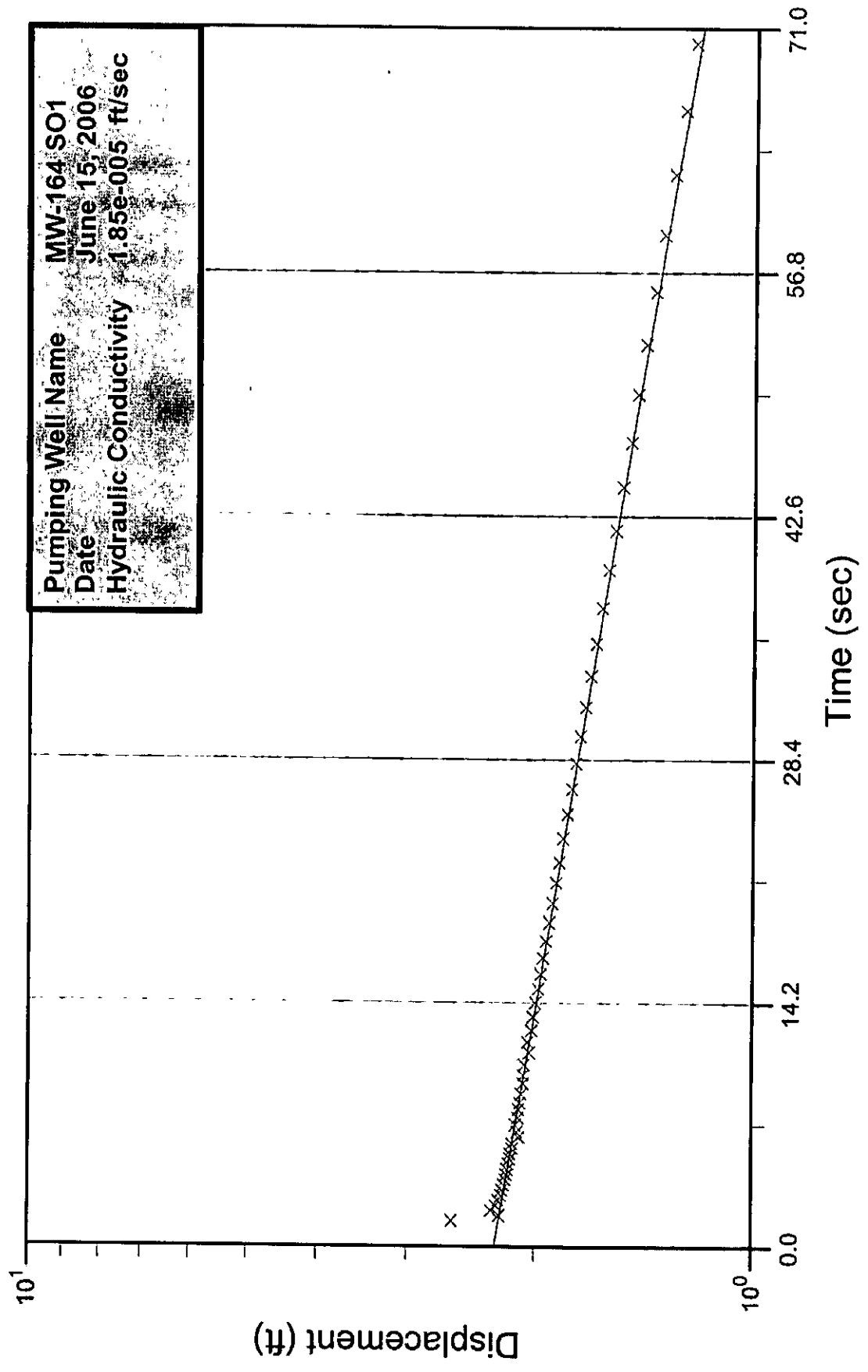
Residual Mean = 0.017924
 Residual Standard Dev. = 0.114248
 Residual Sum of Squares = 0.829187
 Absolute Residual Mean = 0.026820
 Minimum Residual = -0.017063
 Maximum Residual = 0.904407

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	1.625000e+000	7.205926e-001	9.044074e-001
1	1.500000e+000	7.110000e-001	6.705311e-001	4.046894e-002
2	1.800000e+000	6.240000e-001	6.239475e-001	5.254607e-005
3	2.100000e+000	5.820000e-001	5.806001e-001	1.399867e-003
4	2.400000e+000	5.330000e-001	5.402643e-001	-7.264268e-003
5	2.700000e+000	4.890000e-001	5.027306e-001	-1.373064e-002
6	3.000000e+000	4.550000e-001	4.678046e-001	-1.280458e-002
7	3.300000e+000	4.190000e-001	4.353049e-001	-1.630493e-002
8	3.600000e+000	3.880000e-001	4.050631e-001	-1.706312e-002

9	3.900000e+000	3.620000e-001	3.769223e-001	-1.492228e-002
10	4.200000e+000	3.380000e-001	3.507365e-001	-1.273647e-002
11	4.500000e+000	3.110000e-001	3.263699e-001	-1.536986e-002
12	4.800000e+000	2.890000e-001	3.036961e-001	-1.469606e-002
13	5.100000e+000	2.670000e-001	2.825975e-001	-1.559747e-002
14	5.400000e+000	2.490000e-001	2.629647e-001	-1.396466e-002
15	5.700000e+000	2.310000e-001	2.446958e-001	-1.369579e-002
16	6.000000e+000	2.110000e-001	2.276961e-001	-1.669611e-002
17	6.400000e+000	1.970000e-001	2.068527e-001	-9.852654e-003
18	6.700000e+000	1.780000e-001	1.924820e-001	-1.448204e-002
19	7.100000e+000	1.580000e-001	1.748621e-001	-1.686210e-002
20	7.500000e+000	1.440000e-001	1.588551e-001	-1.485511e-002
21	8.000000e+000	1.300000e-001	1.408909e-001	-1.089093e-002
22	8.400000e+000	1.180000e-001	1.279937e-001	-9.993679e-003
23	8.900000e+000	1.040000e-001	1.135195e-001	-9.519477e-003
24	9.500000e+000	9.400000e-002	9.829436e-002	-4.294362e-003
25	1.000000e+001	8.700000e-002	8.717872e-002	-1.787152e-004
26	1.060000e+001	8.100000e-002	7.548640e-002	5.513604e-003
27	1.130000e+001	7.300000e-002	6.381214e-002	9.187863e-003
28	1.190000e+001	6.700000e-002	5.525372e-002	1.174628e-002
29	1.260000e+001	5.800000e-002	4.670852e-002	1.129148e-002
30	1.340000e+001	5.200000e-002	3.854846e-002	1.345154e-002
31	1.420000e+001	4.600000e-002	3.181398e-002	1.418602e-002
32	1.500000e+001	4.200000e-002	2.625603e-002	1.574397e-002
33	1.590000e+001	3.800000e-002	2.115516e-002	1.684484e-002
34	1.680000e+001	3.400000e-002	1.704526e-002	1.695474e-002
35	1.780000e+001	3.000000e-002	1.340811e-002	1.659189e-002
36	1.890000e+001	2.800000e-002	1.029692e-002	1.770308e-002
37	2.000000e+001	2.400000e-002	7.907653e-003	1.609235e-002
38	2.120000e+001	2.400000e-002	5.928762e-003	1.807124e-002
39	2.240000e+001	2.000000e-002	4.445089e-003	1.555491e-002
40	2.380000e+001	1.800000e-002	3.176506e-003	1.482349e-002
41	2.520000e+001	1.800000e-002	2.269964e-003	1.573004e-002
42	2.670000e+001	1.500000e-002	1.583669e-003	1.341633e-002
43	2.820000e+001	1.300000e-002	1.104867e-003	1.189513e-002
44	2.980000e+001	1.300000e-002	7.525441e-004	1.224746e-002
45	3.150000e+001	1.300000e-002	5.004150e-004	1.249959e-002
46	3.330000e+001	1.300000e-002	3.248665e-004	1.267513e-002
47	3.520000e+001	1.300000e-002	2.058999e-004	1.279410e-002
48	3.730000e+001	1.100000e-002	1.243827e-004	1.087562e-002
49	3.950000e+001	1.100000e-002	7.335674e-005	1.092664e-002
50	4.180000e+001	1.100000e-002	4.223734e-005	1.095776e-002
51	4.430000e+001	1.100000e-002	2.317959e-005	1.097682e-002
52	4.690000e+001	9.000000e-003	1.241914e-005	8.987581e-003
53	4.970000e+001	9.000000e-003	6.342053e-006	8.993658e-003
54	5.260000e+001	9.000000e-003	3.161875e-006	8.996838e-003
55	5.570000e+001	9.000000e-003	1.502492e-006	8.998498e-003
56	5.900000e+001	1.100000e-002	6.805067e-007	1.099932e-002
57	6.250000e+001	1.100000e-002	2.937686e-007	1.099971e-002
58	6.620000e+001	9.000000e-003	1.208735e-007	8.999879e-003
59	7.010000e+001	9.000000e-003	4.740341e-008	8.999953e-003
60	7.430000e+001	8.000000e-003	1.729885e-008	7.999983e-003
61	7.870000e+001	8.000000e-003	6.016966e-009	7.999994e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 59

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 5.8 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 2.26986 ft
Hydraulic Conductivity	
Calculated Value	= 1.84708e-005 ft/sec
Aquifer Thickness	
Fixed Value	= 5.8 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
Selected Value = None

Kz/Kr
Fixed Value = 1

Effective Casing Inner Diameter
Calculated Value = 0.17 ft

Effective Screen Inner Diameter
Calculated Value = 0.17 ft

A
Calculated Value = 3.56522

B
Calculated Value = 0.574076

C
Calculated Value = 3.26917

Linear Regression Slope
Fixed Value = -0.00914548 ft/sec

Linear Regression Intercept
Fixed Value = 2.26986 ft

ANALYSIS STATISTICS

Regression Line
Slope: -0.009145 ft/sec
Intercept: 2.269865 ft

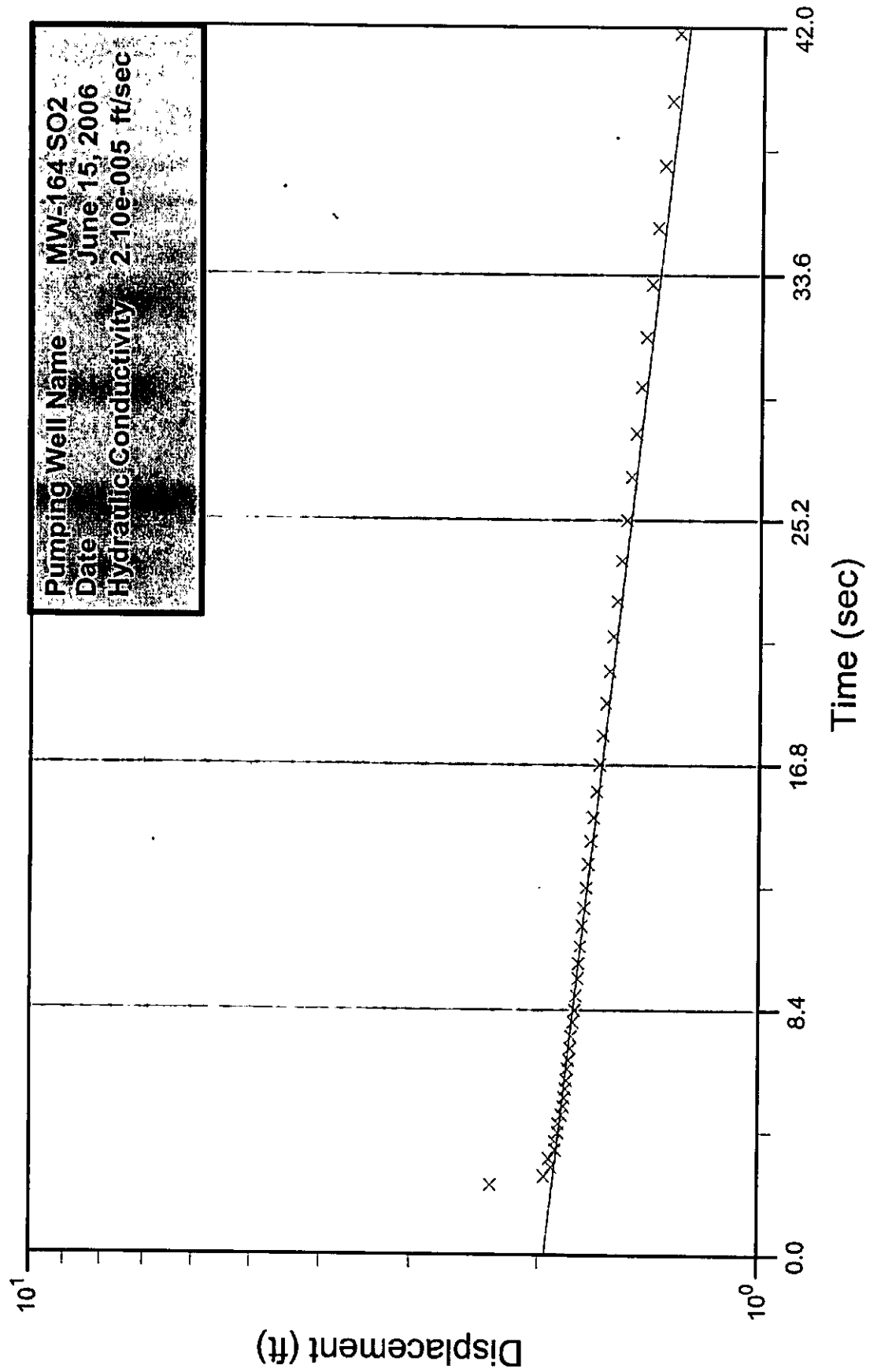
Residual Mean = 0.011906
Residual Standard Dev. = 0.047787
Residual Sum of Squares = 0.143096
Absolute Residual Mean = 0.015720
Minimum Residual = -0.038821
Maximum Residual = 0.362061

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	2.601000e+000	2.238939e+000	3.620610e-001
1	1.800000e+000	2.236000e+000	2.232805e+000	3.195472e-003
2	2.100000e+000	2.292000e+000	2.226687e+000	6.531310e-002
3	2.400000e+000	2.261000e+000	2.220586e+000	4.041396e-002
4	2.700000e+000	2.241000e+000	2.214502e+000	2.649810e-002
5	3.000000e+000	2.224000e+000	2.208434e+000	1.556558e-002
6	3.300000e+000	2.218000e+000	2.202384e+000	1.561643e-002
7	3.600000e+000	2.206000e+000	2.196349e+000	9.650708e-003
8	3.900000e+000	2.193000e+000	2.190332e+000	2.668449e-003

9	4.200000e+000	2.185000e+000	2.184330e+000	6.697014e-004
10	4.500000e+000	2.179000e+000	2.178345e+000	6.545115e-004
11	4.800000e+000	2.170000e+000	2.172377e+000	-2.377076e-003
12	5.100000e+000	2.162000e+000	2.166425e+000	-4.425016e-003
13	5.400000e+000	2.161000e+000	2.160489e+000	5.107353e-004
14	5.700000e+000	2.147000e+000	2.154570e+000	-7.569776e-003
15	6.000000e+000	2.147000e+000	2.148667e+000	-1.666507e-003
16	6.400000e+000	2.102000e+000	2.140821e+000	-3.882063e-002
17	6.700000e+000	2.118000e+000	2.134955e+000	-1.695503e-002
18	7.100000e+000	2.127000e+000	2.127159e+000	-1.592274e-004
19	7.500000e+000	2.109000e+000	2.119392e+000	-1.039189e-002
20	8.000000e+000	2.104000e+000	2.109723e+000	-5.722585e-003
21	8.400000e+000	2.096000e+000	2.102019e+000	-6.018915e-003
22	8.900000e+000	2.089000e+000	2.092429e+000	-3.428873e-003
23	9.500000e+000	2.075000e+000	2.080979e+000	-5.978559e-003
24	1.000000e+001	2.075000e+000	2.071485e+000	3.515490e-003
25	1.060000e+001	2.069000e+000	2.060149e+000	8.851191e-003
26	1.130000e+001	2.038000e+000	2.047002e+000	-9.002202e-003
27	1.190000e+001	2.049000e+000	2.035800e+000	1.319953e-002
28	1.260000e+001	2.024000e+000	2.022809e+000	1.190756e-003
29	1.340000e+001	2.015000e+000	2.008064e+000	6.936395e-003
30	1.420000e+001	2.000000e+000	1.993425e+000	6.574544e-003
31	1.500000e+001	1.983000e+000	1.978894e+000	4.105984e-003
32	1.590000e+001	1.966000e+000	1.962673e+000	3.327274e-003
33	1.680000e+001	1.953000e+000	1.946584e+000	6.415596e-003
34	1.780000e+001	1.934000e+000	1.928863e+000	5.136884e-003
35	1.890000e+001	1.915000e+000	1.909556e+000	5.444021e-003
36	2.000000e+001	1.896000e+000	1.890442e+000	5.557901e-003
37	2.120000e+001	1.874000e+000	1.869809e+000	4.191270e-003
38	2.240000e+001	1.857000e+000	1.849401e+000	7.599435e-003
39	2.380000e+001	1.834000e+000	1.825872e+000	8.127606e-003
40	2.520000e+001	1.810000e+000	1.802644e+000	7.356449e-003
41	2.670000e+001	1.785000e+000	1.778083e+000	6.916660e-003
42	2.820000e+001	1.761000e+000	1.753858e+000	7.142250e-003
43	2.980000e+001	1.736000e+000	1.728381e+000	7.619187e-003
44	3.150000e+001	1.710000e+000	1.701717e+000	8.283053e-003
45	3.330000e+001	1.683000e+000	1.673933e+000	9.067166e-003
46	3.520000e+001	1.653000e+000	1.645097e+000	7.902853e-003
47	3.730000e+001	1.623000e+000	1.613804e+000	9.196310e-003
48	3.950000e+001	1.589000e+000	1.581658e+000	7.341659e-003
49	4.180000e+001	1.557000e+000	1.548736e+000	8.263746e-003
50	4.430000e+001	1.521000e+000	1.513728e+000	7.271850e-003
51	4.690000e+001	1.481000e+000	1.478159e+000	2.841086e-003
52	4.970000e+001	1.451000e+000	1.440788e+000	1.021227e-002
53	5.260000e+001	1.415000e+000	1.403078e+000	1.192240e-002
54	5.570000e+001	1.375000e+000	1.363858e+000	1.114244e-002
55	5.900000e+001	1.337000e+000	1.323311e+000	1.368885e-002
56	6.250000e+001	1.294000e+000	1.281624e+000	1.237620e-002
57	6.620000e+001	1.254000e+000	1.238981e+000	1.501859e-002
58	7.010000e+001	1.214000e+000	1.195569e+000	1.843099e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 47

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 5.8 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.95992 ft
Hydraulic Conductivity Calculated Value	= 2.10377e-005 ft/sec
Aquifer Thickness Fixed Value	= 5.8 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.56522

B
 Calculated Value = 0.574076

C
 Calculated Value = 3.26917

Linear Regression Slope
 Fixed Value = -0.0104165 ft/sec

Linear Regression Intercept
 Fixed Value = 1.95992 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.010416 ft/sec
 Intercept: 1.959916 ft

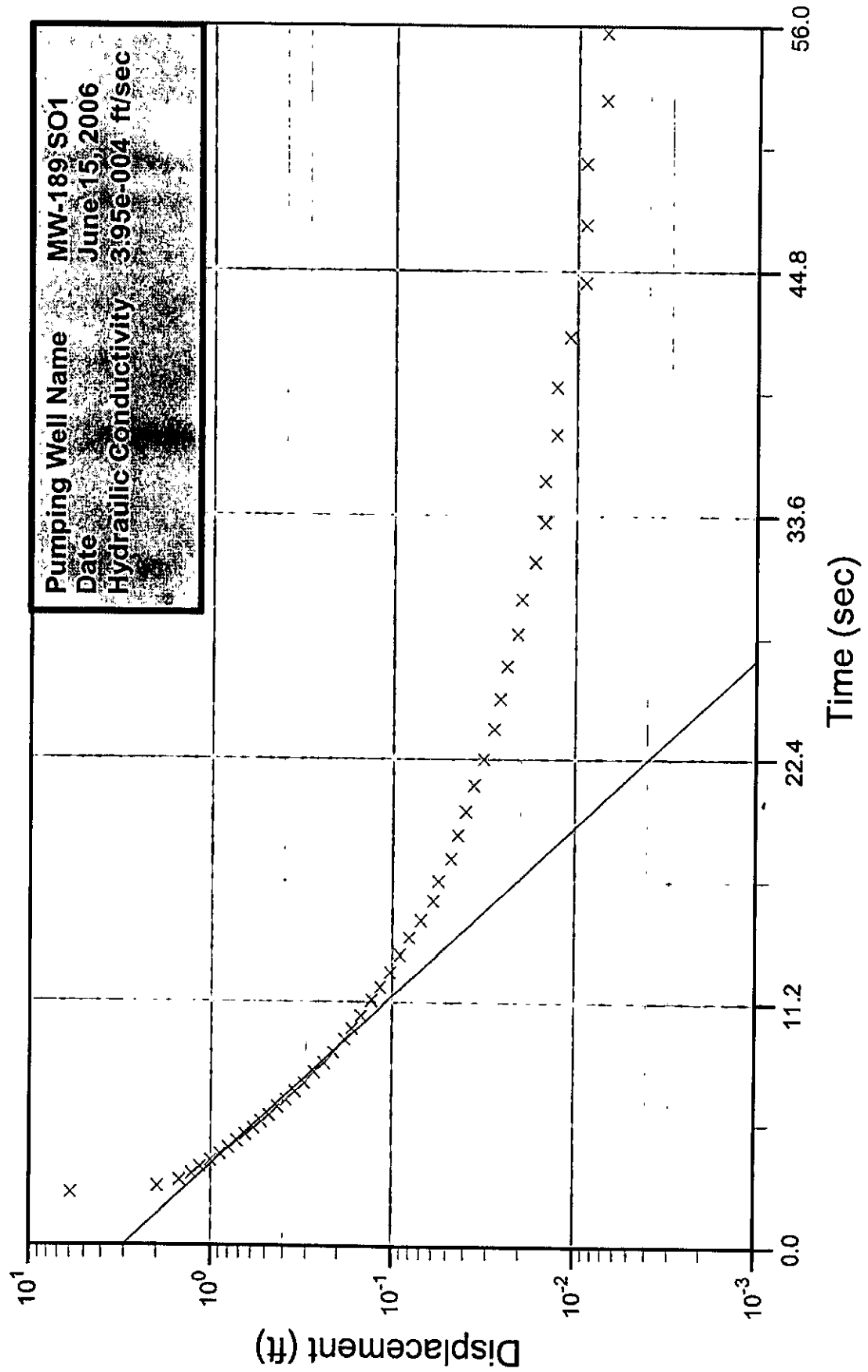
Residual Mean = 0.019258
 Residual Standard Dev. = 0.060029
 Residual Sum of Squares = 0.186796
 Absolute Residual Mean = 0.024085
 Minimum Residual = -0.010173
 Maximum Residual = 0.411473

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	2.400000e+000	2.323000e+000	1.911527e+000	4.114734e-001
1	2.700000e+000	1.963000e+000	1.905563e+000	5.743743e-002
2	3.000000e+000	1.919000e+000	1.899617e+000	1.938290e-002
3	3.300000e+000	1.933000e+000	1.893690e+000	3.930981e-002
4	3.600000e+000	1.894000e+000	1.887782e+000	6.218239e-003
5	3.900000e+000	1.898000e+000	1.881892e+000	1.610823e-002
6	4.200000e+000	1.878000e+000	1.876020e+000	1.979845e-003
7	4.500000e+000	1.876000e+000	1.870167e+000	5.833139e-003
8	4.800000e+000	1.860000e+000	1.864332e+000	-4.331829e-003

9	5.100000e+000	1.849000e+000	1.858515e+000	-9.515003e-003
10	5.400000e+000	1.843000e+000	1.852716e+000	-9.716326e-003
11	5.700000e+000	1.837000e+000	1.846936e+000	-9.935741e-003
12	6.000000e+000	1.831000e+000	1.841173e+000	-1.017319e-002
13	6.400000e+000	1.825000e+000	1.833518e+000	-8.517752e-003
14	6.700000e+000	1.819000e+000	1.827797e+000	-8.797067e-003
15	7.100000e+000	1.811000e+000	1.820197e+000	-9.197244e-003
16	7.500000e+000	1.805000e+000	1.812629e+000	-7.629019e-003
17	8.000000e+000	1.794000e+000	1.803213e+000	-9.212976e-003
18	8.400000e+000	1.786000e+000	1.795715e+000	-9.715370e-003
19	8.900000e+000	1.778000e+000	1.786387e+000	-8.387188e-003
20	9.500000e+000	1.768000e+000	1.775257e+000	-7.257310e-003
21	1.000000e+001	1.765000e+000	1.766035e+000	-1.035400e-003
22	1.060000e+001	1.757000e+000	1.755032e+000	1.967678e-003
23	1.130000e+001	1.747000e+000	1.742282e+000	4.717990e-003
24	1.190000e+001	1.736000e+000	1.731427e+000	4.573076e-003
25	1.260000e+001	1.724000e+000	1.718848e+000	5.151894e-003
26	1.340000e+001	1.714000e+000	1.704584e+000	9.415824e-003
27	1.420000e+001	1.701000e+000	1.690439e+000	1.056139e-002
28	1.500000e+001	1.687000e+000	1.676410e+000	1.058956e-002
29	1.590000e+001	1.672000e+000	1.660768e+000	1.123215e-002
30	1.680000e+001	1.658000e+000	1.645271e+000	1.272878e-002
31	1.780000e+001	1.641000e+000	1.628222e+000	1.277773e-002
32	1.890000e+001	1.625000e+000	1.609672e+000	1.532759e-002
33	2.000000e+001	1.609000e+000	1.591334e+000	1.766612e-002
34	2.120000e+001	1.590000e+000	1.571566e+000	1.843359e-002
35	2.240000e+001	1.571000e+000	1.552044e+000	1.895551e-002
36	2.380000e+001	1.551000e+000	1.529575e+000	2.142480e-002
37	2.520000e+001	1.528000e+000	1.507431e+000	2.056880e-002
38	2.670000e+001	1.507000e+000	1.484061e+000	2.293889e-002
39	2.820000e+001	1.485000e+000	1.461053e+000	2.394666e-002
40	2.980000e+001	1.462000e+000	1.436905e+000	2.509526e-002
41	3.150000e+001	1.440000e+000	1.411684e+000	2.831598e-002
42	3.330000e+001	1.415000e+000	1.385462e+000	2.953792e-002
43	3.520000e+001	1.390000e+000	1.358312e+000	3.168842e-002
44	3.730000e+001	1.362000e+000	1.328922e+000	3.307826e-002
45	3.950000e+001	1.333000e+000	1.298814e+000	3.418581e-002
46	4.180000e+001	1.304000e+000	1.268067e+000	3.593282e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 52

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 10 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 3.01272 ft
Hydraulic Conductivity Calculated Value	= 0.000394671 ft/sec
Aquifer Thickness Fixed Value	= 10 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

 Kz/Kr
 Fixed Value = 1

 Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

 Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

 A
 Calculated Value = 4.78096

 B
 Calculated Value = 0.812488

 C
 Calculated Value = 4.74486

 Linear Regression Slope
 Fixed Value = -0.296127 ft/sec

 Linear Regression Intercept
 Fixed Value = 3.01272 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.296127 ft/sec
 Intercept: 3.012716 ft

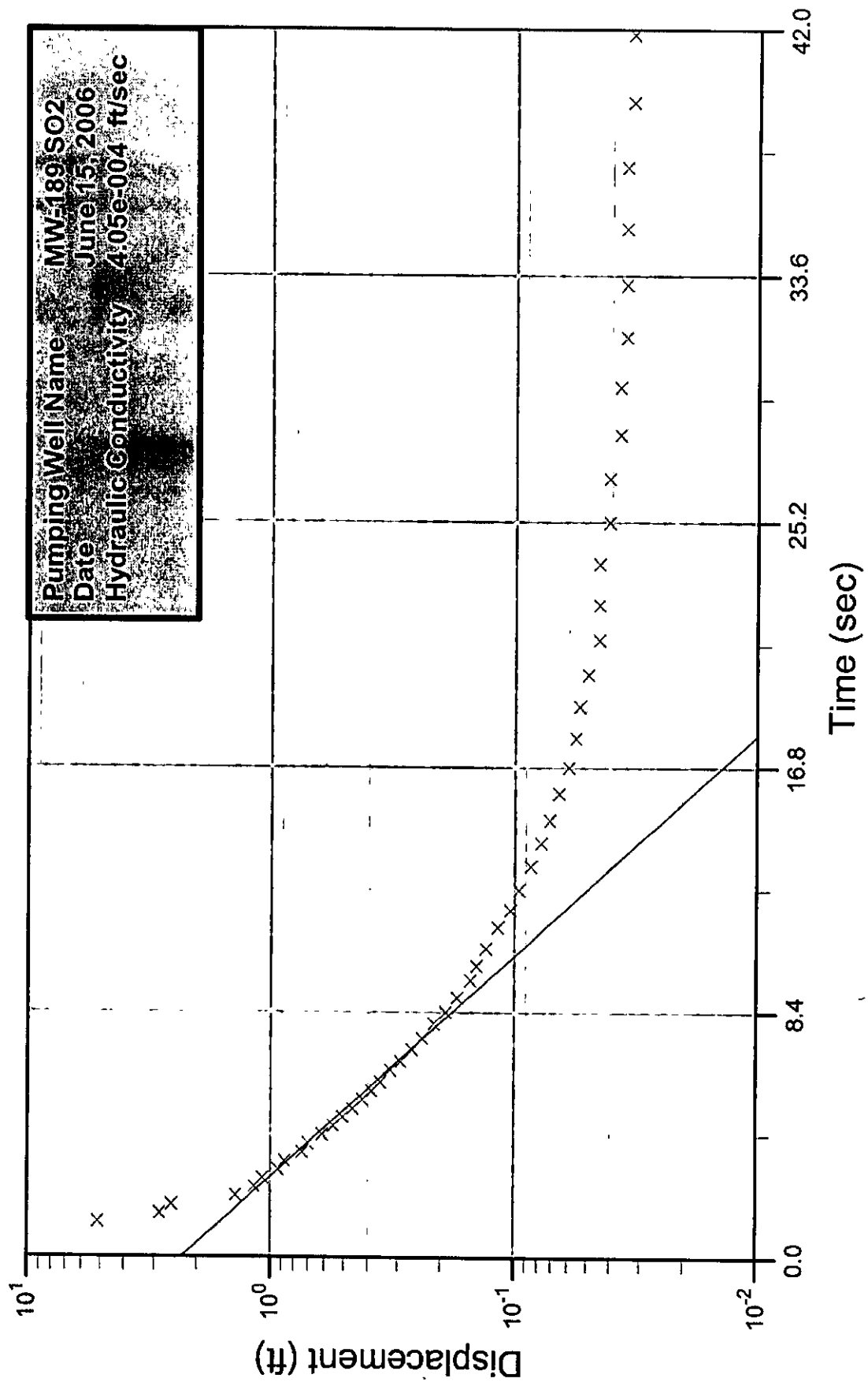
Residual Mean = 0.117380
 Residual Standard Dev. = 0.615897
 Residual Sum of Squares = 20.441563
 Absolute Residual Mean = 0.126701
 Minimum Residual = -0.030705
 Maximum Residual = 4.464861

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	2.400000e+000	5.945000e+000	1.480139e+000	4.464861e+000
1	2.700000e+000	1.976000e+000	1.354318e+000	6.216821e-001
2	3.000000e+000	1.487000e+000	1.239192e+000	2.478079e-001
3	3.300000e+000	1.275000e+000	1.133853e+000	1.411472e-001
4	3.600000e+000	1.148000e+000	1.037468e+000	1.105320e-001
5	3.900000e+000	1.000000e+000	9.492766e-001	5.072341e-002
6	4.200000e+000	8.890000e-001	8.685820e-001	2.041803e-002
7	4.500000e+000	8.000000e-001	7.947469e-001	5.253082e-003
8	4.800000e+000	7.170000e-001	7.271883e-001	-1.018832e-002

9	5.100000e+000	6.430000e-001	6.653726e-001	-2.237263e-002
10	5.400000e+000	5.820000e-001	6.088117e-001	-2.681168e-002
11	5.700000e+000	5.270000e-001	5.570588e-001	-3.005877e-002
12	6.000000e+000	4.790000e-001	5.097052e-001	-3.070519e-002
13	6.400000e+000	4.310000e-001	4.527688e-001	-2.176875e-002
14	6.700000e+000	3.860000e-001	4.142805e-001	-2.828050e-002
15	7.100000e+000	3.440000e-001	3.680034e-001	-2.400344e-002
16	7.500000e+000	3.060000e-001	3.268957e-001	-2.089574e-002
17	8.000000e+000	2.710000e-001	2.819071e-001	-1.090709e-002
18	8.400000e+000	2.390000e-001	2.504168e-001	-1.141676e-002
19	8.900000e+000	2.110000e-001	2.159534e-001	-4.953440e-003
20	9.500000e+000	1.840000e-001	1.807991e-001	3.200923e-003
21	1.000000e+001	1.680000e-001	1.559168e-001	1.208319e-002
22	1.060000e+001	1.500000e-001	1.305356e-001	1.946438e-002
23	1.130000e+001	1.310000e-001	1.060973e-001	2.490267e-002
24	1.190000e+001	1.170000e-001	8.882609e-002	2.817391e-002
25	1.260000e+001	1.030000e-001	7.219647e-002	3.080353e-002
26	1.340000e+001	9.100000e-002	5.696797e-002	3.403203e-002
27	1.420000e+001	8.100000e-002	4.495164e-002	3.604836e-002
28	1.500000e+001	7.000000e-002	3.546993e-002	3.453007e-002
29	1.590000e+001	6.000000e-002	2.717155e-002	3.282845e-002
30	1.680000e+001	5.600000e-002	2.081462e-002	3.518538e-002
31	1.780000e+001	4.800000e-002	1.547968e-002	3.252032e-002
32	1.890000e+001	4.400000e-002	1.117622e-002	3.282378e-002
33	2.000000e+001	4.000000e-002	8.069148e-003	3.193085e-002
34	2.120000e+001	3.600000e-002	5.655875e-003	3.034412e-002
35	2.240000e+001	3.200000e-002	3.964350e-003	2.803565e-002
36	2.380000e+001	2.800000e-002	2.618924e-003	2.538108e-002
37	2.520000e+001	2.600000e-002	1.730110e-003	2.426989e-002
38	2.670000e+001	2.400000e-002	1.109594e-003	2.289041e-002
39	2.820000e+001	2.100000e-002	7.116298e-004	2.028837e-002
40	2.980000e+001	2.000000e-002	4.430816e-004	1.955692e-002
41	3.150000e+001	1.700000e-002	2.678259e-004	1.673217e-002
42	3.330000e+001	1.500000e-002	1.571668e-004	1.484283e-002
43	3.520000e+001	1.500000e-002	8.953821e-005	1.491046e-002
44	3.730000e+001	1.300000e-002	4.807671e-005	1.295192e-002
45	3.950000e+001	1.300000e-002	2.506111e-005	1.297494e-002
46	4.180000e+001	1.100000e-002	1.268251e-005	1.098732e-002
47	4.430000e+001	9.000000e-003	6.049076e-006	8.993951e-003
48	4.690000e+001	9.000000e-003	2.800993e-006	8.997199e-003
49	4.970000e+001	9.000000e-003	1.222401e-006	8.998778e-003
50	5.260000e+001	7.000000e-003	5.179106e-007	6.999482e-003
51	5.570000e+001	7.000000e-003	2.068115e-007	6.999793e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 51

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 10 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 2.30221 ft
Hydraulic Conductivity Calculated Value	= 0.000404916 ft/sec
Aquifer Thickness Fixed Value	= 10 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.78096

B
 Calculated Value = 0.812488

C
 Calculated Value = 4.74486

Linear Regression Slope
 Fixed Value = -0.303815 ft/sec

Linear Regression Intercept
 Fixed Value = 2.30221 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.303815 ft/sec
 Intercept: 2.302214 ft

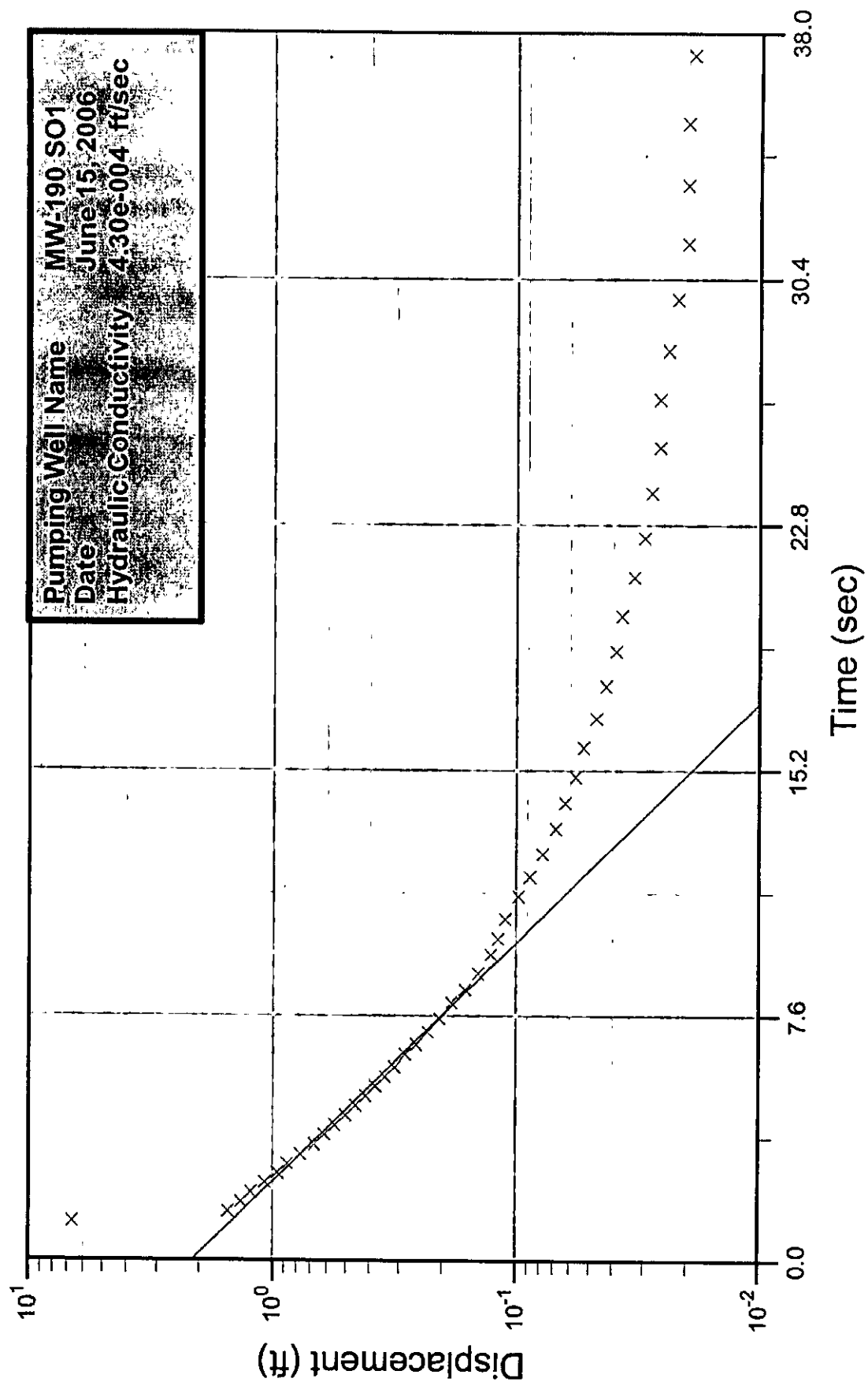
Residual Mean = 0.144400
 Residual Standard Dev. = 0.539778
 Residual Sum of Squares = 15.922782
 Absolute Residual Mean = 0.153183
 Minimum Residual = -0.031669
 Maximum Residual = 3.527135

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	5.126000e+000	1.598865e+000	3.527135e+000
1	1.500000e+000	2.846000e+000	1.459581e+000	1.386419e+000
2	1.800000e+000	2.545000e+000	1.332431e+000	1.212569e+000
3	2.100000e+000	1.391000e+000	1.216357e+000	1.746425e-001
4	2.400000e+000	1.165000e+000	1.110396e+000	5.460444e-002
5	2.700000e+000	1.081000e+000	1.013664e+000	6.733556e-002
6	3.000000e+000	9.310000e-001	9.253600e-001	5.640040e-003
7	3.300000e+000	8.750000e-001	8.447480e-001	3.025195e-002
8	3.600000e+000	7.430000e-001	7.711586e-001	-2.815857e-002

