FINAL

Well Installation Report For
Wells CS-WB05 to CS-WB08 and CS-B-3-MW01
CDRL A001D

Prepared for:

Camp Stanley Storage Activity
Boerne, Texas

SEPTEMBER 2007

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TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

SECTION 1
INTRODUCTION

1.1 PURPOSE

From August 2005 through November 2005, five new groundwater monitoring wells were installed at Solid Waste Management Unit (SWMU) B-3, located at Camp Stanley Storage Activity (CSSA). These well installations were performed under Task Order 0006 (TO-6), Work Breakdown Structure (WBS) 07000.

The wells were installed to aid in the horizontal and vertical delineation of solvent contamination within the middle Trinity Aquifer (the aquifer) at CSSA. The aquifer consists of the Lower Glen Rose Limestone (LGR), the Bexar Shale (BS), and the Cow Creek Limestone (CC) formations. This report describes the field methods, results, conclusions, and recommendations associated with the SWMU B-3 groundwater monitoring well installation activities. New wells constructed under TO-6 WBS 06000 will be included in reports scheduled for delivery under that WBS.

1.2 PROJECT AUTHORIZATION

The monitoring well installations were authorized under Air Force Center for Environmental Excellence (AFCEE) Contract Number FA8903-04-D-8675, TO-6. This work was conducted by Parsons under the technical supervision of AFCEE, and has been overseen by the U.S. Environmental Protection Agency (EPA) Region VI Resource Conservation and Recovery Act (RCRA) Enforcement Section since October 1993.

This report summarizes work associated with new monitoring well installations at SWMU B-3. Limited interpretation of data collected during installation of the wells, including data from discrete-interval sampling, is presented in this report. Detailed interpretation of the CSSA well data collected under TO-6 will be presented in an update report addendum to the ***Hydrogeologic Conceptual Site Model (HCSM) Report*** (Parsons 2005).

A chronology of work conducted in association with the CSSA groundwater investigation is provided in ***Volume 1-1*** of the ***CSSA Environmental Encyclopedia*** (***Encyclopedia***). A detailed review of the investigation's regulatory basis, and previous monitoring well installation reports, is contained in ***Volume 4-1*** of the ***Encyclopedia***. Decontamination and investigation-derived media management procedures are also explained therein.

1.3 OBJECTIVES AND SCOPE OF INVESTIGATION

The objective of the additional monitoring well installation is to provide additional data for determining the extent of groundwater contamination in the aquifer at CSSA, and to monitor the effects of an interim remedial action at SWMU B-3. Parsons was contracted to perform a Pilot Study to evaluate enhanced anaerobic bioremediation as a remedial option for groundwater contaminants at the SWMU B-3 landfill. The Pilot Study will involve injection of an organic substrate into the LGR Formation at SWMU B-3 and monitoring the effects of the substrate on anaerobic contaminant biodegradation rates. For Pilot Study details, see the ***Work Plan For Enhanced Anaerobic Biodegradation Pilot Test At SWMU B-3*** (Parsons 2005) and ***Groundwater Tracer and Organic Substrate Injection Specifications*** (Parsons Technical Memorandum, January 2006). The SWMU B-3 well installation efforts included the following specific objectives:

1. Install one conventional monitoring well and three multi-port monitoring wells in the LGR.
2. Install one multi-port monitoring well into the CC Formation with monitoring access to all three members of the aquifer.
3. Conduct downhole geophysical surveys at each drilling location.
4. Conduct a hydrophysical survey at the deep CC multi-port monitoring well location.
5. Collect soil vapor samples from selected hydrologic zones at each multi-port well borehole. Provide laboratory analysis for up to four samples from each borehole for the predetermined list of volatile organic compounds (VOC).
6. Collect up to four discrete groundwater samples from selected hydrologic zones at each multi-port well borehole. Analyze samples for the predetermined short list of VOCs.
7. Develop the monitoring wells.
8. Survey new monitoring well locations.
9. Complete the conventional monitoring well so it is capable of also serving as a groundwater and substrate injection well.
10. Manage investigation-derived media and construction debris.
11. Prepare a well installation report.

1.4 REPORT ORGANIZATION

This report is organized into five sections. ***Section 1*** presents an overview of the report, including the project purpose, objectives, and scope of the well installation work accomplished under TO-6. ***Section 2*** contains the methods used for installation of the wells. This includes discussion of the drilling activities, monitoring well construction, surface completions, monitoring well development, geophysical and hydrophysical logging (HPL), discrete interval sampling, and well location surveys. A field narrative of relevant events in chronological order is presented in ***Section 3***. ***Section 4*** describes findings of the ongoing groundwater investigation. ***Section 5*** contains report conclusions and recommendations. Supporting data and electronic data compact discs (CDs) are included in the appendices.

SECTION 2
WELL INSTALLATION METHODS

2.1 SCOPE

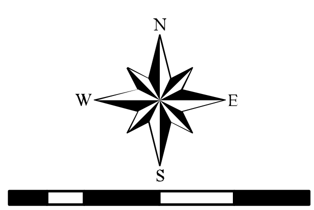
A total of five groundwater monitoring wells were drilled and installed at SWMU B-3. Four wells were designed to monitor selected, discrete-depth intervals within the aquifer and were completed with Westbay® (WB) MP-38 Multi-port Systems. Three of the WB wells also monitor the lower portion of the Upper Glen Rose Limestone (UGR). The main purpose of these wells is to generate data from the Pilot Study substrate injection and monitor the effects of subsequent interim remedial efforts against the solvent plume associated with SWMU B-3. A fifth well was constructed as a conventional monitoring well, monitoring only one screened interval, and will serve a dual purpose as an injection well and monitoring well.

2.2 DETERMINATION OF WELL LOCATIONS

Well locations were selected in accordance with project objectives and with consideration given to drilling rig accessibility and existing utilities. The CSSA Environmental Office approved the specific drilling locations after review of Parsons' recommendations. Final well locations are shown in Figure 1.

Drilling locations for the four TO-6 WB monitoring wells were selected to optimize observations of recharge and flow pathways, both vertically and horizontally, from SWMU B-3. The possible recharge pathways are intended to represent the contaminant flow paths within the aquifer. Monitoring in areas of higher contamination (closer to SWMU B-3) provided data to assess effects of enhanced biodegradation within the bioreactor cells.