9	3.900000e+000	7.010000e-001	7.039798e-001	-2.979777e-003
10	4.200000e+000	6.140000e-001	6.426532e-001	-2.865320e-002
11	4.500000e+000	5.550000e-001	5.866690e-001	-3.166904e-002
12	4.800000e+000	5.070000e-001	5.355619e-001	-2.856189e-002
13	5.100000e+000	4.620000e-001	4.889069e-001	-2.690689e-002
14	5.400000e+000	4.220000e-001	4.463162e-001	-2.431620e-002
15	5.700000e+000	3.880000e-001	4.074358e-001	-1.943576e-002
16	6.000000e+000	3.560000e-001	3.719424e-001	-1.594235e-002
17	6.400000e+000	3.230000e-001	3.293803e-001	-6.380304e-003
18	6.700000e+000	2.930000e-001	3.006866e-001	-7.686631e-003
19	7.100000e+000	2.630000e-001	2.662785e-001	-3.278505e-003
20	7.500000e+000	2.390000e-001	2.358078e-001	3.192236e-003
21	8.000000e+000	2.140000e-001	2.025749e-001	1.142512e-002
22	8.400000e+000	1.920000e-001	1.793939e-001	1.260614e-002
23	8.900000e+000	1.720000e-001	1.541115e-001	1.788849e-002
24	9.500000e+000	1.520000e-001	1.284305e-001	2.356954e-002
25	1.000000e+001	1.430000e-001	1.103305e-001	3.266951e-002
26	1.060000e+001	1.310000e-001	9.194509e-002	3.905491e-002
27	1.130000e+001	1.170000e-001	7.433049e-002	4.266951e-002
28	1.190000e+001	1.040000e-001	6.194411e-002	4.205589e-002
29	1.260000e+001	9.600000e-002	5.007702e-002	4.592298e-002
30	1.340000e+001	8.600000e-002	3.927195e-002	4.672805e-002
31	1.420000e+001	7.800000e-002	3.079828e-002	4.720172e-002
32	1.500000e+001	7.200000e-002	2.415296e-002	4.784704e-002
33	1.590000e+001	6.600000e-002	1.837469e-002	4.762531e-002
34	1.680000e+001	6.000000e-002	1.397878e-002	4.602122e-002
35	1.780000e+001	5.600000e-002	1.031631e-002	4.568369e-002
36	1.890000e+001	5.400000e-002	7.385584e-003	4.661442e-002
37	2.000000e+001	5.000000e-002	5.287438e-003	4.471256e-002
38	2.120000e+001	4.500000e-002	3.672073e-003	4.132793e-002
39	2.240000e+001	4.500000e-002	2.550218e-003	4.244978e-002
40	2.380000e+001	4.500000e-002	1.666688e-003	4.333331e-002
41	2.520000e+001	4.100000e-002	1.089259e-003	3.991074e-002
42	2.670000e+001	4.100000e-002	6.905795e-004	4.030942e-002
43	2.820000e+001	3.700000e-002	4.378205e-004	3.656218e-002
44	2.980000e+001	3.700000e-002	2.692676e-004	3.673073e-002
45	3.150000e+001	3.500000e-002	1.606488e-004	3.483935e-002
46	3.330000e+001	3.500000e-002	9.297721e-005	3.490702e-002
47	3.520000e+001	3.500000e-002	5.220126e-005	3.494780e-002
48	3.730000e+001	3.500000e-002	2.758014e-005	3.497242e-002
49	3.950000e+001	3.300000e-002	1.413570e-005	3.298586e-002
50	4.180000e+001	3.300000e-002	7.028195e-006	3.299297e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 49

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 9.5 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 2.12429 ft
Hydraulic Conductivity	
Calculated Value	= 0.000430043 ft/sec
Aquifer Thickness	
Fixed Value	= 9.5 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.65088

B
 Calculated Value = 0.786959

C
 Calculated Value = 4.56228

Linear Regression Slope
 Fixed Value = -0.309925 ft/sec

Linear Regression Intercept
 Fixed Value = 2.12429 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.309925 ft/sec
 Intercept: 2.124287 ft

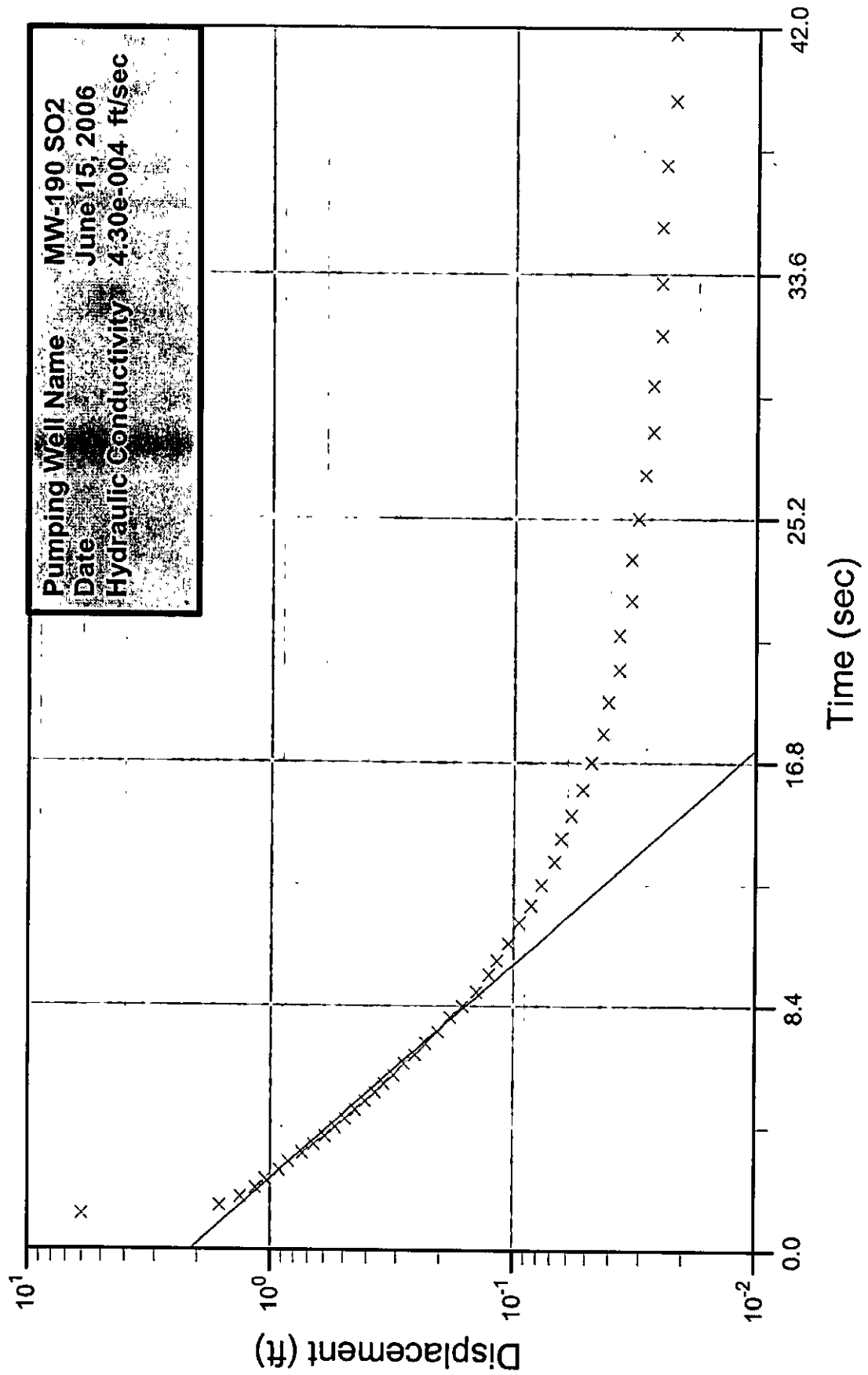
Residual Mean = 0.129053
 Residual Standard Dev. = 0.731492
 Residual Sum of Squares = 27.035051
 Absolute Residual Mean = 0.137509
 Minimum Residual = -0.023646
 Maximum Residual = 5.189483

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	6.654000e+000	1.464517e+000	5.189483e+000
1	1.500000e+000	1.527000e+000	1.334489e+000	1.925112e-001
2	1.800000e+000	1.355000e+000	1.216005e+000	1.389952e-001
3	2.100000e+000	1.228000e+000	1.108041e+000	1.199595e-001
4	2.400000e+000	1.080000e+000	1.009662e+000	7.033799e-002
5	2.700000e+000	9.600000e-001	9.200181e-001	3.998189e-002
6	3.000000e+000	8.730000e-001	8.383333e-001	3.466666e-002
7	3.300000e+000	7.740000e-001	7.639010e-001	1.009896e-002
8	3.600000e+000	6.770000e-001	6.960773e-001	-1.907729e-002

9	3.900000e+000	6.140000e-001	6.342753e-001	-2.027534e-002
10	4.200000e+000	5.560000e-001	5.779605e-001	-2.196054e-002
11	4.500000e+000	5.030000e-001	5.266457e-001	-2.364571e-002
12	4.800000e+000	4.570000e-001	4.798869e-001	-2.288692e-002
13	5.100000e+000	4.160000e-001	4.372797e-001	-2.127966e-002
14	5.400000e+000	3.780000e-001	3.984553e-001	-2.045533e-002
15	5.700000e+000	3.450000e-001	3.630781e-001	-1.807805e-002
16	6.000000e+000	3.150000e-001	3.308418e-001	-1.584179e-002
17	6.400000e+000	2.850000e-001	2.922677e-001	-7.267716e-003
18	6.700000e+000	2.570000e-001	2.663184e-001	-9.318421e-003
19	7.100000e+000	2.300000e-001	2.352674e-001	-5.267366e-003
20	7.500000e+000	2.060000e-001	2.078367e-001	-1.836669e-003
21	8.000000e+000	1.840000e-001	1.780011e-001	5.998862e-003
22	8.400000e+000	1.620000e-001	1.572473e-001	4.752677e-003
23	8.900000e+000	1.430000e-001	1.346740e-001	8.325967e-003
24	9.500000e+000	1.270000e-001	1.118213e-001	1.517869e-002
25	1.000000e+001	1.190000e-001	9.576905e-002	2.323095e-002
26	1.060000e+001	1.110000e-001	7.951809e-002	3.148191e-002
27	1.130000e+001	9.800000e-002	6.400984e-002	3.399016e-002
28	1.190000e+001	8.800000e-002	5.314807e-002	3.485193e-002
29	1.260000e+001	7.800000e-002	4.278271e-002	3.521729e-002
30	1.340000e+001	6.900000e-002	3.338792e-002	3.561208e-002
31	1.420000e+001	6.300000e-002	2.605615e-002	3.694385e-002
32	1.500000e+001	5.700000e-002	2.033439e-002	3.666561e-002
33	1.590000e+001	5.300000e-002	1.538482e-002	3.761518e-002
34	1.680000e+001	4.700000e-002	1.164001e-002	3.535999e-002
35	1.780000e+001	4.300000e-002	8.537970e-003	3.446203e-002
36	1.890000e+001	3.900000e-002	6.071499e-003	3.292850e-002
37	2.000000e+001	3.700000e-002	4.317549e-003	3.268245e-002
38	2.120000e+001	3.300000e-002	2.976588e-003	3.002341e-002
39	2.240000e+001	3.000000e-002	2.052108e-003	2.794789e-002
40	2.380000e+001	2.800000e-002	1.329725e-003	2.667027e-002
41	2.520000e+001	2.600000e-002	8.616354e-004	2.513836e-002
42	2.670000e+001	2.600000e-002	5.412842e-004	2.545872e-002
43	2.820000e+001	2.400000e-002	3.400378e-004	2.365996e-002
44	2.980000e+001	2.200000e-002	2.070948e-004	2.179291e-002
45	3.150000e+001	2.000000e-002	1.222788e-004	1.987772e-002
46	3.330000e+001	2.000000e-002	6.999602e-005	1.993000e-002
47	3.520000e+001	2.000000e-002	3.884505e-005	1.996115e-002
48	3.730000e+001	1.900000e-002	2.026181e-005	1.897974e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 51

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 9.5 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 2.12429 ft
Hydraulic Conductivity Calculated Value	= 0.000430043 ft/sec
Aquifer Thickness Fixed Value	= 9.5 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.65088

B
 Calculated Value = 0.786959

C
 Calculated Value = 4.56228

Linear Regression Slope
 Fixed Value = -0.309925 ft/sec

Linear Regression Intercept
 Fixed Value = 2.12429 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.309925 ft/sec
 Intercept: 2.124287 ft

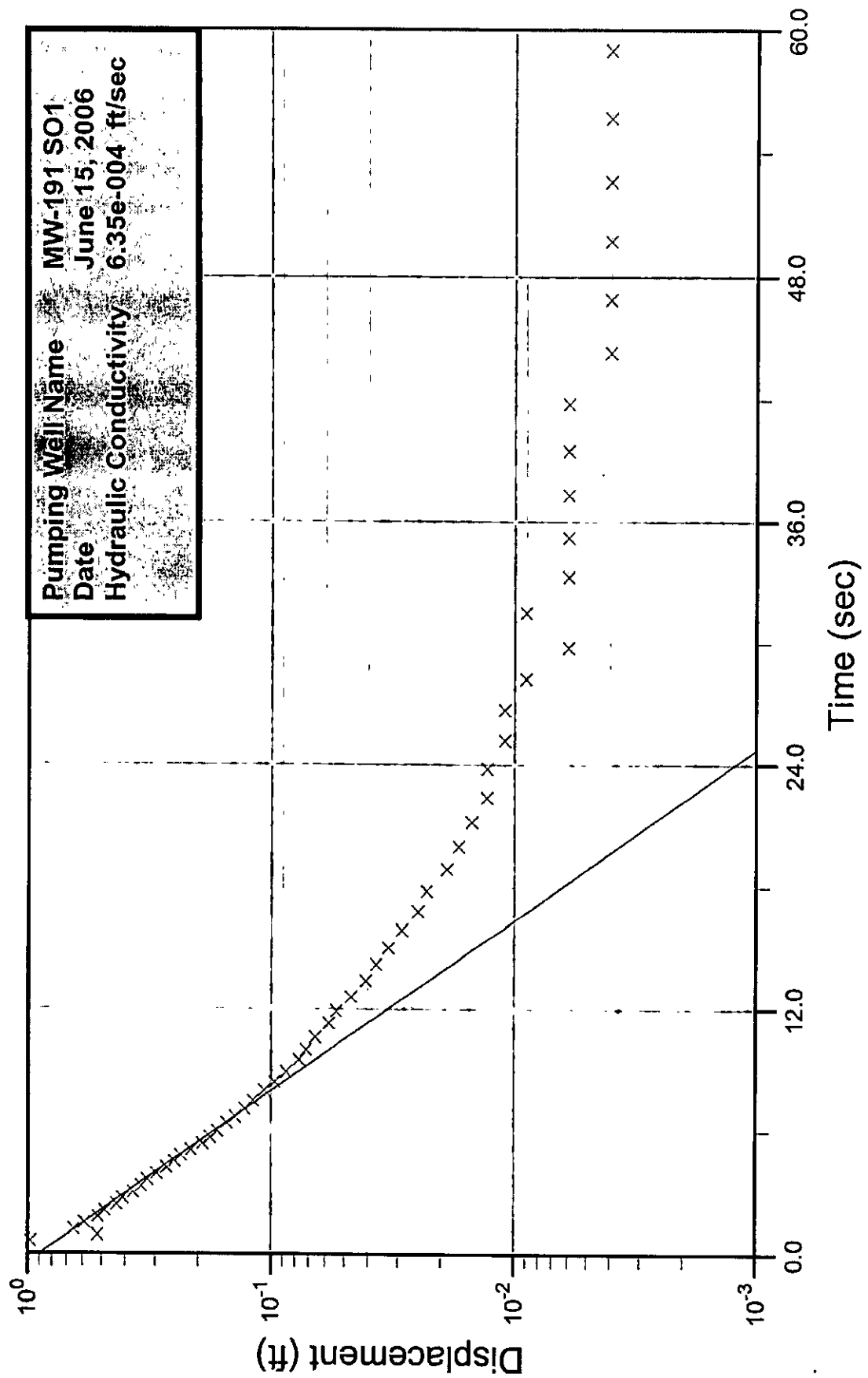
Residual Mean = 0.107991
 Residual Standard Dev. = 0.628649
 Residual Sum of Squares = 20.749973
 Absolute Residual Mean = 0.121486
 Minimum Residual = -0.038275
 Maximum Residual = 4.540483

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	6.005000e+000	1.464517e+000	4.540483e+000
1	1.500000e+000	1.620000e+000	1.334489e+000	2.855112e-001
2	1.800000e+000	1.333000e+000	1.216005e+000	1.169952e-001
3	2.100000e+000	1.153000e+000	1.108041e+000	4.495946e-002
4	2.400000e+000	1.056000e+000	1.009662e+000	4.633799e-002
5	2.700000e+000	9.190000e-001	9.200181e-001	-1.018110e-003
6	3.000000e+000	8.450000e-001	8.383333e-001	6.66659e-003
7	3.300000e+000	7.380000e-001	7.639010e-001	-2.590104e-002
8	3.600000e+000	6.610000e-001	6.960773e-001	-3.507729e-002

9	3.900000e+000	5.960000e-001	6.342753e-001	-3.827534e-002
10	4.200000e+000	5.420000e-001	5.779605e-001	-3.596054e-002
11	4.500000e+000	4.910000e-001	5.266457e-001	-3.564571e-002
12	4.800000e+000	4.470000e-001	4.798869e-001	-3.288692e-002
13	5.100000e+000	4.060000e-001	4.372797e-001	-3.127966e-002
14	5.400000e+000	3.700000e-001	3.984553e-001	-2.845533e-002
15	5.700000e+000	3.400000e-001	3.630781e-001	-2.307805e-002
16	6.000000e+000	3.090000e-001	3.308418e-001	-2.184179e-002
17	6.400000e+000	2.810000e-001	2.922677e-001	-1.126772e-002
18	6.700000e+000	2.530000e-001	2.663184e-001	-1.331842e-002
19	7.100000e+000	2.290000e-001	2.352674e-001	-6.267366e-003
20	7.500000e+000	2.040000e-001	2.078367e-001	-3.836669e-003
21	8.000000e+000	1.820000e-001	1.780011e-001	3.998862e-003
22	8.400000e+000	1.620000e-001	1.572473e-001	4.752677e-003
23	8.900000e+000	1.420000e-001	1.346740e-001	7.325967e-003
24	9.500000e+000	1.260000e-001	1.118213e-001	1.417869e-002
25	1.000000e+001	1.170000e-001	9.576905e-002	2.123095e-002
26	1.060000e+001	1.050000e-001	7.951809e-002	2.548191e-002
27	1.130000e+001	9.500000e-002	6.400984e-002	3.099016e-002
28	1.190000e+001	8.500000e-002	5.314807e-002	3.185193e-002
29	1.260000e+001	7.700000e-002	4.278271e-002	3.421729e-002
30	1.340000e+001	6.800000e-002	3.338792e-002	3.461208e-002
31	1.420000e+001	6.400000e-002	2.605615e-002	3.794385e-002
32	1.500000e+001	5.800000e-002	2.033439e-002	3.766561e-002
33	1.590000e+001	5.200000e-002	1.538482e-002	3.661518e-002
34	1.680000e+001	4.800000e-002	1.164001e-002	3.635999e-002
35	1.780000e+001	4.300000e-002	8.537970e-003	3.446203e-002
36	1.890000e+001	4.100000e-002	6.071499e-003	3.492850e-002
37	2.000000e+001	3.700000e-002	4.317549e-003	3.268245e-002
38	2.120000e+001	3.700000e-002	2.976588e-003	3.402341e-002
39	2.240000e+001	3.300000e-002	2.052108e-003	3.094789e-002
40	2.380000e+001	3.300000e-002	1.329725e-003	3.167027e-002
41	2.520000e+001	3.100000e-002	8.616354e-004	3.013836e-002
42	2.670000e+001	2.900000e-002	5.412842e-004	2.845872e-002
43	2.820000e+001	2.700000e-002	3.400378e-004	2.665996e-002
44	2.980000e+001	2.700000e-002	2.070948e-004	2.679291e-002
45	3.150000e+001	2.500000e-002	1.222788e-004	2.487772e-002
46	3.330000e+001	2.500000e-002	6.999602e-005	2.493000e-002
47	3.520000e+001	2.500000e-002	3.884505e-005	2.496115e-002
48	3.730000e+001	2.400000e-002	2.026181e-005	2.397974e-002
49	3.950000e+001	2.200000e-002	1.024615e-005	2.198975e-002
50	4.180000e+001	2.200000e-002	5.023236e-006	2.199498e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 59

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 4 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 0.891073 ft
Hydraulic Conductivity	
Calculated Value	= 0.000635085 ft/sec
Aquifer Thickness	
Fixed Value	= 9.5 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 2.94965

B
 Calculated Value = 0.473765

C
 Calculated Value = 2.60739

Linear Regression Slope
 Fixed Value = -0.274441 ft/sec

Linear Regression Intercept
 Fixed Value = 0.891073 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.274441 ft/sec
 Intercept: 0.891073 ft

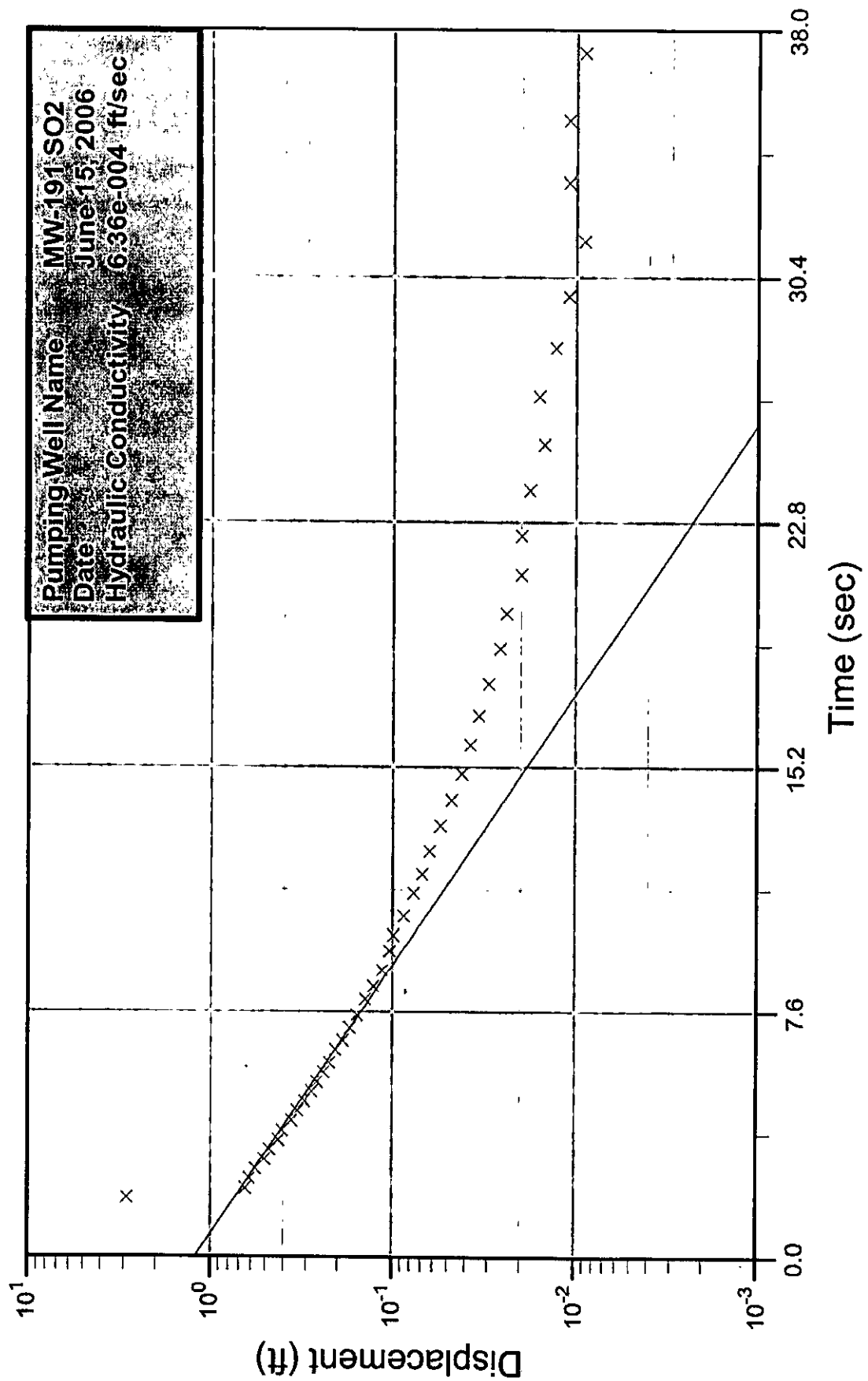
Residual Mean = 0.004499
 Residual Standard Dev. = 0.038893
 Residual Sum of Squares = 0.090442
 Absolute Residual Mean = 0.017051
 Minimum Residual = -0.176055
 Maximum Residual = 0.225212

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	6.000000e-001	9.810000e-001	7.557880e-001	2.252120e-001
1	9.000000e-001	5.200000e-001	6.960549e-001	-1.760549e-001
2	1.200000e+000	6.520000e-001	6.410427e-001	1.095730e-002
3	1.500000e+000	5.910000e-001	5.903784e-001	6.216339e-004
4	1.800000e+000	5.170000e-001	5.437183e-001	-2.671825e-002
5	2.100000e+000	4.860000e-001	5.007459e-001	-1.474589e-002
6	2.400000e+000	4.340000e-001	4.611698e-001	-2.716981e-002
7	2.700000e+000	4.090000e-001	4.247216e-001	-1.572160e-002
8	3.000000e+000	3.690000e-001	3.911540e-001	-2.215405e-002

9	3.300000e+000	3.430000e-001	3.602395e-001	-1.723948e-002
10	3.600000e+000	3.230000e-001	3.317682e-001	-8.768220e-003
11	3.900000e+000	2.970000e-001	3.055472e-001	-8.547167e-003
12	4.200000e+000	2.700000e-001	2.813985e-001	-1.139847e-002
13	4.500000e+000	2.500000e-001	2.591584e-001	-9.158357e-003
14	4.800000e+000	2.360000e-001	2.386760e-001	-2.675970e-003
15	5.100000e+000	2.140000e-001	2.198124e-001	-5.812393e-003
16	5.400000e+000	1.920000e-001	2.024397e-001	-1.043968e-002
17	5.700000e+000	1.790000e-001	1.864400e-001	-7.440016e-003
18	6.000000e+000	1.670000e-001	1.717049e-001	-4.704868e-003
19	6.400000e+000	1.530000e-001	1.538535e-001	-8.534525e-004
20	6.700000e+000	1.410000e-001	1.416938e-001	-6.937599e-004
21	7.100000e+000	1.290000e-001	1.269625e-001	2.037530e-003
22	7.500000e+000	1.190000e-001	1.137627e-001	5.237271e-003
23	8.000000e+000	1.070000e-001	9.917582e-002	7.824181e-003
24	8.400000e+000	9.700000e-002	8.886494e-002	8.135064e-003
25	8.900000e+000	8.700000e-002	7.747048e-002	9.529523e-003
26	9.500000e+000	7.700000e-002	6.570875e-002	1.129125e-002
27	1.000000e+001	7.200000e-002	5.728343e-002	1.471657e-002
28	1.060000e+001	6.600000e-002	4.858654e-002	1.741346e-002
29	1.130000e+001	5.800000e-002	4.009443e-002	1.790557e-002
30	1.190000e+001	5.400000e-002	3.400721e-002	1.999279e-002
31	1.260000e+001	4.700000e-002	2.806333e-002	1.893667e-002
32	1.340000e+001	4.100000e-002	2.253141e-002	1.846859e-002
33	1.420000e+001	3.700000e-002	1.808996e-002	1.891004e-002
34	1.500000e+001	3.300000e-002	1.452402e-002	1.847598e-002
35	1.590000e+001	2.900000e-002	1.134534e-002	1.765466e-002
36	1.680000e+001	2.500000e-002	8.862328e-003	1.613767e-002
37	1.780000e+001	2.300000e-002	6.735338e-003	1.626466e-002
38	1.890000e+001	1.900000e-002	4.980262e-003	1.401974e-002
39	2.000000e+001	1.700000e-002	3.682518e-003	1.331748e-002
40	2.120000e+001	1.500000e-002	2.649225e-003	1.235078e-002
41	2.240000e+001	1.300000e-002	1.905868e-003	1.109413e-002
42	2.380000e+001	1.300000e-002	1.297863e-003	1.170214e-002
43	2.520000e+001	1.100000e-002	8.838228e-004	1.011618e-002
44	2.670000e+001	1.100000e-002	5.855751e-004	1.041442e-002
45	2.820000e+001	9.000000e-003	3.879717e-004	8.612028e-003
46	2.980000e+001	6.000000e-003	2.500913e-004	5.749909e-003
47	3.150000e+001	9.000000e-003	1.568477e-004	8.843152e-003
48	3.330000e+001	6.000000e-003	9.570599e-005	5.904294e-003
49	3.520000e+001	6.000000e-003	5.681737e-005	5.943183e-003
50	3.730000e+001	6.000000e-003	3.192901e-005	5.968071e-003
51	3.950000e+001	6.000000e-003	1.745706e-005	5.982543e-003
52	4.180000e+001	6.000000e-003	9.286192e-006	5.990714e-003
53	4.430000e+001	4.000000e-003	4.675916e-006	3.995324e-003
54	4.690000e+001	4.000000e-003	2.290745e-006	3.997709e-003
55	4.970000e+001	4.000000e-003	1.062305e-006	3.998938e-003
56	5.260000e+001	4.000000e-003	4.792950e-007	3.999521e-003
57	5.570000e+001	4.000000e-003	2.047005e-007	3.999795e-003
58	5.900000e+001	4.000000e-003	8.275554e-008	3.999917e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 53

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 4 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.21337 ft
Hydraulic Conductivity Calculated Value	= 0.000635598 ft/sec
Aquifer Thickness Fixed Value	= 9.5 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type		
Selected Value		= None
Kz/Kr		
Fixed Value		= 1
Effective Casing Inner Diameter		
Calculated Value		= 0.17 ft
Effective Screen Inner Diameter		
Calculated Value		= 0.17 ft
A		
Calculated Value		= 2.94965
B		
Calculated Value		= 0.473765
C		
Calculated Value		= 2.60739
Linear Regression Slope		
Fixed Value		= -0.274663 ft/sec
Linear Regression Intercept		
Fixed Value		= 1.21337 ft

ANALYSIS STATISTICS

Regression Line		
Slope:	-0.274663	ft/sec
Intercept:	1.213367	ft

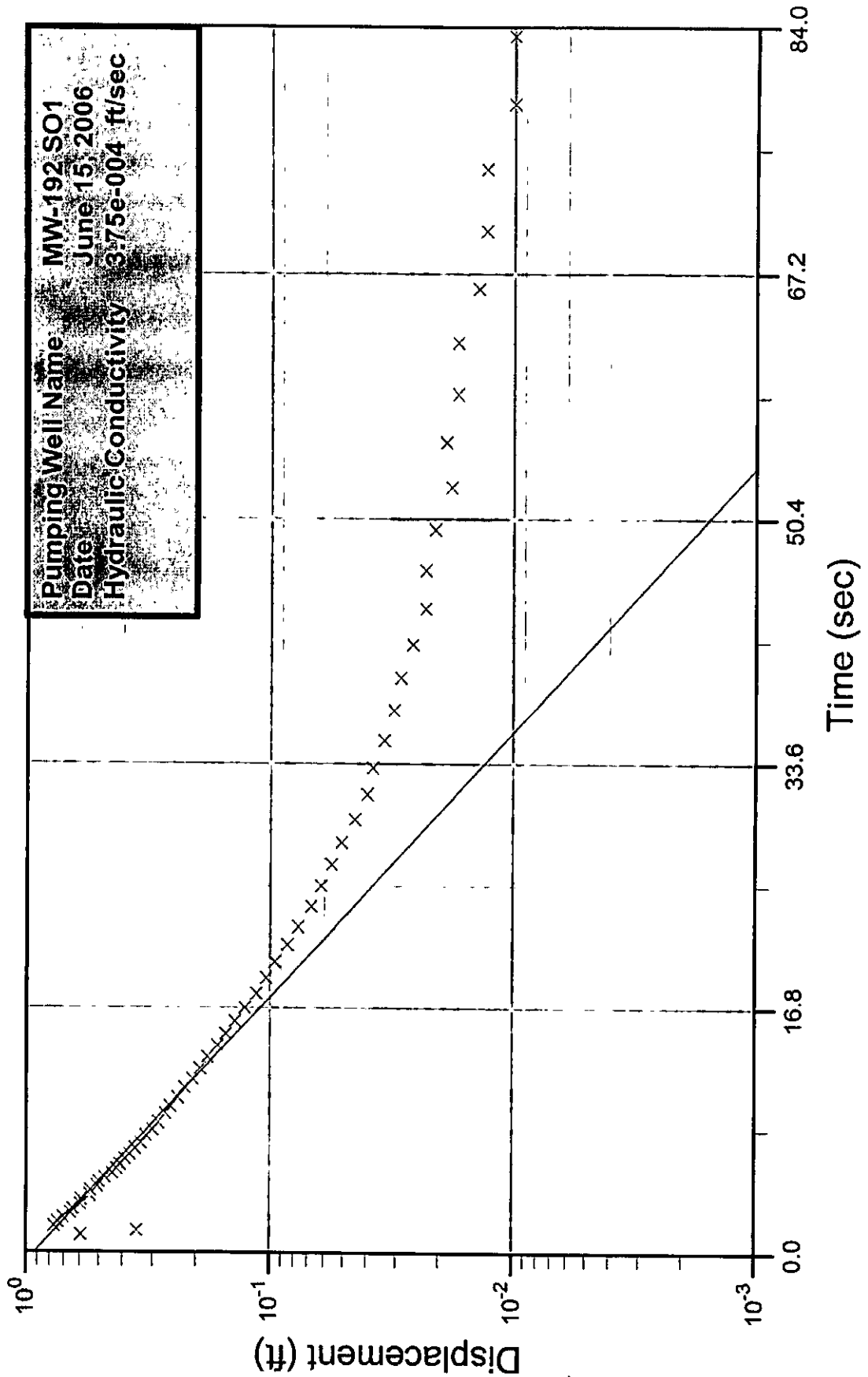
Residual Mean	=	-0.069645
Residual Standard Dev.	=	0.443942
Residual Sum of Squares	=	10.702572
Absolute Residual Mean	=	0.167650
Minimum Residual	=	-1.213367
Maximum Residual	=	2.127918

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	0.000000e+000	0.000000e+000	1.213367e+000	-1.213367e+000
1	3.000000e-001	-5.000000e-003	1.117395e+000	-
1.122395e+000				
2	6.000000e-001	-9.000000e-003	1.029014e+000	-
1.038014e+000				
3	9.000000e-001	-8.000000e-003	9.476239e-001	-9.556239e-
001				
4	1.200000e+000	-8.000000e-003	8.726711e-001	-8.806711e-
001				

5	1.500000e+000	-1.000000e-002	8.036467e-001	-8.136467e-
001				
6	1.800000e+000	2.868000e+000	7.400818e-001	2.127918e+000
7	2.100000e+000	6.430000e-001	6.815446e-001	-3.854462e-002
8	2.400000e+000	6.120000e-001	6.276375e-001	-1.563746e-002
9	2.700000e+000	5.660000e-001	5.779941e-001	-1.199413e-002
10	3.000000e+000	5.070000e-001	5.322774e-001	-2.527736e-002
11	3.300000e+000	4.770000e-001	4.901766e-001	-1.317658e-002
12	3.600000e+000	4.250000e-001	4.514058e-001	-2.640579e-002
13	3.900000e+000	4.050000e-001	4.157016e-001	-1.070160e-002
14	4.200000e+000	3.600000e-001	3.828214e-001	-2.282145e-002
15	4.500000e+000	3.360000e-001	3.525420e-001	-1.654197e-002
16	4.800000e+000	3.060000e-001	3.246575e-001	-1.865747e-002
17	5.100000e+000	2.790000e-001	2.989785e-001	-1.997850e-002
18	5.400000e+000	2.610000e-001	2.753306e-001	-1.433063e-002
19	5.700000e+000	2.410000e-001	2.535532e-001	-1.255320e-002
20	6.000000e+000	2.230000e-001	2.334983e-001	-1.049827e-002
21	6.400000e+000	2.070000e-001	2.092039e-001	-2.203889e-003
22	6.700000e+000	1.880000e-001	1.926568e-001	-4.656791e-003
23	7.100000e+000	1.720000e-001	1.726118e-001	-6.117721e-004
24	7.500000e+000	1.580000e-001	1.546523e-001	3.347658e-003
25	8.000000e+000	1.420000e-001	1.348075e-001	7.192482e-003
26	8.400000e+000	1.280000e-001	1.207814e-001	7.218560e-003
27	8.900000e+000	1.140000e-001	1.052829e-001	8.717106e-003
28	9.500000e+000	1.040000e-001	8.928674e-002	1.471326e-002
29	1.000000e+001	9.900000e-002	7.782956e-002	2.117044e-002
30	1.060000e+001	8.700000e-002	6.600452e-002	2.099548e-002
31	1.130000e+001	7.700000e-002	5.445959e-002	2.254041e-002
32	1.190000e+001	6.900000e-002	4.618527e-002	2.281473e-002
33	1.260000e+001	6.300000e-002	3.810695e-002	2.489305e-002
34	1.340000e+001	5.500000e-002	3.058978e-002	2.441022e-002
35	1.420000e+001	4.800000e-002	2.455548e-002	2.344452e-002
36	1.500000e+001	4.200000e-002	1.971155e-002	2.228845e-002
37	1.590000e+001	3.800000e-002	1.539446e-002	2.260554e-002
38	1.680000e+001	3.400000e-002	1.202287e-002	2.197713e-002
39	1.780000e+001	3.000000e-002	9.135310e-003	2.086469e-002
40	1.890000e+001	2.600000e-002	6.753207e-003	1.924679e-002
41	2.000000e+001	2.400000e-002	4.992255e-003	1.900774e-002
42	2.120000e+001	2.000000e-002	3.590501e-003	1.640950e-002
43	2.240000e+001	2.000000e-002	2.582339e-003	1.741766e-002
44	2.380000e+001	1.800000e-002	1.757983e-003	1.624202e-002
45	2.520000e+001	1.500000e-002	1.196785e-003	1.380322e-002
46	2.670000e+001	1.600000e-002	7.926634e-004	1.520734e-002
47	2.820000e+001	1.300000e-002	5.250028e-004	1.247500e-002
48	2.980000e+001	1.100000e-002	3.383031e-004	1.066170e-002
49	3.150000e+001	9.000000e-003	2.120908e-004	8.787909e-003
50	3.330000e+001	1.100000e-002	1.293628e-004	1.087064e-002
51	3.520000e+001	1.100000e-002	7.676587e-005	1.092323e-002
52	3.730000e+001	9.000000e-003	4.311915e-005	8.956881e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER.TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 63

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 3.4 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 0.921434 ft
Hydraulic Conductivity Calculated Value	= 0.00037472 ft/sec
Aquifer Thickness Fixed Value	= 3.4 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 2.7536

B
 Calculated Value = 0.4364

C
 Calculated Value = 2.4181

Linear Regression Slope
 Fixed Value = -0.126486 ft/sec

Linear Regression Intercept
 Fixed Value = 0.921434 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.126486 ft/sec
 Intercept: 0.921434 ft

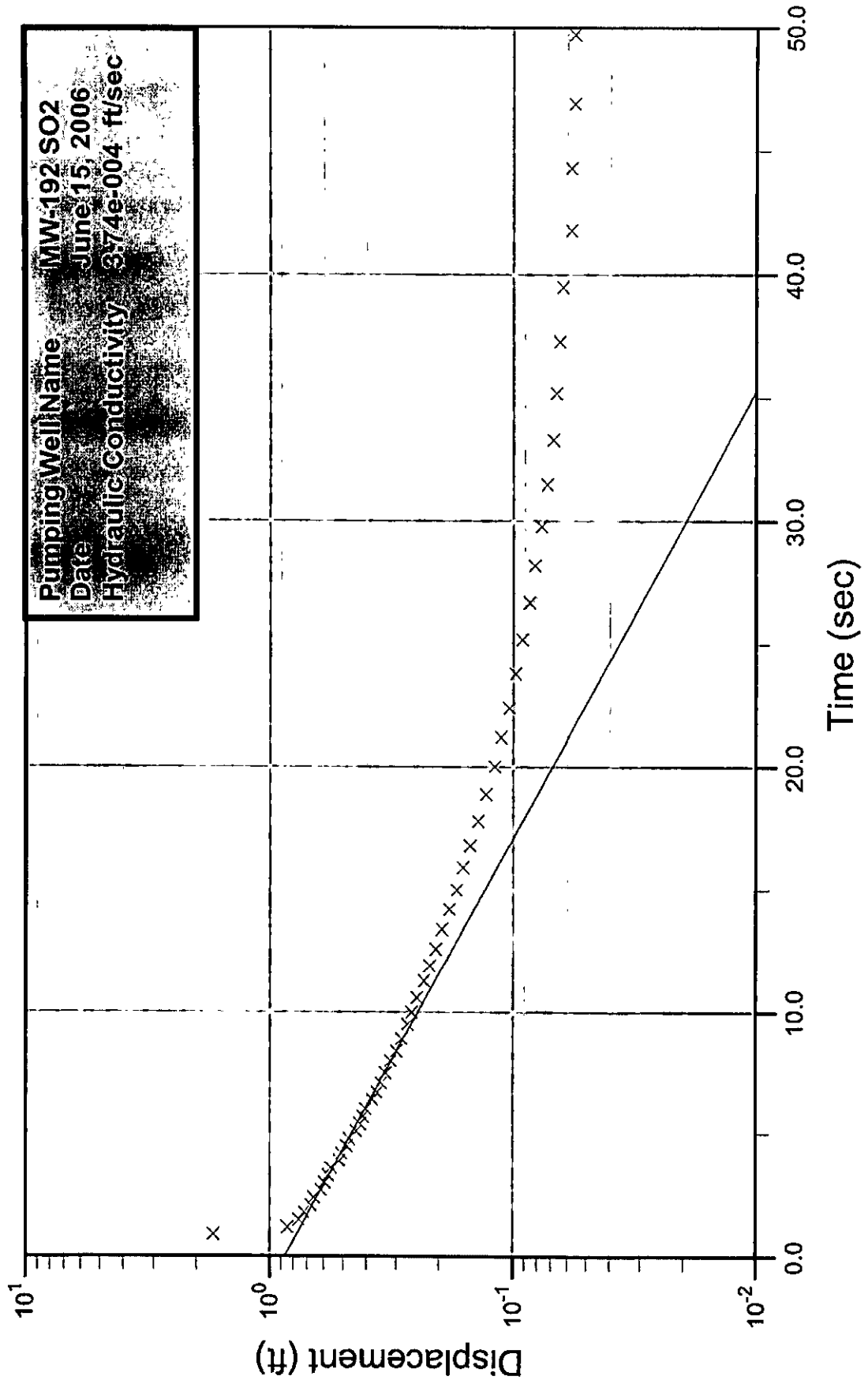
Residual Mean = -0.002157
 Residual Standard Dev. = 0.060420
 Residual Sum of Squares = 0.230282
 Absolute Residual Mean = 0.025943
 Minimum Residual = -0.413194
 Maximum Residual = 0.036509

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.200000e+000	5.950000e-001	7.916723e-001	-1.966723e-001
1	1.500000e+000	3.490000e-001	7.621944e-001	-4.131944e-001
2	1.800000e+000	7.690000e-001	7.338141e-001	3.518586e-002
3	2.100000e+000	7.430000e-001	7.064906e-001	3.650941e-002
4	2.400000e+000	7.060000e-001	6.801844e-001	2.581556e-002
5	2.700000e+000	6.560000e-001	6.548578e-001	1.142204e-003
6	3.000000e+000	6.440000e-001	6.304742e-001	1.352581e-002
7	3.300000e+000	5.970000e-001	6.069985e-001	-9.998504e-003
8	3.600000e+000	5.930000e-001	5.843969e-001	8.603064e-003

9	3.900000e+000	5.450000e-001	5.626369e-001	-1.763694e-002
10	4.200000e+000	5.430000e-001	5.416872e-001	1.312830e-003
11	4.500000e+000	5.080000e-001	5.215175e-001	-1.351747e-002
12	4.800000e+000	5.000000e-001	5.020988e-001	-2.098782e-003
13	5.100000e+000	4.720000e-001	4.834032e-001	-1.140315e-002
14	5.400000e+000	4.400000e-001	4.654037e-001	-2.540365e-002
15	5.700000e+000	4.230000e-001	4.480744e-001	-2.507436e-002
16	6.000000e+000	4.090000e-001	4.313903e-001	-2.239033e-002
17	6.400000e+000	3.910000e-001	4.101073e-001	-1.910729e-002
18	6.700000e+000	3.730000e-001	3.948370e-001	-2.183696e-002
19	7.100000e+000	3.540000e-001	3.753573e-001	-2.135731e-002
20	7.500000e+000	3.360000e-001	3.568387e-001	-2.083870e-002
21	8.000000e+000	3.200000e-001	3.349699e-001	-1.496991e-002
22	8.400000e+000	3.010000e-001	3.184439e-001	-1.744386e-002
23	8.900000e+000	2.850000e-001	2.989281e-001	-1.392809e-002
24	9.500000e+000	2.670000e-001	2.770814e-001	-1.008139e-002
25	1.000000e+001	2.550000e-001	2.601005e-001	-5.100507e-003
26	1.060000e+001	2.380000e-001	2.410915e-001	-3.091455e-003
27	1.130000e+001	2.230000e-001	2.206628e-001	2.337158e-003
28	1.190000e+001	2.070000e-001	2.045360e-001	2.463968e-003
29	1.260000e+001	1.930000e-001	1.872049e-001	5.795099e-003
30	1.340000e+001	1.800000e-001	1.691887e-001	1.081129e-002
31	1.420000e+001	1.640000e-001	1.529064e-001	1.109365e-002
32	1.500000e+001	1.520000e-001	1.381910e-001	1.380902e-002
33	1.590000e+001	1.390000e-001	1.233220e-001	1.567798e-002
34	1.680000e+001	1.270000e-001	1.100529e-001	1.694709e-002
35	1.780000e+001	1.140000e-001	9.697711e-002	1.702289e-002
36	1.890000e+001	1.040000e-001	8.438081e-002	1.961919e-002
37	2.000000e+001	9.600000e-002	7.342064e-002	2.257936e-002
38	2.120000e+001	8.500000e-002	6.308112e-002	2.191888e-002
39	2.240000e+001	7.700000e-002	5.419768e-002	2.280232e-002
40	2.380000e+001	6.800000e-002	4.540205e-002	2.259795e-002
41	2.520000e+001	6.200000e-002	3.803384e-002	2.396616e-002
42	2.670000e+001	5.600000e-002	3.146094e-002	2.453906e-002
43	2.820000e+001	5.100000e-002	2.602396e-002	2.497604e-002
44	2.980000e+001	4.500000e-002	2.125600e-002	2.374400e-002
45	3.150000e+001	4.000000e-002	1.714339e-002	2.285661e-002
46	3.330000e+001	3.800000e-002	1.365270e-002	2.434730e-002
47	3.520000e+001	3.400000e-002	1.073612e-002	2.326388e-002
48	3.730000e+001	3.100000e-002	8.231697e-003	2.276830e-002
49	3.950000e+001	2.900000e-002	6.232156e-003	2.276784e-002
50	4.180000e+001	2.600000e-002	4.659014e-003	2.134099e-002
51	4.430000e+001	2.300000e-002	3.395965e-003	1.960403e-002
52	4.690000e+001	2.300000e-002	2.444214e-003	2.055579e-002
53	4.970000e+001	2.100000e-002	1.715255e-003	1.928474e-002
54	5.260000e+001	1.800000e-002	1.188571e-003	1.681143e-002
55	5.570000e+001	1.900000e-002	8.030360e-004	1.819696e-002
56	5.900000e+001	1.700000e-002	5.290033e-004	1.647100e-002
57	6.250000e+001	1.700000e-002	3.397781e-004	1.666022e-002
58	6.620000e+001	1.400000e-002	2.127874e-004	1.378721e-002
59	7.010000e+001	1.300000e-002	1.299301e-004	1.287007e-002
60	7.430000e+001	1.300000e-002	7.638256e-005	1.292362e-002
61	7.870000e+001	1.000000e-002	4.378164e-005	9.956218e-003
62	8.340000e+001	1.000000e-002	2.416074e-005	9.975839e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 58

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 3.4 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 0.863535 ft
Hydraulic Conductivity	
Calculated Value	= 0.00037437 ft/sec
Aquifer Thickness	
Fixed Value	= 3.4 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 2.7536

B
 Calculated Value = 0.4364

C
 Calculated Value = 2.4181

Linear Regression Slope
 Fixed Value = -0.126368 ft/sec

Linear Regression Intercept
 Fixed Value = 0.863535 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.126368 ft/sec
 Intercept: 0.863535 ft

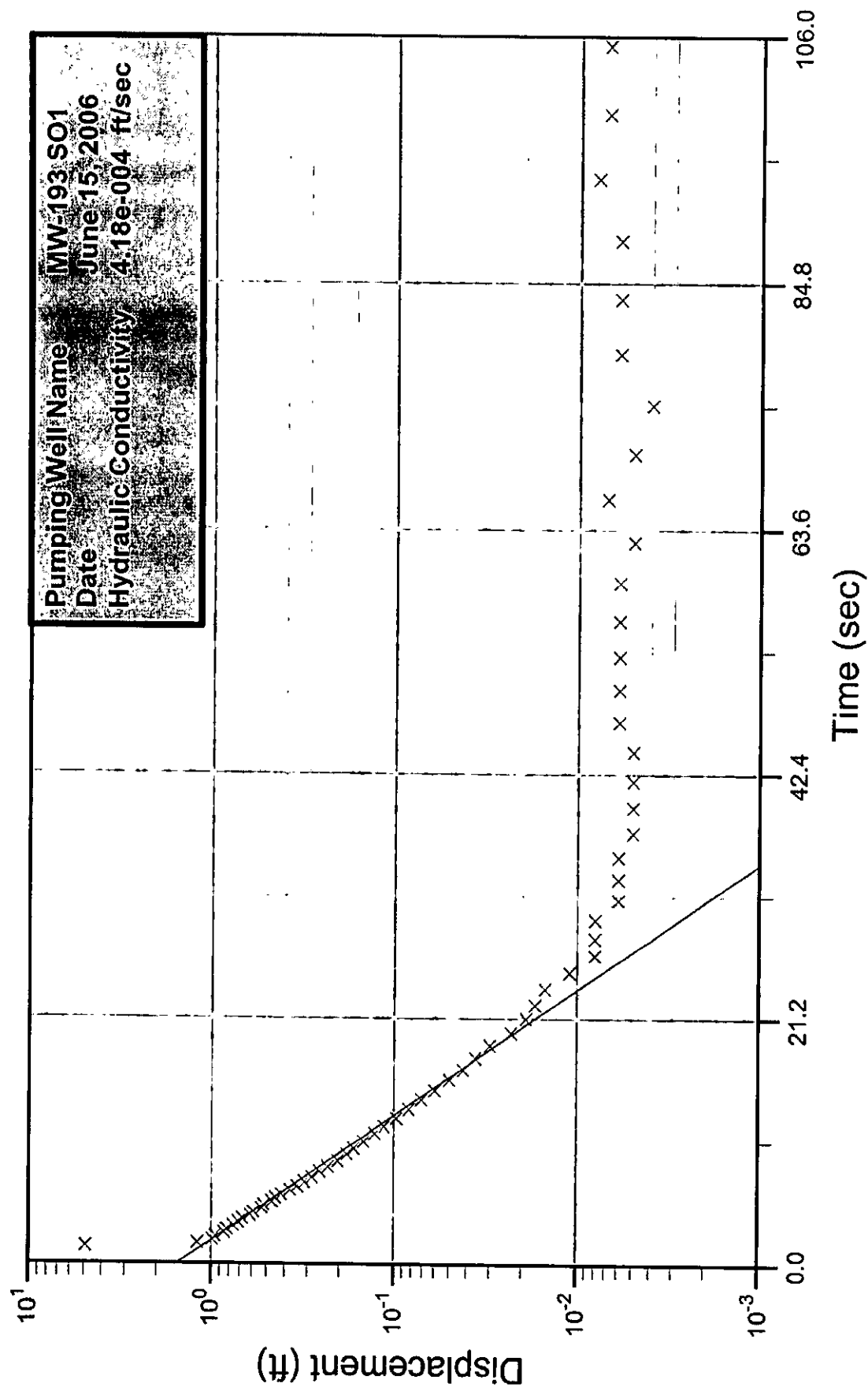
Residual Mean = -0.000042
 Residual Standard Dev. = 0.230292
 Residual Sum of Squares = 3.075994
 Absolute Residual Mean = 0.088857
 Minimum Residual = -0.863535
 Maximum Residual = 0.942298

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	0.000000e+000	0.000000e+000	8.635346e-001	-8.635346e-001
1	3.000000e-001	-8.000000e-003	8.314103e-001	-8.394103e-
001				
2	6.000000e-001	-8.000000e-003	8.004810e-001	-8.084810e-
001				
3	9.000000e-001	1.713000e+000	7.707024e-001	9.422976e-001
4	1.200000e+000	8.460000e-001	7.420316e-001	1.039684e-001
5	1.500000e+000	7.610000e-001	7.144273e-001	4.657270e-002
6	1.800000e+000	7.240000e-001	6.878499e-001	3.615006e-002

7	2.100000e+000	6.780000e-001	6.622613e-001	1.573871e-002
8	2.400000e+000	6.580000e-001	6.376246e-001	2.037544e-002
9	2.700000e+000	6.180000e-001	6.139043e-001	4.095666e-003
10	3.000000e+000	5.960000e-001	5.910665e-001	4.933475e-003
11	3.300000e+000	5.750000e-001	5.690783e-001	5.921697e-003
12	3.600000e+000	5.610000e-001	5.479081e-001	1.309194e-002
13	3.900000e+000	5.170000e-001	5.275254e-001	-1.052538e-002
14	4.200000e+000	5.070000e-001	5.079009e-001	-9.009451e-004
15	4.500000e+000	4.820000e-001	4.890066e-001	-7.006560e-003
16	4.800000e+000	4.720000e-001	4.708151e-001	1.184936e-003
17	5.100000e+000	4.420000e-001	4.533003e-001	-1.130031e-002
18	5.400000e+000	4.260000e-001	4.364371e-001	-1.043712e-002
19	5.700000e+000	4.140000e-001	4.202013e-001	-6.201253e-003
20	6.000000e+000	4.040000e-001	4.045694e-001	-5.693773e-004
21	6.400000e+000	3.790000e-001	3.846277e-001	-5.627701e-003
22	6.700000e+000	3.630000e-001	3.703192e-001	-7.319195e-003
23	7.100000e+000	3.470000e-001	3.520657e-001	-5.065749e-003
24	7.500000e+000	3.330000e-001	3.347120e-001	-1.712035e-003
25	8.000000e+000	3.170000e-001	3.142178e-001	2.782210e-003
26	8.400000e+000	3.000000e-001	2.987296e-001	1.270356e-003
27	8.900000e+000	2.860000e-001	2.804386e-001	5.561418e-003
28	9.500000e+000	2.700000e-001	2.599615e-001	1.003847e-002
29	1.000000e+001	2.600000e-001	2.440442e-001	1.595578e-002
30	1.060000e+001	2.470000e-001	2.262246e-001	2.077538e-002
31	1.130000e+001	2.310000e-001	2.070728e-001	2.392719e-002
32	1.190000e+001	2.190000e-001	1.919528e-001	2.704722e-002
33	1.260000e+001	2.070000e-001	1.757024e-001	3.129763e-002
34	1.340000e+001	1.950000e-001	1.588081e-001	3.619187e-002
35	1.420000e+001	1.820000e-001	1.435383e-001	3.846169e-002
36	1.500000e+001	1.700000e-001	1.297367e-001	4.026327e-002
37	1.590000e+001	1.600000e-001	1.157897e-001	4.421030e-002
38	1.680000e+001	1.500000e-001	1.033420e-001	4.665799e-002
39	1.780000e+001	1.390000e-001	9.107429e-002	4.792571e-002
40	1.890000e+001	1.290000e-001	7.925498e-002	4.974502e-002
41	2.000000e+001	1.190000e-001	6.896954e-002	5.003046e-002
42	2.120000e+001	1.120000e-001	5.926523e-002	5.273477e-002
43	2.240000e+001	1.040000e-001	5.092636e-002	5.307364e-002
44	2.380000e+001	9.800000e-002	4.266867e-002	5.533133e-002
45	2.520000e+001	9.200000e-002	3.574996e-002	5.625004e-002
46	2.670000e+001	8.600000e-002	2.957698e-002	5.642302e-002
47	2.820000e+001	8.200000e-002	2.446990e-002	5.753010e-002
48	2.980000e+001	7.700000e-002	1.999044e-002	5.700956e-002
49	3.150000e+001	7.300000e-002	1.612592e-002	5.687408e-002
50	3.330000e+001	6.900000e-002	1.284513e-002	5.615487e-002
51	3.520000e+001	6.700000e-002	1.010333e-002	5.689667e-002
52	3.730000e+001	6.500000e-002	7.748435e-003	5.725157e-002
53	3.950000e+001	6.300000e-002	5.867803e-003	5.713220e-002
54	4.180000e+001	5.800000e-002	4.387821e-003	5.361218e-002
55	4.430000e+001	5.800000e-002	3.199235e-003	5.480076e-002
56	4.690000e+001	5.600000e-002	2.303325e-003	5.369667e-002
57	4.970000e+001	5.600000e-002	1.616918e-003	5.438308e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 66

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 6 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.52606 ft
Hydraulic Conductivity	
Calculated Value	= 0.000418049 ft/sec
Aquifer Thickness	
Fixed Value	= 6 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.63129

B
 Calculated Value = 0.586641

C
 Calculated Value = 3.33749

Linear Regression Slope
 Fixed Value = -0.21225 ft/sec

Linear Regression Intercept
 Fixed Value = 1.52606 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.212250 ft/sec
 Intercept: 1.526063 ft

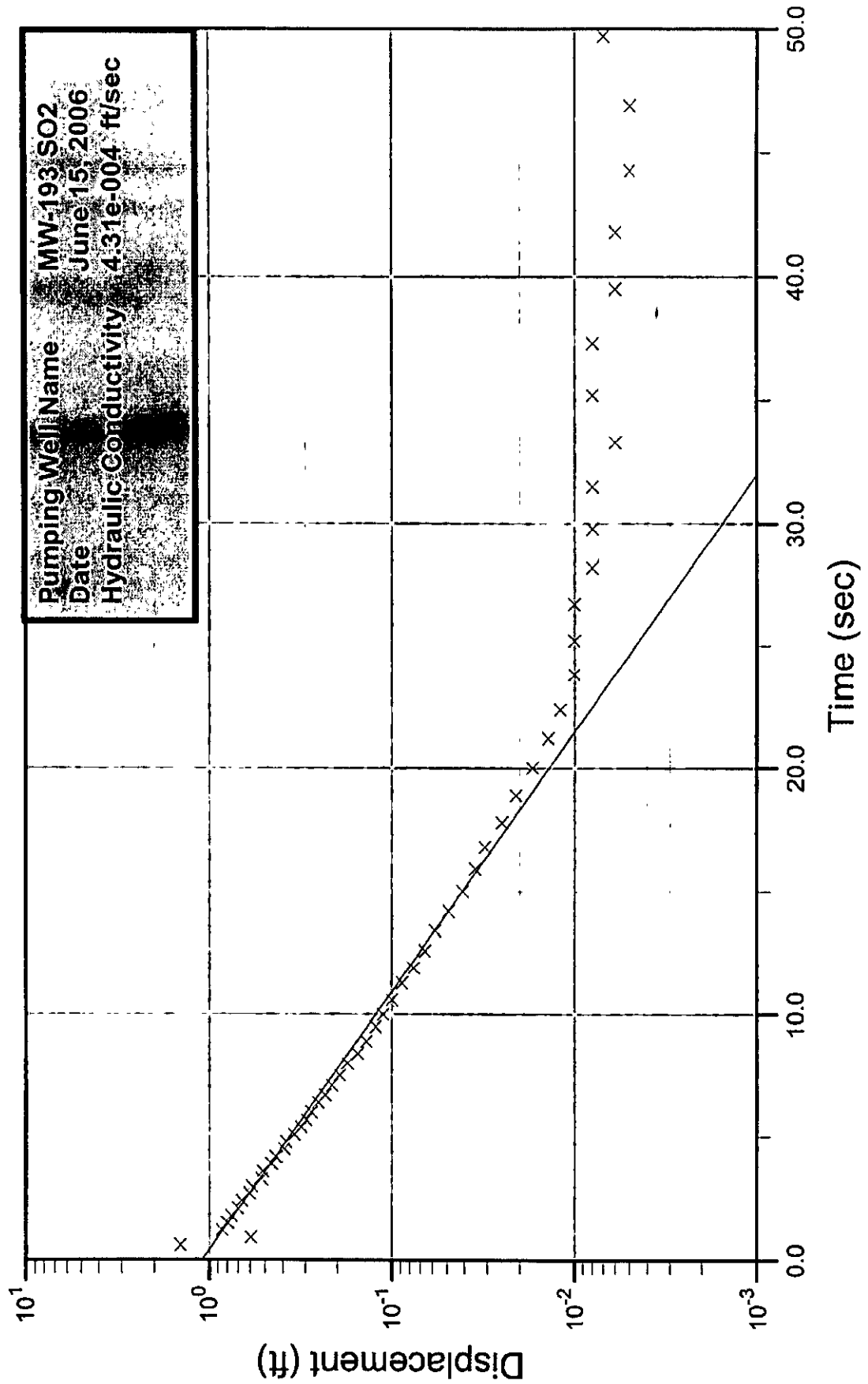
Residual Mean = 0.057630
 Residual Standard Dev. = 0.461447
 Residual Sum of Squares = 14.272826
 Absolute Residual Mean = 0.067837
 Minimum Residual = -0.027105
 Maximum Residual = 3.774049

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	4.884000e+000	1.109951e+000	3.774049e+000
1	1.800000e+000	1.185000e+000	1.041478e+000	1.435222e-001
2	2.100000e+000	9.850000e-001	9.772288e-001	7.771205e-003
3	2.400000e+000	9.510000e-001	9.169433e-001	3.405665e-002
4	2.700000e+000	8.520000e-001	8.603769e-001	-8.376919e-003
5	3.000000e+000	8.240000e-001	8.073001e-001	1.669991e-002
6	3.300000e+000	7.570000e-001	7.574976e-001	-4.975758e-004
7	3.600000e+000	7.110000e-001	7.107674e-001	2.326081e-004
8	3.900000e+000	6.720000e-001	6.669200e-001	5.079997e-003

9	4.200000e+000	6.140000e-001	6.257776e-001	-1.177757e-002
10	4.500000e+000	5.910000e-001	5.871732e-001	3.826781e-003
11	4.800000e+000	5.310000e-001	5.509504e-001	-1.995038e-002
12	5.100000e+000	5.170000e-001	5.169621e-001	3.786363e-005
13	5.400000e+000	4.680000e-001	4.850706e-001	-1.707063e-002
14	5.700000e+000	4.500000e-001	4.551465e-001	-5.146525e-003
15	6.000000e+000	4.160000e-001	4.270684e-001	-1.106844e-002
16	6.400000e+000	3.730000e-001	3.923068e-001	-1.930678e-002
17	6.700000e+000	3.410000e-001	3.681053e-001	-2.710529e-002
18	7.100000e+000	3.120000e-001	3.381430e-001	-2.614299e-002
19	7.500000e+000	2.840000e-001	3.106195e-001	-2.661950e-002
20	8.000000e+000	2.580000e-001	2.793439e-001	-2.134386e-002
21	8.400000e+000	2.320000e-001	2.566064e-001	-2.460639e-002
22	8.900000e+000	2.050000e-001	2.307692e-001	-2.576922e-002
23	9.500000e+000	1.830000e-001	2.031750e-001	-2.017505e-002
24	1.000000e+001	1.670000e-001	1.827178e-001	-1.571777e-002
25	1.060000e+001	1.480000e-001	1.608693e-001	-1.286934e-002
26	1.130000e+001	1.280000e-001	1.386589e-001	-1.065894e-002
27	1.190000e+001	1.140000e-001	1.220788e-001	-8.078830e-003
28	1.260000e+001	9.700000e-002	1.052240e-001	-8.224031e-003
29	1.340000e+001	8.300000e-002	8.879154e-002	-5.791542e-003
30	1.420000e+001	7.100000e-002	7.492526e-002	-3.925260e-003
31	1.500000e+001	6.000000e-002	6.322443e-002	-3.224430e-003
32	1.590000e+001	5.000000e-002	5.223044e-002	-2.230438e-003
33	1.680000e+001	4.200000e-002	4.314817e-002	-1.148173e-003
34	1.780000e+001	3.600000e-002	3.489661e-002	1.103390e-003
35	1.890000e+001	3.000000e-002	2.763033e-002	2.369665e-003
36	2.000000e+001	2.300000e-002	2.187706e-002	1.122935e-003
37	2.120000e+001	1.900000e-002	1.695798e-002	2.042023e-003
38	2.240000e+001	1.700000e-002	1.314495e-002	3.855047e-003
39	2.380000e+001	1.500000e-002	9.765808e-003	5.234192e-003
40	2.520000e+001	1.100000e-002	7.255333e-003	3.744667e-003
41	2.670000e+001	8.000000e-003	5.277018e-003	2.722982e-003
42	2.820000e+001	8.000000e-003	3.838131e-003	4.161869e-003
43	2.980000e+001	8.000000e-003	2.732959e-003	5.267041e-003
44	3.150000e+001	6.000000e-003	1.905147e-003	4.094853e-003
45	3.330000e+001	6.000000e-003	1.300188e-003	4.699812e-003
46	3.520000e+001	6.000000e-003	8.686916e-004	5.131308e-003
47	3.730000e+001	5.000000e-003	5.562748e-004	4.443725e-003
48	3.950000e+001	5.000000e-003	3.487347e-004	4.651265e-003
49	4.180000e+001	5.000000e-003	2.140342e-004	4.785966e-003
50	4.430000e+001	5.000000e-003	1.259027e-004	4.874097e-003
51	4.690000e+001	6.000000e-003	7.250522e-005	5.927495e-003
52	4.970000e+001	6.000000e-003	4.001913e-005	5.959981e-003
53	5.260000e+001	6.000000e-003	2.162460e-005	5.978375e-003
54	5.570000e+001	6.000000e-003	1.119934e-005	5.988801e-003
55	5.900000e+001	6.000000e-003	5.559059e-006	5.994441e-003
56	6.250000e+001	5.000000e-003	2.644686e-006	4.997355e-003
57	6.620000e+001	7.000000e-003	1.205900e-006	6.998794e-003
58	7.010000e+001	5.000000e-003	5.270023e-007	4.999473e-003
59	7.430000e+001	4.000000e-003	2.161026e-007	3.999784e-003
60	7.870000e+001	6.000000e-003	8.493205e-008	5.999915e-003
61	8.340000e+001	6.000000e-003	3.132056e-008	5.999969e-003
62	8.840000e+001	6.000000e-003	1.083761e-008	5.999989e-003
63	9.370000e+001	8.000000e-003	3.518714e-009	7.999996e-003
64	9.930000e+001	7.000000e-003	1.071965e-009	6.999999e-003
65	1.052000e+002	7.000000e-003	3.064245e-010	7.000000e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 58

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 6 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.09324 ft
Hydraulic Conductivity	
Calculated Value	= 0.00043066 ft/sec
Aquifer Thickness	
Fixed Value	= 6 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
Selected Value = None

Kz/Kr
Fixed Value = 1

Effective Casing Inner Diameter
Calculated Value = 0.17 ft

Effective Screen Inner Diameter
Calculated Value = 0.17 ft

A
Calculated Value = 3.63129

B
Calculated Value = 0.586641

C
Calculated Value = 3.33749

Linear Regression Slope
Fixed Value = -0.218653 ft/sec

Linear Regression Intercept
Fixed Value = 1.09324 ft

ANALYSIS STATISTICS

Regression Line

Slope: -0.218653 ft/sec
Intercept: 1.093239 ft

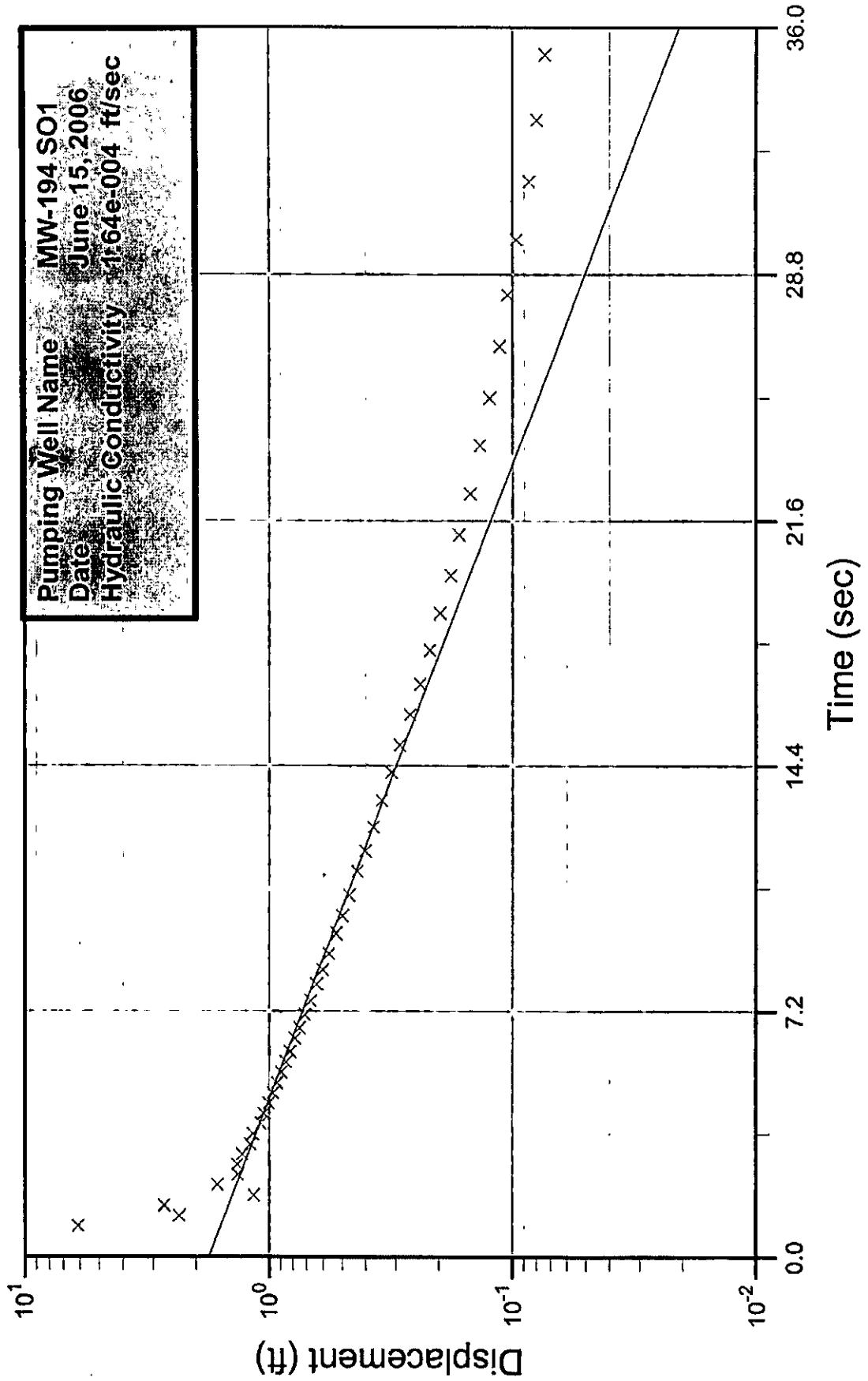
Residual Mean = -0.034451
Residual Standard Dev. = 0.208645
Residual Sum of Squares = 2.593733
Absolute Residual Mean = 0.058621
Minimum Residual = -1.093239
Maximum Residual = 0.482175

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	0.000000e+000	0.000000e+000	1.093239e+000	-1.093239e+000
1	3.000000e-001	-1.000000e-002	1.023828e+000	-
1.033828e+000				
2	6.000000e-001	1.441000e+000	9.588247e-001	4.821753e-001
3	9.000000e-001	5.970000e-001	8.979481e-001	-3.009481e-001
4	1.200000e+000	8.540000e-001	8.409367e-001	1.306333e-002
5	1.500000e+000	7.990000e-001	7.875449e-001	1.145508e-002
6	1.800000e+000	7.590000e-001	7.375431e-001	2.145694e-002
7	2.100000e+000	7.000000e-001	6.907159e-001	9.284143e-003

8	2.400000e+000	6.680000e-001	6.468618e-001	2.113825e-002
9	2.700000e+000	6.040000e-001	6.057920e-001	-1.791978e-003
10	3.000000e+000	5.870000e-001	5.673298e-001	1.967024e-002
11	3.300000e+000	5.210000e-001	5.313095e-001	-1.030954e-002
12	3.600000e+000	5.130000e-001	4.975763e-001	1.542373e-002
13	3.900000e+000	4.600000e-001	4.659847e-001	-5.984748e-003
14	4.200000e+000	4.380000e-001	4.363990e-001	1.600999e-003
15	4.500000e+000	3.910000e-001	4.086917e-001	-1.769168e-002
16	4.800000e+000	3.830000e-001	3.827435e-001	2.564864e-004
17	5.100000e+000	3.450000e-001	3.584428e-001	-1.344282e-002
18	5.400000e+000	3.170000e-001	3.356850e-001	-1.868500e-002
19	5.700000e+000	2.950000e-001	3.143721e-001	-1.937209e-002
20	6.000000e+000	2.770000e-001	2.944123e-001	-1.741235e-002
21	6.400000e+000	2.540000e-001	2.697566e-001	-1.575660e-002
22	6.700000e+000	2.340000e-001	2.526295e-001	-1.862954e-002
23	7.100000e+000	2.140000e-001	2.314729e-001	-1.747292e-002
24	7.500000e+000	1.940000e-001	2.120881e-001	-1.808808e-002
25	8.000000e+000	1.760000e-001	1.901237e-001	-1.412373e-002
26	8.400000e+000	1.550000e-001	1.742017e-001	-1.920170e-002
27	8.900000e+000	1.390000e-001	1.561610e-001	-1.716096e-002
28	9.500000e+000	1.230000e-001	1.369609e-001	-1.396089e-002
29	1.000000e+001	1.120000e-001	1.227769e-001	-1.077689e-002
30	1.060000e+001	1.000000e-001	1.076814e-001	-7.681408e-003
31	1.130000e+001	8.800000e-002	9.239933e-002	-4.399332e-003
32	1.190000e+001	7.600000e-002	8.103879e-002	-5.038786e-003
33	1.260000e+001	6.600000e-002	6.953781e-002	-3.537814e-003
34	1.340000e+001	5.800000e-002	5.837853e-002	-3.785300e-004
35	1.420000e+001	4.900000e-002	4.901006e-002	-1.006486e-005
36	1.500000e+001	4.100000e-002	4.114503e-002	-1.450315e-004
37	1.590000e+001	3.500000e-002	3.379508e-002	1.204915e-003
38	1.680000e+001	3.100000e-002	2.775810e-002	3.241904e-003
39	1.780000e+001	2.500000e-002	2.230642e-002	2.693582e-003
40	1.890000e+001	2.100000e-002	1.753775e-002	3.462245e-003
41	2.000000e+001	1.700000e-002	1.378854e-002	3.211464e-003
42	2.120000e+001	1.400000e-002	1.060636e-002	3.393640e-003
43	2.240000e+001	1.200000e-002	8.158579e-003	3.841421e-003
44	2.380000e+001	1.000000e-002	6.007181e-003	3.992819e-003
45	2.520000e+001	1.000000e-002	4.423102e-003	5.576898e-003
46	2.670000e+001	1.000000e-002	3.186304e-003	6.813696e-003
47	2.820000e+001	8.000000e-003	2.295342e-003	5.704658e-003
48	2.980000e+001	8.000000e-003	1.617751e-003	6.382249e-003
49	3.150000e+001	8.000000e-003	1.115527e-003	6.884473e-003
50	3.330000e+001	6.000000e-003	7.525792e-004	5.247421e-003
51	3.520000e+001	8.000000e-003	4.967393e-004	7.503261e-003
52	3.730000e+001	8.000000e-003	3.138433e-004	7.686157e-003
53	3.950000e+001	6.000000e-003	1.939997e-004	5.806000e-003
54	4.180000e+001	6.000000e-003	1.173258e-004	5.882674e-003
55	4.430000e+001	5.000000e-003	6.791941e-005	4.932081e-003
56	4.690000e+001	5.000000e-003	3.846788e-005	4.961532e-003
57	4.970000e+001	7.000000e-003	2.085502e-005	6.979145e-003

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 49

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 10 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.77408 ft
Hydraulic Conductivity Calculated Value	= 0.000164365 ft/sec
Aquifer Thickness Fixed Value	= 10 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.78096

B
 Calculated Value = 0.812488

C
 Calculated Value = 4.74486

Linear Regression Slope
 Fixed Value = -0.123326 ft/sec

Linear Regression Intercept
 Fixed Value = 1.77408 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.123326 ft/sec
 Intercept: 1.774080 ft

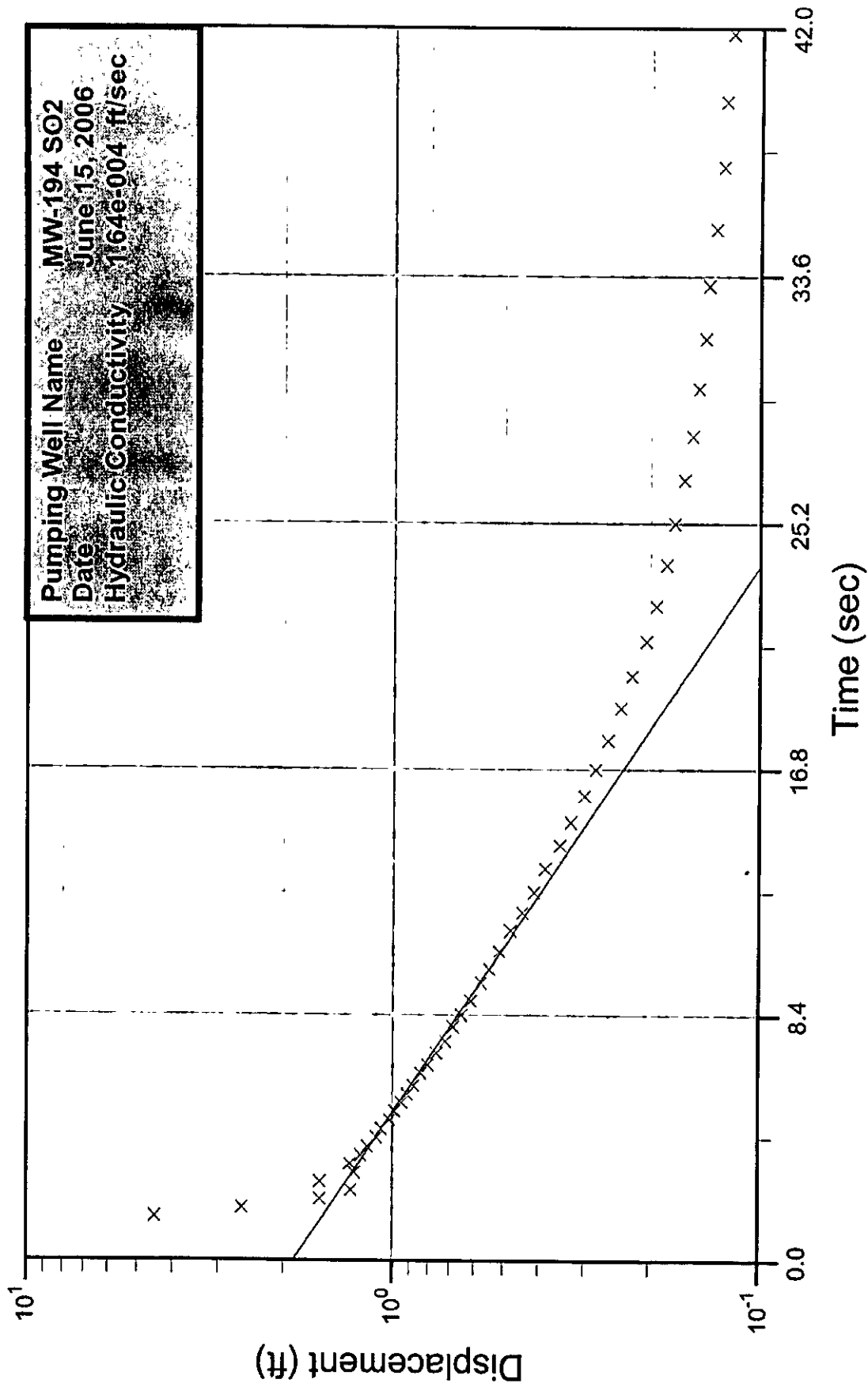
Residual Mean = 0.144230
 Residual Standard Dev. = 0.665465
 Residual Sum of Squares = 22.718634
 Absolute Residual Mean = 0.169107
 Minimum Residual = -0.260907
 Maximum Residual = 4.509296

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	9.000000e-001	6.097000e+000	1.587704e+000	4.509296e+000
1	1.200000e+000	2.350000e+000	1.530036e+000	8.199643e-001
2	1.500000e+000	2.709000e+000	1.474462e+000	1.234538e+000
3	1.800000e+000	1.160000e+000	1.420907e+000	-2.609074e-001
4	2.100000e+000	1.639000e+000	1.369298e+000	2.697023e-001
5	2.400000e+000	1.355000e+000	1.319563e+000	3.543744e-002
6	2.700000e+000	1.361000e+000	1.271634e+000	8.936611e-002
7	3.000000e+000	1.300000e+000	1.225446e+000	7.455394e-002
8	3.300000e+000	1.205000e+000	1.180936e+000	2.406415e-002

9	3.600000e+000	1.172000e+000	1.138042e+000	3.395767e-002
10	3.900000e+000	1.088000e+000	1.096707e+000	-8.706767e-003
11	4.200000e+000	1.059000e+000	1.056873e+000	2.127419e-003
12	4.500000e+000	1.007000e+000	1.018485e+000	-1.148524e-002
13	4.800000e+000	9.690000e-001	9.814922e-001	-1.249218e-002
14	5.100000e+000	9.300000e-001	9.458428e-001	-1.584278e-002
15	5.400000e+000	8.920000e-001	9.114882e-001	-1.948822e-002
16	5.700000e+000	8.570000e-001	8.783815e-001	-2.138148e-002
17	6.000000e+000	8.230000e-001	8.464772e-001	-2.347722e-002
18	6.400000e+000	7.870000e-001	8.057335e-001	-1.873350e-002
19	6.700000e+000	7.500000e-001	7.764679e-001	-2.646794e-002
20	7.100000e+000	7.140000e-001	7.390940e-001	-2.509399e-002
21	7.500000e+000	6.750000e-001	7.035190e-001	-2.851897e-002
22	8.000000e+000	6.390000e-001	6.614484e-001	-2.244843e-002
23	8.400000e+000	6.030000e-001	6.296108e-001	-2.661075e-002
24	8.900000e+000	5.680000e-001	5.919599e-001	-2.395994e-002
25	9.500000e+000	5.300000e-001	5.497390e-001	-1.973898e-002
26	1.000000e+001	4.990000e-001	5.168645e-001	-1.786451e-002
27	1.060000e+001	4.680000e-001	4.799997e-001	-1.199965e-002
28	1.130000e+001	4.340000e-001	4.403005e-001	-6.300496e-003
29	1.190000e+001	4.030000e-001	4.088965e-001	-5.896497e-003
30	1.260000e+001	3.730000e-001	3.750780e-001	-2.078042e-003
31	1.340000e+001	3.440000e-001	3.398396e-001	4.160444e-003
32	1.420000e+001	3.140000e-001	3.079117e-001	6.088284e-003
33	1.500000e+001	2.900000e-001	2.789835e-001	1.101651e-002
34	1.590000e+001	2.630000e-001	2.496749e-001	1.332514e-002
35	1.680000e+001	2.390000e-001	2.234453e-001	1.555474e-002
36	1.780000e+001	2.180000e-001	1.975202e-001	2.047981e-002
37	1.890000e+001	1.980000e-001	1.724630e-001	2.553702e-002
38	2.000000e+001	1.790000e-001	1.505845e-001	2.841549e-002
39	2.120000e+001	1.650000e-001	1.298700e-001	3.513004e-002
40	2.240000e+001	1.490000e-001	1.120049e-001	3.699507e-002
41	2.380000e+001	1.360000e-001	9.424399e-002	4.175601e-002
42	2.520000e+001	1.240000e-001	7.929945e-002	4.470055e-002
43	2.670000e+001	1.130000e-001	6.590687e-002	4.709313e-002
44	2.820000e+001	1.050000e-001	5.477612e-002	5.022388e-002
45	2.980000e+001	9.700000e-002	4.496720e-002	5.203280e-002
46	3.150000e+001	8.600000e-002	3.646233e-002	4.953767e-002
47	3.330000e+001	8.000000e-002	2.920364e-002	5.079636e-002
48	3.520000e+001	7.400000e-002	2.310329e-002	5.089671e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 50