The selected Pilot Study location is between the suspected source area at the SWMU B-3 landfill and well CS-MW16-LGR, where known contaminants are present in the groundwater. The monitoring/injection well (CS-B3-MW01) was installed along the migration pathway between the suspected source and well MW16-LGR to facilitate injection of organic substrate. The deepest WB monitoring well (CS-WB05) will be utilized as the downgradient monitoring point for the study. Well CS-WB05 was installed between CS-B3-MW01 and the pilot study's pumping wells (CS-MW16-LGR and CS-MW16-CC). It will also be utilized as the main downgradient monitoring point for the substrate injection test. CS-WB05 also served as the main multi-port observation well for the CS-MW16 cluster pumping tests conducted under TO-6 WBS 12000. CS-WB06 and CS-WB07 will monitor the study's effects in the southward and westward downgradient directions, respectively, from SWMU B-3. Well CS-WB08 was drilled in an upgradient location, east of SWMU B-3, and should provide site background data.



Westbay® Well Location
Injection Well Location
Water Well Locations
SWMU Boundary

Figure 1

Locations of TO-06 Westbay Wells at SWMU B-3
Camp Stanley Storage Activity, Texas

PARSONS

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2.3 WORK PLAN DEVELOPMENT

2.3.1 Original TO-6 Statement of Work

Construction of monitoring wells at SWMU B-3 under TO-6 was conducted in accordance with AFCEE's Model Field Sampling Plan (MFSP) Version 1.1, and the TO-6 Sampling and Analysis Plan (SAP) Addendum. Two modifications were completed for the initial SOW.

2.3.2 TO-6 Modification 01, September 2004

Modification 01 did not impact TO-6 WBS 07000.

2.3.3 TO-6 Modification 02, June 2005

Modification 02 additions to WBS 07000 included extending one of the WB wells into the CC (instead of terminating the well in the lower portion of the LGR), additional geophysical logging and discrete sampling services as a result of the added borehole depth, hydrophysical logging and testing for all four WB wells, and use of FLUTe™ liners. The liners were added to seal the boreholes and prevent cross contamination during periods of inactivity between construction and testing phases.

In addition, construction of a monitoring/injection well was added. Originally, Well CS-D was to be used as an injection well for the push-pull substrate test. It was later determined that well CS-D would not be suitable for the push-pull substrate test. The new well was constructed for injection of tracer and substrate material into the groundwater as part of the B-3 enhanced anaerobic biodegradation pilot study.

2.4 WELL INSTALLATION

Monitoring well installations at each location generally followed the same sequence of events, beginning with the set up of a safety and quality assurance/quality control (QA/QC) exclusion zone around the drilling rig and impacted area. A containment area was constructed to surround the wellhead and the drilling table of the rig. The overall size of each exclusion zone depended on the well location and anticipated volume of water and cuttings that might be produced. Each well was drilled using air rotary methods in accordance with the SAP. The subcontractor for drilling operations was GeoProjects International, Inc. (GPI) located in Austin, Texas. Non-chlorinated water used for fluid injection during drilling was obtained from CSSA water supply well CS-9. Drilling through the dry portions of the limestone formation requires small amounts of injected water for lubrication, cooling, and to assist in lifting the drill cuttings out of the hole. For the installation of the wells at SWMU B-3, the drilling subcontractor did not use foaming agents or other drilling additives to aid fluid circulation.

A "TOTCO" single shot declination tool was used during drilling to check the plumbness every 50 feet of borehole advancement. According to the ***Work Plan***, borehole declination may not deviate more than 2 degrees from true vertical as per AFCEE specifications. A summary of results for the declination surveys is included in **Appendix A**. After drilling, the well was cleaned by surging and forced air-lifting.

All investigation-generated water, soil, and cuttings were characterized by laboratory analysis prior to final disposition. All water produced during SWMU B-3 drilling and development was assumed to contain tetrachloroethene (PCE) or trichloroethene (TCE) and was treated at the on-post granular activated carbon (GAC) system and released at Texas Pollutant Discharge Elimination System (TPDES) permitted Outfall 002. For safety purposes, air at the drilling areas and active wellheads was periodically screened by photoionization detector (PID) to monitor for the presence of VOCs. Concentrations of VOCs and metals in all solid media were below Texas Risk Reduction Program (TRRP) Tier 1 Residential Primary Contaminant Levels (PCL), and the media were discharged on-post as per the ***CSSA RCRA Facility Investigation and Interim Measures Waste Management Plan*** approved by the EPA and Texas Commission on Environmental Quality (TCEQ).

2.5 INJECTION WELL CONSTRUCTION

Well construction design for the monitoring/injection well CS-B3-MW01, followed specifications used for previous monitoring well installation work at CSSA. Monitoring well construction materials included 4-inch diameter Schedule 80 polyvinyl chloride (PVC) risers, 10 feet of 4-inch diameter stainless steel well screen, clean ¾-inch pea gravel, bentonite, and cement-bentonite grout.

Surface completion followed standard specifications, with a 4-foot square concrete pad on top, and 3-foot bollards emplaced at each outside corner of the pad. The terminal end of the PVC riser above ground is protected by a lockable, steel cover cemented into the pad.

Well CS-B3-MW01 was drilled with a 7-$^{7}/_{8}$-inch diameter tri-cone drill bit to a depth of 292.5 feet below ground surface (bgs). Drilling depth was based on geophysical logs from CS-WB05 located adjacent to the CS-B3-MW01 borehole. During this portion of the project, geophysical logs from CS-WB05 were used to determine hydrostragraphic zones suitable for substrate injection. Visual observations of cuttings were recorded to provide indication of unusual or unexpected changes in rock characteristics.

Geo Cam, Inc., of San Antonio, Texas conducted geophysical logging at the injection well. A 10-foot, Schedule 304 stainless steel, continuous-wrap screen was installed at an interval determined by geophysical logging, water injection tests, and discrete interval groundwater (DIGW) sampling results at the adjacent CS-WB05. The diameter of the well screen is 4 inches, and the wire-wound slot size is 0.050 inch.