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter	
Fixed Value	= 0.17 ft
Screen Inner Diameter	
Fixed Value	= 0.17 ft
Diameter of Drilled Hole	
Fixed Value	= 0.5 ft
Screen Length	
Fixed Value	= 10 ft
Depth to Screen Top	
Fixed Value	= 0 ft
Initial Displacement	
Fixed Value	= 1.87441 ft
Hydraulic Conductivity	
Calculated Value	= 0.000164303 ft/sec
Aquifer Thickness	
Fixed Value	= 10 ft
Gravel Pack Porosity	
Fixed Value	= 0.3
Calculation Type	
Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 4.78096

B
 Calculated Value = 0.812488

C
 Calculated Value = 4.74486

Linear Regression Slope
 Fixed Value = -0.123279 ft/sec

Linear Regression Intercept
 Fixed Value = 1.87441 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.123279 ft/sec
 Intercept: 1.874411 ft

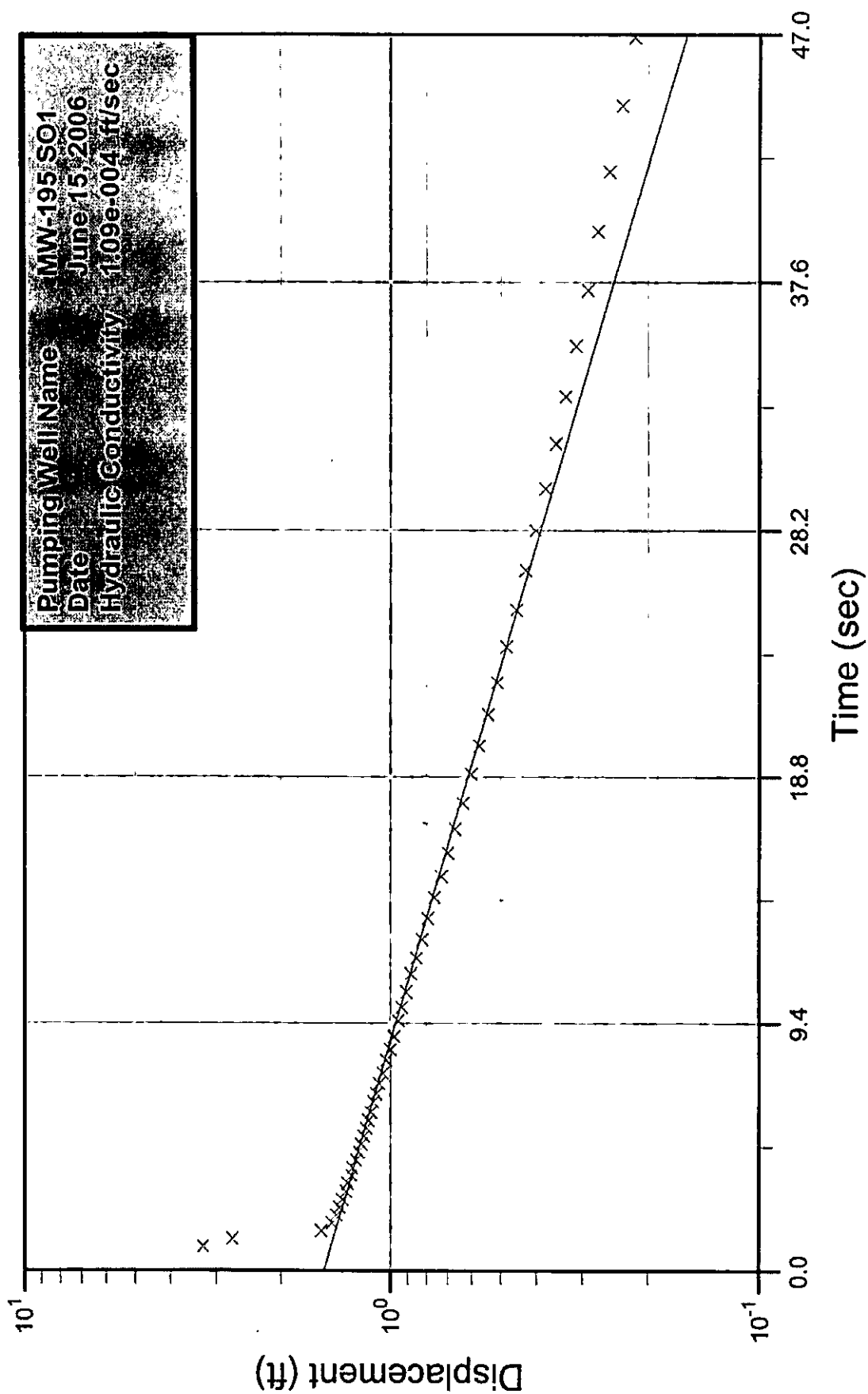
Residual Mean = 0.116693
 Residual Standard Dev. = 0.430245
 Residual Sum of Squares = 9.936411
 Absolute Residual Mean = 0.129083
 Minimum Residual = -0.088346
 Maximum Residual = 2.920041

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	1.500000e+000	4.478000e+000	1.557959e+000	2.920041e+000
1	1.800000e+000	2.585000e+000	1.501392e+000	1.083608e+000
2	2.100000e+000	1.589000e+000	1.446880e+000	1.421203e-001
3	2.400000e+000	1.306000e+000	1.394346e+000	-8.834633e-002
4	2.700000e+000	1.587000e+000	1.343720e+000	2.432797e-001
5	3.000000e+000	1.278000e+000	1.294932e+000	-1.693242e-002
6	3.300000e+000	1.316000e+000	1.247916e+000	6.808407e-002
7	3.600000e+000	1.230000e+000	1.202607e+000	2.739349e-002
8	3.900000e+000	1.177000e+000	1.158942e+000	1.805780e-002

9	4.200000e+000	1.108000e+000	1.116863e+000	-8.863248e-003
10	4.500000e+000	1.076000e+000	1.076312e+000	-3.121031e-004
11	4.800000e+000	1.020000e+000	1.037233e+000	-1.723329e-002
12	5.100000e+000	9.890000e-001	9.995734e-001	-1.057336e-002
13	5.400000e+000	9.470000e-001	9.632808e-001	-1.628078e-002
14	5.700000e+000	9.140000e-001	9.283059e-001	-1.430592e-002
15	6.000000e+000	8.780000e-001	8.946009e-001	-1.660093e-002
16	6.400000e+000	8.400000e-001	8.515568e-001	-1.155684e-002
17	6.700000e+000	8.030000e-001	8.206385e-001	-1.763846e-002
18	7.100000e+000	7.610000e-001	7.811531e-001	-2.015311e-002
19	7.500000e+000	7.190000e-001	7.435676e-001	-2.456761e-002
20	8.000000e+000	6.860000e-001	6.991186e-001	-1.311857e-002
21	8.400000e+000	6.500000e-001	6.654802e-001	-1.548019e-002
22	8.900000e+000	6.140000e-001	6.256991e-001	-1.169907e-002
23	9.500000e+000	5.750000e-001	5.810881e-001	-6.088066e-003
24	1.000000e+001	5.470000e-001	5.463517e-001	6.482613e-004
25	1.060000e+001	5.140000e-001	5.073980e-001	6.601969e-003
26	1.130000e+001	4.790000e-001	4.654481e-001	1.355186e-002
27	1.190000e+001	4.450000e-001	4.322627e-001	1.273731e-002
28	1.260000e+001	4.140000e-001	3.965247e-001	1.747528e-002
29	1.340000e+001	3.860000e-001	3.592848e-001	2.671518e-002
30	1.420000e+001	3.520000e-001	3.255423e-001	2.645767e-002
31	1.500000e+001	3.290000e-001	2.949688e-001	3.403121e-002
32	1.590000e+001	3.010000e-001	2.639920e-001	3.700802e-002
33	1.680000e+001	2.810000e-001	2.362683e-001	4.473173e-002
34	1.780000e+001	2.600000e-001	2.088652e-001	5.113477e-002
35	1.890000e+001	2.400000e-001	1.823782e-001	5.762178e-002
36	2.000000e+001	2.240000e-001	1.592501e-001	6.474987e-002
37	2.120000e+001	2.050000e-001	1.373513e-001	6.764873e-002
38	2.240000e+001	1.930000e-001	1.184638e-001	7.453622e-002
39	2.380000e+001	1.810000e-001	9.968519e-002	8.131481e-002
40	2.520000e+001	1.720000e-001	8.388333e-002	8.811667e-002
41	2.670000e+001	1.620000e-001	6.972151e-002	9.227849e-002
42	2.820000e+001	1.540000e-001	5.795060e-002	9.604940e-002
43	2.980000e+001	1.480000e-001	4.757679e-002	1.004232e-001
44	3.150000e+001	1.420000e-001	3.858144e-002	1.034186e-001
45	3.330000e+001	1.390000e-001	3.090350e-002	1.080965e-001
46	3.520000e+001	1.330000e-001	2.445024e-002	1.085498e-001
47	3.730000e+001	1.270000e-001	1.887342e-002	1.081266e-001
48	3.950000e+001	1.250000e-001	1.439012e-002	1.106099e-001
49	4.180000e+001	1.200000e-001	1.083737e-002	1.091626e-001

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 57

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 5 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.52757 ft
Hydraulic Conductivity Calculated Value	= 0.000109026 ft/sec
Aquifer Thickness Fixed Value	= 5 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
Selected Value = None

Kz/Kr
Fixed Value = 1

Effective Casing Inner Diameter
Calculated Value = 0.17 ft

Effective Screen Inner Diameter
Calculated Value = 0.17 ft

A
Calculated Value = 3.29956

B
Calculated Value = 0.5265

C
Calculated Value = 2.98783

Linear Regression Slope
Fixed Value = -0.0484033 ft/sec

Linear Regression Intercept
Fixed Value = 1.52757 ft

ANALYSIS STATISTICS

Regression Line

Slope: -0.048403 ft/sec
Intercept: 1.527566 ft

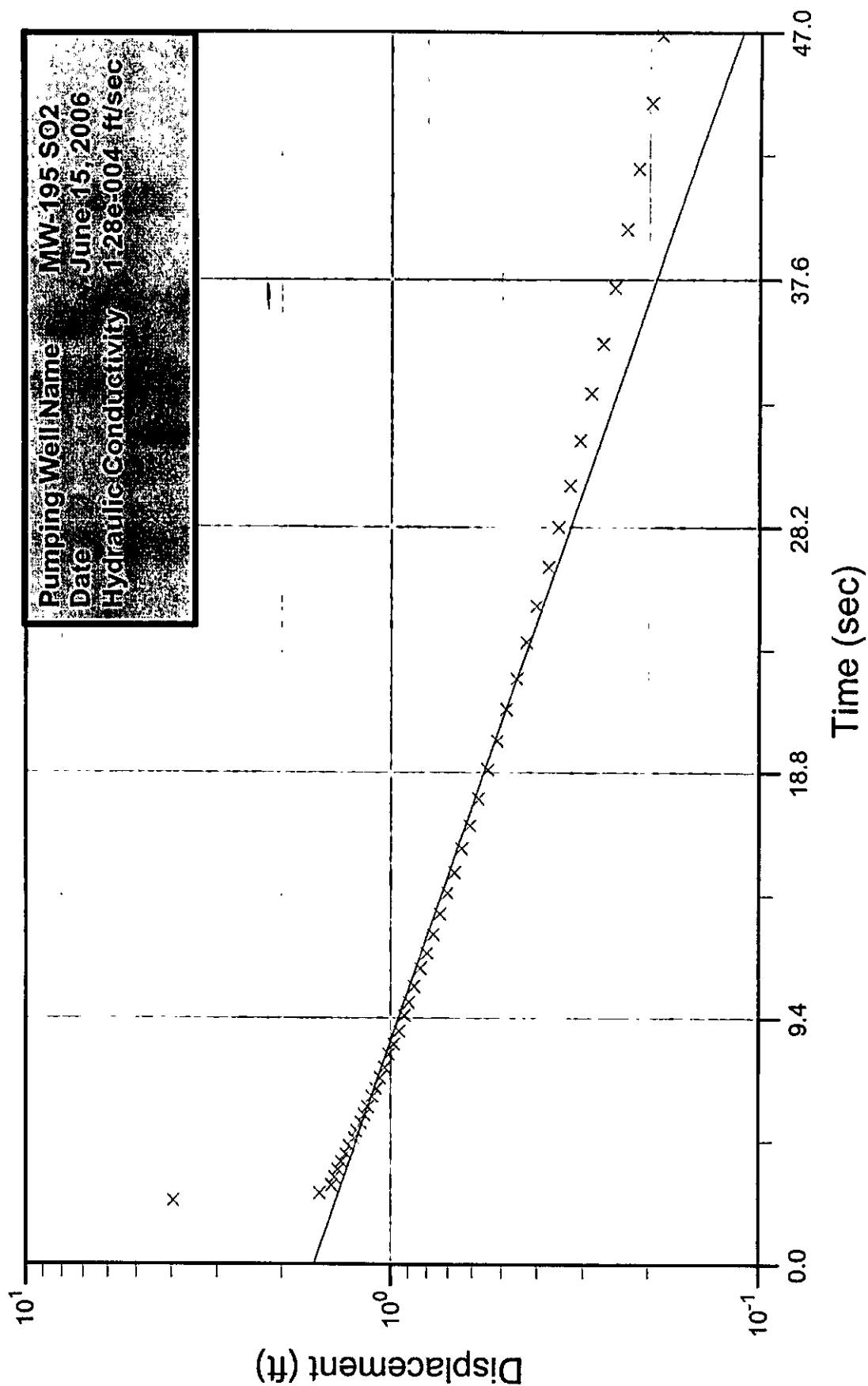
Residual Mean = -0.018434
Residual Standard Dev. = 0.453598
Residual Sum of Squares = 11.747162
Absolute Residual Mean = 0.149914
Minimum Residual = -1.527566
Maximum Residual = 1.794551

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	0.000000e+000	0.000000e+000	1.527566e+000	-1.527566e+000
1	3.000000e-001	-1.000000e-002	1.505545e+000	-
1.515545e+000				
2	6.000000e-001	-1.200000e-002	1.483841e+000	-
1.495841e+000				
3	9.000000e-001	3.257000e+000	1.462449e+000	1.794551e+000
4	1.200000e+000	2.713000e+000	1.441367e+000	1.271633e+000
5	1.500000e+000	1.554000e+000	1.420588e+000	1.334122e-001
6	1.800000e+000	1.453000e+000	1.400109e+000	5.289147e-002

7	2.100000e+000	1.411000e+000	1.379924e+000	3.107552e-002
8	2.400000e+000	1.386000e+000	1.360031e+000	2.596860e-002
9	2.700000e+000	1.360000e+000	1.340425e+000	1.957490e-002
10	3.000000e+000	1.332000e+000	1.321101e+000	1.089855e-002
11	3.300000e+000	1.316000e+000	1.302056e+000	1.394363e-002
12	3.600000e+000	1.283000e+000	1.283286e+000	-2.858460e-004
13	3.900000e+000	1.275000e+000	1.264786e+000	1.021408e-002
14	4.200000e+000	1.247000e+000	1.246553e+000	4.473156e-004
15	4.500000e+000	1.223000e+000	1.228582e+000	-5.582303e-003
16	4.800000e+000	1.203000e+000	1.210871e+000	-7.870984e-003
17	5.100000e+000	1.184000e+000	1.193415e+000	-9.414992e-003
18	5.400000e+000	1.166000e+000	1.176211e+000	-1.021065e-002
19	5.700000e+000	1.150000e+000	1.159254e+000	-9.254321e-003
20	6.000000e+000	1.134000e+000	1.142542e+000	-8.542438e-003
21	6.400000e+000	1.115000e+000	1.120634e+000	-5.634090e-003
22	6.700000e+000	1.095000e+000	1.104479e+000	-9.478959e-003
23	7.100000e+000	1.075000e+000	1.083300e+000	-8.300481e-003
24	7.500000e+000	1.051000e+000	1.062528e+000	-1.152810e-002
25	8.000000e+000	1.029000e+000	1.037122e+000	-8.121858e-003
26	8.400000e+000	1.002000e+000	1.017235e+000	-1.523496e-002
27	8.900000e+000	9.800000e-001	9.929117e-001	-1.291172e-002
28	9.500000e+000	9.530000e-001	9.644903e-001	-1.149032e-002
29	1.000000e+001	9.330000e-001	9.414283e-001	-8.428267e-003
30	1.060000e+001	9.070000e-001	9.144805e-001	-7.480540e-003
31	1.130000e+001	8.800000e-001	8.840149e-001	-4.014878e-003
32	1.190000e+001	8.500000e-001	8.587106e-001	-8.710570e-003
33	1.260000e+001	8.210000e-001	8.301029e-001	-9.102869e-003
34	1.340000e+001	7.910000e-001	7.985735e-001	-7.573499e-003
35	1.420000e+001	7.600000e-001	7.682417e-001	-8.241692e-003
36	1.500000e+001	7.270000e-001	7.390620e-001	-1.206196e-002
37	1.590000e+001	6.970000e-001	7.075574e-001	-1.055744e-002
38	1.680000e+001	6.660000e-001	6.773959e-001	-1.139588e-002
39	1.780000e+001	6.340000e-001	6.453886e-001	-1.138858e-002
40	1.890000e+001	6.030000e-001	6.119245e-001	-8.924543e-003
41	2.000000e+001	5.730000e-001	5.801956e-001	-7.195650e-003
42	2.120000e+001	5.420000e-001	5.474556e-001	-5.455642e-003
43	2.240000e+001	5.120000e-001	5.165631e-001	-4.563129e-003
44	2.380000e+001	4.830000e-001	4.827181e-001	2.818627e-004
45	2.520000e+001	4.540000e-001	4.510907e-001	2.909345e-003
46	2.670000e+001	4.280000e-001	4.195000e-001	8.500049e-003
47	2.820000e+001	4.020000e-001	3.901216e-001	1.187840e-002
48	2.980000e+001	3.790000e-001	3.610488e-001	1.795116e-002
49	3.150000e+001	3.550000e-001	3.325292e-001	2.247080e-002
50	3.330000e+001	3.340000e-001	3.047835e-001	2.921647e-002
51	3.520000e+001	3.130000e-001	2.780040e-001	3.499599e-002
52	3.730000e+001	2.910000e-001	2.511345e-001	3.986550e-002
53	3.950000e+001	2.730000e-001	2.257665e-001	4.723346e-002
54	4.180000e+001	2.540000e-001	2.019811e-001	5.201894e-002
55	4.430000e+001	2.350000e-001	1.789606e-001	5.603939e-002
56	4.690000e+001	2.170000e-001	1.577982e-001	5.920177e-002

Bouwer & Rice



AQUIFERWIN32 ANALYSIS SUMMARY FILE

Selected Analysis: Bouwer & Rice, 1976 (Unconfined Aquifer)

Slug test for determining hydraulic conductivity of unconfined aquifers
with completely or partially penetrating wells

AQUIFER TEST INFORMATION

Test Designator:
Job Number:
Date: June 15, 2006
Area Name: Memphis Depot
Additional Info:

ANALYSIS SUMMARY

Simple Analysis - No Wells Defined

Number of Points = 49

Manual Match

ANALYSIS PARAMETERS

Casing Inner Diameter Fixed Value	= 0.17 ft
Screen Inner Diameter Fixed Value	= 0.17 ft
Diameter of Drilled Hole Fixed Value	= 0.5 ft
Screen Length Fixed Value	= 5 ft
Depth to Screen Top Fixed Value	= 0 ft
Initial Displacement Fixed Value	= 1.63067 ft
Hydraulic Conductivity Calculated Value	= 0.000128447 ft/sec
Aquifer Thickness Fixed Value	= 5 ft
Gravel Pack Porosity Fixed Value	= 0.3
Calculation Type Selected Value	= Isotropic

Correction Type
 Selected Value = None

Kz/Kr
 Fixed Value = 1

Effective Casing Inner Diameter
 Calculated Value = 0.17 ft

Effective Screen Inner Diameter
 Calculated Value = 0.17 ft

A
 Calculated Value = 3.29956

B
 Calculated Value = 0.5265

C
 Calculated Value = 2.98783

Linear Regression Slope
 Fixed Value = -0.0570257 ft/sec

Linear Regression Intercept
 Fixed Value = 1.63067 ft

ANALYSIS STATISTICS

Regression Line
 Slope: -0.057026 ft/sec
 Intercept: 1.630666 ft

Residual Mean = 0.066905
 Residual Standard Dev. = 0.358451
 Residual Sum of Squares = 6.515200
 Absolute Residual Mean = 0.084990
 Minimum Residual = -0.031630
 Maximum Residual = 2.532911

DATA DETAIL

Index	Time (sec)	Obs. Displacement (ft)	Calc. Displacement (ft)	Residual
0	2.400000e+000	3.955000e+000	1.422089e+000	2.532911e+000
1	2.700000e+000	1.575000e+000	1.397967e+000	1.770330e-001
2	3.000000e+000	1.461000e+000	1.374254e+000	8.674563e-002
3	3.300000e+000	1.433000e+000	1.350944e+000	8.205602e-002
4	3.600000e+000	1.401000e+000	1.328029e+000	7.297102e-002
5	3.900000e+000	1.373000e+000	1.305503e+000	6.749733e-002
6	4.200000e+000	1.333000e+000	1.283358e+000	4.964154e-002
7	4.500000e+000	1.304000e+000	1.261590e+000	4.241013e-002
8	4.800000e+000	1.266000e+000	1.240191e+000	2.580949e-002

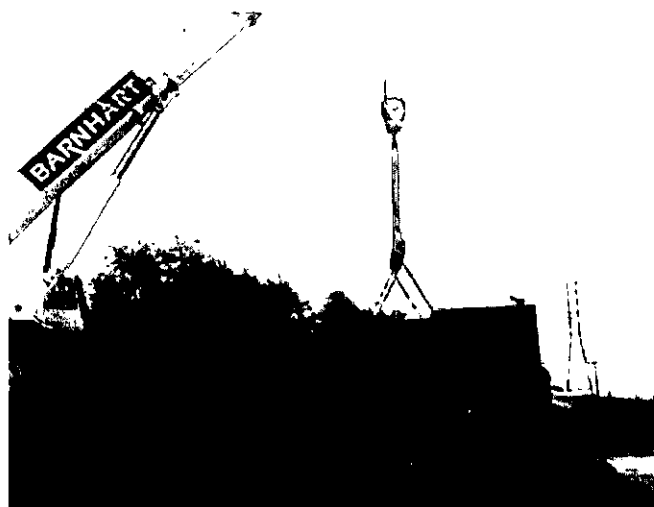
9	5.100000e+000	1.246000e+000	1.219154e+000	2.684586e-002
10	5.400000e+000	1.211000e+000	1.198475e+000	1.252541e-002
11	5.700000e+000	1.181000e+000	1.178146e+000	2.854191e-003
12	6.000000e+000	1.157000e+000	1.158162e+000	-1.161851e-003
13	6.400000e+000	1.127000e+000	1.132043e+000	-5.042866e-003
14	6.700000e+000	1.098000e+000	1.112841e+000	-1.484092e-002
15	7.100000e+000	1.072000e+000	1.087744e+000	-1.574401e-002
16	7.500000e+000	1.042000e+000	1.063213e+000	-2.121310e-002
17	8.000000e+000	1.013000e+000	1.033326e+000	-2.032596e-002
18	8.400000e+000	9.830000e-001	1.010022e+000	-2.702229e-002
19	8.900000e+000	9.500000e-001	9.816304e-001	-3.163035e-002
20	9.500000e+000	9.200000e-001	9.486115e-001	-2.861154e-002
21	1.000000e+001	8.940000e-001	9.219459e-001	-2.794588e-002
22	1.060000e+001	8.630000e-001	8.909347e-001	-2.793465e-002
23	1.130000e+001	8.310000e-001	8.560708e-001	-2.507079e-002
24	1.190000e+001	7.980000e-001	8.272754e-001	-2.927539e-002
25	1.260000e+001	7.660000e-001	7.949026e-001	-2.890263e-002
26	1.340000e+001	7.350000e-001	7.594535e-001	-2.445347e-002
27	1.420000e+001	7.010000e-001	7.255852e-001	-2.458518e-002
28	1.500000e+001	6.700000e-001	6.932273e-001	-2.322727e-002
29	1.590000e+001	6.400000e-001	6.585462e-001	-1.854624e-002
30	1.680000e+001	6.100000e-001	6.256003e-001	-1.560025e-002
31	1.780000e+001	5.770000e-001	5.909231e-001	-1.392309e-002
32	1.890000e+001	5.450000e-001	5.549941e-001	-9.994149e-003
33	2.000000e+001	5.140000e-001	5.212497e-001	-7.249740e-003
34	2.120000e+001	4.860000e-001	4.867732e-001	-7.732478e-004
35	2.240000e+001	4.550000e-001	4.545771e-001	4.229005e-004
36	2.380000e+001	4.290000e-001	4.196964e-001	9.303630e-003
37	2.520000e+001	4.030000e-001	3.874921e-001	1.550788e-002
38	2.670000e+001	3.740000e-001	3.557246e-001	1.827537e-002
39	2.820000e+001	3.520000e-001	3.265615e-001	2.543849e-002
40	2.980000e+001	3.280000e-001	2.980846e-001	2.991545e-002
41	3.150000e+001	3.080000e-001	2.705436e-001	3.745635e-002
42	3.330000e+001	2.870000e-001	2.441511e-001	4.284894e-002
43	3.520000e+001	2.670000e-001	2.190803e-001	4.791971e-002
44	3.730000e+001	2.480000e-001	1.943546e-001	5.364542e-002
45	3.950000e+001	2.300000e-001	1.714390e-001	5.856098e-002
46	4.180000e+001	2.140000e-001	1.503654e-001	6.363458e-002
47	4.430000e+001	1.970000e-001	1.303866e-001	6.661336e-002
48	4.690000e+001	1.850000e-001	1.124195e-001	7.258051e-002

ATTACHMENT C

Photographs



Crane used to position large equipment.



Crane placing high-pressure, extended-duty triplex pump.



Connex boxes, which housed much of HBI's equipment.



ZVI PRB location before columns were installed.



Vibrating hopper; part of the non-pumping tremie pipe system. Not used during implementation.



Triplex pump, biopolymer slurry mixing and storage system, and HBI's Connex boxes (l to r)



ZVI in 3,000 pound supersacks.



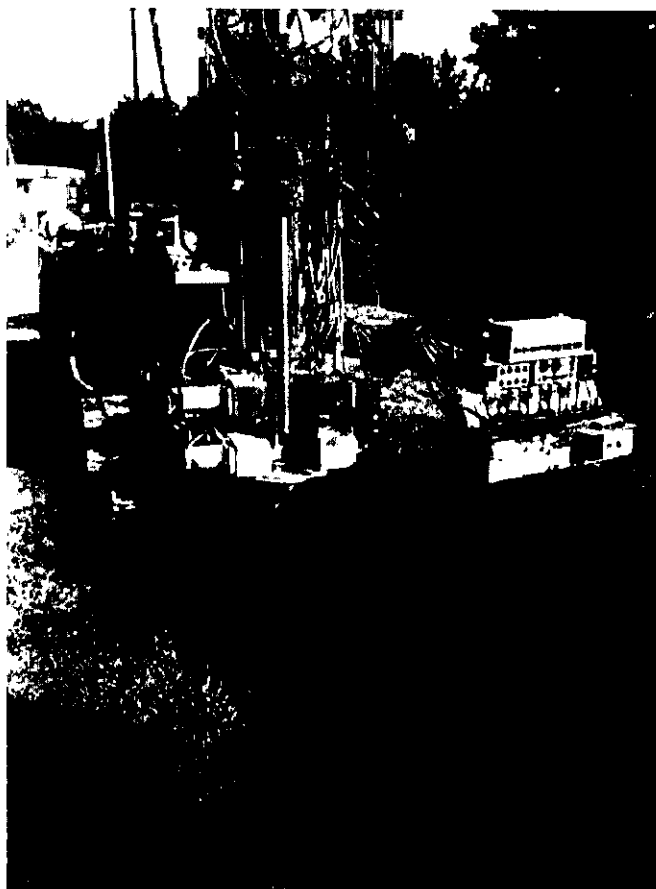
Covered ZVI supersacks.



Air rotary track mounted drill rig. Sand in foreground.



Air rotary track mounted drill rig in test column area.



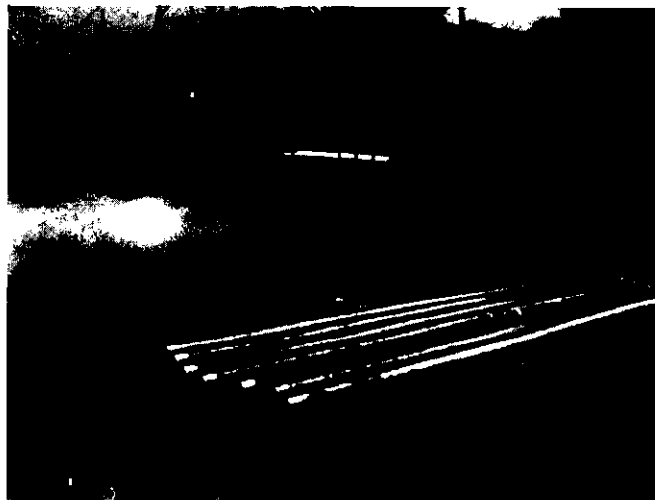
Air rotary track mounted drill rig with jetting spoils containment.



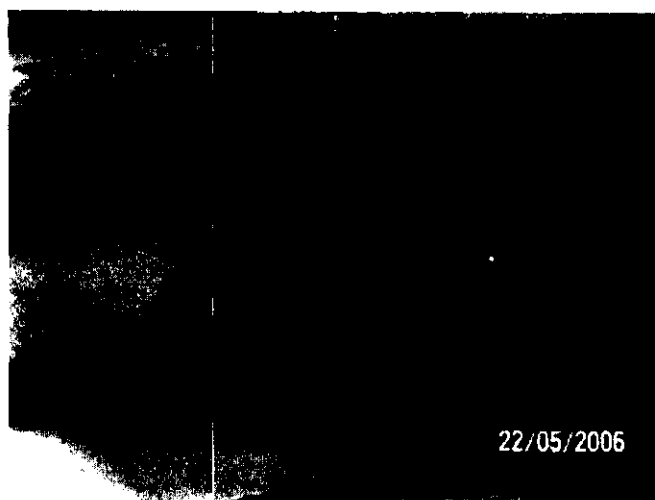
Drill bit with jet nozzle.



Jetting test at 1,000 psi.



Jetting test at 6,000 psi.



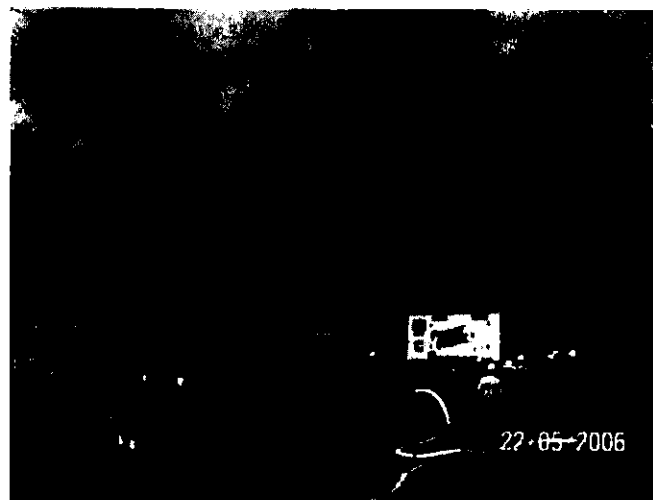
Biopolymer slurry in storage tank.



Air rotary track mounted drill rig with jetting spoils containment.



Spoils accumulation during jetting.



Jetting operation.



Jetting operation.



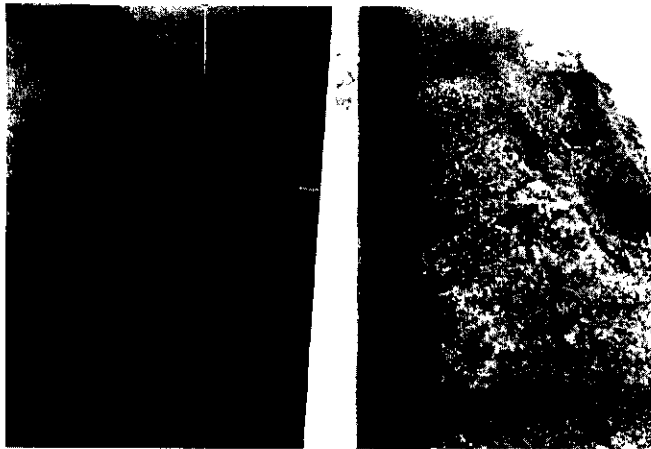
Cemen tech concrete dispenser and Reed C50 concrete pump. Used to inject ZVI/sand/guar mix into jetted columns.



Placement of ZVI in cemen tech concrete dispenser.



Placement of ZVI in cemen tech concrete dispenser.



ZVI and sand hoppers in the cemen tech concrete dispenser.



ZVI and sand gates at the bottom of their respective hoppers in the cemen tech concrete dispenser.



Cemen tech concrete dispenser and Reed C50 concrete pump. Auger is used to convey and mix ZVI, iron, and guar.



Discharge of cemen tech concrete dispenser to Reed C50 concrete pump.



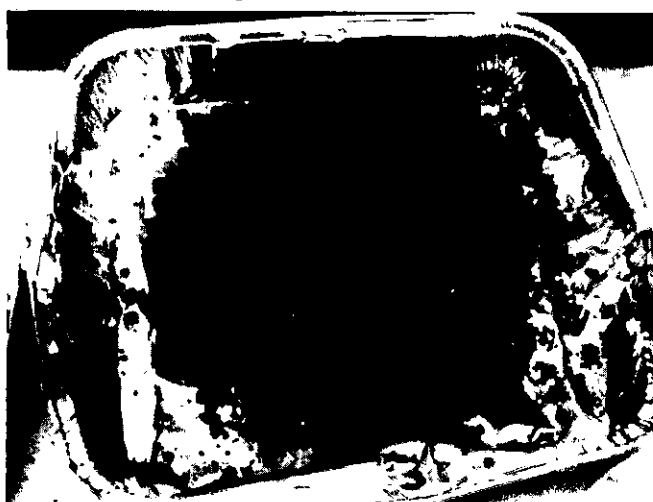
Blended ZVI, sand, and guar.



Blended ZVI, sand, and guar.



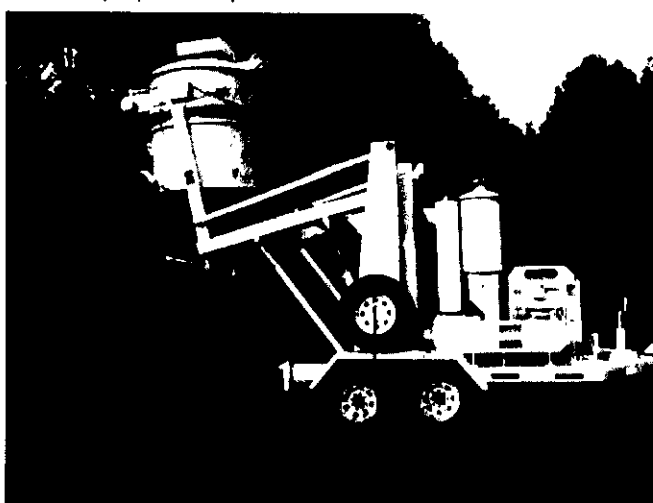
Magnetic separation test station.



Dried sample prior to separation of ZVI and sand.



Displaced formation materials and guar during injection of ZVI, sand, and guar mixture.



Hurricane 500E vacuum trailer used to collect jetting and injection spoils and transfer them to the lined roll-off containers.



Jetting and injection spoils in lined roll-off container.



Location on Dunn Field where jetting and injection spoils were stored and characterized.

ATTACHMENT D

Example Calculations

M_i = MASS OF IRON (lb) M_s = MASS OF SAND (lb) V_i = VOLUME OF IRON (ft^3) V_s = VOLUME OF SAND (ft^3) M_t = TOTAL MASS (lb) M_v = TOTAL VOLUME (ft^3) ρ_i = DENSITY OF IRON (150 lb/ ft^3) ρ_s = DENSITY OF SAND (104.6 lb/ ft^3)KNOWN V_t, P_i, P_s, P_v $\rightarrow$ FROM STABLE COUNTS $\rightarrow$ FROM MAGNETIC SEPARATION TEST P_i = PERCENTAGE OF IRON FROM MAGNETIC SEPARATION TEST (MASS) P_s = PERCENTAGE OF SAND (MASS)

$$P_i = \frac{M_i}{M_i + M_s}$$

$$M_i = P_i (M_i + M_s)$$

$$M_i = P_i (M_v) + P_i (M_s)$$

$$M_i - P_i (M_i) = P_i (M_s)$$

$$\frac{M_i (1 - P_i)}{P_i} = M_s$$

$$V_t = V_s + V_i$$

$$V_s = M_s / \rho_s$$

$$V_i = M_i / \rho_i$$

$$V_t = M_s / \rho_s + M_i / \rho_i$$

$$V_t = \frac{M_i (1 - P_i)}{P_i \rho_s} + \frac{M_i}{\rho_i}$$

$$V_t = \frac{M_i}{\rho_s P_i} - \frac{M_i}{\rho_s} + \frac{M_i}{\rho_i}$$

$$V_t = M_i \left[\frac{1}{\rho_s P_i} - \frac{1}{\rho_s} + \frac{1}{\rho_i} \right]$$

$$M_i = \frac{V_t}{\left[\frac{1}{\rho_s P_i} - \frac{1}{\rho_s} + \frac{1}{\rho_i} \right]}$$

$$V_i = M_i / \rho_i$$

$$V_s = V_t - V_i$$

$$M_s = V_s \rho_s$$

$$P_s = \frac{M_s}{(M_s + M_i)} \times 100$$

Example: Calculate M_i

$$V_0 = 216.7 \text{ ft}^3$$

$$P_0 = 104.6 \text{ lb/ft}^3$$

$$P_i = 150 \text{ lb/ft}^3$$

$$P_i = 40.4 \% \text{ by mass}$$

$$M_i = \frac{216.7 \text{ ft}^3}{\left[\frac{1}{(104.6 \text{ lb/ft}^3)(0.427)} - \frac{1}{(104.6 \text{ lb/ft}^3)} + \frac{1}{150 \text{ lb/ft}^3} \right]}$$

$$M_i = \frac{216.7 \text{ ft}^3}{(0.022 \text{ ft}^3/\text{lb}) - (0.0096 \text{ ft}^3/\text{lb}) + (0.0067 \text{ ft}^3/\text{lb})}$$

$$M_i = 11,155 \text{ lb} = 5.6 \text{ tons}$$

$$V_i = (5.6 \text{ tons})(2000 \text{ lb/ton}) / 150 \text{ lb/ft}^3$$

$$V_i = 74.1 \text{ ft}^3$$

$$V_s = 216.7 \text{ ft}^3 - 74.1 \text{ ft}^3$$

$$V_s = 142.6 \text{ ft}^3$$

$$M_s = (142.6 \text{ ft}^3)(104.6 \text{ lb/ft}^3)$$

$$M_s = 14,916 \text{ lb} = 7.5 \text{ tons}$$

$$P_s = (7.5 \text{ tons}) / (5.6 \text{ tons} + 7.5 \text{ tons}) \times 100$$

$$P_s = 57.3 \%$$

ATTACHMENT E

Waste Characterization Data

I

Attachment E-1

Jetting Spoils Characterization Data

Memphis Depot Dunn Field ZVI PRB Implementation Study

Analysis Method	Parameter	Units	IDW-2-052606	IDW-4-052606	IDW-6-052606
E7.3.3	REACTIVE CYANIDE	mg/kg	6.37 U	6.02 U	5.73 U
E7.3.4	REACTIVE SULFIDE	mg/kg	63.7 U	60.2 U	57.3 U
SW1010	IGNITABILITY	degrees C	64.0 =	62.0 =	79.0 =
SW9045C	CORROSIONITY	units	5.81 =	6.17 =	6.30 =
SW6010B	ARSENIC	mg/L	0.100 U	0.100 U	0.100 U
SW6010B	BARIUM	mg/L	1.22 J	0.113 J	0.0548 J
SW6010B	CADMIUM	mg/L	0.0250 U	0.0250 U	0.0250 U
SW6010B	CHROMIUM, TOTAL	mg/L	0.0254 J	0.0630 J	0.0802 J
SW6010B	LEAD	mg/L	0.100 U	0.100 U	0.100 U
SW6010B	SELENIUM	mg/L	0.500 U	0.500 U	0.500 U
SW6010B	SILVER	mg/L	0.0500 U	0.0500 U	0.0500 U
SW7470A	MERCURY	mg/L	0.00100 U	0.00100 U	0.00100 U
SW8081A	CHLORDANE	ug/L	3.00 U	3.00 U	3.00 U
SW8081A	ENDRIN	ug/L	0.100 U	0.100 U	0.100 U
SW8081A	GAMMA BHC (LINDANE)	ug/L	0.100 U	0.100 U	0.100 U
SW8081A	HEPTACHLOR EPOXIDE	ug/L	0.100 U	0.100 U	0.100 U
SW8081A	HEPTACHLOR	ug/L	0.100 U	0.100 U	0.100 U
SW8081A	METHOXYCHLOR	ug/L	0.100 U	0.100 U	0.100 U
SW8081A	TOXAPHENE	ug/L	3.00 U	3.00 U	3.00 U
SW8151A	2,4-D (DICHLOROPHENOXYACETIC ACID)	ug/L	10.0 U	10.0 U	10.0 U
SW8151A	SILVEX (2,4,5-TP)	ug/L	1.00 U	1.00 U	1.00 U
SW8260B	1,1-DICHLOROETHENE	ug/L	5.00 U	5.00 U	5.00 U
SW8260B	1,2-DICHLOROETHANE	ug/L	2.50 U	2.50 U	2.50 U
SW8260B	BENZENE	ug/L	1.25 U	1.25 U	1.25 U
SW8260B	CARBON TETRACHLORIDE	ug/L	2.50 U	2.50 U	2.50 U
SW8260B	CHLOROBENZENE	ug/L	1.25 U	1.25 U	1.25 U
SW8260B	CHLOROFORM	ug/L	1.25 U	1.25 U	1.25 U
SW8260B	METHYL ETHYL KETONE (2-BUTANONE)	ug/L	25.0 U	25.0 U	25.0 U
SW8260B	TETRACHLOROETHYLENE (PCE)	ug/L	2.50 U	2.50 U	2.50 U
SW8260B	TRICHLOROETHYLENE (TCE)	ug/L	2.50 U	2.50 U	2.50 U
SW8260B	VINYL CHLORIDE	ug/L	2.50 U	2.50 U	2.50 U

Attachment E-1**Jetting Spoils Characterization Data****Memphis Depot Dunn Field ZVI PRB Implementation Study**

Analysis Method	Parameter	Units	IDW-2-052606	IDW-4-052606	IDW-6-052606
SW8270C	1,4-DICHLOROBENZENE	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	2,4,5-TRICHLOROPHENOL	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	2,4,6-TRICHLOROPHENOL	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	2,4-DINITROTOLUENE	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	2-METHYLPHENOL (o-CRESOL)	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	HEXACHLOROBENZENE	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	HEXACHLOROBUTADIENE	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	HEXACHLOROETHANE	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	m & p CRESOLS,	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	NITROBENZENE	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	PENTACHLOROPHENOL	ug/L	25.0 U	25.0 U	25.0 U
SW8270C	PYRIDINE	ug/L	250 U	250 U	250 U

Note: Detections are bold.

Attachment E-2

Jetting Spoils Characterization Data

Memphis Depot Dunn Field ZVI PRB Implementation Study

Analysis Method	Parameter	Units	IDW-1-052606	IDW-1-052606DL	IDW-2-052606	IDW-2-052606DL
SW6010B	ALUMINUM	mg/kg	6660 =	--	--	--
SW6010B	ANTIMONY	mg/kg	0.0577 U	--	0.0634 U	--
SW6010B	ARSENIC	mg/kg	1.86 =	--	8.31 =	--
SW6010B	BARIUM	mg/kg	86.5 =	--	--	--
SW6010B	BERYLLIUM	mg/kg	0.204 J	--	--	--
SW6010B	CADMIUM	mg/kg	0.0458 U	--	--	--
SW6010B	CALCIUM	mg/kg	--	68000 =	--	--
SW6010B	CHROMIUM, TOTAL	mg/kg	12.5 =	--	--	--
SW6010B	COBALT	mg/kg	2.30 =	--	--	--
SW6010B	COPPER	mg/kg	15.9 =	--	--	--
SW6010B	IRON	mg/kg	7090 =	--	--	30400 =
SW6010B	LEAD	mg/kg	7.80 =	--	31.0 =	--
SW6010B	MAGNESIUM	mg/kg	3500 =	--	--	--
SW6010B	MANGANESE	mg/kg	124 =	--	--	557 =
SW6010B	MERCURY	mg/kg	0.0115 U	--	--	--
SW6010B	NICKEL	mg/kg	8.98 =	--	--	--
SW6010B	POTASSIUM	mg/kg	754 =	--	--	--
SW6010B	SELENIUM	mg/kg	0.224 J	--	0.503 =	--
SW6010B	SILVER	mg/kg	0.229 U	--	--	--
SW6010B	SODIUM	mg/kg	176 =	--	--	--
SW6010B	THALLIUM	mg/kg	0.0248 =	--	0.240 =	--
SW6010B	VANADIUM	mg/kg	18.1 =	--	--	--
SW6010B	ZINC	mg/kg	72.3 =	--	--	--

Attachment E-2

Jetting Spoils Characterization Data

Memphis Depot Dunn Field ZVI PRB Implementation Study

Analysis Method	Parameter	Units	IDW-2-052606RE	IDW-3-052606	IDW-4-052606	IDW-4-052606RE
SW6010B	ALUMINUM	mg/kg	15600 =	498 =	--	939 =
SW6010B	ANTIMONY	mg/kg	--	0.140 =	0.0547 U	--
SW6010B	ARSENIC	mg/kg	--	2.34 =	1.90 =	--
SW6010B	BARIUM	mg/kg	122 =	2.38 =	--	4.78 =
SW6010B	BERYLLIUM	mg/kg	0.617 =	0.118 J	--	0.138 J
SW6010B	CADMIUM	mg/kg	0.0439 U	0.0852 U	--	0.0430 U
SW6010B	CALCIUM	mg/kg	2410 =	810 =	--	419 =
SW6010B	CHROMIUM, TOTAL	mg/kg	29.0 =	139 =	--	53.2 =
SW6010B	COBALT	mg/kg	9.02 =	4.48 =	--	2.38 =
SW6010B	COPPER	mg/kg	46.2 =	173 =	--	383 =
SW6010B	IRON	mg/kg	--	53800 =	--	23200 =
SW6010B	LEAD	mg/kg	--	0.862 =	1.29 =	--
SW6010B	MAGNESIUM	mg/kg	2430 =	26.3 J	--	82.8 =
SW6010B	MANGANESE	mg/kg	--	278 =	--	117 =
SW6010B	MERCURY	mg/kg	0.0357 J	0.0105 U	--	0.0116 U
SW6010B	NICKEL	mg/kg	28.4 =	107 =	--	37.5 =
SW6010B	POTASSIUM	mg/kg	1330 =	42.6 U	--	60.7 =
SW6010B	SELENIUM	mg/kg	--	0.102 U	0.109 U	--
SW6010B	SILVER	mg/kg	0.841 J	1.94 J	--	0.926 J
SW6010B	SODIUM	mg/kg	49.0 =	14.1 J	--	12.7 J
SW6010B	THALLIUM	mg/kg	--	0.0102 U	0.0109 U	--
SW6010B	VANADIUM	mg/kg	35.8 =	13.3 =	--	7.84 =
SW6010B	ZINC	mg/kg	129 =	15.2 =	--	26.0 =

Attachment E-2

Jetting Spoils Characterization Data

Memphis Depot Dunn Field ZVI PRB Implementation Study

Analysis Method	Parameter	Units	IDW-5-052606	IDW-6-052606	IDW-6-052606RE	IDW-7-052606
SW6010B	ALUMINIUM	mg/kg	615 =	--	456 =	2460 =
SW6010B	ANTIMONY	mg/kg	0.0514 U	0.0546 U	--	0.0533 U
SW6010B	ARSENIC	mg/kg	0.734 =	0.564 =	--	1.22 =
SW6010B	BARIUM	mg/kg	3.84 =	--	2.16 =	10.5 =
SW6010B	BERYLLIUM	mg/kg	0.109 J	--	0.0791 J	0.288 J
SW6010B	CADMIUM	mg/kg	0.0415 U	--	0.0395 U	0.0387 U
SW6010B	CALCIUM	mg/kg	140 =	--	161 =	601 =
SW6010B	CHROMIUM, TOTAL	mg/kg	15.2 =	--	16.7 =	36.3 =
SW6010B	COBALT	mg/kg	4.27 =	--	1.04 =	2.35 =
SW6010B	COPPER	mg/kg	17.4 =	--	21.0 =	28.1 =
SW6010B	IRON	mg/kg	7850 =	--	8830 =	16200 =
SW6010B	LEAD	mg/kg	0.392 =	0.488 =	--	1.33 =
SW6010B	MAGNESIUM	mg/kg	23.1 =	--	23.1 =	221 =
SW6010B	MANGANESE	mg/kg	55.2 =	--	39.8 =	82.8 =
SW6010B	MERCURY	mg/kg	0.0108 U	--	0.0107 U	0.0109 U
SW6010B	NICKEL	mg/kg	15.8 =	--	26.1 =	11.7 =
SW6010B	POTASSIUM	mg/kg	38.8 J	--	35.2 J	150 =
SW6010B	SELENIUM	mg/kg	0.103 U	0.109 U	--	0.107 U
SW6010B	SILVER	mg/kg	0.297 J	--	0.331 J	0.619 J
SW6010B	SODIUM	mg/kg	8.64 J	--	7.13 J	14.6 J
SW6010B	THALLIUM	mg/kg	0.0103 U	0.0109 U	--	0.0107 U
SW6010B	VANADIUM	mg/kg	4.33 =	--	3.41 =	16.5 =
SW6010B	ZINC	mg/kg	5.64 =	--	4.44 =	17.4 =



ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, TN 38133 (901)213-2400 FAX (901)213-2440

www.etcmemphis.com

"A Laboratory Management Partner"

929 402

April 11, 2006

Ms. Jenny Caldwell
Prosonic Corporation
3737 Cherry Road
Memphis, TN 38118

Ref: Analytical Testing
Lab Order Number 0603A53
Project Description Special
Site Memphis, TN
Project Number 1856917

Environmental Testing and Consulting, Inc. received 2 sample(s) on 3/31/2006 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in our laboratory in accordance with Standard Methods, The Solid Waste Manual SW-846, EPA Methods for Chemical Analysis of Water and Wastes and/or 40 CFR part 136.

The EPA requires that analysis for pH, dissolved oxygen and total residual chlorine be analyzed in the field. Analyses and results reported which do not indicate "Field" for these parameters were analyzed outside the holding time as specified in Table II of 40 CFR Part 136.3.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, instrumentation maintenance and calibration were performed in accordance with guidelines established by the USEPA, NELAP, and USACE.

The results are shown on the attached analysis sheet(s).

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Connie Bradberry
Laboratory Project Manager

Attachment
PROSONIC

Certifications

Alabama #40750	Louisiana #04015	Florida #E87943	California #05240CA
Arkansas #88-0650	Mississippi	Pennsylvania #68-3195	Texas #T104704180-05-TX
Illinois #200015	Oklahoma #9311	USDA #S-46279	U.S. Army Corps of Engineers
Kentucky #90047	Tennessee #02027	EPA #TN00012	
Kentucky UST #41	Virginia #00106	NELAP #04015	





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Prosonic Corporation
3737 Cherry Road

Memphis, TN 38118

Lab Order Number **0603A53**

Project **Special**
Description

Project No. **1856917**

Site **Memphis, TN**

Lab ID **0603A53-001**

Field ID **IDW**

Received **03/31/06**

Matrix **Aqueous**

Sampled **03/29/06 16:00**

Test	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method
Silver	< 0.0050	mg/L	0.0050	1	04/05/06 03:44	JTR	6010B
Aluminum	0.336	mg/L	0.100	1	04/05/06 03:44	JTR	6010B
Arsenic	< 0.0100	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Barium	0.136	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Beryllium	< 0.0010	mg/L	0.0010	1	04/05/06 03:44	JTR	6010B
Calcium	16.3	mg/L	0.100	1	04/05/06 03:44	JTR	6010B
Cadmium	< 0.0020	mg/L	0.0020	1	04/05/06 03:44	JTR	6010B
Cobalt	< 0.0100	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Chromium	< 0.0050	mg/L	0.0050	1	04/05/06 03:44	JTR	6010B
Copper	< 0.0050	mg/L	0.0050	1	04/05/06 03:44	JTR	6010B
Iron	1.44	mg/L	0.100	1	04/05/06 03:44	JTR	6010B
Potassium	0.912	mg/L	0.100	1	04/05/06 03:44	JTR	6010B
Magnesium	8.53	mg/L	0.100	1	04/05/06 03:44	JTR	6010B
Manganese	0.273	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Sodium	15.9	mg/L	1.00	2	04/04/06 20:34	JTR	6010B
Nickel	< 0.0050	mg/L	0.0050	1	04/05/06 03:44	JTR	6010B
Lead	< 0.0060	mg/L	0.0060	1	04/05/06 03:44	JTR	6010B
Antimony	< 0.0100	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Selenium	< 0.0100	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Thallium	< 0.0200	mg/L	0.0200	1	04/05/06 03:44	JTR	6010B
Vanadium	< 0.0100	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Zinc	0.0273	mg/L	0.0100	1	04/05/06 03:44	JTR	6010B
Mercury	< 0.00020	mg/L	0.00020	1	04/11/06 13:12	KS	7470A

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)



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3737 Cherry Road

Memphis, TN 38118

Lab Order Number **0603A53**

Project **Special**
Description

Project No. **1856917**

Site **Memphis, TN**

Lab ID **0603A53-002**

Field ID **IDW**

Received **03/31/06**

Matrix **Soil**

Sampled **03/29/06 16:30**

Test	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method
Silver	< 0.500	mg/Kg	0.500	1	04/05/06 13:09	JTR	6010B
Aluminum	2,260	mg/Kg	10.0	1	04/05/06 13:09	JTR	6010B
Arsenic	2.80	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Barium	16.9	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Beryllium	0.292	mg/Kg	0.100	1	04/05/06 13:09	JTR	6010B
Calcium	320 B	mg/Kg	10.0	1	04/05/06 13:09	JTR	6010B
Cadmium	< 0.200	mg/Kg	0.200	1	04/05/06 13:09	JTR	6010B
Cobalt	3.16	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Chromium	11.7	mg/Kg	0.500	1	04/05/06 13:09	JTR	6010B
Copper	4.77	mg/Kg	0.500	1	04/05/06 13:09	JTR	6010B
Iron	11,600	mg/Kg	100	10	04/05/06 15:54	JTR	6010B
Potassium	154	mg/Kg	10.0	1	04/05/06 13:09	JTR	6010B
Magnesium	289	mg/Kg	10.0	1	04/05/06 13:09	JTR	6010B
Manganese	121	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Sodium	< 50.0	mg/Kg	50.0	1	04/05/06 13:09	JTR	6010B
Nickel	5.67	mg/Kg	0.500	1	04/05/06 13:09	JTR	6010B
Lead	2.89	mg/Kg	0.600	1	04/05/06 13:09	JTR	6010B
Antimony	< 1.00	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Selenium	< 1.00	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Thallium	< 2.00	mg/Kg	2.00	1	04/05/06 13:09	JTR	6010B
Vanadium	9.75	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Zinc	14.8	mg/Kg	1.00	1	04/05/06 13:09	JTR	6010B
Mercury	< 0.0200	mg/Kg	0.0200	1	04/03/06 11:23	KS	7471A

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)



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3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-001A

Field ID IDW

Project **Special**
Description

Project No. 1856917

Site **Memphis, TN**

Received 03/31/06

Matrix **Aqueous**

Sampled 03/29/06

GCMS Volatiles

Prep Method	5030B	Prep Batch	9488	Date/Time Prepped	04/01/06 09:42	Analytical Batch	14760	
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method	
Acetone	< 20.0	µg/L	20.0	1	04/01/06 13:54	VS	8260B	
Acetonitrile	< 50.0	µg/L	50.0	1	04/01/06 13:54	VS	8260B	
Acrolein	< 20.0	µg/L	20.0	1	04/01/06 13:54	VS	8260B	
Acrylonitrile	< 20.0	µg/L	20.0	1	04/01/06 13:54	VS	8260B	
Benzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Bromobenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Bromochloromethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Bromodichloromethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Bromoform	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Bromomethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
n-Butylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
sec-Butylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
tert-Butylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
2-Butanone (MEK)	< 20.0	µg/L	20.0	1	04/01/06 13:54	VS	8260B	
Carbon disulfide	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Carbon tetrachloride	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Chlorobenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Chlorodibromomethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Chloroethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
2-Chloroethyl vinyl ether	< 5.00	µg/L	5.00	1	04/01/06 13:54	VS	8260B	
Chloroform	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Chloromethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
2-Chlorotoluene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
4-Chlorotoluene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
1,2-Dibromo-3-chloropropane	< 5.00	µg/L	5.00	1	04/01/06 13:54	VS	8260B	
1,2-Dibromoethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
Dibromomethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
1,2-Dichlorobenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	
1,3-Dichlorobenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B	

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits

B Analyte detected in the associated Method Blank

E Value exceeds method calibration range

J Estimated Value Analyte below reported detection limit

MDL Method Detection Limit (unadjusted)

MRL Method Reporting Limit

* I Recoveries affected by interferences or high background

DF Dilution Factor

H Prepped / Analyzed out of holding time.

M Minimum value.

MQL Method Quantitation Limit (adjusted)

SQL Sample Quantitation Limit (adjusted MDL)

04/11/06 PROSONIC



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Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-001A

Field ID IDW

Project Special

Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Aqueous

Sampled 03/29/06

GCMS Volatiles

Prep Method	5030B	Prep Batch	9488	Date/Time Prepped	04/01/06 09:42	Analytical Batch	14760
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method
1,4-Dichlorobenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Dichlorodifluoromethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,1-Dichloroethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,2-Dichloroethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,1-Dichloroethene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
cis-1,2-Dichloroethene	3.47	µg/L	1.00	1	04/01/06 13:54	VS	8260B
trans-1,2-Dichloroethene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,2-Dichloropropane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,3-Dichloropropane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
2,2-Dichloropropane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,1-Dichloropropene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
cis-1,3-Dichloropropene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
trans-1,3-Dichloropropene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Ethyl acetate	< 10.0	µg/L	10.0	1	04/01/06 13:54	VS	8260B
Ethylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Hexachlorobutadiene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
2-Hexanone	< 5.00	µg/L	5.00	1	04/01/06 13:54	VS	8260B
Iodomethane	< 5.00	µg/L	5.00	1	04/01/06 13:54	VS	8260B
Isopropylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
4-Isopropyltoluene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Methylene chloride	< 10.0	µg/L	10.0	1	04/01/06 13:54	VS	8260B
4-Methyl-2-pentanone	< 5.00	µg/L	5.00	1	04/01/06 13:54	VS	8260B
Methyl tert-butyl ether	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Naphthalene	< 5.00	µg/L	5.00	1	04/01/06 13:54	VS	8260B
n-Propylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Styrene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,1,1,2-Tetrachloroethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,1,2,2-Tetrachloroethane	57.7	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Tetrachloroethene	1.86	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Toluene	< 5.00	µg/L	5.00	1	04/01/06 13:54	VS	8260B

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)

04/11/06 PROSONIC



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3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-001A

Field ID IDW

Project Special

Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Aqueous

Sampled 03/29/06

GCMS Volatiles

Prep Method	5030B	Prep Batch	9488	Date/Time Prepped	04/01/06 09:42	Analytical Batch	14760
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method
1,2,3-Trichlorobenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,2,4-Trichlorobenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,1,1-Trichloroethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,1,2-Trichloroethane	2.46	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Trichloroethene	122	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Trichlorofluoromethane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,2,3-Trichloropropane	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,2,4-Trimethylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
1,3,5-Trimethylbenzene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Vinyl acetate	< 10.0	µg/L	10.0	1	04/01/06 13:54	VS	8260B
Vinyl chloride	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
m,p-Xylene	< 2.00	µg/L	2.00	1	04/01/06 13:54	VS	8260B
o-Xylene	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Xylenes, Total	< 1.00	µg/L	1.00	1	04/01/06 13:54	VS	8260B
Surrogate: Dibromofluoromethane			126 % *		Limits: 80-124		
Surrogate: Toluene-d8			111 %		Limits: 80-120		
Surrogate: 4-Bromofluorobenzene			118 %		Limits: 75-120		
Surrogate: 1,2-Dichloroethane-d4			121 %		Limits: 78-124		

Qualifiers/ Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

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3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-001B

Field ID IDW

Project Special

Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Aqueous

Sampled 03/29/06

GCMS Semi-Volatiles

Prep Method	625	Prep Batch	9504	Date/Time Prepped	04/03/06 15 45	Analytical Batch	14822	
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method	
Acenaphthene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Acenaphthylene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Acetophenone	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Aniline	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Anthracene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Benzidine	< 20.6	µg/L	20.6	1	04/04/06 18:38	EDS	8270C	
Benzo(a)anthracene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Benzo(b)fluoranthene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Benzo(k)fluoranthene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Benzo(g,h,i)perylene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Benzo(a)pyrene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Benzoic acid	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C	
Benzyl alcohol	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C	
Bis(2-chloroethyl)ether	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Bis(2-chloroethoxy)methane	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Bis(2-chloroisopropyl)ether	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Bis(2-ethylhexyl)phthalate	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C	
4-Bromophenyl phenyl ether	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Butyl benzyl phthalate	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Carbazole	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
4-Chloroaniline	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
4-Chloro-3-methylphenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
2-Chloronaphthalene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
2-Chlorophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
4-Chlorophenyl phenyl ether	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Chrysene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Dibenz(a,h)anthracene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Dibenzofuran	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
1,2-Dichlorobenzene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	

Qualifiers/ * Surrogate Recovery outside accepted limits.
Definitions B Analyte detected in the associated Method Blank
 E Value exceeds method calibration range
 J Estimated Value Analyte below reported detection limit
 MDL Method Detection Limit (unadjusted)
 MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
 DF Dilution Factor
 H Prepped / Analyzed out of holding time.
 M Minimum value.
 MQL Method Quantitation Limit (adjusted)
 SQL Sample Quantitation Limit (adjusted MDL)

04/11/06 PROSONIC



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3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-001B

Field ID IDW

Project **Special**
Description

Project No. 1856917

Site **Memphis, TN**

Received 03/31/06

Matrix **Aqueous**

Sampled 03/29/06

GCMS Semi-Volatiles

Prep Method	625	Prep Batch	9504	Date/Time Prepped	04/03/06 15:45	Analytical Batch	14822	
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method	
1,3-Dichlorobenzene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
1,4-Dichlorobenzene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Di-n-butyl phthalate	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
3,3'-Dichlorobenzidine	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C	
2,4-Dichlorophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
2,6-Dichlorophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Diethyl phthalate	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
3,3'-Dimethylbenzidine	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C	
2,4-Dimethylphenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Dimethyl phthalate	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
4,6-Dinitro-2-methylphenol	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C	
2,4-Dinitrophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
2,4-Dinitrotoluene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
2,6-Dinitrotoluene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Di-n-octyl phthalate	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Fluoranthene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Fluorene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Hexachlorobenzene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Hexachlorobutadiene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Hexachlorocyclopentadiene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Hexachloroethane	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Indeno(1,2,3-cd)pyrene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
Isophorone	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
2-Methylnaphthalene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
2-Methylphenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
3&4-Methylphenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
Naphthalene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C	
2-Nitroaniline	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	
3-Nitroaniline	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C	
4-Nitroaniline	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C	

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

*1 Recoveries affected by interferences or high background
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

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Prosonic Corporation

3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-001B

Field ID IDW

Project Special

Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Aqueous

Sampled 03/29/06

GCMS Semi-Volatiles

Prep Method	625	Prep Batch	9504	Date/Time Prepped	04/03/06 15:45	Analytical Batch	14822		
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method		
Nitrobenzene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
2-Nitrophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
4-Nitrophenol	< 20.6	µg/L	20.6	1	04/04/06 18:38	EDS	8270C		
N-Nitroso-di-n-butylamine	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
N-Nitrosodiethylamine	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
N-Nitrosodimethylamine	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
N-Nitrosodiphenylamine	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C		
N-Nitrosodi-n-propylamine	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
Pentachlorophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
Phenanthrene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C		
Phenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
Pyrene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C		
Pyridine	< 10.3	µg/L	10.3	1	04/04/06 18:38	EDS	8270C		
1,2,3,4-Tetrachlorobenzene	< 2.06	µg/L	2.06	1	04/04/06 18:38	EDS	8270C		
1,2,4,5-Tetrachlorobenzene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
2,3,4,6-Tetrachlorophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
1,2,4-Trichlorobenzene	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
2,4,5-Trichlorophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
2,4,6-Trichlorophenol	< 5.15	µg/L	5.15	1	04/04/06 18:38	EDS	8270C		
Surrogate: Nitrobenzene-d5			59 %	Limits: 29-110					
Surrogate: 2-Fluorobiphenyl			77 %	Limits: 38-107					
Surrogate: 4-Terphenyl-d14			102 %	Limits: 33-122					
Surrogate: Phenol-d6			21 %	Limits: 7-58					
Surrogate: 2,4,6-Tribromophenol			96 %	Limits: 16-138					
Surrogate: 2-Fluorophenol			36 %	Limits: 8-88					

Qualifiers/ Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

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3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-002A

Field ID IDW

Project **Special**
Description

Project No. 1856917

Site **Memphis, TN**

Received 03/31/06

Matrix **Soil**

Sampled 03/29/06

GCMS Volatiles

Prep Method	5030A	Prep Batch	9506	Date/Time Prepped	04/03/06 14:11	Analytical Batch	14798	
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method	
Acetone	< 53.1	µg/Kg-dry	53.1	1	04/03/06 19:16	LS	8260B	
Acetonitrile	< 133	µg/Kg-dry	133	1	04/03/06 19:16	LS	8260B	
Acrolein	< 53.1	µg/Kg-dry	53.1	1	04/03/06 19:16	LS	8260B	
Acrylonitrile	< 53.1	µg/Kg-dry	53.1	1	04/03/06 19:16	LS	8260B	
Benzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Bromobenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Bromochloromethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Bromodichloromethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Bromoform	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Bromomethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
n-Butylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
sec-Butylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
tert-Butylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
2-Butanone (MEK)	< 53.1	µg/Kg-dry	53.1	1	04/03/06 19:16	LS	8260B	
Carbon disulfide	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Carbon tetrachloride	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Chlorobenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Chlorodibromomethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Chloroethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Chloroform	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Chloromethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
2-Chlorotoluene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
4-Chlorotoluene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,2-Dibromo-3-chloropropane	< 13.3	µg/Kg-dry	13.3	1	04/03/06 19:16	LS	8260B	
1,2-Dibromoethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Dibromomethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,2-Dichlorobenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,3-Dichlorobenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,4-Dichlorobenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits

B Analyte detected in the associated Method Blank

E Value exceeds method calibration range

J Estimated Value Analyte below reported detection limit

MDL Method Detection Limit (unadjusted)

MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.

DF Dilution Factor

H Prepped / Analyzed out of holding time.

M Minimum value

MQL Method Quantitation Limit (adjusted)

SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

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3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-002A

Field ID IDW

Project Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Soil

Sampled 03/29/06

GCMS Volatiles

Prep Method	5030A	Prep Batch	9506	Date/Time Prepped	04/03/06 14:11	Analytical Batch	14798
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method
Dichlorodifluoromethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,1-Dichloroethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,2-Dichloroethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,1-Dichloroethene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
cis-1,2-Dichloroethene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
trans-1,2-Dichloroethene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,2-Dichloropropane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,3-Dichloropropane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
2,2-Dichloropropane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,1-Dichloropropene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
cis-1,3-Dichloropropene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
trans-1,3-Dichloropropene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
Ethyl acetate	< 53.1	µg/Kg-dry	53.1	1	04/03/06 19:16	LS	8260B
Ethylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
Hexachlorobutadiene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
2-Hexanone	< 13.3	µg/Kg-dry	13.3	1	04/03/06 19:16	LS	8260B
Iodomethane	< 13.3	µg/Kg-dry	13.3	1	04/03/06 19:16	LS	8260B
Isopropylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
4-Isopropyltoluene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
Methylene chloride	< 26.6	µg/Kg-dry	26.6	1	04/03/06 19:16	LS	8260B
4-Methyl-2-pentanone	< 13.3	µg/Kg-dry	13.3	1	04/03/06 19:16	LS	8260B
Methyl tert-butyl ether	< 13.3	µg/Kg-dry	13.3	1	04/03/06 19:16	LS	8260B
Naphthalene	< 13.3	µg/Kg-dry	13.3	1	04/03/06 19:16	LS	8260B
n-Propylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
Styrene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,1,1,2-Tetrachloroethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
1,1,2,2-Tetrachloroethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
Tetrachloroethene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B
Toluene	< 5.31	µg/Kg-dry	5.31	1	04/03/06 19:16	LS	8260B
1,2,3-Trichlorobenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

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Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-002A

Field ID IDW

Project Special

Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Soil

Sampled 03/29/06

GCMS Volatiles

Prep Method	5030A	Prep Batch	9506	Date/Time Prepped	04/03/06 14:11	Analytical Batch	14798	
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method	
1,2,4-Trichlorobenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,1,1-Trichloroethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,1,2-Trichloroethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Trichloroethene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Trichlorofluoromethane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,2,3-Trichloropropane	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,2,4-Trimethylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
1,3,5-Trimethylbenzene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Vinyl acetate	< 53.1	µg/Kg-dry	53.1	1	04/03/06 19:16	LS	8260B	
Vinyl chloride	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
m,p-Xylene	< 5.31	µg/Kg-dry	5.31	1	04/03/06 19:16	LS	8260B	
o-Xylene	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Xylenes, Total	< 2.66	µg/Kg-dry	2.66	1	04/03/06 19:16	LS	8260B	
Surrogate: Dibromofluoromethane			111 %	Limits: 79-125				
Surrogate: Toluene-d8			112 %	Limits: 84-117				
Surrogate: 4-Bromofluorobenzene			108 %	Limits: 52-135				
Surrogate: 1,2-Dichloroethane-d4			110 %	Limits: 48-136				

Qualifiers/ Definitions

- * Surrogate Recovery outside accepted limits.
- B Analyte detected in the associated Method Blank
- E Value exceeds method calibration range
- J Estimated Value Analyte below reported detection limit
- MDL Method Detection Limit (unadjusted)
- MRL Method Reporting Limit

- * I Recoveries affected by interferences or high background.

- DF Dilution Factor
- H Prepped / Analyzed out of holding time.
- M Minimum value.
- MQL Method Quantitation Limit (adjusted)
- SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

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Lab Order Number 0603A53

Lab ID 0603A53-002B

Field ID IDW

Project Special
Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Soil

Sampled 03/29/06

GCMS Semi-Volatiles

Prep Method	3550B	Prep Batch	9513	Date/Time Prepped	04/04/06 08:30	Analytical Batch	14822		
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method		
Acenaphthene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Acenaphthylene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Acetophenone	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Aniline	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Anthracene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Benzidine	< 890	µg/Kg-dry	890	1	04/04/06 21:12	EDS	8270C		
Benzo(a)anthracene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Benzo(b)fluoranthene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Benzo(k)fluoranthene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Benzo(g,h,i)perylene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Benzo(a)pyrene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Benzoic acid	< 438	µg/Kg-dry	438	1	04/04/06 21:12	EDS	8270C		
Benzyl alcohol	< 438	µg/Kg-dry	438	1	04/04/06 21:12	EDS	8270C		
Bis(2-chloroethyl)ether	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Bis(2-chloroethoxy)methane	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Bis(2-chloroisopropyl)ether	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Bis(2-ethylhexyl)phthalate	< 438	µg/Kg-dry	438	1	04/04/06 21:12	EDS	8270C		
4-Bromophenyl phenyl ether	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Butyl benzyl phthalate	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Carbazole	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
4-Chloroaniline	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
4-Chloro-3-methylphenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
2-Chloronaphthalene	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
2-Chlorophenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
4-Chlorophenyl phenyl ether	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
Chrysene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Dibenz(a,h)anthracene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C		
Dibenzofuran	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		
1,2-Dichlorobenzene	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C		

Qualifiers/
Definitions

* Surrogate Recovery outside accepted limits.
B Analyte detected in the associated Method Blank
E Value exceeds method calibration range
J Estimated Value Analyte below reported detection limit
MDL Method Detection Limit (unadjusted)
MRL Method Reporting Limit

* I Recoveries affected by interferences or high background.
DF Dilution Factor
H Prepped / Analyzed out of holding time.
M Minimum value.
MQL Method Quantitation Limit (adjusted)
SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

PROSONIC

2790 Whitter Road Memphis, TN 38133 (901)213-2400 FAX (901)213-2440
www.etcmeniphis.com

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Site **Memphis, TN**

Field ID	IDW

Prep Method	3550B	Prep Batch	9513	Date/Time	Prepped	04/04/06 08 30	Analytical Batch	14822	
Compound	Result	Units		MQL	DF	Date/Time Analyzed	By	Analytical Method	
1,3-Dichlorobenzene	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
1,4-Dichlorobenzene	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Di-n-butyl phthalate	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
3,3'-Dichlorobenzidine	< 438	µg/Kg-dry		438	1	04/04/06 21:12	EDS	8270C	
2,4-Dichlorophenol	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
2,6-Dichlorophenol	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Diethyl phthalate	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
3,3'-Dimethylbenzidine	< 438	µg/Kg-dry		438	1	04/04/06 21:12	EDS	8270C	
2,4-Dimethylphenol	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Dimethyl phthalate	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
4,6-Dinitro-2-methylphenol	< 438	µg/Kg-dry		438	1	04/04/06 21:12	EDS	8270C	
2,4-Dinitrophenol	< 2,220	µg/Kg-dry		2,220	1	04/04/06 21:12	EDS	8270C	
2,4-Dinitrotoluene	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
2,6-Dinitrotoluene	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Di-n-octyl phthalate	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Fluoranthene	< 22.2	µg/Kg-dry		22.2	1	04/04/06 21:12	EDS	8270C	
Fluorene	< 22.2	µg/Kg-dry		22.2	1	04/04/06 21:12	EDS	8270C	
Hexachlorobenzene	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Hexachlorobutadiene	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Hexachlorocyclopentadiene	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Hexachloroethane	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Indeno(1,2,3-cd)pyrene	< 22.2	µg/Kg-dry		22.2	1	04/04/06 21:12	EDS	8270C	
Isophorone	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
2-Methylnaphthalene	< 22.2	µg/Kg-dry		22.2	1	04/04/06 21:12	EDS	8270C	
2-Methylphenol	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
3&4-Methylphenol	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
Naphthalene	< 22.2	µg/Kg-dry		22.2	1	04/04/06 21:12	EDS	8270C	
2-Nitroaniline	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	
3-Nitroaniline	< 438	µg/Kg-dry		438	1	04/04/06 21:12	EDS	8270C	
4-Nitroaniline	< 226	µg/Kg-dry		226	1	04/04/06 21:12	EDS	8270C	

Qualifiers/	*	Surrogate Recovery outside accepted limits.
Definitions	B	Analyte detected in the associated Method Blank
	E	Value exceeds method calibration range
	J	Estimated Value Analyte below reported detection limit
	MDL	Method Detection Limit (unadjusted)
	MRL	Method Reporting Limit

* I	Recoveries affected by interferences or high background
DF	Dilution Factor
H	Prepped / Analyzed out of holding time.
M	Minimum value.
MQL	Method Quantitation Limit (adjusted)
SQL	Sample Quantitation Limit (adjusted MDL)

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ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, TN 38133 (901)213-2400 FAX (901)213-2440
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"A Laboratory Management Partner"

Prosonic Corporation

3737 Cherry Road

Memphis, TN 38118

Lab Order Number 0603A53

Lab ID 0603A53-002B

Field ID IDW

Project Special

Description

Project No. 1856917

Site Memphis, TN

Received 03/31/06

Matrix Soil

Sampled 03/29/06

GCMS Semi-Volatiles

Prep Method	3550B	Prep Batch	9513	Date/Time Prepped	04/04/06 08:30	Analytical Batch	14822	
Compound	Result	Units	MQL	DF	Date/Time Analyzed	By	Analytical Method	
Nitrobenzene	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
2-Nitrophenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
4-Nitrophenol	< 876	µg/Kg-dry	876	1	04/04/06 21:12	EDS	8270C	
N-Nitroso-di-n-butylamine	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
N-Nitrosodiethylamine	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
N-Nitrosodimethylamine	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
N-Nitrosodiphenylamine	< 438	µg/Kg-dry	438	1	04/04/06 21:12	EDS	8270C	
N-Nitrosodi-n-propylamine	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
Pentachlorophenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
Phenanthrene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C	
Phenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
Pyrene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C	
Pyridine	< 438	µg/Kg-dry	438	1	04/04/06 21:12	EDS	8270C	
1,2,3,4-Tetrachlorobenzene	< 22.2	µg/Kg-dry	22.2	1	04/04/06 21:12	EDS	8270C	
1,2,4,5-Tetrachlorobenzene	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
2,3,4,6-Tetrachlorophenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
1,2,4-Trichlorobenzene	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
2,4,5-Trichlorophenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
2,4,6-Trichlorophenol	< 226	µg/Kg-dry	226	1	04/04/06 21:12	EDS	8270C	
Surrogate: Nitrobenzene-d5			49 %	Limits: 25-110				
Surrogate: 2-Fluorobiphenyl			62 %	Limits: 33-114				
Surrogate: 4-Terphenyl-d14			107 %	Limits: 37-115				
Surrogate: Phenol-d6			50 %	Limits: 11-125				
Surrogate: 2,4,6-Tribromophenol			82 %	Limits: 9-134				
Surrogate: 2-Fluorophenol			81 %	Limits: 10-119				

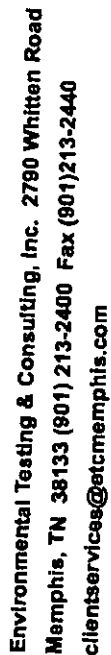
Qualifiers/ Definitions

- * Surrogate Recovery outside accepted limits.
- B Analyte detected in the associated Method Blank
- E Value exceeds method calibration range
- J Estimated Value Analyte below reported detection limit
- MDL Method Detection Limit (unadjusted)
- MRL Method Reporting Limit

- * I Recoveries affected by interferences or high background.
- DF Dilution Factor
- H Prepped / Analyzed out of holding time.
- M Minimum value.
- MQL Method Quantitation Limit (adjusted)
- SQL Sample Quantitation Limit (adjusted MDL)

04/11/06

PROSONIC



CHAIN OF CUSTODY RECORD

ETC_Work Order
ETC Quote No.