Using a decontaminated scoop and approximately 1 to 2 gallons per minute (gpm) of clean water, clean pea gravel was deposited downhole into the annulus between the well screen and the rock formation. The pea gravel was deposited to a depth 3 feet above the top of the screen. Gravel was used instead of sand because the particular grain size of sand needed was unavailable from several suppliers. A finer-grained filter pack with reduced porosity and conductivity would not allow the injected substrate to flow through the well screen and filter pack at the required rates. The pea gravel was thoroughly washed and steam-cleaned before use. Dehydrated bentonite pellets were then added to create a 6.5-foot thick plug above the gravel. These uncoated pellets were added slowly by hand to prevent bridging in the upper portions of the well. The bentonite pellets were then allowed to hydrate for 2 hours before proceeding with grouting in the annular space above. The annular space was pressure-grouted in small separate lifts, from bottom to surface. The grout slurry mixture consisted of water, Portland cement, and 3 to 5 percent bentonite powder mixed to a density of 14.5 pounds per gallon.

2.6 WESTBAY WELL CONSTRUCTION

Three WB multi-port well systems were constructed to profile the upper portions of the LGR and the basal layers of the UGR in the SWMU B-3 area. These wells were completed 330 to 335 feet bgs to the base of the LGR. One WB well was completed to 480 feet bgs to monitor the Middle Trinity horizon from the top of the LGR to the base of the CC.

2.6.1 WB Borehole Construction

The start of the WB installation process was the same as that of the injection well. An exclusion zone was set up around the wellhead and the drill rig. Containment around the wellhead was erected using 2″x10″ boards and heavy plastic liner. The drilling subcontractor used no foaming agents or other drilling additives during drilling or well construction.

Overdrilling at 7-$^{7}/_{8}$-inch diameter was performed, and then PVC surface casing was installed and temporarily grouted with bentonite chips. The UGR at the CS-WB05 location was cased off due to borehole stability concerns. Borehole drilling proceeded at a nominal diameter of 4.25 inches to total depth.

A "TOTCO" single shot declination tool was used at all the boreholes during drilling to check the plumbness every 50 feet of advancement. When the well total depth was reached, the drillers surged the wells to remove loose sediment. After review of the logs, discrete interval soil gas (DISG) sampling and DIGW sampling was performed for selected geologic zones. Geophysical logging and discrete sampling procedures followed the procedures presented in ***Sections 2.8*** and ***2.9*** of the ***TO-42 Well Installation Report*** (TO-42 Report), ***Volume 4-1*** of the ***Encyclopedia***.

RAS, Inc. (RAS) performed geophysical logging and video surveying for each new WB borehole. Hydrophysical logging was also conducted at the deeper CC borehole. Parsons and GPI then performed standard DIGW sampling at selected zones utilizing GPI's dual packer apparatus. Discrete groundwater samples were analyzed for short list VOCs (see Sec. 2.10). The wells were developed and the discharge transported to the on-post GAC system for treatment. Following development, each borehole was temporarily sealed by flexible FLUTe liner technology pending mobilization of RAS. After logging, the wells were resealed with FLUTe liners until emplacement of WB systems was complete.

2.6.2 Interim Sealing of WB Boreholes

After drilling, a lapse of several weeks occurred between significant operations at the four new WB wells. To prevent contaminant communication between separate hydrologic zones in the boreholes, flexible FLUTe liners were installed.

FLUTe liners were delivered on large reels. Liners were clamped onto the temporary surface casings and filled with clean water, causing them to descend into the monitoring well. Once installed, the flexible liners sealed the boreholes against vertical flow of subsurface contaminants. The head of clean water within the liner was maintained above the head of surrounding groundwater to maintain positive liner pressure against the borehole wall. Neighboring wells were monitored on a weekly basis to ensure the liner did not lose positive pressure to possible groundwater fluctuations. Clean water was added to the liner as needed to ensure maintenance of positive pressure.

The process of liner removal was opposite to that of installation. Clean water inside the liner was pumped out as the liner was pulled upward. The liner exited the wellhead inverted and was rewound onto its reel.

2.6.3 WB Well Installation

All lithologic, geophysical, and video logs were reviewed before final well specifications were given to Westbay personnel. Special consideration regarding possible faults, fractures, and joints, water-bearing zones, karstic, and other geologic features was given toward selection of WB monitoring intervals. Final designs were a result of consultation between Parsons geologists, CSSA, and Westbay personnel. CSSA approved the specific placement of WB discrete monitoring intervals after a detailed review of justification in the ***Construction Recommendations for Proposed Westbay MP38 System Wells at CSSA SWMU B-3*** (Parsons Technical Memorandum, October 2005 [**Appendix B**]).

The WB apparatus was assembled in sections at CSSA according to Parsons final specifications. The WB well materials consisted of 1.5-inch PVC casing with multiple purge ports and 0.125-inch button valve sampling ports separated into zones by inflatable packers. The bottom portion of casing was capped.

Trained Westbay personnel carried out the installation of each WB system. GPI provided a winch truck and operators to assist with lowering the WB apparatus into the boreholes several sections at a time. Once the PVC pipe reached the water level in the borehole, clean water was added to the casing interior to counter buoyancy. There was no communication between the inside contents of the casing and the formation waters that filled the borehole annular space. Installation of the WB apparatus involved no reaming, outer casing, or grouting as required for the injection well.

Packers were inflated after an entire WB string was assembled and inserted into the borehole to the required depth. Packers were inflated with clean water and effectively isolated the selected sampling intervals. Westbay personnel used a MOSDAX® pressure probe to profile each WB interval. The pressure probe monitored the unique hydraulic pressure of each interval for change over time, which if observed would have indicated either a possible faulty seal between zones, or hydraulic connection with other zones via geologic features. Based on the readings, Westbay was able to assure that each zone was isolated and that the packers had sealed the sampling intervals properly. Parsons supervised and documented the installations. Digital photographs were taken at various points during the drilling and installations. Detailed construction specifications of each WB well are itemized in the ***Completion Report, MP38 Monitoring Wells: WB05,***

WB06, WB07, and WB08, prepared by Westbay Instruments, Inc. (**Appendix A)**. Specific details about WB casing installation may be found in the ***TO42 Report*** and ***TO42 SAP***, in the ***Encyclopedia***.