003453

[illegible]

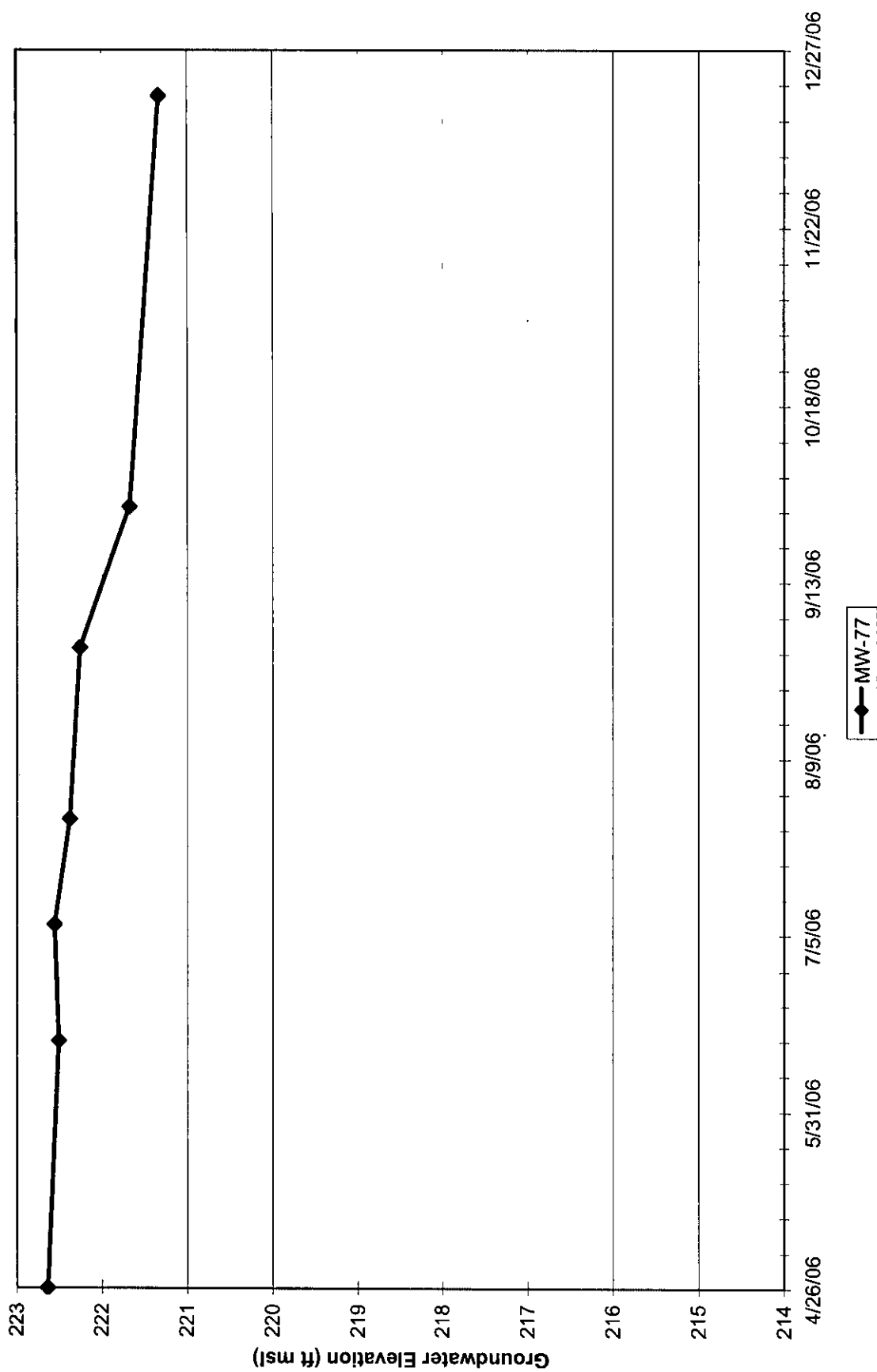
Page ____ of ____

ATTACHMENT F

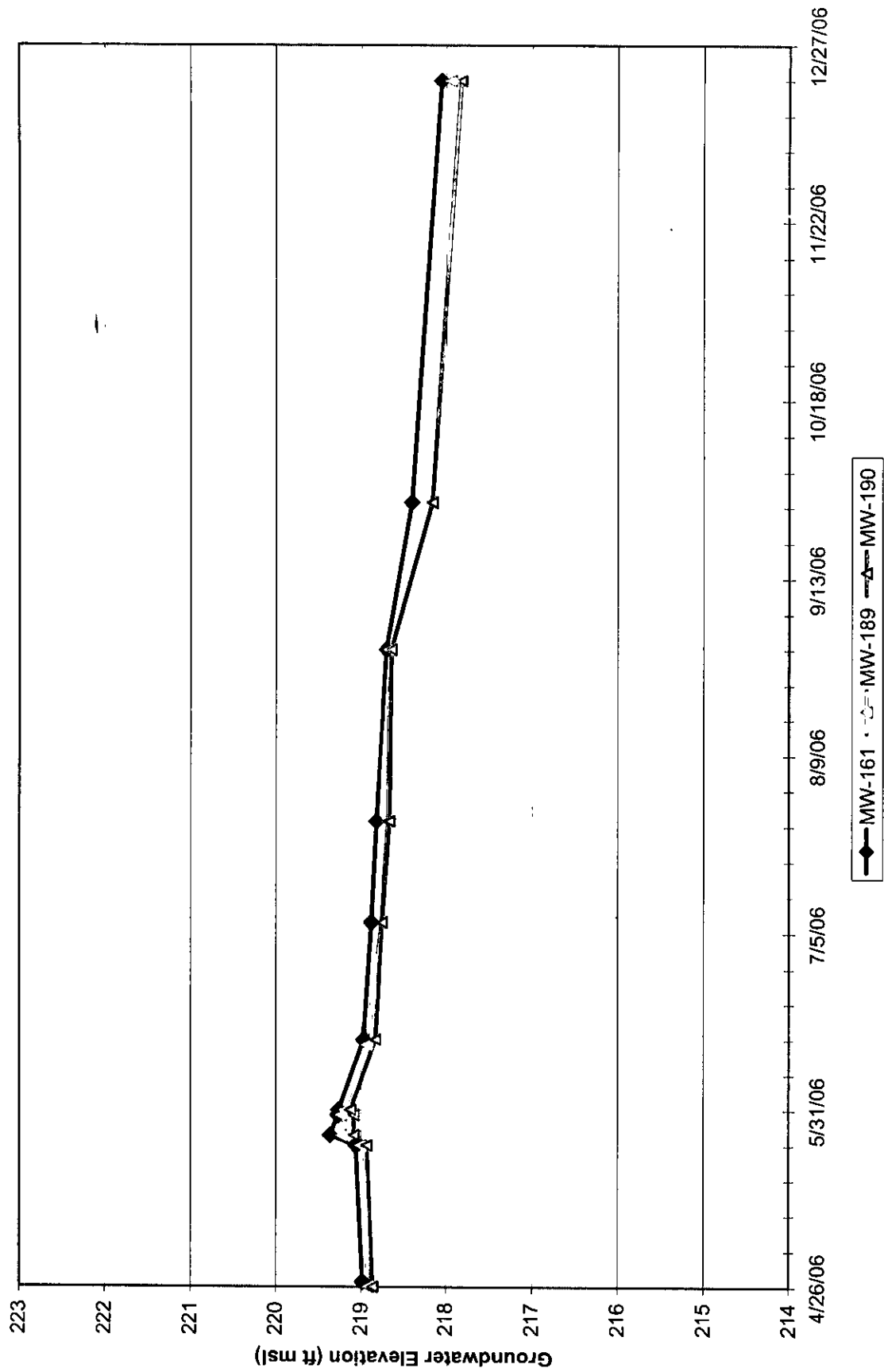
Monitoring Well Data Trends

I

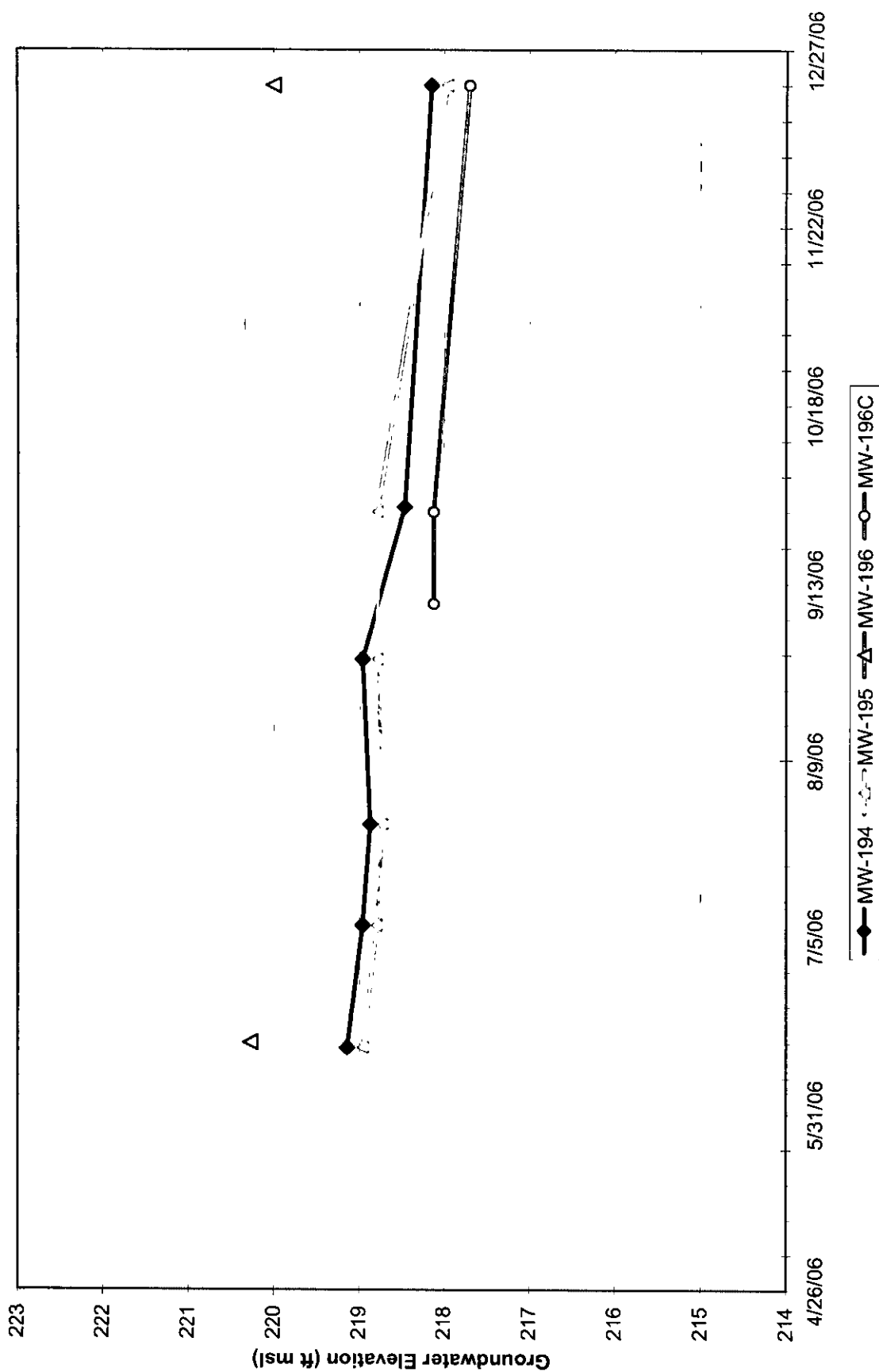
Far Upgradient Monitoring Well
Temporal Groundwater Elevation Data



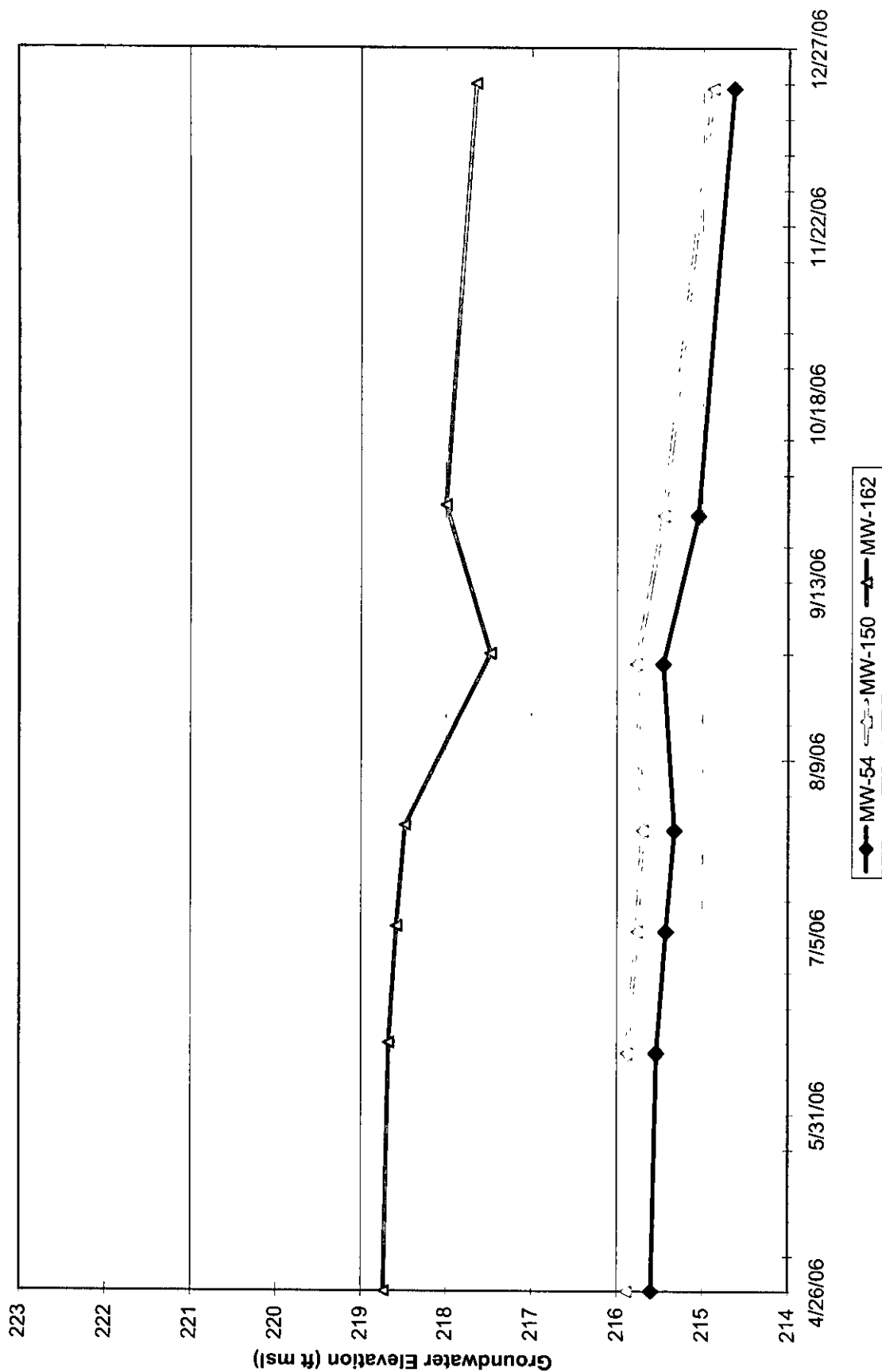
Upgradient Monitoring Wells Temporal Groundwater Elevation Data



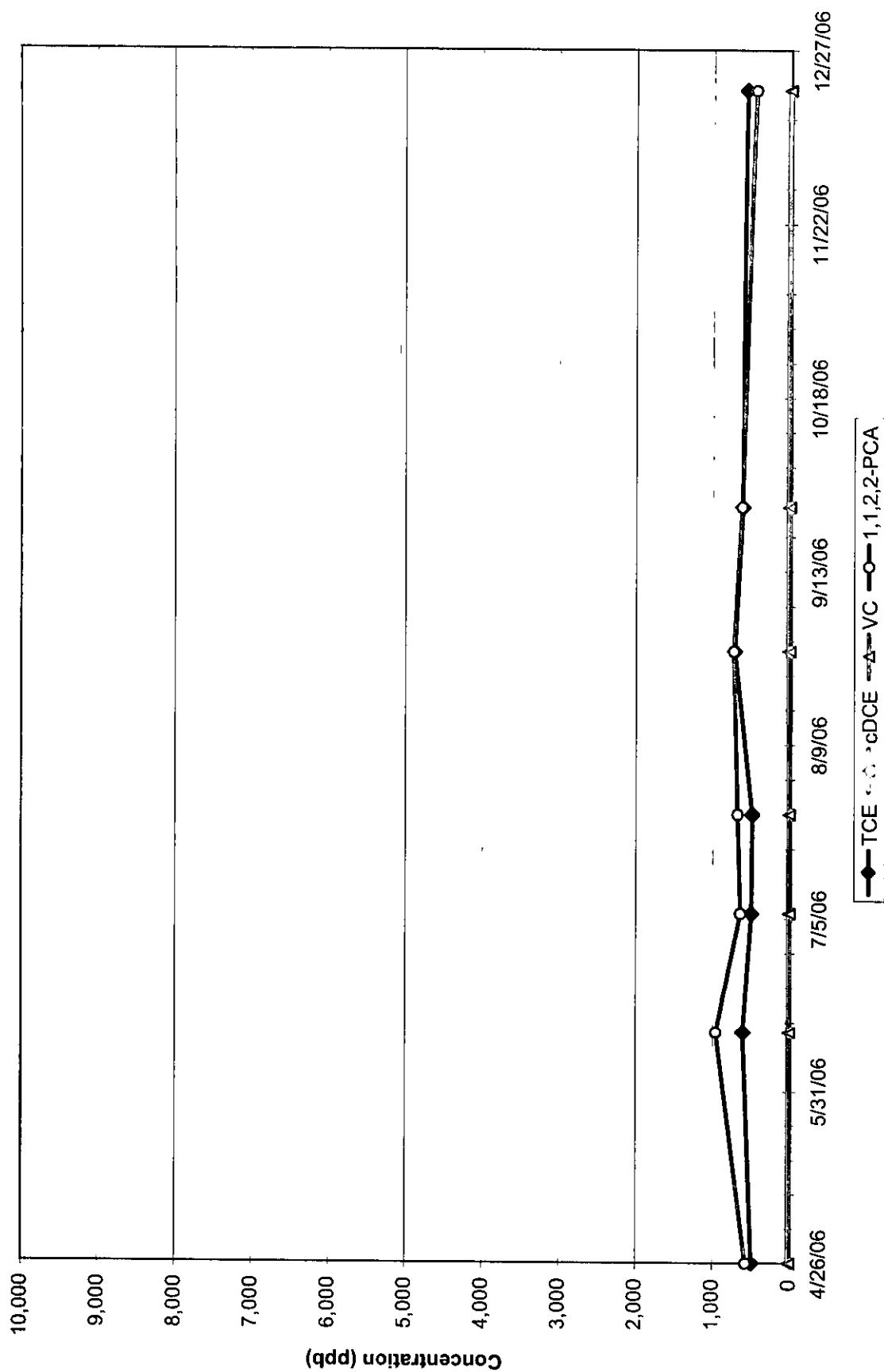
ZVI PRB Monitoring Wells
Temporal Groundwater Elevation Data



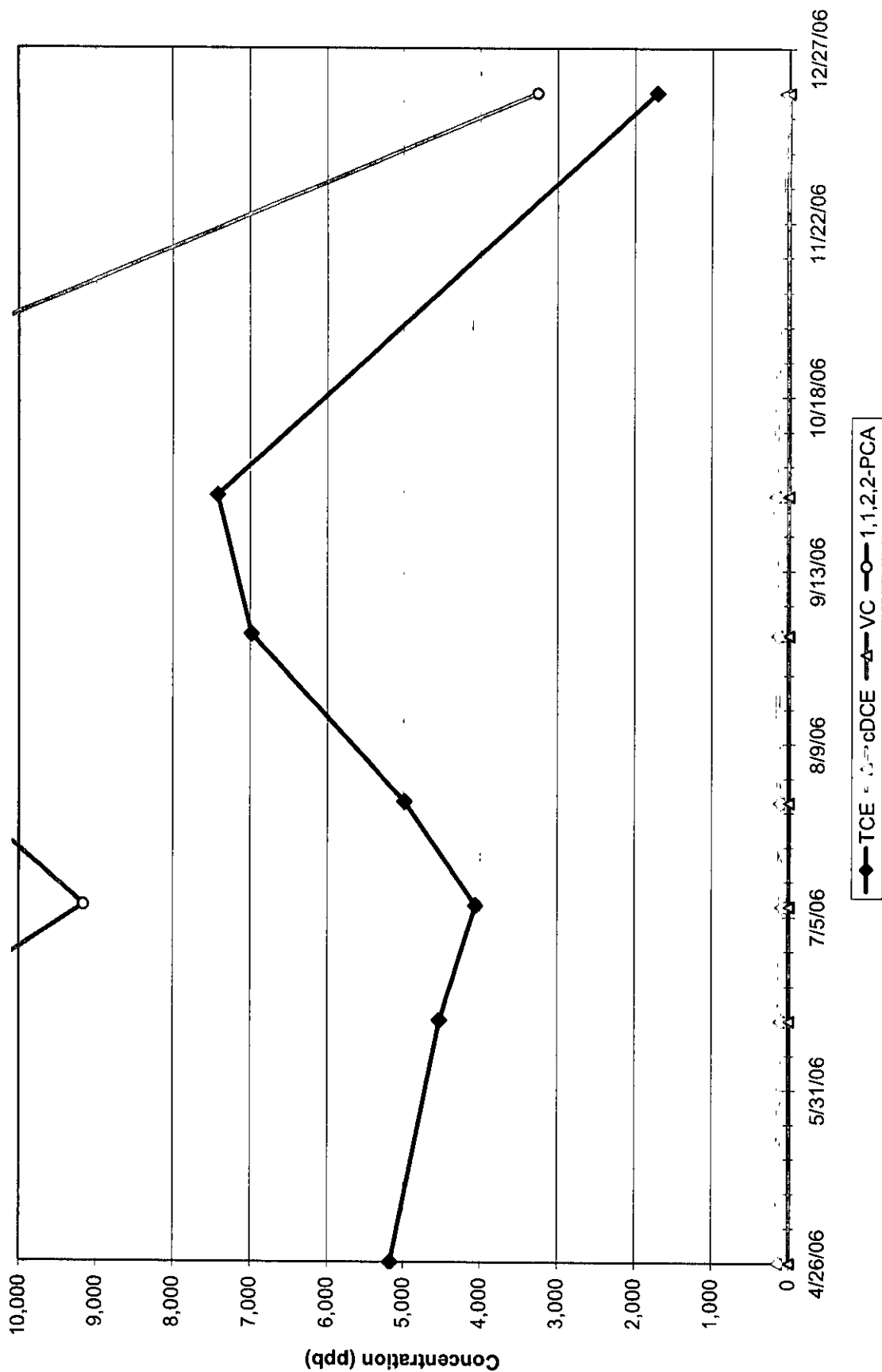
Far Downgradient and Sidegradient Monitoring Wells Temporal Water Elevation Data



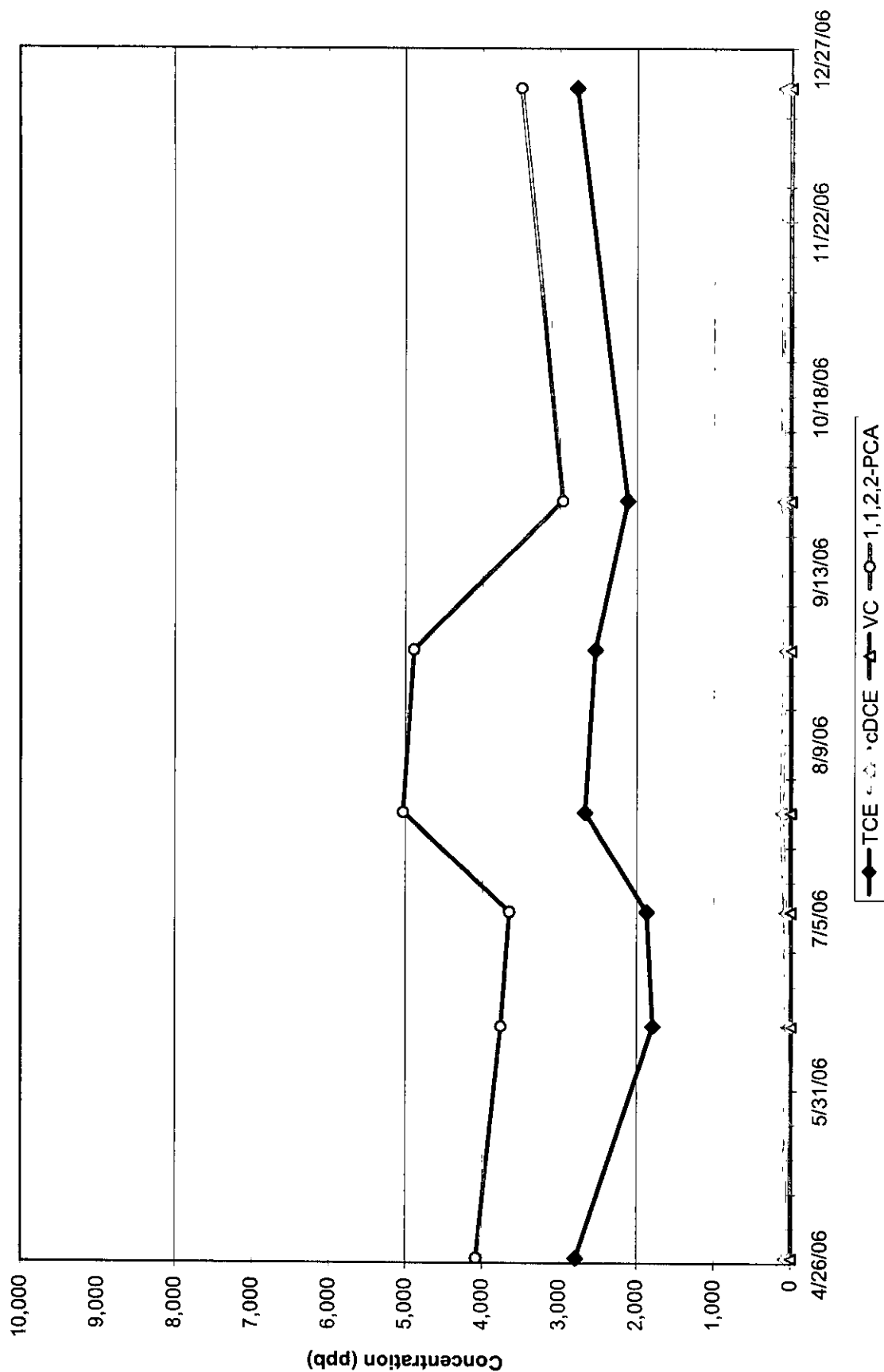
MW-54
400 feet downgradient of end of reactive zone



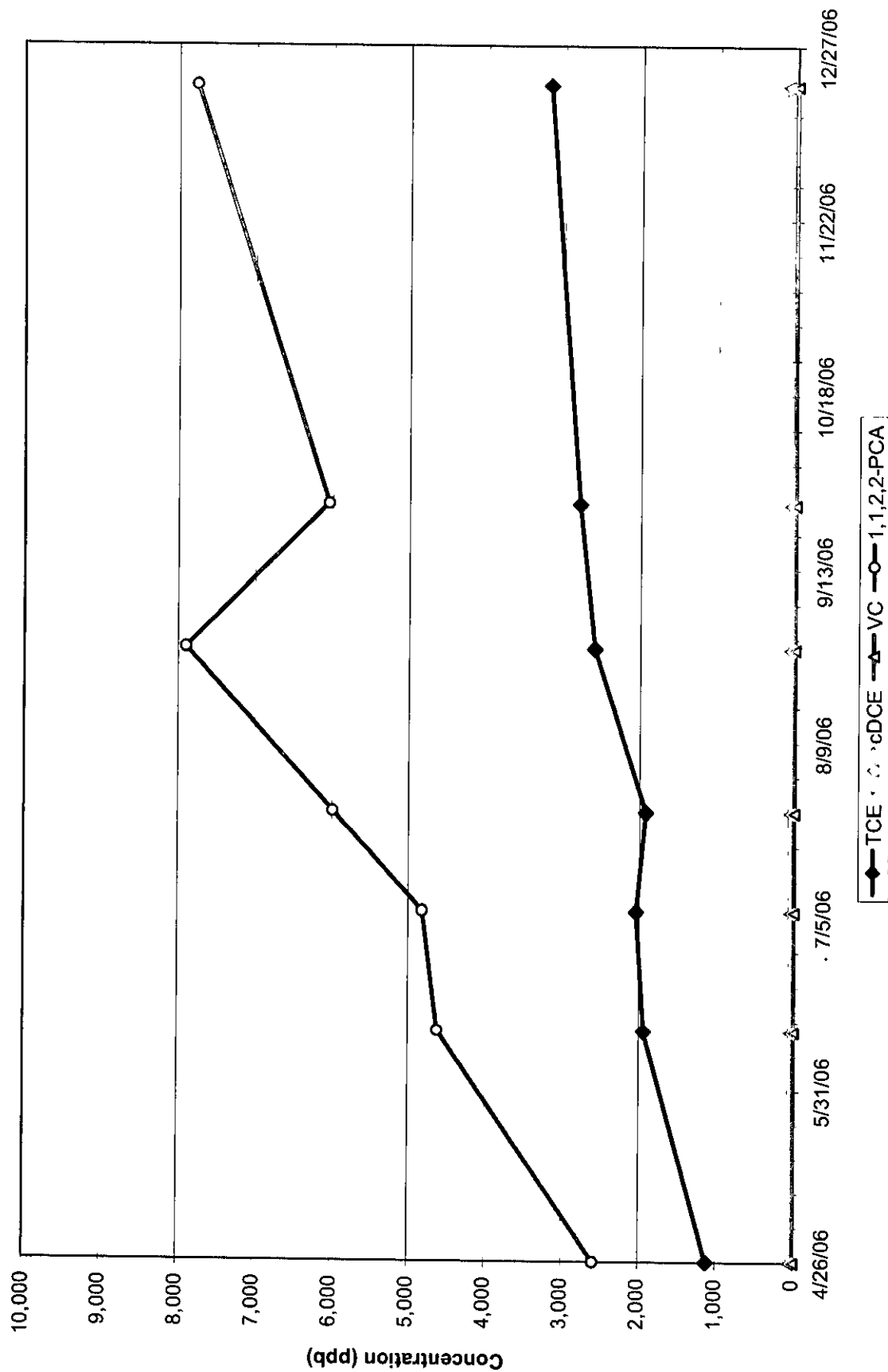
MW-77
250 feet upgradient of downgradient end of reactive zone



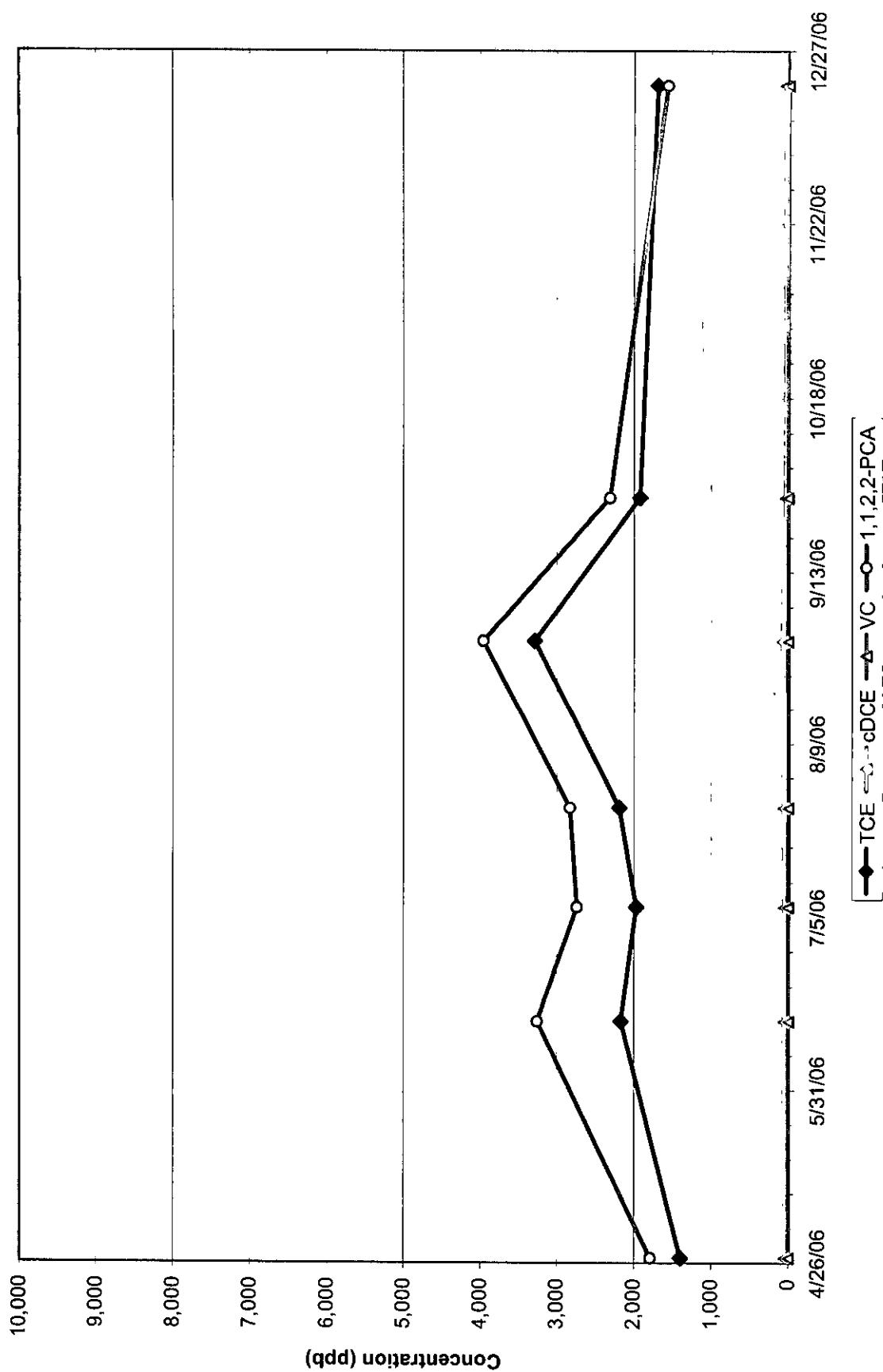
MW-144
30 feet downgradient of end of reactive zone



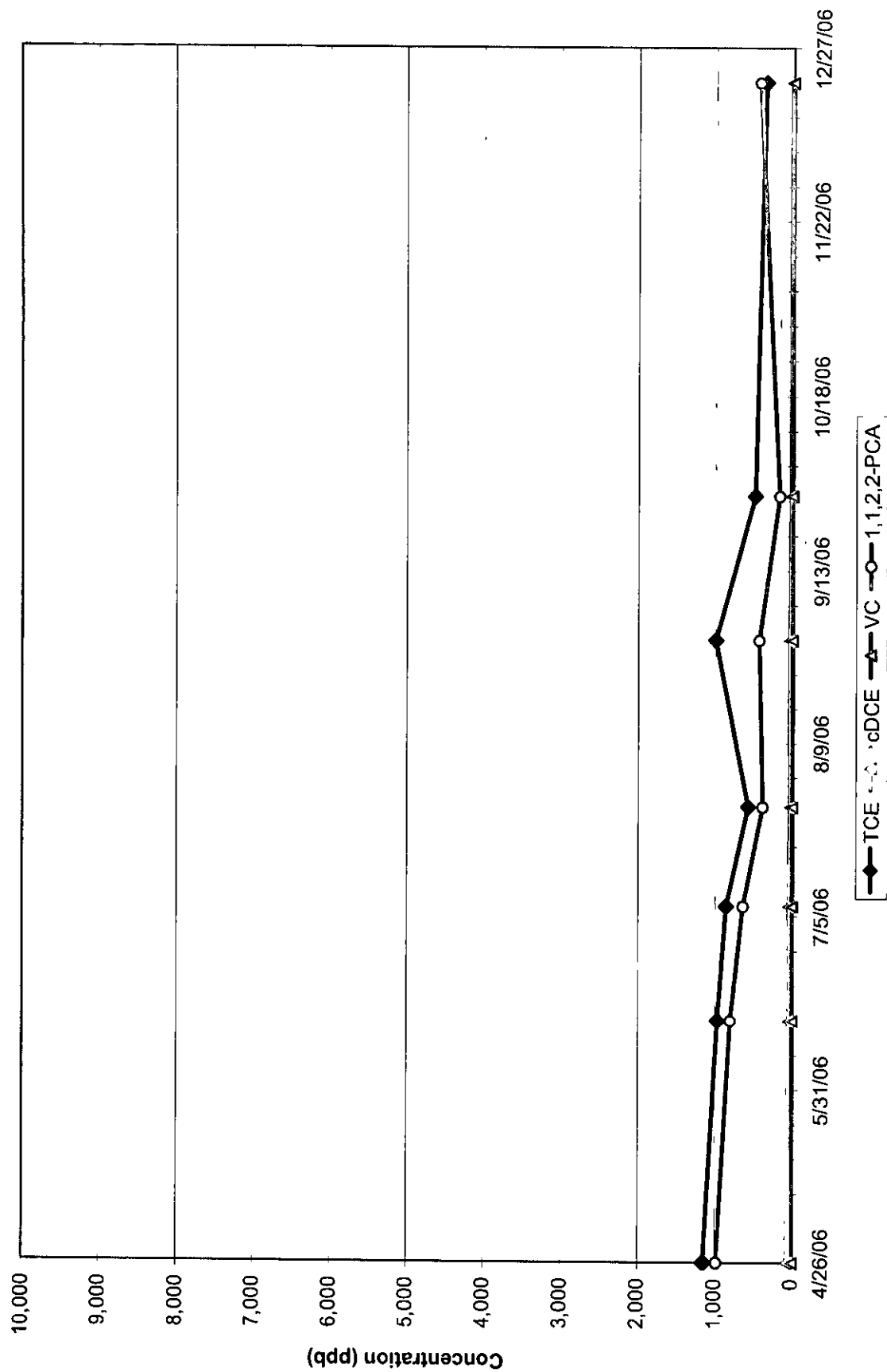
MW-150
300 feet downgradient of end of reactive zone



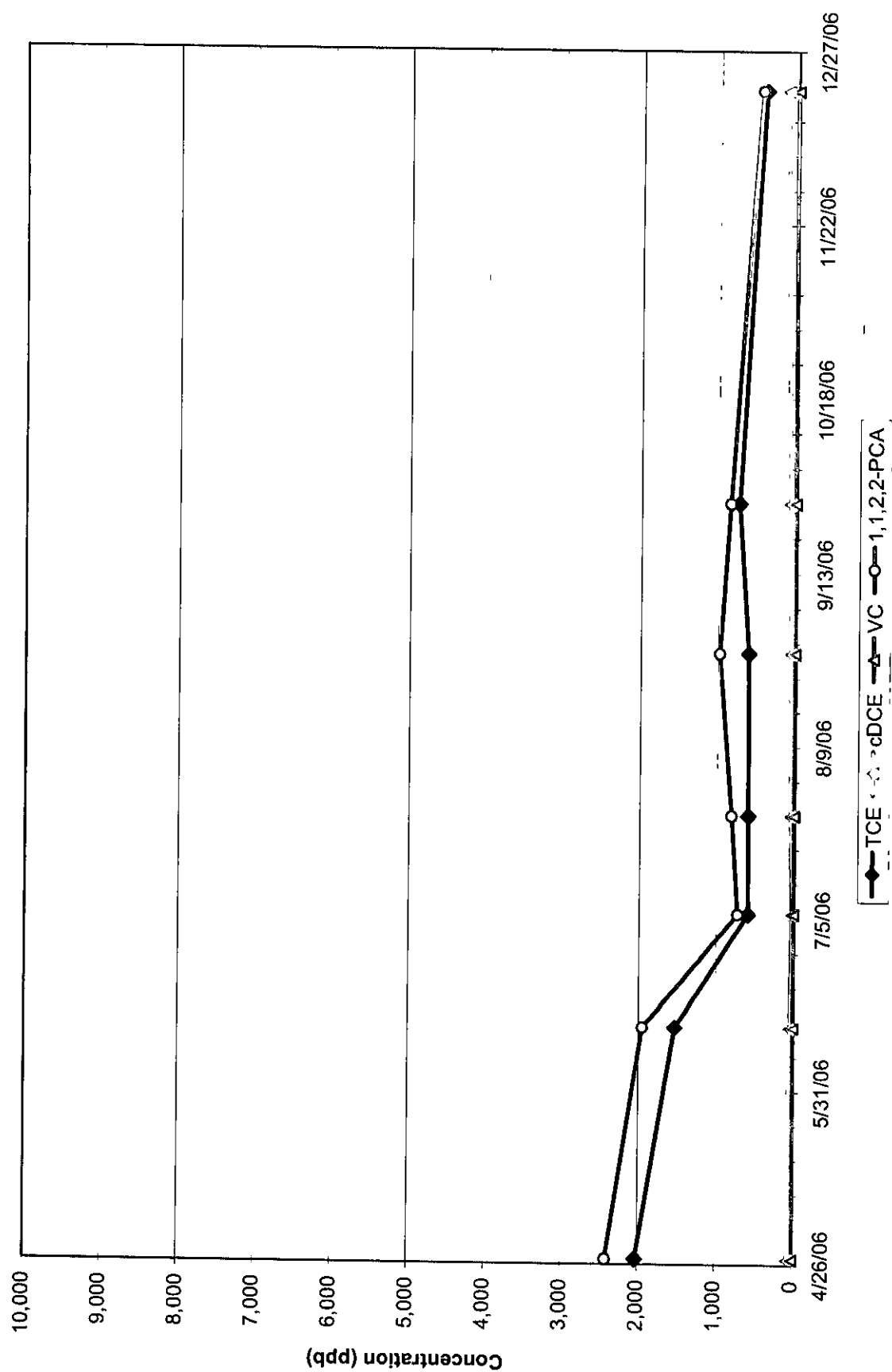
MW-161
42 feet upgradient of downgradient end of reactive zone



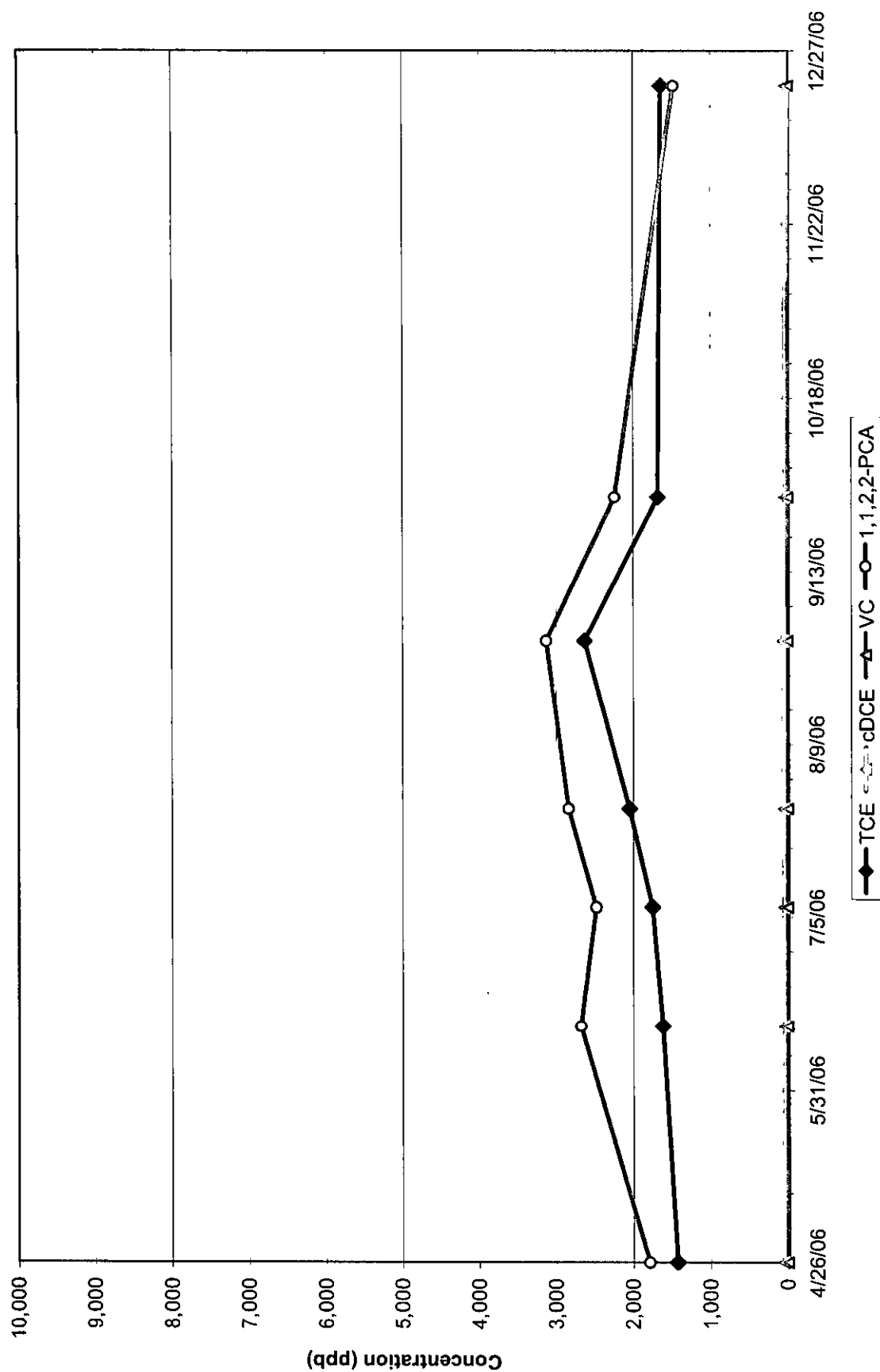
MW-162
50 feet sidegradient



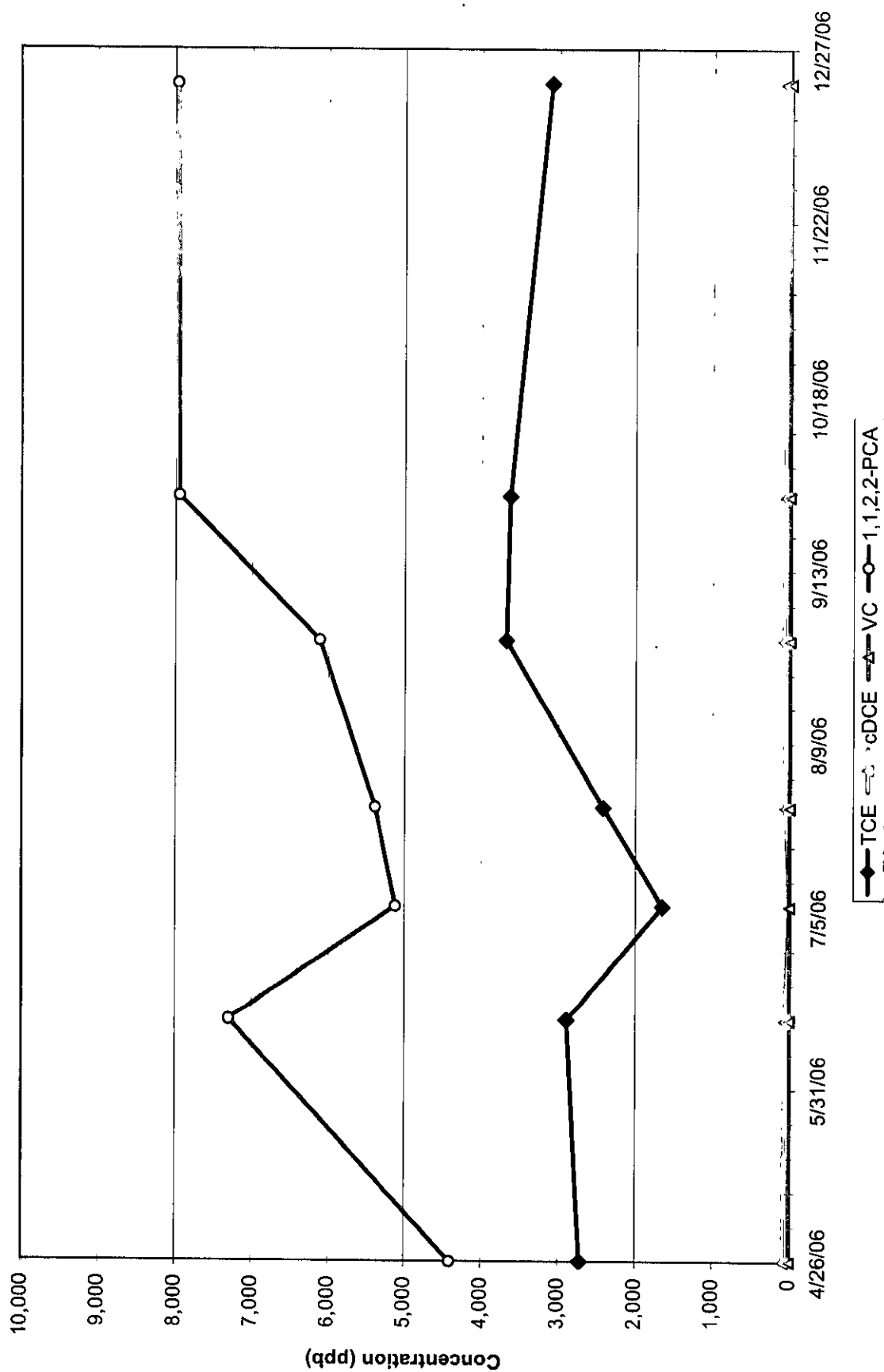
MW-163
70 feet downgradient of end of reactive zone