2.7 SURFACE COMPLETIONS

CS-B3-MW01 was completed with risers extending approximately 2.5 feet above ground surface (ags). The WB well risers were completed 1.2 feet ags to accommodate sampling equipment setup. A 6-inch square lockable well protector was installed over each monitoring wellhead. These housings consist of a 5-foot length of square tubing set 2 feet into concrete, leaving a remaining stick-up of 3 feet. The top portion of the square tubing is sealed, hinged, and provided with a lockable hasp.

A concrete pad, 4 feet square and 6 inches thick, was constructed around each well. A 2-inch diameter brass monument permanently stamped with the well identification was set into the concrete pad. Protective bollards, consisting of 4-inch-diameter carbon steel in 5-foot lengths, were installed at the corners of each well pad to provide protection to the aboveground portion of the well. The bollards were set in cement 2 feet below grade, leaving 3 feet above grade. The steel well protector and bollards were painted yellow.

2.8 GEOPHYSICAL AND HYDROPHYSICAL LOGGING

2.8.1 Remote Access Services

Hydrophysical logging, optical borehole imaging (OBI), natural gamma logging, electromagnetic induction (EM) logging, electrical resistivity logging, and caliper logging to characterize subsurface hydraulic characteristics at the four SWMU B-3 boreholes was performed by RAS. Characterization was achieved by:

- Evaluating temperature and fluid electrical conductivity (FEC);
- identifying fractures and features intersecting the boreholes and orientation of the features;
- quantifying groundwater flow in the boreholes;
- evaluating the vertical distribution of flow and interval-specific permeability for all identified water-producing fractures or intervals; and
- evaluating and correlating the lithology with transmissive zones.

Hydrophysical logging (HPL) was performed under non-pumping and pumping conditions to fully evaluate the water-bearing horizon of each well. Test results are explained in greater detail in the ***RAS Hydrophysical and Geophysical Logging Results Report,*** included in **Appendix C**.

2.8.1.1 Hydrophysical Logging

HPL was conducted by injecting deionized water (DI). Testing was conducted in two runs, pumping and non-pumping. During this process, FEC changes in the fluid column were recorded. These changes occurred when electrically contrasted formation water was drawn back into the borehole by pumping or by naturally occurring subsurface pressures (for non-pumping characterization). A downhole wireline HPL tool, which simultaneously measures FEC and temperature, was employed to log the physical and chemical changes of the emplaced fluid.

Additionally, prior to emplacement of DI water, ambient FEC and temperature (FEC/T) logs were acquired to assess the ambient fluid conditions within the borehole. During these runs, no pumping or DI emplacement was performed, and precautions were taken to preserve the existing ambient hydrogeological and geochemical conditions. These ambient water quality logs were completed to provide baseline values for the undisturbed subsurface groundwater conditions prior to testing. Computer analysis utilized the data for identification and evaluation of hydraulically conductive intervals and quantification of interval-specific flow rates. No heat-pulse flow metering was run by RAS.

2.8.1.2 Optical Televiewer

The optical borehole imaging televiewer, or OBI, provided direct optical observation of the borehole wall face. Precise measurements of the dip and direction of bedding and joint planes, along with other geological features, were possible in both air and clear fluid-filled boreholes.

The OBI tool directly imaged the borehole wall face. As the instrument was lowered, the raw analog video signal from the camera was transmitted uphole via coaxial wireline to televiewer surface instrumentation, where the analog signal was digitized and recorded. Features were picked by COLOG throughout each well by visual inspection of the digital images and analyzed by computer. Orientations were based on magnetic north and were corrected for declination.

2.8.1.3 Wireline Straddle Packer Apparatus

The basic operation of the RAS straddle packer system was similar to previous sampling efforts (see ***RL83*** and ***TO42 Reports*** in the ***Encyclopedia***). The main difference being that RAS employed three pressure transducers on its packer system to simultaneously monitor hydraulic pressure above, within, and below the interval being sampled. This allowed for real-time monitoring of any unusual pressure changes, which could be an indication of poor seal or potential hydraulic connections across geologic intervals.

2.8.2 Geophysical Logging

Geophysical logging of the injection well borehole was performed by GeoCam. GeoCam logged spontaneous potential (SP), gamma ray, caliper, and electrical resistivity. The log sheet is located in **Appendix C**.

2.9 DISCRETE INTERVAL SOIL-GAS SAMPLING

Packers were set to collect samples where the borehole walls appeared to be stable, relatively free of sharp features, and where optimum coverage could be achieved according to the geologic logs. The analytical parameter list consisted of PCE, TCE, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), *trans*-1,2-dichloroethene (*trans*-1,2-DCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene

(1,1-DCE), 1,2-dichloroethane (1,2-DCA), dichloromethane (DCM), vinyl chloride (VC), chloroform, and benzene.

The DISG samples were collected from 4.25-inch diameter boreholes utilizing a dual packer apparatus with an open interval of 20 feet. Packers were inflated by compressed nitrogen gas. A submersible pump was affixed between the packers on the end of a 1-1/2-inch diameter pipe string. Air was drawn up the pipe by an air pump at the ground surface. The packer systems were assembled, maintained, and operated by GPI in the same manner as described in the ***TO42 Report***. Parsons field personnel collected the samples and supervised the efforts.

2.10 DISCRETE INTERVAL GROUNDWATER SAMPLING

Discrete intervals were selected based on interpretation of the geologic and geophysical logs. The general strategy was to gather groundwater data from permeable zones throughout the local portion of the Middle Trinity Aquifer. Yield of these zones is dependent upon many factors, such as porosity, permeability, and transmissivity. Other major factors affecting sample collection are seasonal effects on groundwater levels. Some zones that could be easily sampled during wet seasons may be dry during the late summer and fall months. Analytical and general flow data provide information relevant to plume delineation and potential migration pathways for groundwater contamination.

The sampling parameter list included acetone, *cis*-1,2-DCE, *trans*-1,2-DCE, isopropanol (IPA), methyl ethyl ketone (MEK), PCE, TCE, and toluene. All samples were analyzed by Gulf Coast Analytical Laboratory, in Baton Rouge, Louisiana. Each sampling interval was purged of at least three volumes of water, or until the water appeared clear. Occasionally, time constraints, low-flow zones, and persistent turbidity problems caused samples to be collected before normal purging quantity and quality standards could be completely satisfied. In some instances, purging was carried out over an extended period of time for critically located intervals exhibiting poor yield. In those cases, a sample was collected after alternating periods of pumping and recovery. Some zones exhibiting good flow had to be purged of larger volumes to reduce turbidity prior to sampling. Most intervals selected for WB DIGW samples in the LGR corresponded stratigraphically from well to well. This allowed for direct observation of changes in contaminant concentrations at various distances from the source area.

The DIGW samples were collected in 4.25-inch diameter boreholes utilizing a dual packer apparatus with an open interval of 20 feet. Packers were inflated by compressed nitrogen gas. A 1.5 horsepower (hp) pump was affixed between the packers on the end of a 1-1/2-inch diameter pipe string (5-to 21-foot sections). The packer systems were assembled, maintained, and operated by GPI in the same manner as described in the ***TO42 Report***. Parsons field personnel collected the samples and supervised the efforts.

2.11 WELL DEVELOPMENT

Well development was performed by air-lifting, bailing, and pumping. Each well was surged using the drill rig immediately after achieving final drilling depth. Bailing was accomplished by the drill rig before demobilizing to the decontamination pad. Pumping took place after the majority of work around the well was finished.

Development by pumping was performed twice at each WB borehole, after drilling and airlifting and after final FLUTe liner removal. Borehole development field records are in Appendix A.

2.11.1 Air-Lifting

Air-lifting was performed after a well had been reamed to its final depth, but before casing emplacement. At this point, the bottom portion of a well was still an uncased borehole. Compressed air was injected downhole via the drill pipe string to within 20 feet of the total depth of the well. This process flushed out the majority of loose, heavy sediments produced during final stages of drilling. At selected intervals, the driller jetted the well by releasing bursts of air pressure in the saturated column, causing the sediments to become suspended and airlifted to the surface where they were expelled and collected in the rig containment pit.

2.11.2 Bailing

The injection well was bailed 48 hours after grouting was complete and prior to any pumping. The WB boreholes were not completed with conventional well screens and were not bailed. The bailing apparatus used was a 6-foot steel dart valve with a 3-gallon capacity bailer. Drilling subcontractor personnel operated the bailing apparatus. A pump installation truck (Smeal™) was backed over each well and the bailer was lowered and raised by a motorized cable reel. The drill rig derrick cable and pulley system was also used to operate the bailer prior to demobilizing off the wellhead.

The bailer was gently lowered to the bottom of the screened interval, and then raised several feet. The cable was marked at that point so the operator would have an indication as to when the bailer approached the bottom of the screen. This allowed rapid descent of the bailer in the well while preventing the heavy bailer from striking the screen bottom. The bailer was lowered within the well screen and then quickly raised to surge the screened interval.

Parsons geologists occasionally monitored the color and odor of bailed groundwater. Bailing continued until visible sediments were no longer observed in the discharge. Bailed groundwater was contained in 55-gallon drums. Development water was then transported to the GAC via GPI vacuum truck or in a 500-gallon flatbed-mounted tank. The injection well was bailed "dry" several times. In such cases, bailing was suspended until the well recovered adequately for bailing to resume.

2.11.3 Pumping

Once visible sediment was removed by air-lifting or bailing, well development was completed by pumping. Each completed WB borehole was pumped with a decontaminated 1.5-hp Grundfos submersible pump.

The developed volume of each well was monitored by tank volumes and rate/time calculations. Field parameters, including turbidity, odor, temperature, pH, conductivity, and specific conductivity, were periodically monitored. This process continued until the water removed from the wells was clear, field parameters stabilized, and the volume withdrawn surpassed the estimated volume of water injected during drilling. Strict adherence to this procedure was not always feasible as in the case of the injection well. This well was bailed dry before the requisite volume of groundwater could be evacuated.

Stabilization was achieved when water appeared sediment-free, turbidity remained within 10 nephelometric turbidity units (NTU), temperature was +/- 1.0˚C; pH was +/-0.1 units within a range of 6.5 to 8; and conductivity was +/- 5 percent; for a period of at least 30 minutes. Procedures were followed according to the CSSA WP and FSP. All developed groundwater was discharged into rolloff containment for processing through the on-post GAC.

2.12 WELL SURVEYING

Surveying for the new wells was completed by Baker Surveying and Engineering (Baker). Baker surveyed the northing, easting, and elevation for the survey monument set within each well pad, a notch at the top of the PVC casing, and natural ground elevations. A licensed surveyor performed the surveying.

Control was established using existing survey data and permanent benchmarks previously constructed at CSSA. Reference points were established during prior surveying efforts by Baker to National Vertical Geodetic Datum [NVGD] 1983 and horizontal control to North American Datum [NAD] 1983. All points required to control the survey were occupied as stations within a closed and adjusted traverse. The controls met or exceeded third-order accuracy standards.

Baker completed the survey using a professional-grade Trimble Real-Time Kinematic (RTK) global positioning system (GPS), and reported all coordinate point data in Universal Transverse Mercator (UTM), Zone 14 North, NAD 1983. The northings and eastings were recorded in meters, and the elevations are reported in U.S. feet above mean sea level (msl). Surveying data reported by Baker are presented in **Appendix D**.

SECTION 3
CHRONOLOGICAL FIELD NARRATIVES

Five new wells were installed at CSSA under AFCEE TO-6 WBS 07000 (Figure 1). Drilling of the wells was performed by GPI under direct supervision of Parsons geologists. GPI maintained one crew during the field event, which mobilized to CSSA on July 25, 2005. The field crew was equipped with a Gardner-Denver 1500 drilling rig, a 2,900-gallon water truck, a 2,900-gallon vacuum truck, a winch truck, and various support vehicles and well installation equipment. A rig and equipment decontamination station was constructed by GPI before drilling activities began. Rolloff containers for containment of investigation-derived waste (IDW) were provided by Prudent Environmental, Inc. as a tiered subcontractor through GPI. Final site restoration tasks were completed on November 21, 2005. Surveys of the new wells were completed on March 7, 2006.

3.1 MULTI-PORT WELL INSTALLATION

Four WB multi-port wells were constructed for CSSA as part of the TO-6 well installation fieldwork. One WB well, CS-WB05, was drilled to the base of the CC and completed with sampling ports in all three members of the Middle Trinity Aquifer. The three other WB wells, CS-WB06, CS-WB07, and CS-WB08, were drilled to the base of the LGR portion of the aquifer.