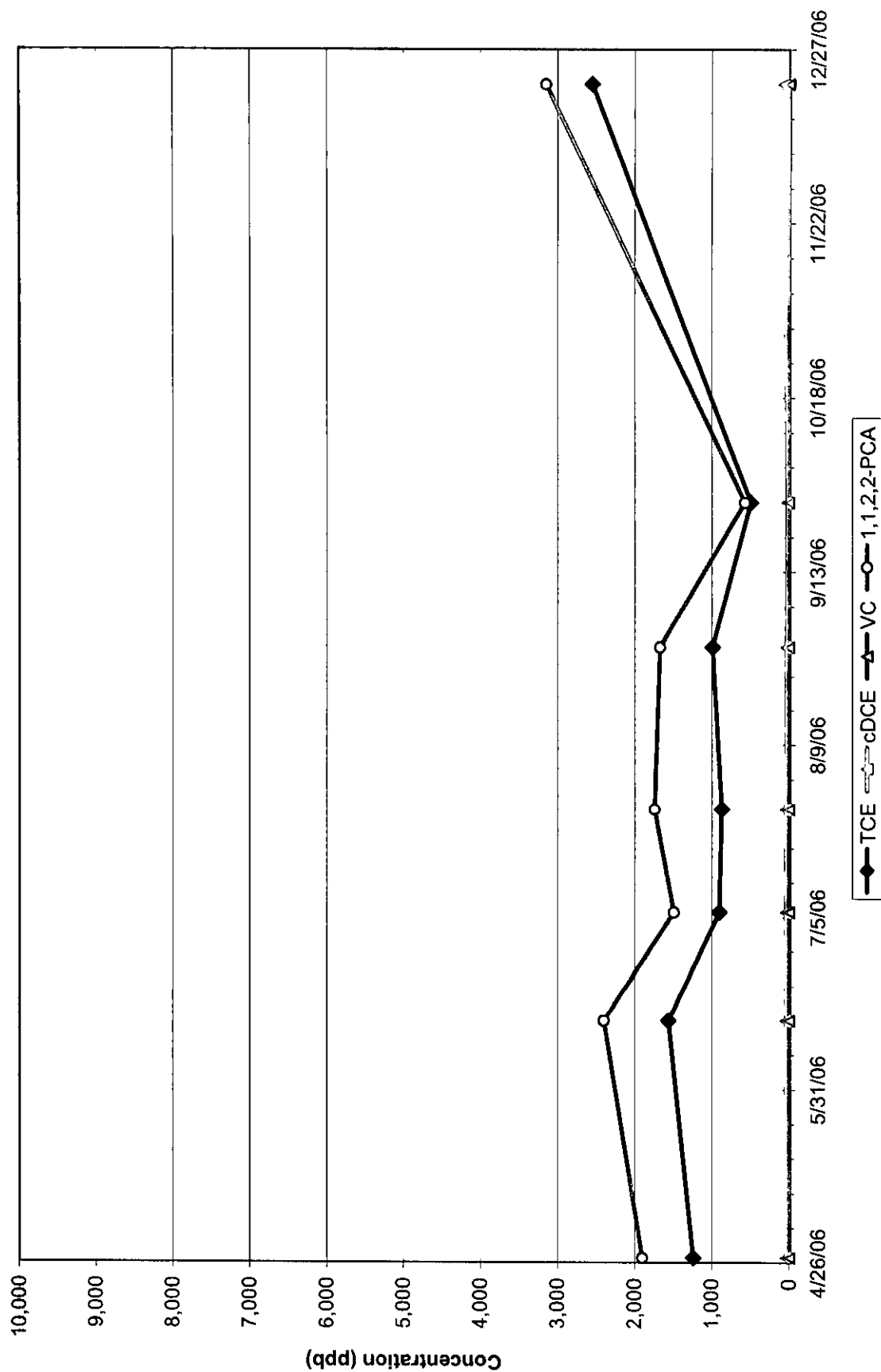
MW-189
27 feet upgradient of downgradient end of reactive zone



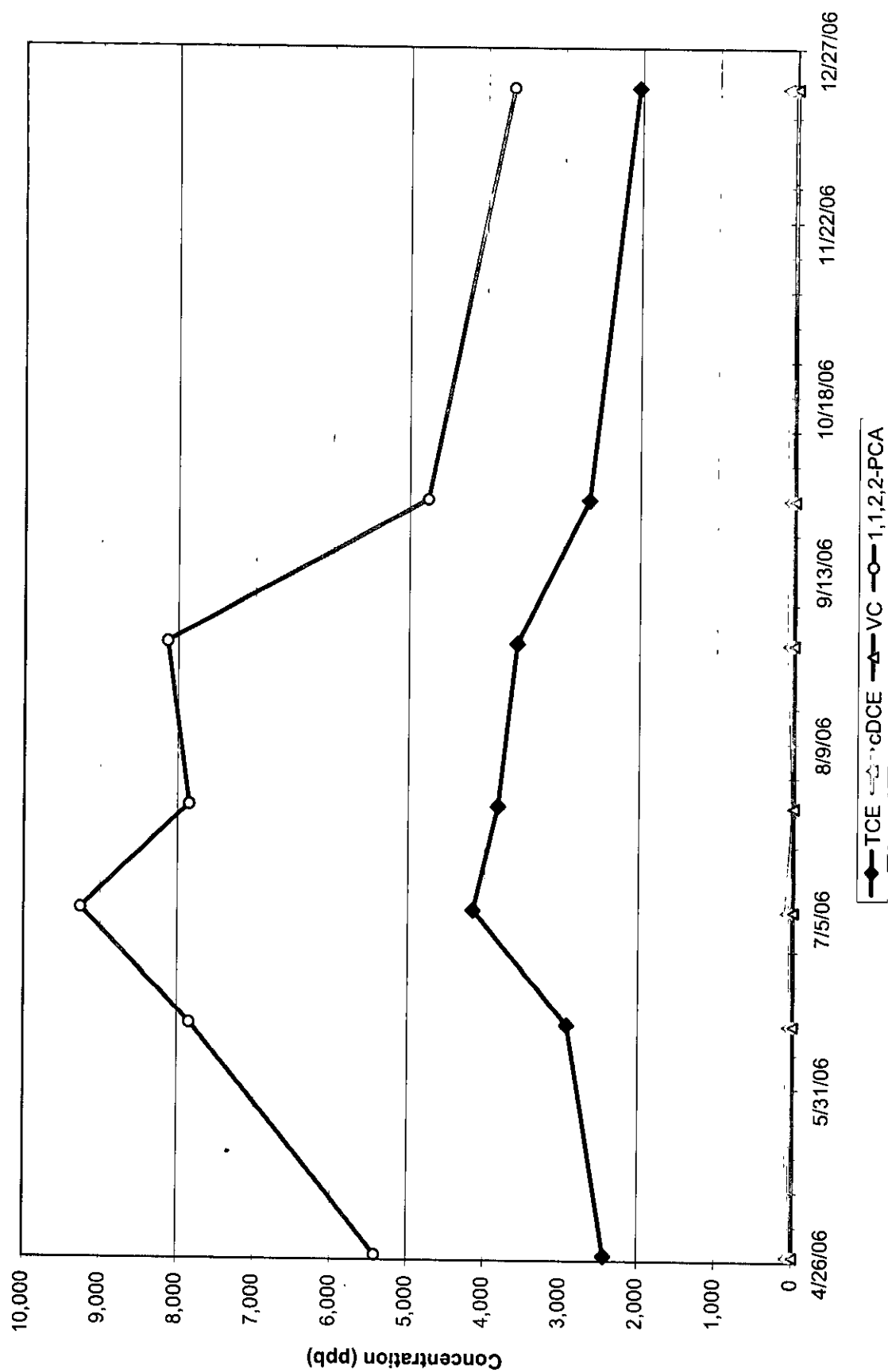
MW-190
27 feet upgradient of downgradient end of reactive zone



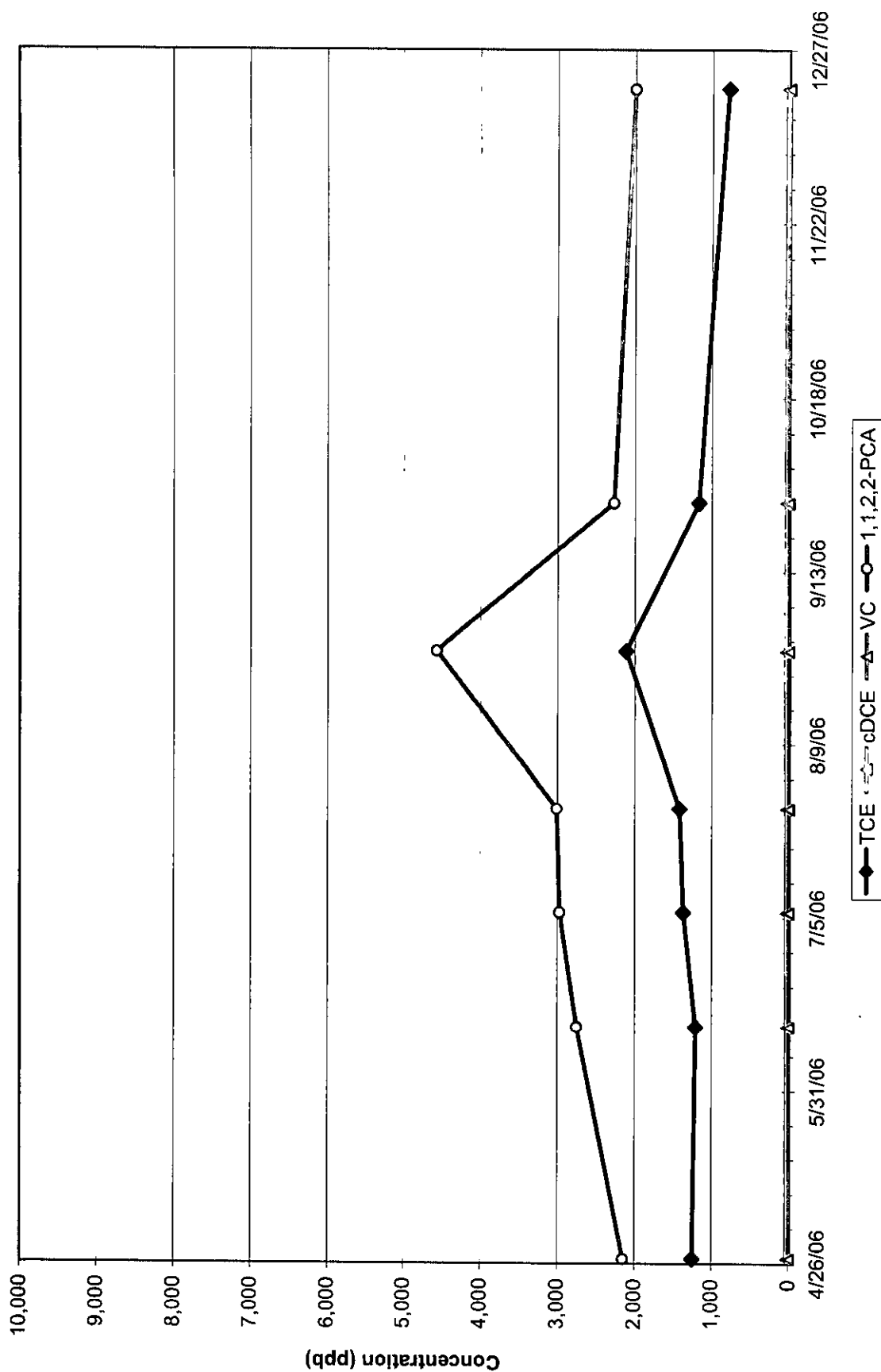
MW-191
15 feet downgradient of end of reactive zone



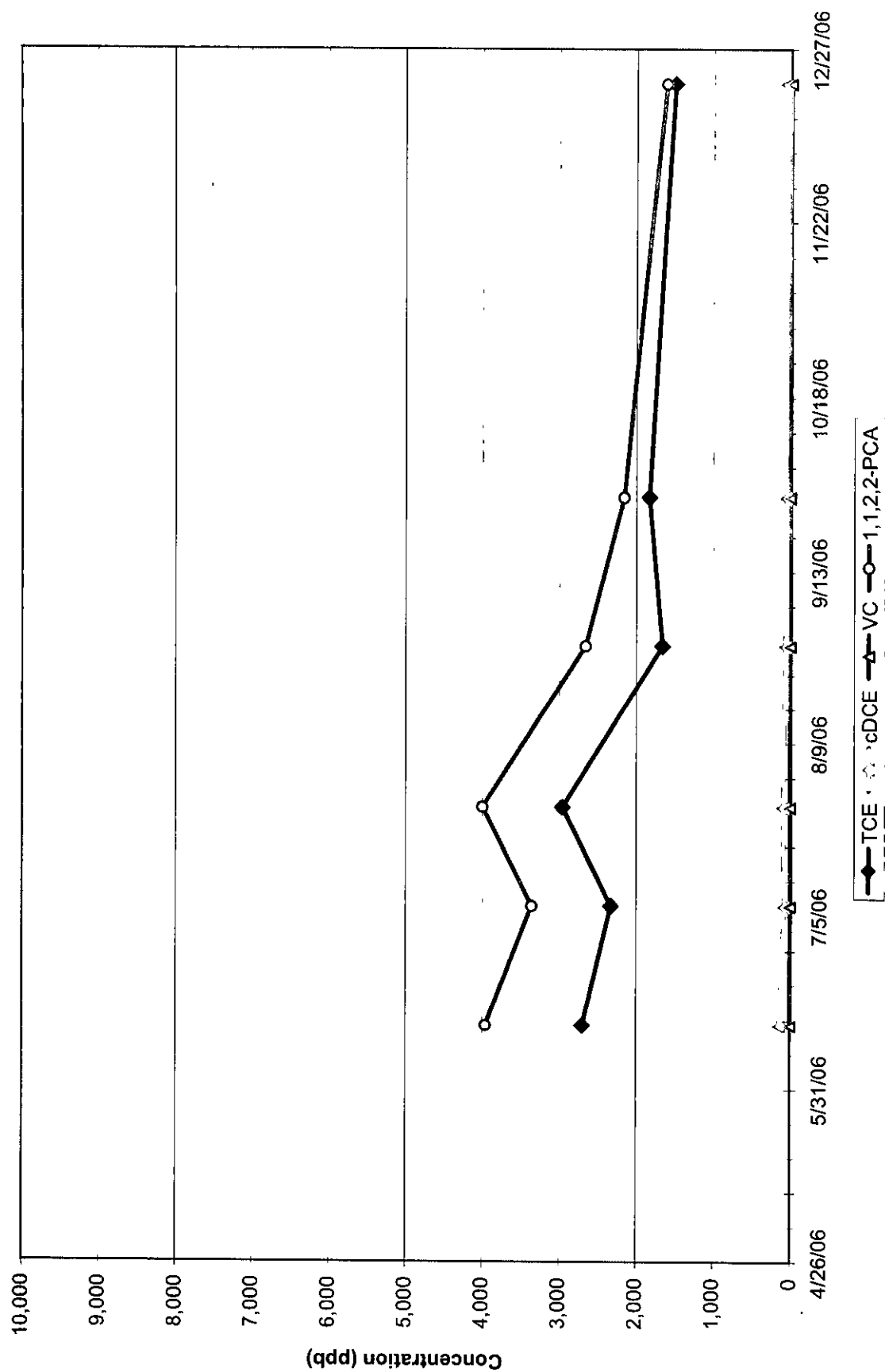
MW-192
15 feet downgradient of end of reactive zone



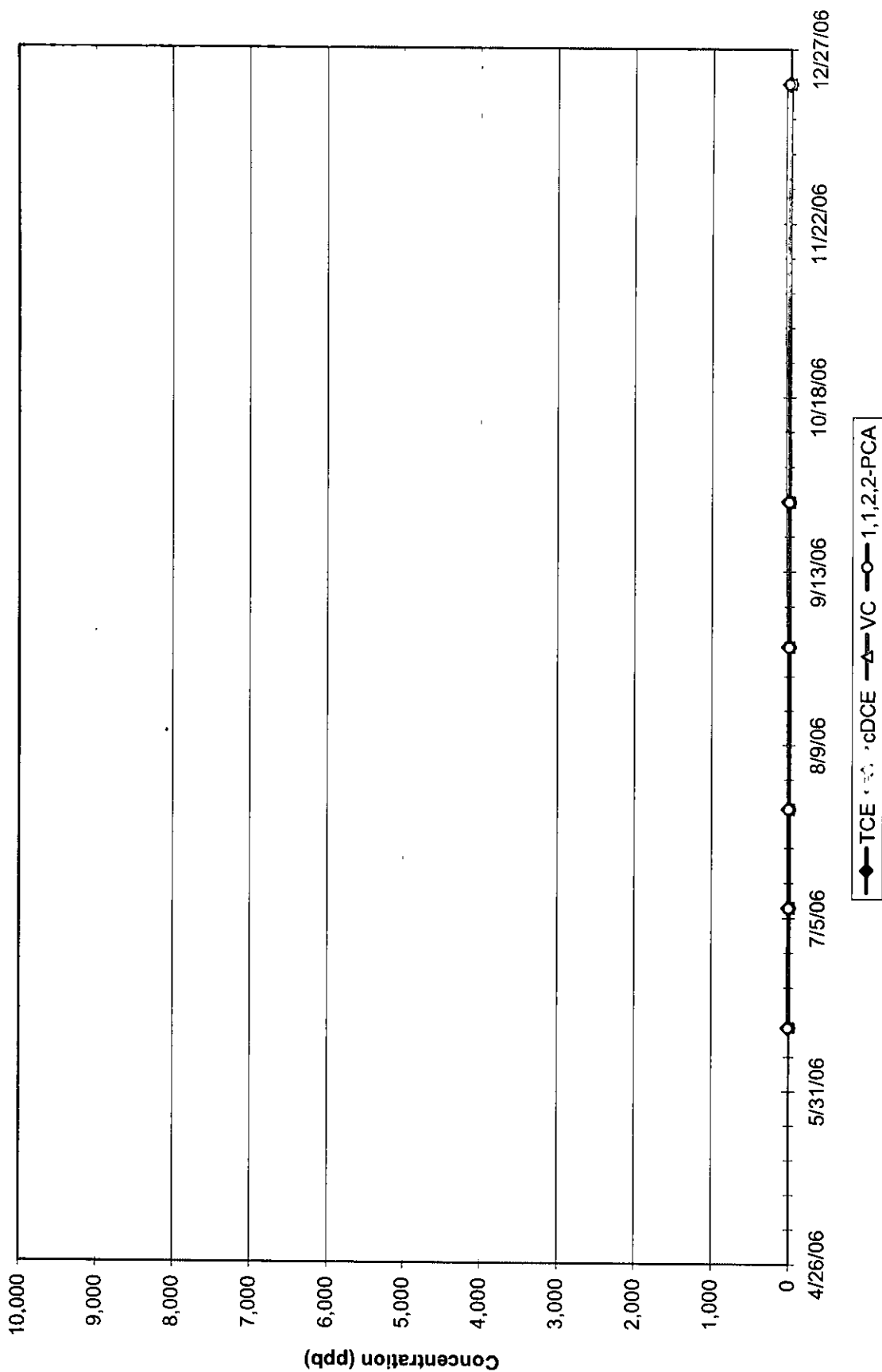
MW-193
30 feet downgradient of end of reactive zone



MW-194
10 feet upgradient of downgradient end of reactive zone



MW-195
at downgradient end of reactive zone (within PRB)



ATTACHMENT G

February 2006 ETI Memorandum

I



envirometal
technologies
inc.

Memorandum

To: Mike Perlmutter, CH2M Hill (Mike.Perlmutter@CH2M.com)

From: Mike Duchene, Stephanie O'Hannesin, EnviroMetal Technologies Inc.

Date: 28 February 2006

Re: **Revised Full-Scale Design, Zero Valent Iron Permeable Reactive Barrier, Defense Distribution Center (Memphis), Dunn Field – ETI No. 31925.20**

EnviroMetal Technologies Inc. (ETI) has revised the design for the proposed full-scale permeable reactive barrier (PRB) at the Memphis Depot based on the revised data provided by CH2M Hill on 22 February 2006. The estimate of the groundwater flow velocity has increased from 1.1 ft/day to 4.6 ft/day based on additional slug test data.

Table 1 summarizes the information provided by CH2M Hill and the estimates of residence time and iron tonnage completed by ETI.

To follow up on our discussion of potential locations for the full-scale PRB, it should be noted that, in general, an equivalent mass of granular iron is required to treat an equivalent mass flux of contaminants. That is, the mass of granular iron required to treat a plume is about the same regardless of the location of the PRB (assuming there are no inputs of contaminants or a significant influx of groundwater between the locations). In the design presented in Table 1, the flow-through thickness of granular iron varies between 2.1 feet and 6.5 feet and the saturated thickness is 8 feet. If the PRB location was moved to a where the saturated thickness was 16 feet, the groundwater flow velocity should be about 2.3 ft/day at this location (one-half of 4.6 ft/day). The resulting iron flow-through thickness would be one-half the values presented in Table 1. The primary difference between different locations for treating the same contaminant plume is the constructability of a short and wide PRB (e.g. 6.5 feet wide and 8 feet high) versus a taller thinner PRB (3.25 feet wide and 16 feet high). Obviously surface access issues will also factor into this.

envirometal technologies inc.

Table 1 Summary of Revised Design

Design Element	Section 1	Section 2	Section 3	Section 4
TCE (ug/L)	73	2,280	5,300	117
1,1,2,2 PCA (ug/L)	10.2	4,970	14,000	2.2
GW velocity (ft/day)	4.6	4.6	4.6	4.6
Required Residence Time ^a (hrs)	11	28	34	13
PRB Length (ft)	150	150	150	150
Iron Thickness (ft)	2.1	5.4	6.5	2.5
Saturated Thickness (ft)	8	8	8	8
Iron Volume (ft ³)	2,520	6,480	7,800	3,000
Iron Volume ^b (tons)	227	583	702	270

Notes

a – based on the half-lives and molar conversions determined from the bench-scale test for MW-77

b - assumes a bulk density of 0.09 tons/ft³ for Connelly CC-1167 (-18 +84 mesh)

APPENDIX D

Microcosm Study Results

Note: Data through day 140 are provided. The final microcosm report from SiREM will be included when the study has been completed.