3.1.1 CS-WB05

CS-WB05 was installed approximately 150 feet southeast of the CS-MW16 well cluster and approximately 150 feet from the north boundary of SWMU B-3. CS-WB05 was placed between SWMU B-3 and the CS-MW16 cluster to serve as an observation well for future CS-MW16 pumping tests and to facilitate data collection for a pumping gradient on SWMU B-3 contaminants.

Drilling of CS-WB05 took place July 26-28, 2005. The well was drilled to 480 feet bgs. The 7-$^{7}/_{8}$-inch diameter overdrill was advanced to 30 feet bgs rather than the originally planned 10 feet due to many soft, weathered, unstable layers encountered in the shallow overburden. The 4.5-inch ID PVC surface casing was set to 30 feet bgs in unweathered limestone to eliminate the risk of hole collapse. No elevated PID readings were observed at the wellhead during drilling. Excess drilling fluids were periodically transported to rolloff boxes located adjacent to the CSSA on-post GAC unit.

The borehole was developed on July 29, 2005, discharging 590 gallons via submersible pump. After development, the drill rig was demobilized and decontaminated. Parsons then installed a FLUTe liner in the borehole with assistance from FLUTe, Ltd. personnel. FLUTe generated a fluid conductivity log during the installation of the liner. This was a newly developed process, and was analyzed by a Parsons senior geologist for future potential (Appendix C).

On August 15, 2005, the CS-WB05 liner was removed and geophysical logging was performed. Hydrophysical logging was performed 2 days later. The FLUTe liner was redeployed overnight on August 18-19, 2005.

On August 19, 2005, RAS attempted to collect DIGW samples from 0-200 feet (top packer disengaged) and 203-223 feet bgs, but water could not be brought to surface. A purge was initiated on the next zone, 268-288 feet bgs, but was abandoned. These intervals were too low-yielding to obtain a water sample using the submersible pump straddle packer apparatus. The packers were then inflated at the Bexar Shale (BS)/CC contact to keep the LGR and CC separated overnight and prevent migration of groundwater contaminants.

The next day the tool was brought to the surface and reconfigured with a low-flow bladder pump. With the low-flow setup, DIGW samples were collected from 268-288, 290-310, and 320-340 feet bgs, at flow rates of 0.05, 0.2, and 0.15 gpm, respectively.

On August 23, 2005, the RAS straddle packer tool was converted to conduct injection testing. Parsons and RAS used the HPL logs to select intervals for injection testing. Intervals 168-188, 198-218, 230-250, and 268-288 feet bgs were tested. The next day, seven soil gas samples were collected in 20-foot intervals from the majority of the borehole above the saturated level, from between 30 and 176 feet bgs.

RAS was unable to complete DIGW sampling at CS-WB05 and other wells due to time lost when their tool became wedged downhole. On August 26, 2005, GPI and Parsons collected a discrete groundwater sample from 416-436 feet bgs. The FLUTe liner was then reinstalled into CS-WB05 until WB installation.

The CS-WB05 FLUTe liner was extracted for the final time on November 9, 2005. The borehole was developed for 2.5 hours with the pump set at 420 feet bgs. Later, the pump was raised into the LGR, 300 feet bgs, and pumped for an additional 3 hours for a total of approximately 5500 gallons. A borehole development summary is shown in Table 3.1.

Development stabilization parameters were monitored during the final round of pumping. Westbay and GPI personnel installed the WB multi-port system at CS-WB05 on November 11-12, 2005. The system comprised nine isolated monitoring intervals. Integrity of the system was tested the same day by profiling each interval with a MOSDAX pressure probe. The test indicated all zones were properly sealed and the ports functioned properly.

3.1.2 CS-WB06

CS-WB06 was installed approximately 120 feet south of SWMU B-3. GPI mobilized to the site on July 29, 2005, and drilling began on August 1, 2005. Temporary surface casing was installed to 10 feet bgs. Drilling was completed to 333 feet bgs on August 3, 2005.

Approximately 1,300 gallons were purged from the well during development. Development water was conveyed to rolloff containers by GPI. After development, the drilling rig was moved to the decontamination pad and a FLUTe liner was installed.

RAS performed geophysical logging at CS-WB06 from August 16-18, 2005 and the FLUTe liner was reinstalled following the logging.

From September 6-8, 2005, DISG and DIGW samples were collected. The liner was reinstalled on September 9, 2005. The liner was removed on November 6, 2005 and an additional 4,680 gallons of water were pumped from the well.

Westbay and GPI personnel installed the CS-WB06 multi-port system on November 8, 2005. There are five isolated monitoring intervals contained in the CS-WB06 system. Integrity of the system was tested by profiling each interval with a MOSDAX pressure probe. The test indicated all zones were properly sealed and the ports functioned properly.

Table 3.1

Borehole Development Summary

July – November 2005

Development Process	**WB05**	Date	**WB06**	Date	**WB07**	Date	**WB08**	Date	**B3-MW01**	Date
Surged and Airlifted	675	(7-28)	150	(8-3)	600	(8-9)	300	(8-15)	300	(9-15)
Bailed	0		0		0		0		470	(9-23 to 9-28)
Borehole pumping	590	(7-29)	400	(8-3)	1,800	(8-10)	80	(8-15)		
			900	(8-4)	303	(8-11)	1,012	(8-16)	0	
Total DIGWSs purges	229	(8-20)	505	(9-8)	485	(9-7)	552	(8-26)	0	
Pre-WB Install Borehole Pumping	2,250	(11-10)	290	(11-6)	2,366	(11-7)	2,665	(11-9)	0	
	2,655	(11-11)	2,436	(11-7)						
Total pumped development	5,495		4,026		4,469		3,757		0	
Total Volume Withdrawn	6,399		4,681		5,554		4,609		770	
IDW Fluid Processed at GAC*	17,146		8,271		8,946		8,828		3,473	

* *Includes fluids and groundwater ejected during drilling and total withdrawals.*

3.1.3 CS-WB07

CS-WB07 is located approximately 114 feet from the western boundary of SWMU B-3. Drilling began on August 4, 2005 and concluded on August 9, 2005. The well was drilled to a depth of 335 feet bgs. The overdrill and surface casing were to 10 feet bgs. Approximately 1,800 gallons were pumped from CS-WB07 on August 10, 2005, but a severe storm caused pumping to be suspended before stabilization parameters could be recorded. The next morning, an additional 300 gallons were pumped from the well and a FLUTe liner was installed.

Geophysical logging was completed on August 19, 2005, and the FLUTe liner reinstalled. On September 6, 2005, the FLUTe liner was removed and two shallow soil gas intervals were sampled. On September 7, 2005, the DISG and DIGW sampling was completed. Parsons reinserted the liner the following day. The borehole was intermittently developed, discharging approximately 4470 gallons.

Westbay and GPI personnel installed the multi-port sampling system on November 10, 2005. The system comprises five isolated monitoring intervals. Integrity of the system was tested by profiling each interval with a MOSDAX pressure probe. The test indicated all zones were properly sealed and the ports functioned properly.

3.1.4 CS-WB08

CS-WB08 is located approximately 108 feet upgradient of the eastern boundary of SWMU B-3. Drilling was completed to 355 feet bgs on August 15, 2005. The next day, 1,012 gallons were discharged to rolloff containment during development of CS-WB08. RAS conducted geophysical logging between August 16-18, 2005.

Collection of DISG samples took place on August 24, 2005. Collection of three DIGW samples occurred on August 26, 2005. The FLUTe liner was reinstalled following DIGW sampling. The final liner extraction at CS-WB08 occurred on November 8, 2005, and the borehole was redeveloped by approximately 2,500 gallons, for an approximate total of 3760 gallons.

Westbay and GPI personnel installed the multi-port sampling system on November 10-11, 2005. The system comprises five isolated monitoring intervals. Integrity of the system was tested by profiling each interval with a MOSDAX pressure probe. The test indicated all zones were properly sealed and the ports functioned properly.

3.2 INJECTION WELL

CS-B3-MW01 was installed 35 feet southeast of CS-WB05, directly between CS-WB05 and SWMU B-3. The location and distance of CS-B3-MW01 with respect to CS-WB05 were based on calculated estimates of groundwater velocities (see ***Technical Memo***, **Appendix E**). For permitting purposes, the well was designated, designed, and constructed as a conventional monitoring well.

The well was drilled at a 7-$^{7}/_{8}$-inch diameter to 292.5 feet bgs during September 12-15, 2005. The same day that total depth was achieved, the borehole was surged by GPI and geophysically logged by GeoCam. Excess drilling fluids were transported to rolloffs located adjacent to the CSSA on-post GAC. The fluid was processed through the GAC and discharged at CSSA Outfall 002 (see Table 3.1).

A water injection test was performed on September 16, 2005 at CS-B3-MW01. The injection interval was selected for its porosity, permeability potential, position relative to impermeable layers, and depth in the saturated zone.

GPI provided and operated a dual packer system, which isolated the injection zone from other portions of the open borehole during the test. The packers were inflated (110 psi) at the injection test zone (274.5-287 feet bgs). Water from Well CS-9 was used for injection. Injection flow was controlled and measured by a ball valve and totalizing flowmeter between the pump and wellhead.

For the first step of the test, water was pumped into the test zone at 5 gpm for 20 minutes. At this rate the zone apparently accepted all the injected water without build-up of pressure in the system. At 8 gpm and 12.5 gpm, the same result was observed. No positive pressure was measured in the system between the surface pump and the borehole interval. Subsequently, the packers were then inflated to their maximum limit of 140 psi to verify no leakage of packer gas was occurring which might have lessened the integrity of the seal, and the pump's maximum rate of 25 gpm was applied to the interval. Again, the interval readily accepted the influx and no pressure built up in the system. A total of 502 gallons was injected during the stepped injection tests. Normal packer inflation pressure is 110 psi, which is usually adequate for sealing a borehole section. 140 psi is the maximum that the packers can safely sustain, and is almost never utilized. The ability to maintain 140 psi showed that the packers themselves were not leaking gas, that the packers were pressed against the walls to the greatest extent possible, and that the system was properly deployed. If there was any rapid flow of water out of the sealed zone laterally into the formation it would have to be attributed to existing geologic features and characteristics (*e.g.* karst, porosity), not the packers. Likewise, any water circumventing the packers would have been due to geologic features not discernable in the geophysical and video logs used for packer placement. The packer apparatus had been successfully tested in a section of blank casing prior to tripping into the borehole.

Well completion activities were conducted in late September. On September 21, 2005, the borehole was back-plugged to 287 feet bgs. The well screen was set 277 to 287 feet bgs and riser materials were installed. A pea-gravel pack was emplaced 287 to 274 feet bgs, and a 6.5-foot bentonite seal installed on top. After hydration, one 60-gallon lift of grout was pumped by tremie pipe above the seal. Grouting continued by periodically pumping in small lifts and was completed on September 26, 2005. Development by bailing began once 50 percent of the well had been grouted and after at least 48 hours had passed since the first lift was installed. Bailing activities were conducted during September 23-28, 2005.

The ***Parsons Technical Memorandum*** (September 2005) provides a summary of the injection well details and is included in **Appendix E**.

SECTION 4
RESULTS AND INTERPRETATION

4.1 GEOPHYSICAL LOGS

Collection of geophysical and downhole imaging data was performed by RAS and GeoCam. FLUTe, Ltd. performed one conductivity differential logging run at the CS-WB05 borehole. The geophysical parameters recorded by RAS were SP, gamma ray, caliper, electrical resistivity, FEC, and optical televiewing. RAS logged CS-WB05, CS-WB06, CS-WB07, and CS-WB08. RAS also performed hydrophysical logging at CS-WB05. GeoCam ran one standard geophysical suite at CS-B3-MW01 consisting of caliper, gamma, and resistivity logs. Logging runs were complete through the entire depth of each borehole, excluding surface-cased portions.

Geophysical logging identified features such as water-bearing zones, dry and impermeable layers, subsurface voids, faults, and fractures. Many of the features will allow for correlation between the wells, thus contributing to the overall picture of subsurface conditions, most notably groundwater occurrence and movement, and contaminant transport. The geophysical logs and the RAS report of findings can be viewed in **Appendix C**. Discussion of previous CSSA geophysical results and base-wide geological correlations are described in the ***CSSA HCSM***, ***Volume 5***, of the ***Encyclopedia***.