- Figures D-1 to D-14
- Microcosm analytical data summary table
- SiREM Report

Figure D-3: Lactate Amended

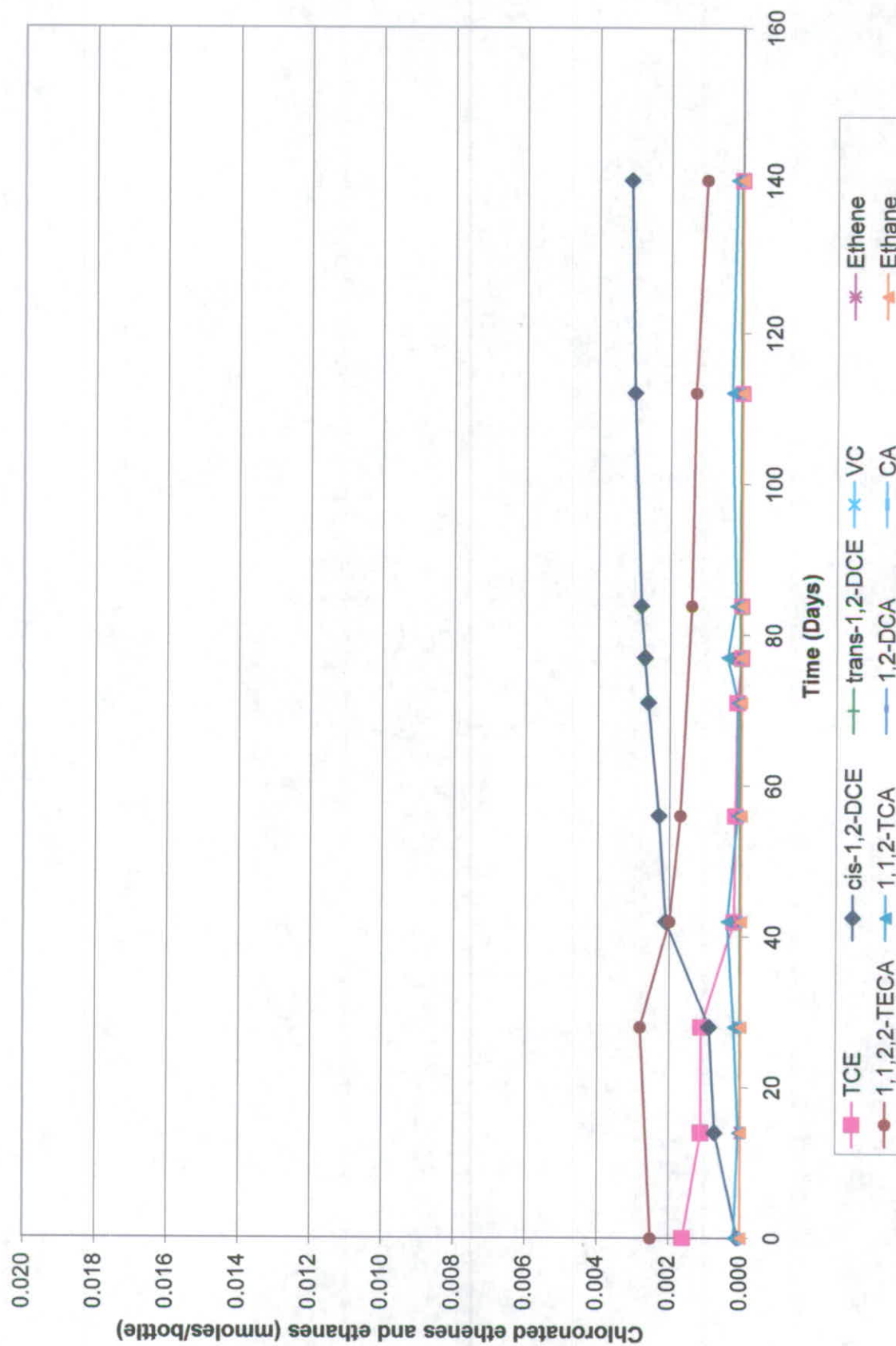


Figure D-5: Amended with Lactate and Bioaugmented with WBC-2

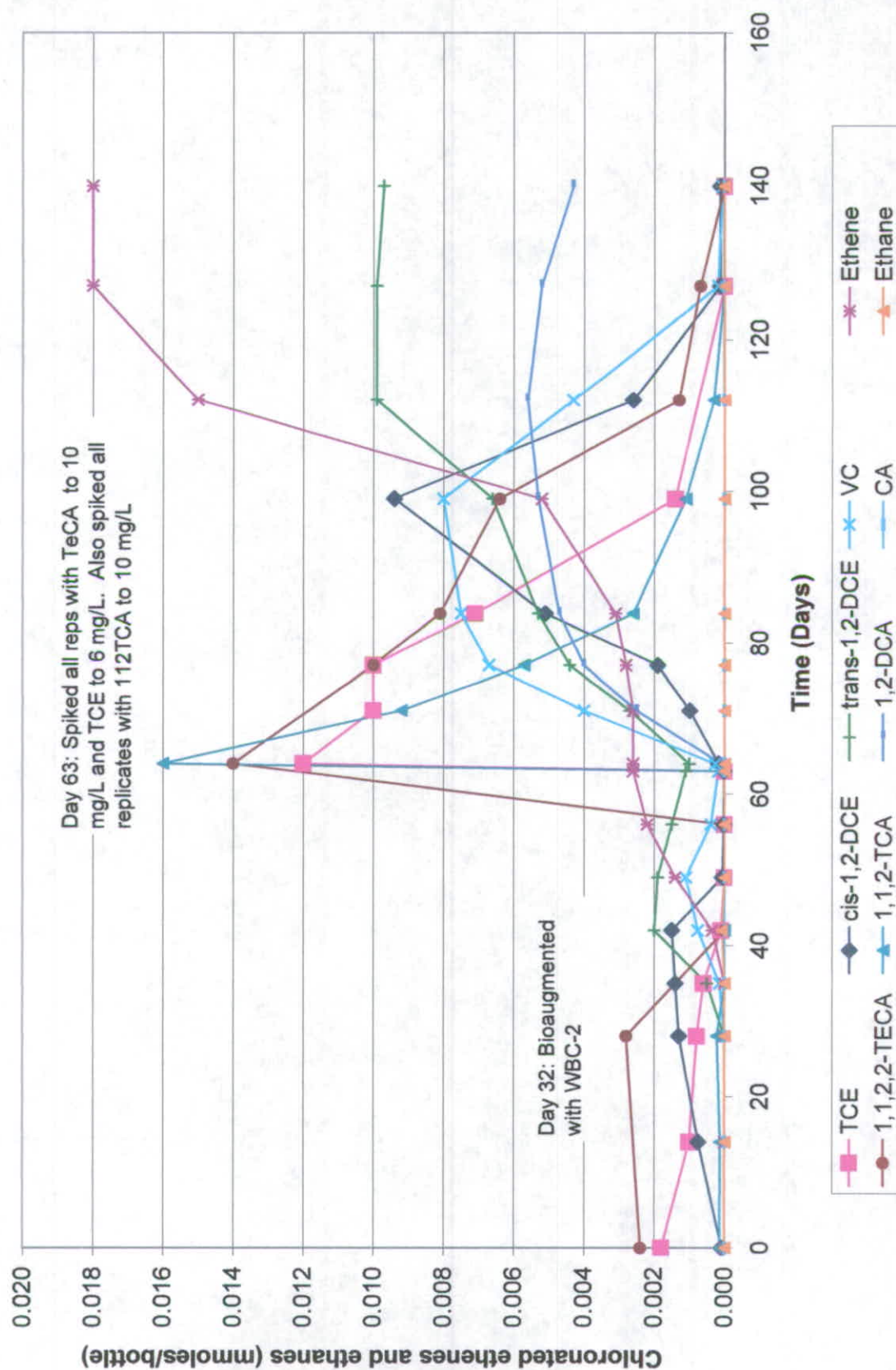


**Figure D-8: Anaerobic Sterile Control
Degradation Rate Assessment**

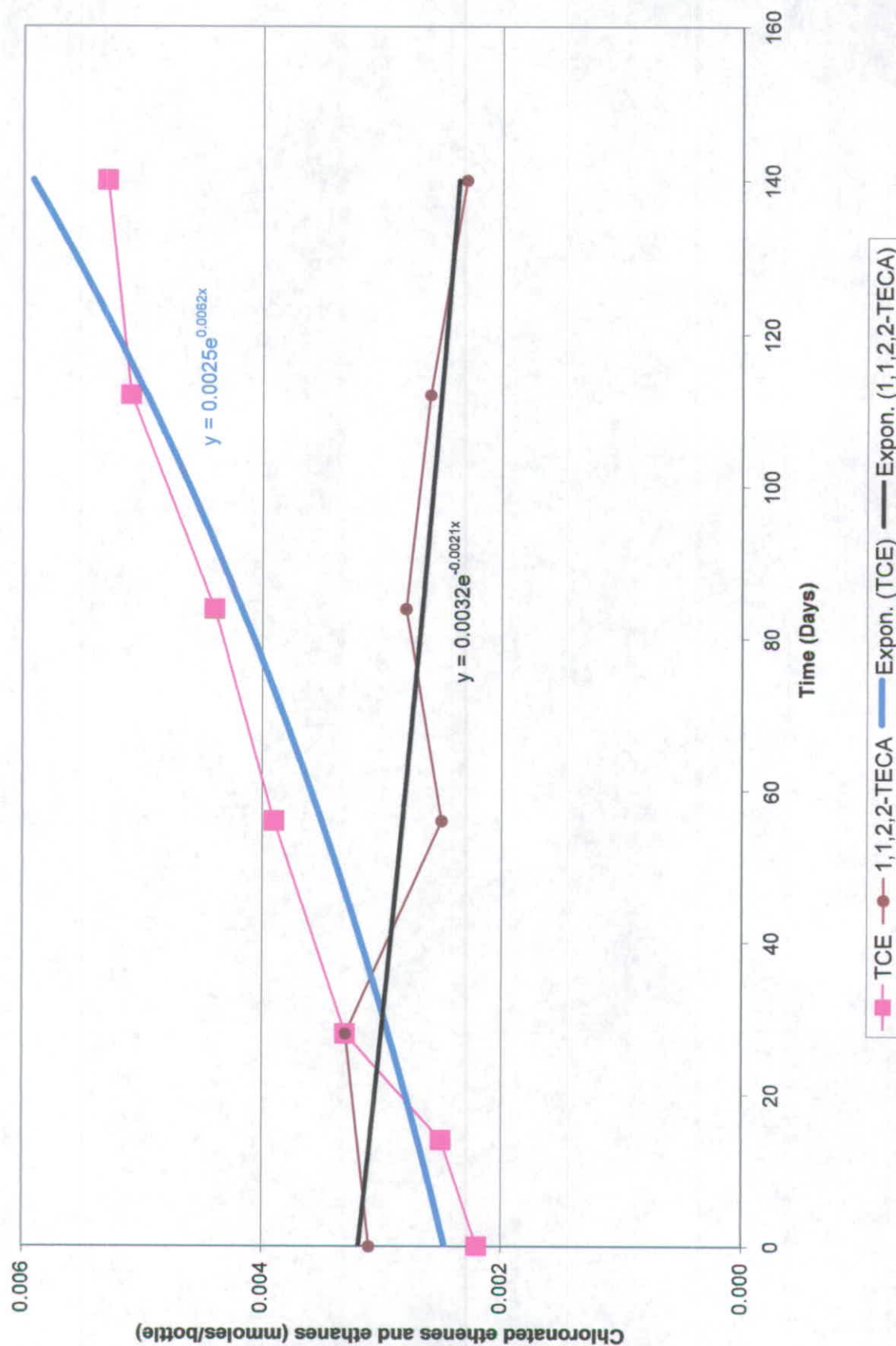


**Figure D-9: Anaerobic Active Control
Degradation Rate Assessment**

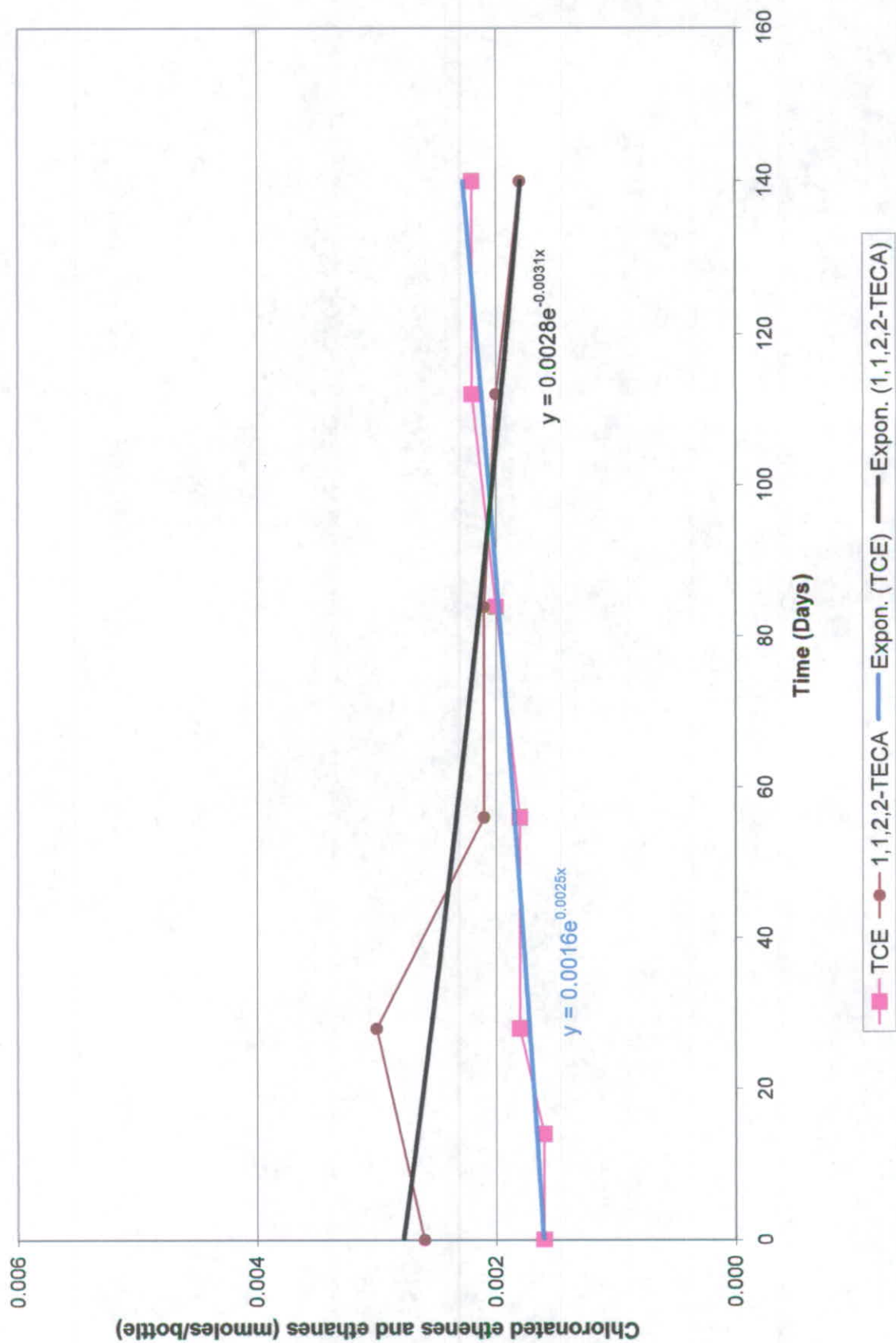


**Figure D-10: Lactate Amended
Degradation Rate Assessment**

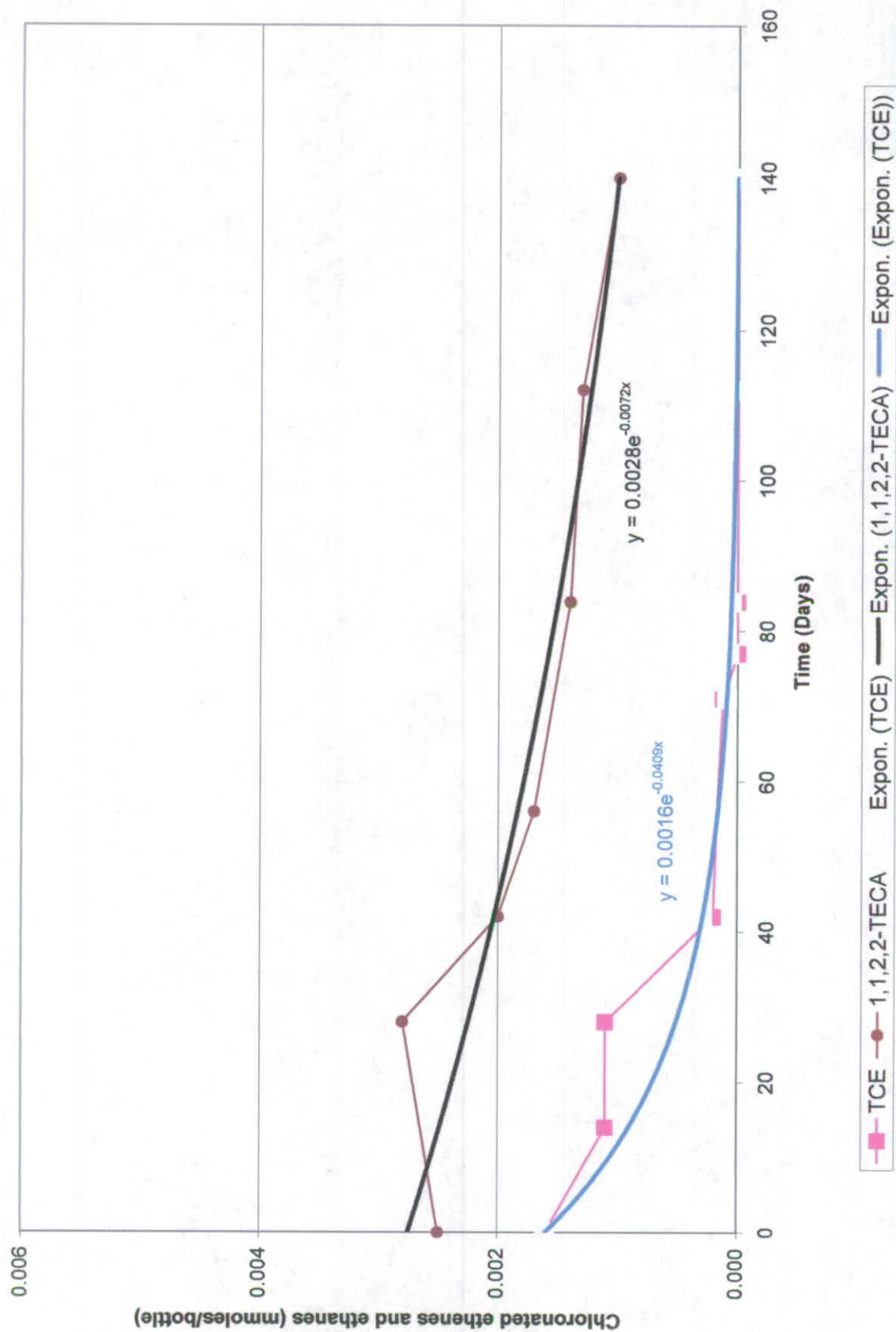


Figure D-11: Amended with EOS 598
Degradation Rate Assessment



**Figure D-12: Amended with Lactate and Bioaugmented with WBC-2
Degradation Rate Assessment**

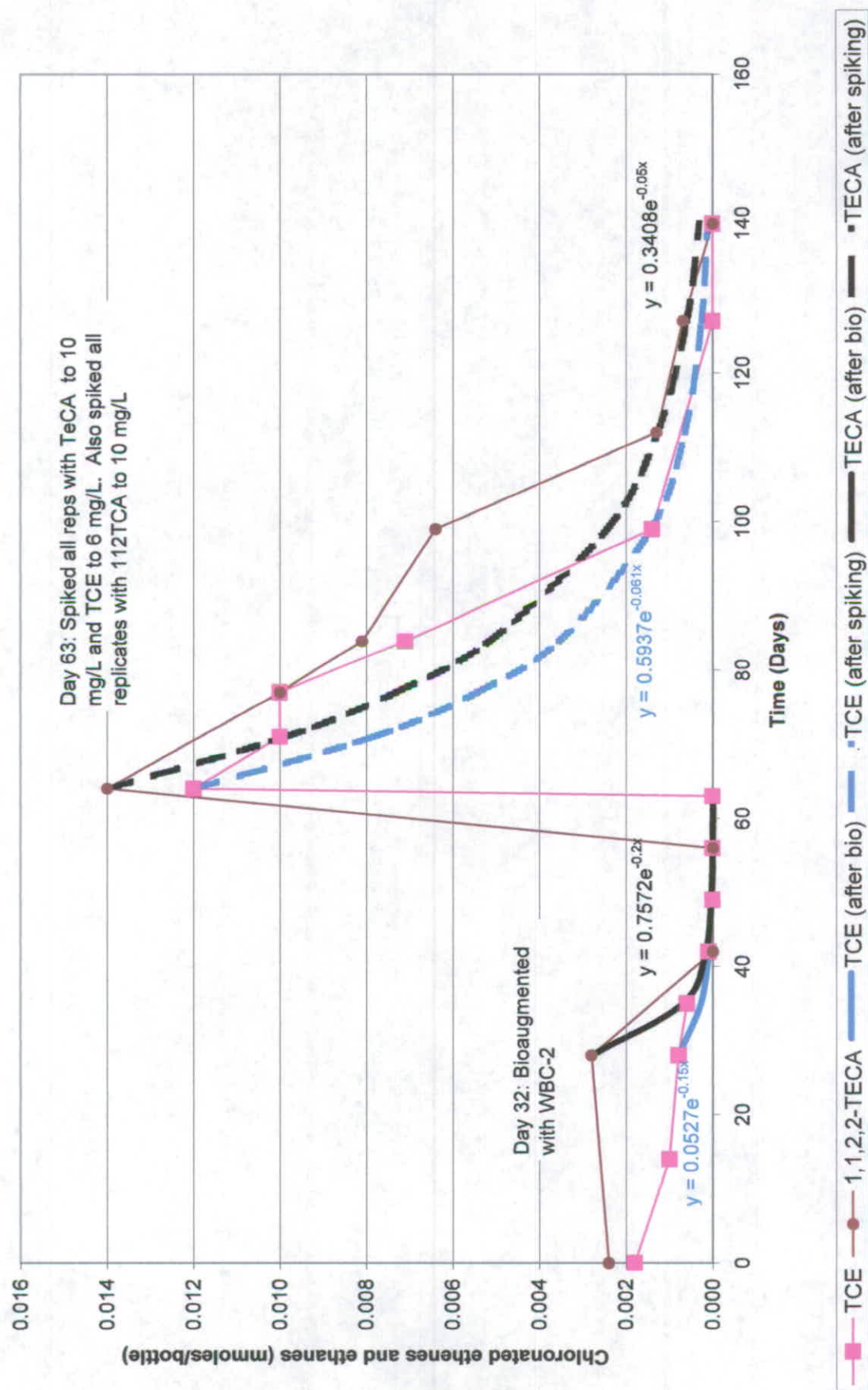


**Figure D-13: Amended with EOS 598 and Bioaugmented with WBC-2
Degradation Rate Assessment**

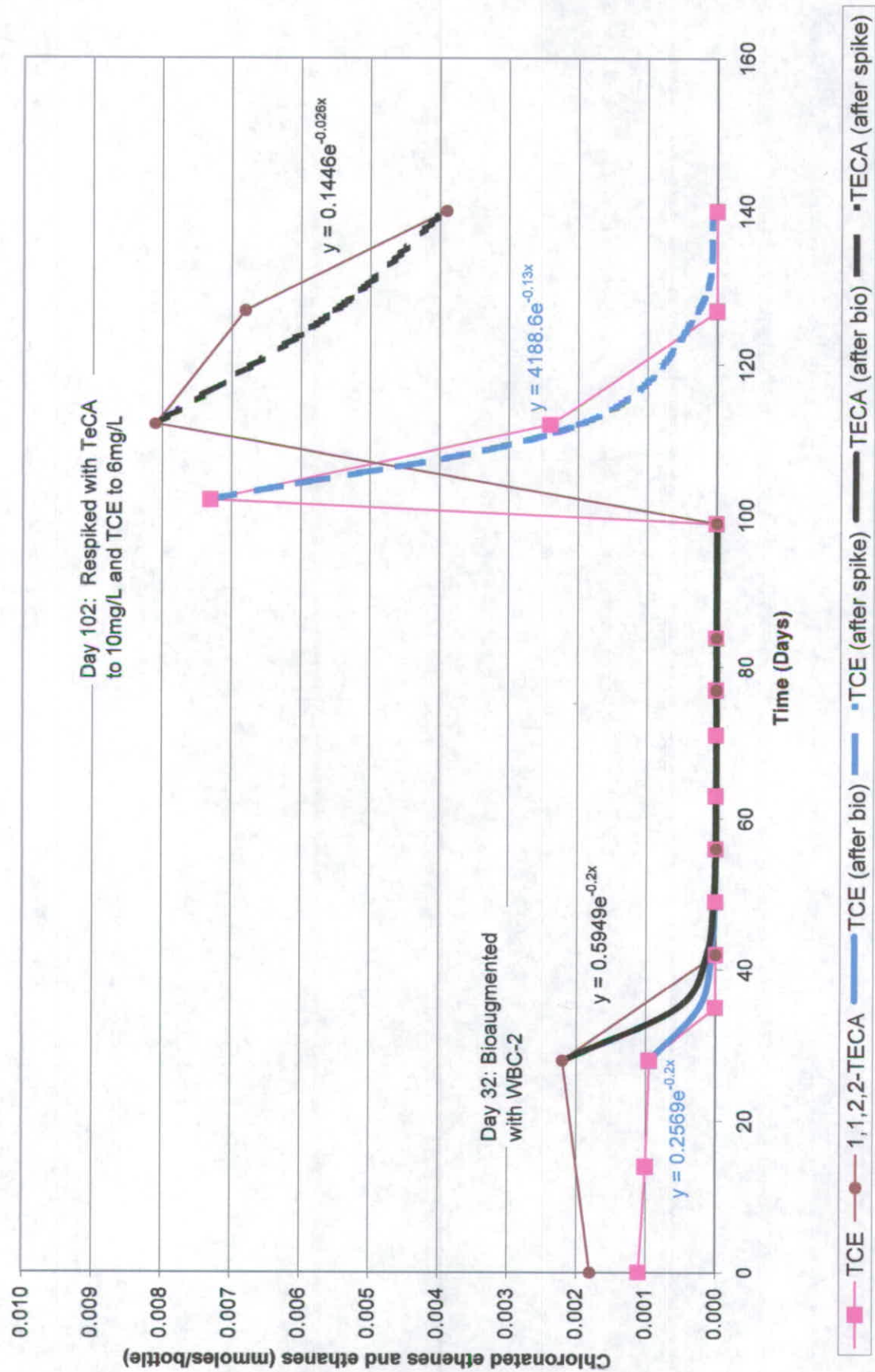
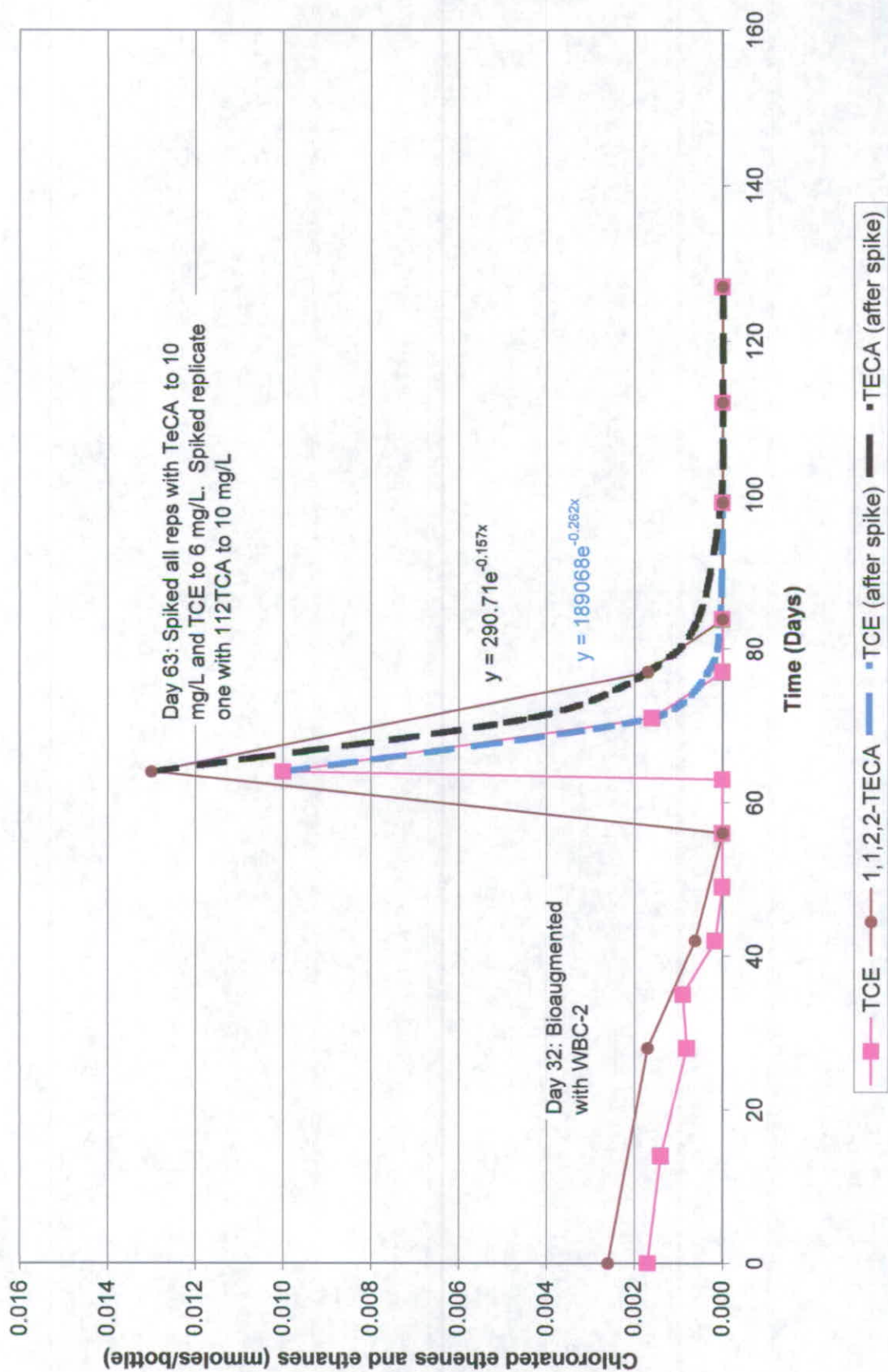


**Figure D-14: Amended with Chitin and Bioaugmented with WBC-2
Degradation Rate Assessment**



[illegible]

[illegible]

TREATMENT	DATE	DAY	Ingestant (mg/L)	Residue (mg/L)	Chlorinated Ethanes				Chlorinated Ethenes				CA	Ethane	Comment	
					TCF	CS-1,3-DCE	trans-1,2-DCE	VC	Total Ethanes	1,1,1,2-TECA	1,1,2-TECA	1,3-TECA				
WBC-3 culture + lactate	22-Jan-07	14	EOB 104-1	10	0.71	0.033	<0.010	<0.010	<0.010	<0.010	0.076	<0.010	<0.010	<0.010	<0.010	
			EOB 104-2	11	0.76	0.034	<0.010	<0.010	<0.010	<0.010	0.076	<0.010	<0.010	<0.010	<0.010	
			EOB 104-3	12	0.71	0.033	<0.010	<0.010	<0.010	<0.010	0.074	<0.010	<0.010	<0.010	<0.010	
			Standard Deviation (mg/L)													
			Average Total residues													
	03-Feb-07	28	EOB 104-1	10	0.74	0.036	<0.010	<0.010	<0.010	<0.010	0.077	<0.010	<0.010	<0.010	<0.010	
			EOB 104-2	11	0.89	0.034	<0.010	<0.010	<0.010	<0.010	0.077	<0.010	<0.010	<0.010	<0.010	
			EOB 104-3	12	0.71	0.035	<0.010	<0.010	<0.010	<0.010	0.074	<0.010	<0.010	<0.010	<0.010	
			Standard Deviation (mg/L)													
			Average Total residues													
	19-Feb-07	42	EOB 104-1	10	0.75	0.036	<0.010	<0.010	<0.010	<0.010	0.077	<0.010	<0.010	<0.010	<0.010	
			EOB 104-2	11	0.79	0.036	<0.010	<0.010	<0.010	<0.010	0.076	<0.010	<0.010	<0.010	<0.010	
		EOB 104-3	12	0.77	0.035	<0.010	<0.010	<0.010	<0.010	0.074	<0.010	<0.010	<0.010	<0.010		
		Standard Deviation (mg/L)														
		Average Total residues														
03-Mar-07	56	EOB 104-1	10	0.88	0.041	<0.010	<0.010	<0.010	<0.010	0.077	<0.010	<0.010	<0.010	<0.010		
		EOB 104-2	11	0.58	0.034	<0.010	<0.010	<0.010	<0.010	0.076	<0.010	<0.010	<0.010	<0.010		
		EOB 104-3	12	0.78	0.033	<0.010	<0.010	<0.010	<0.010	0.074	<0.010	<0.010	<0.010	<0.010		
		Standard Deviation (mg/L)														
		Average Total residues														
20-Mar-07	71	EOB 104-1	10	0.71	0.041	<0.010	<0.010	<0.010	<0.010	0.077	<0.010	<0.010	<0.010	<0.010		
		EOB 104-2	11	0.78	0.035	<0.010	<0.010	<0.010	<0.010	0.076	<0.010	<0.010	<0.010	<0.010		
		EOB 104-3	12	0.6	0.03	<0.010	<0.010	<0.010	<0.010	0.073	<0.010	<0.010	<0.010	<0.010		
		Standard Deviation (mg/L)														
		Average Total residues														
25-Mar-07	77	EOB 104-1	10	0.74	0.044	<0.010	<0.010	<0.010	<0.010	0.076	<0.010	<0.010	<0.010			

TREATMENT	DATE	DAY	Treatments Analyzed	Depth	Chlorinated Ethanes				Chlorinated Ethanes				CA	Ethane	Comment	
					TCE	cis-1,2-DC	trans-1,2-DC	VC	Total Ethane	1,1,2,2-TECA	1,1,2-TECA	1,3-DCA				
14-Feb-07	42		Average Concentration (mg/L)	0.38	0.06	0.06	0.04	0	0	0	0	0	0	0	0	
			Standard Deviation (mmoles)	1.0E-03	1.0E-03	1.5E-04	1.5E-04	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
25-Feb-07	43		Average Concentration (mg/L)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			Standard Deviation (mmoles)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
05-Mar-07	58		Average Concentration (mg/L)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			Standard Deviation (mmoles)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
12-Mar-07	61		Average Concentration (mg/L)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			Standard Deviation (mmoles)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
13-Mar-07	64		Average Concentration (mg/L)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			Standard Deviation (mmoles)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
20-Mar-07	71		Average Concentration (mg/L)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			Standard Deviation (mmoles)	0	0.01	0.01	0.01	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
			WBC-2 + LAC-2	0.010	0.011	0.002	0.001	0	0	0	0	0	0	0	0	
20-Mar-07	77		Average Concentration (mg/L)													

TREATMENT	DATE	DAY	Turbidity (ntu)	pH	TCE (mg/L)	Chlorine Residual (mg/L)		Chlorine Demand (mg/L)		Chlorine Demand (mg/L)		Chlorine Demand (mg/L)		CA (mg/L)	Etiology (mg/L)																																																														
						Free Chlorine (mg/L)	Total Chlorine (mg/L)	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Free Chlorine (mg/L)	Total Chlorine (mg/L)																																																																
WB2C3 bioaugmented with EGS 598	05-Jun-07 05-Jun-07	3	Average Total Turbidity (ntu)	Average pH	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013																																																														
																WB2C3 + EGS 598-1	19	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03																																																			
																											WB2C3 + EGS 598-2	17	0.08	0.08	0.08	0.08	0.08	0.08	0.08																																										
																																				WB2C3 + EGS 598-3	18	0.08	0.08	0.08	0.08	0.08	0.08																																		
																																												Standard Deviation (mg/L)	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011																											
																																																			Average Total Turbidity (ntu)	0.0011	0.0011	0.0011	0.0011	0.0011																					
																																																									WB2C3 + EGS 598-1	18	0.03	0.03	0.03	0.03	0.03														
																																																																WB2C3 + EGS 598-2	17	0.04	0.04	0.04	0.04	0.04							
																																																																							WB2C3 + EGS 598-3	18	0.04	0.04	0.04	0.04	0.04
Average Total Turbidity (ntu)	0.0011	0.0011	0.0011	0.0011	0.0011																																																																								
						WB2C3 + EGS 598-1	18	0.04	0.04	0.04	0.04	0.04																																																																	
													WB2C3 + EGS 598-2	17	0.05	0.05	0.05	0.05	0.05																																																										
																				WB2C3 + EGS 598-3	18	0.05	0.05	0.05	0.05	0.05																																																			
																											Standard Deviation (mg/L)	0.0011	0.0011	0.0011	0.0011	0.0011																																													
																																	Average Total Turbidity (ntu)	0.0011	0.0011	0.0011	0.0011	0.0011																																							
																																							WB2C3 + EGS 598-1	18	0.05	0.05	0.05	0.05	0.05																																
																																														WB2C3 + EGS 598-2	17	0.06	0.06	0.06	0.06	0.06																									
																																																					WB2C3 + EGS 598-3	18	0.06	0.06	0.06	0.06	0.06																		
																																																												Standard Deviation (mg/L)	0.0011	0.0011	0.0011	0.0011	0.0011												
Average Total Turbidity (ntu)	0.0011	0.0011	0.0011	0.0011	0.0011																																																																								
						WB2C3 + EGS 598-1	18	0.06	0.06	0.06	0.06	0.06																																																																	
													WB2C3 + EGS 598-2	17	0.07	0.07	0.07	0.07	0.07																																																										
																				WB2C3 + EGS 598-3	18	0.07	0.07	0.07	0.07	0.07																																																			
																											Standard Deviation (mg/L)	0.0011	0.0011	0.0011	0.0011	0.0011																																													
																																	Average Total Turbidity (ntu)	0.0011	0.0011	0.0011	0.0011	0.0011																																							
																																							WB2C3 + EGS 598-1	18	0.07	0.07	0.07	0.07	0.07																																
																																														WB2C3 + EGS 598-2	17	0.08	0.08	0.08	0.08	0.08																									
																																																					WB2C3 + EGS 598-3	18	0.08	0.08	0.08	0.08	0.08																		
																																																												Standard Deviation (mg/L)	0.0011	0.0011	0.0011	0.0011	0.0011												
Average Total Turbidity (ntu)	0.0011	0.0011	0.0011	0.0011	0.0011																																																																								
						WB2C3 + EGS 598-1	18	0.08	0.08	0.08	0.08	0.08																																																																	
													WB2C3 + EGS 598-2	17																																																															

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Analytical Results of Microbial Indicator Parameters During Microcosm Study
Off Depot Groundwater Remedial Design

TREATMENT	DATE	DAY	Treatment Replicate	bottle #	Total VFA mg/L	Chloride mg/L	Nitrite mg/L	Nitrate mg/L	Sulphate mg/L	Bromide mg/L	Phosphate mg/L	pH
Anaerobic Active Control	8-Jan-07	0	ANSC-1	1	8.0	82	<0.12	12	23	<0.39	<0.59	6.40
			ANSC-2	2	12	84	0.25	12	22	<0.39	<0.59	-
			ANSC-3	3	4.9	80	0.21	12	21	<0.39	<0.59	-
			Average Concentration		8.2	82	0.23	12	22	ND	ND	-
	22-Jan-07	14	ANSC-1	1	8.5	85	<0.12	13	34	<0.39	<0.59	-
			ANSC-2	2	9.6	95	<0.12	13	33	<0.39	<0.59	6.27
			ANSC-3	3	9.4	89	<0.12	13	34	<0.39	<0.59	-
			Average Concentration		9.2	93	ND	13	34	ND	ND	-
	5-Feb-07	28	ANSC-1	1	12	118	<0.12	22	23	2.9	<0.59	-
			ANSC-2	2	4.4	110	<0.12	21	23	2.3	<0.59	6.73
			ANSC-3	3	7.4	103	<0.12	21	23	2.4	<0.59	6.31
			Average Concentration		8.0	110	ND	21	23	2.8	ND	-
	5-Mar-07	56	ANSC-1	1	8.8	109	<0.12	18	24	1.0	<0.59	6.18
			ANSC-2	2	4.6	109	<0.12	18	24	0.70	<0.59	6.18
			ANSC-3	3	11	104	<0.12	17	23	0.77	<0.59	6.12
			Average Concentration		7.2	107	ND	18	24	0.81	ND	-
	22-Mar-07	73	ANSC-1	1	-	-	-	-	-	-	-	-
			ANSC-2	2	-	-	-	-	-	-	-	-
			ANSC-3	3	-	-	-	-	-	-	-	6.30
			Average Concentration		-	-	-	-	-	-	-	-
	2-Apr-07	84	ANSC-1	1	6.4	107	<0.12	17	23	<0.39	0.72	6.34
			ANSC-2	2	5.7	112	<0.12	18	24	<0.39	<0.59	-
			ANSC-3	3	8.5	108	<0.12	17	23	<0.39	<0.59	-
			Average Concentration		6.9	108	NA	17	23	ND	0.72	-
	8-Jan-07	0	ANAC-1	4	3.1	11	0.24	1.9	18	<0.39	<0.59	6.49
			ANAC-2	5	7.7	11	<0.12	2.3	19	<0.39	<0.59	-
			ANAC-3	6	12	10	0.21	2.2	18	<0.39	<0.59	-
			Average Concentration		7.8	11	0.23	2.2	18	ND	ND	-
	22-Jan-07	14	ANAC-1	4	6.3	20	<0.12	2.3	26	<0.39	<0.59	-
			ANAC-2	5	7.1	13	<0.12	2.4	26	<0.39	<0.59	6.64
			ANAC-3	6	9.9	12	<0.12	2.4	26	<0.39	<0.59	-
			Average Concentration		7.4	16	ND	2.4	26	ND	ND	-
	5-Feb-07	28	ANAC-1	4	3.9	16	<0.12	2.7	22	1.0	<0.59	-
			ANAC-2	5	4.0	16	<0.12	2.8	23	0.92	<0.59	6.91
			ANAC-3	6	4.0	17	<0.12	2.8	24	1.0	<0.59	6.64
			Average Concentration		4.0	17	ND	2.7	23	1.0	ND	-
	5-Mar-07	56	ANAC-1	4	6.8	17	<0.12	2.5	23	0.42	<0.59	6.19
			ANAC-2	5	4.2	15	<0.12	2.3	21	0.17	<0.59	6.17
			ANAC-3	6	3.5	15	<0.12	1.7	21	<0.39	<0.59	6.18
			Average Concentration		4.8	15	ND	2.1	22	0.28	ND	-
	22-Mar-07	73	ANAC-1	4	-	-	-	-	-	-	-	-
			ANAC-2	5	-	-	-	-	-	-	-	6.32
			ANAC-3	6	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
	2-Apr-07	84	ANAC-1	4	4.8	16	<0.12	2.0	23	<0.39	<0.59	6.35
			ANAC-2	5	4.7	16	<0.12	2.0	23	<0.39	<0.59	-
			ANAC-3	6	5.0	18	<0.12	1.0	23	<0.39	<0.59	-
			Average Concentration		4.8	17	ND	1.7	23	ND	ND	-
Lactate	8-Jan-07	0	Lactate - 1	7	203	13	0.28	2.3	18	<0.39	<0.59	6.56
			Lactate - 2	8	187	10	0.37	2.1	18	<0.39	<0.59	-
			Lactate - 3	8	186	10	0.22	2.0	18	<0.39	<0.59	-
			Average Concentration		192	11	0.28	2.1	18	ND	ND	-
	22-Jan-07	14	Lactate - 1	7	170	21	<0.12	<0.10	16	<0.39	<0.59	-
			Lactate - 2	8	108	13	<0.12	<0.10	22	<0.39	<0.59	-
			Lactate - 3	9	102	14	<0.12	<0.10	17	<0.39	<0.59	6.53
			Average Concentration		108	16	ND	ND	18	ND	ND	-
	5-Feb-07	28	Lactate - 1	7	258	18	<0.12	<0.10	18	1.0	<0.59	6.82
			Lactate - 2	8	238	18	<0.12	0.12	2.6	1.2	<0.59	6.70
			Average Concentration		238	18	<0.12	0.12	2.6	1.2	<0.59	6.70

Analytical Results of Microbial Indicator Parameters During Microcosm Study
Off Depot Groundwater Remedial Design

TREATMENT	DATE	DAY	Treatment Replicate	bottle #	Total VFA mg/L	Chloride mg/L	Nitrite mg/L	Nitrate mg/L	Sulphate mg/L	Selenide mg/L	Phosphate mg/L	pH
EOS	5-Mar-07	56	Lactate - 3	9	244	17	<0.12	0.16	2.2	1.1	<0.59	-
			Average Concentration		247	17	ND	0.16	2.2	1.1	ND	-
			Lactate - 1	7	250	21	<0.12	<0.10	0.87	<0.39	<0.59	6.46
			Lactate - 2	8	230	17	<0.12	<0.10	0.80	<0.39	<0.59	6.50
			Lactate - 3	9	232	16	<0.12	<0.10	1.0	<0.39	<0.59	6.49
			Average Concentration		237	18	ND	ND	0.88	ND	ND	-
	22-Mar-07	73	Lactate - 1	7	-	-	-	-	-	-	-	-
			Lactate - 2	8	-	-	-	-	-	-	-	6.57
			Lactate - 3	9	-	-	-	-	-	-	-	-
	28-Mar-07	77	Average Concentration		-	-	-	-	-	-	-	-
			Lactate - 1	7	-	-	-	-	-	-	-	6.87
			Lactate - 2	8	-	-	-	-	-	-	-	6.45
	2-Apr	84	Lactate - 3	9	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			Lactate - 1	7	204	17	<0.12	0.12	2.4	<0.39	0.84	6.47
	8-Jan-07	0	Lactate - 2	8	186	18	<0.12	<0.10	2.3	<0.39	0.84	-
			Lactate - 3	9	193	17	<0.12	0.16	1.8	<0.39	<0.59	-
			Average Concentration		188	17	ND	0.14	2.2	ND	0.89	6.24
			EOS - 1	10	50	10	<0.12	2.2	18	<0.39	<0.59	-
			EOS - 2	11	45	10	<0.12	2.1	18	<0.39	<0.59	-
			EOS - 3	12	49	10	0.23	2.2	17	<0.39	<0.59	-
WBC-2 + Lactate	22-Jan-07	14	Average Concentration		47	10	0.23	2.1	18	ND	ND	-
			EOS - 1	10	40	13	<0.12	<0.10	24	<0.39	<0.59	-
			EOS - 2	11	37	12	<0.12	<0.10	26	<0.39	<0.59	-
			EOS - 3	12	38	12	<0.12	<0.10	24	<0.39	<0.59	6.38
			Average Concentration		38	13	ND	ND	28	ND	ND	-
			EOS - 1	10	96	16	<0.12	0.11	2.1	1.2	<0.59	6.77
	5-Feb-07	28	EOS - 2	11	67	18	<0.12	0.12	25	1.0	<0.59	6.62
			EOS - 3	12	82	18	<0.12	<0.10	2.1	0.92	<0.59	-
			Average Concentration		78	17	ND	0.11	1.0	ND	ND	-
	5-Mar-07	56	EOS - 1	10	120	14	<0.12	<0.10	0.68	<0.39	<0.59	6.48
			EOS - 2	11	84	17	<0.12	<0.10	21	<0.39	<0.59	6.22
			EOS - 3	12	82	15	<0.12	<0.10	0.78	<0.39	<0.59	6.33
	22-Mar-07	73	Average Concentration		88	16	ND	ND	7.6	ND	ND	-
			EOS - 1	10	-	-	-	-	-	-	-	-
			EOS - 2	11	-	-	-	-	-	-	-	6.33
	26-Mar-07	77	EOS - 3	12	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			EOS - 1	10	-	-	-	-	-	-	-	6.57
	2-Apr-07	84	EOS - 2	11	-	-	-	-	-	-	-	-
			EOS - 3	12	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
	8-Jan-07	0	EOS - 1	10	108	17	<0.12	<0.10	1.1	<0.39	<0.59	-
			EOS - 2	11	74	18	<0.12	<0.10	24	<0.39	0.85	6.50
			EOS - 3	12	95	18	<0.12	<0.10	2.3	<0.39	<0.59	-
			Average Concentration		91	18	ND	ND	9.0	ND	0.88	-
			WBC-2 + Lactate - 1	13	161	10	0.2	2.1	19	<0.39	<0.59	6.46
			WBC-2 + Lactate - 2	14	180	10	0.2	2.1	18	<0.39	<0.59	-
WBC-2 + Lactate	22-Jan-07	14	WBC-2 + Lactate - 3	15	188	10	0.2	2.1	18	<0.39	<0.59	-
			Average Concentration		183	10	ND	2.1	16	ND	ND	-
			WBC-2 + Lactate - 1	13	108	15	<0.12	<0.10	22	<0.39	<0.59	-
			WBC-2 + Lactate - 2	14	104	18	<0.12	<0.10	21	<0.39	<0.59	6.52
			WBC-2 + Lactate - 3	15	104	12	<0.12	<0.10	22	<0.39	<0.59	-
			Average Concentration		108	18	ND	NA	21	ND	ND	-
	5-Feb-07	28	WBC-2 + Lactate - 1	13	223	17	<0.12	0.30	4.3	<0.39	<0.59	-
			WBC-2 + Lactate - 2	14	238	20	<0.12	0.37	3.0	1.0	<0.59	6.87
			WBC-2 + Lactate - 3	15	232	19	<0.12	0.14	1.7	1.1	<0.59	6.63
			Average Concentration		231	18	ND	0.27	3.0	1.0	ND	-

Analytical Results of Microbial Indicator Parameters During Microcosm Study
Off Depot Groundwater Remedial Design

TREATMENT	DATE	DAY	Treatment Replicate	bottle #	Total VFA mg/L	Chloride mg/L	Nitrite mg/L	Nitrate mg/L	Sulphate mg/L	Bromide mg/L	Phosphate mg/L	pH
WBC-2 + EVO	5-Mar-07	56	WBC-2 + Lactate - 1	13	245	20	<0.12	<0.10	0.78	<0.39	<0.59	6.49
			WBC-2 + Lactate - 2	14	248	21	<0.12	<0.10	0.41	<0.39	<0.59	6.59
			WBC-2 + Lactate - 3	15	252	21	<0.12	<0.10	0.52	<0.39	<0.59	6.61
	22-Mar-07	73	Average Concentration		248	20	ND	ND	0.57	ND	ND	-
			WBC-2 + Lactate - 1	13	-	-	-	-	-	-	-	-
			WBC-2 + Lactate - 2	14	-	-	-	-	-	-	-	6.59
	28-Mar-07	77	WBC-2 + Lactate - 3	15	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	6.62
			WBC-2 + Lactate - 1	13	-	-	-	-	-	-	-	-
	2-Apr-07	84	WBC-2 + Lactate - 2	14	-	-	-	-	-	-	-	-
			WBC-2 + Lactate - 3	15	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
	17-Apr-07	86	WBC-2 + Lactate - 1	13	236	29	<0.12	0.16	2.1	<0.39	<0.59	-
			WBC-2 + Lactate - 2	14	240	28	<0.12	0.18	2.1	<0.39	<0.59	6.48
			WBC-2 + Lactate - 3	15	250	29	<0.12	<0.10	1.2	<0.39	<0.59	-
	8-Jan-07	0	Average Concentration		242	29	ND	0.16	1.8	ND	ND	-
			WBC-2 + Lactate - 1	13	-	-	-	-	-	-	-	-
			WBC-2 + Lactate - 2	14	-	-	-	-	-	-	-	-
	22-Jan-07	14	WBC-2 + Lactate - 3	15	-	-	-	-	-	-	-	6.56
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Lactate - 1	13	37	10	0.13	2.1	18	<0.39	<0.59	6.23
	5-Feb-07	28	WBC-2 + EVO - 2	17	38	9.3	0.13	2.1	17	<0.39	<0.59	-
			WBC-2 + EVO - 3	18	43	9.3	0.18	2.0	17	<0.39	<0.59	-
			Average Concentration		39	10	0.18	2.1	17	ND	ND	-
	5-Mar-07	56	WBC-2 + EVO - 1	16	36	12	<0.12	<0.10	2.4	<0.39	<0.59	-
			WBC-2 + EVO - 2	17	42	13	<0.12	<0.10	2.0	<0.39	<0.59	6.42
			WBC-2 + EVO - 3	18	34	11	<0.12	<0.10	2.4	<0.39	<0.59	-
	22-Mar-07	73	Average Concentration		37	12	ND	ND	17	ND	ND	-
			WBC-2 + EVO - 1	16	90	18	<0.12	0.16	3.8	0.88	<0.59	-
			WBC-2 + EVO - 2	17	106	17	<0.12	<0.10	1.8	0.74	<0.59	6.67
	26-Mar-07	77	WBC-2 + EVO - 3	18	71	16	<0.12	0.26	1.9	0.88	<0.59	6.55
			Average Concentration		89	16	ND	0.20	2.8	0.83	ND	-
			WBC-2 + EVO - 1	16	174	22	<0.12	<0.10	1.4	1.8	<0.59	6.26
	2-Apr-07	84	WBC-2 + EVO - 2	17	183	19	<0.12	<0.10	0.49	3.3	<0.59	6.22
			WBC-2 + EVO - 3	18	153	19	<0.12	<0.10	0.80	<0.39	<0.59	6.20
			Average Concentration		170	20	ND	ND	0.83	2.88	ND	-
	17-Apr-07	86	WBC-2 + EVO - 1	16	-	-	-	-	-	-	-	-
			WBC-2 + EVO - 2	17	-	-	-	-	-	-	-	6.49
			WBC-2 + EVO - 3	18	-	-	-	-	-	-	-	-
	28-Mar-07	77	Average Concentration		-	-	-	-	-	-	-	6.43
			WBC-2 + EVO - 1	16	-	-	-	-	-	-	-	-
			WBC-2 + EVO - 2	17	-	-	-	-	-	-	-	-
	2-Apr-07	84	WBC-2 + EVO - 3	18	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + EVO - 1	16	178	20	<0.12	<0.10	0.91	5.3	<0.59	-
	17-Apr-07	86	WBC-2 + EVO - 2	17	195	23	<0.12	0.26	1.5	6.3	<0.59	6.53
			WBC-2 + EVO - 3	18	136	21	<0.12	0.13	1.0	<0.39	<0.59	-
			Average Concentration		176	21	ND	0.20	1.1	6.8	ND	-
	8-Jan-07	0	WBC-2 + EVO - 1	16	-	-	-	-	-	-	-	-
			WBC-2 + EVO - 2	17	-	-	-	-	-	-	-	-
			WBC-2 + EVO - 3	18	-	-	-	-	-	-	-	6.43
	22-Jan-07	14	Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	3.2	28	0.20	1.9	19	<0.39	<0.59	6.49
			WBC-2 + Chitin-2	20	4.5	29	0.21	2.0	18	<0.39	<0.59	-
	22-Jan-07	14	WBC-2 + Chitin-3	21	4.1	32	0.23	1.8	18	<0.39	<0.59	-
			Average Concentration		3.9	30	0.21	1.9	18	ND	ND	-
			WBC-2 + Chitin-1	19	146	41	<0.12	<0.10	0.66	<0.39	<0.59	-
			WBC-2 + Chitin-2	20	115	43	<0.12	<0.10	0.52	<0.39	<0.59	6.76

Analytical Results of Microbial Indicator Parameters During Microcosm Study
Off Depot Groundwater Remedial Design

TREATMENT	DATE	DAY	Treatment Replicate	bottle #	Total VFA mg/L	Chloride mg/L	Nitrite mg/L	Nitrate mg/L	Sulphate mg/L	Bromide mg/L	Phosphate mg/L	pH
5-Feb-07		28	WBC-2 + Chitin-3	21	102	44	<0.12	<0.10	0.24	<0.39	<0.59	-
			Average Concentration		121	43	ND	ND	0.47	ND	ND	-
			WBC-2 + Chitin-1	19	313	59	<0.12	0.12	2.3	2.3	<0.59	-
			WBC-2 + Chitin-2	20	330	60	<0.12	0.20	6.1	2.3	<0.59	8.82
			WBC-2 + Chitin-3	21	310	59	<0.12	0.16	2.4	1.9	<0.59	7.02
			Average Concentration		318	58	ND	0.16	3.6	2.1	ND	-
			WBC-2 + Chitin-1	19	365	57	<0.12	<0.10	0.64	0.19	6.3	6.74
			WBC-2 + Chitin-2	20	368	60	<0.12	<0.10	6.4	0.21	5.0	6.78
			WBC-2 + Chitin-3	21	379	62	<0.12	<0.10	1.1	0.30	7.8	6.74
			Average Concentration		387	60	ND	ND	2.3	0.23	6.3	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	6.82
22-Mar-07		73	WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	431	107	<0.12	0.19	2.1	<0.39	<0.59	-
			WBC-2 + Chitin-2	20	431	101	<0.12	0.11	6.2	0.41	<0.59	6.52
2-Apr-07		84	WBC-2 + Chitin-3	21	388	117	<0.12	<0.10	2.7	<0.39	<0.59	-
			Average Concentration		420	108	ND	0.16	3.6	0.41	ND	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
17-Apr-07		89	WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-
			WBC-2 + Chitin-1	19	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-2	20	-	-	-	-	-	-	-	-
			WBC-2 + Chitin-3	21	-	-	-	-	-	-	-	-
			Average Concentration		-	-	-	-	-	-	-	-

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