4.1.1 Hydrophysical Logging at WB05

Processing and interpretation of the geophysical and HPL logs in CS-WB05 suggest the presence of three identifiable water producing intervals in this borehole. The intervals are 166-171, 203-215, and 295-305 feet bgs. Another interval, 430-448 feet bgs showed outflow under ambient conditions. Only the two deepest zones had flows large enough to be quantified. Inflow at 295-305 feet bgs showed a rate of 0.75 gpm, while 430-448 feet bgs had an outflow of 0.75 gpm. During ambient conditions, CS-WB05 fluid exhibited overall downward vertical flow. A downward vertical pressure gradient was observed in the borehole under ambient conditions. Ambient flow was observed to enter the wellbore at three of the above-mentioned zones and migrate downward. Water flow exited the borehole at 432-450 feet bgs.

Injection and pressure testing was performed to determine suitable zones for use during the enhanced anaerobic biodegradation pilot test. Zones were tested based on examination of geophysical logs. Straddle packer injection testing produced transmissivities of 1.9 square feet (ft^2)/day and 1.1 ft^2/day for 168-188 feet bgs and 198-218 feet bgs intervals, respectively. Interval 268-288 feet bgs had an estimated transmissivity of 6.1 ft^2/day and was subsequently selected as the best candidate for the LGR injection zone (see ***Location and Construction Information for the Proposed Injection Well at SWMU B-3***, **Parsons Technical Memorandum, September 2005** [**Appendix E**]). Pressure testing of the 203-223 feet bgs interval indicated no flow.

4.2 DISCRETE INTERVAL SAMPLING

A total of 30 DISG samples were collected and field-screened by PID for oxygen, carbon dioxide, and VOC. Based on the field screening, 15 DISG samples were collected in summa canisters and submitted for laboratory analysis. While collecting air samples, the vacuum pressure (inches H_2O) at each sampled zone was recorded. The samples were analyzed for the following VOCs: PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, 1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCA, DCM, VC, chloroform, and benzene. Air samples were collected from as much of the dry portion of the borehole as possible. All DISG sample collection attempts were successful. **Table 4.1** shows a summary of the DISG sample collection effort and results.

A total of 14 DIGW samples were collected from selected geostratigraphic zones at the four SWMU B-3 WB boreholes. Attempts to collect groundwater samples from WB sampling zones were aborted due to poor groundwater yield. These low flow zones were typically found in the UGR, the upper part of the LGR, and throughout the BS at CSSA. No attempts were made to collect samples from the BS during this field effort. Groundwater samples were analyzed for the following VOCs: PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, 1,1-DCE, DBCM, BDCM, DCDFM, DCM, VC, bromoform, chloroform, naphthalene, and toluene.

Table 4.2 shows a summary of the DIGW sample collection effort and results. Sampling interval depths in the following narratives are referenced to depth below ground surface. Comprehensive laboratory analysis reports can be found in **Appendix F**.

4.2.1 CS-WB05

In contrast to the other WB wells, DIGW sampling at CS-WB05 was based more upon results of hydrophysical logging rather than geophysical logging. The zones sampled were selected based on flow potential. Out of six DIGW intervals chosen to be sampled at CS-WB05, two, 169-200 bgs (with top packer disabled, borehole open from 200 feet up to water level) and 203-223 feet bgs, could not be sampled due to very low yield. Interval 268-288 feet bgs was sampled with a low-flow bladder pump at an approximate rate of 0.05 gpm. Intervals selected below 288 feet readily produced water for sampling. Zones 304-316, 327-339, and 362-374 feet bgs are in the LGR, and zone 416-436 feet bgs is in the middle of the CC main water-bearing zone.

VOC concentrations detected in CS-WB05 soil-gas samples show increasing concentrations with depth until the 156-176-foot bgs interval, which was immediately above the water table. This area is in the middle of the “smear zone,” where water levels tend to fluctuate greatly. *Cis*-1,2-DCE concentrations drop from 368 parts per billion by volume (ppbv) in the 116-136-foot bgs interval to 47.7 ppbv in the 156-176 foot bgs interval. PCE also declines from 439 ppbv to 157 ppbv across the same intervals, and TCE drops from 479 ppbv to 328 ppbv (**Table 4.3**).

The CS-WB05 discrete groundwater interval sample results show PCE concentrations increasing with depth. LGR concentrations increased from 31.3 micrograms per liter (µg/L) to 319 µg/L. TCE follows the same pattern in the LGR. TCE increases from 152 µg/L to 427 µg/L in the LGR, but drops to 375 µg/L in the CC.

Cis-1,2-DCE shows the same pattern as TCE, rising from 286 µg/L in the middle section of the LGR to 533 µg/L in the lower section of the LGR, then decreasing to 465 µg/L in the CC.

Table 4.1

TO-6 Discrete Interval Soil Gas Samples
August and September 2005

Well No.	20-foot Interval Depth	Rock Unit	0_2	CO_2	Field PID	Total Vacuum Pressure	Adjusted Pressure	Purging Duration	Date
	(fbgs)	Formation	%	%	ppm VOCs	inches H_2O	inches H_2O	minutes	
WB05	30-50	LGR	21	0.05	0.0	91	45	20	8/25/05
	52-72	LGR	21	0.05	0.0	82	36	20	
	71-91	LGR	21	0.05	0.5	63	17	20	
	89-109	LGR	21	0.05	0.1	80	34	20	
	116-136	LGR	20	0.4	0.8	47	1	20	
	136-156	LGR	21	0.05	1.8	48	2	20	
	156-176	LGR	21	0.05	4.6	48	2	20	
WB06	10-30	UGR/LGR	13	8.8	0.0	54	8	20	9/08/05
	30-50	LGR	19	2.2	0.0	57	11	24	
	50-70	LGR	17.5	3.2	0.2	59	13	20	
	70-90	LGR	17.6	3.4	0.2	60	14	20	
	90-110	LGR	18.7	2.3	0.0	63	17	20	
	110 -130	LGR	20.9	0.3	0.0	120	74	20	
	130-150	LGR	19.5	1.5	0.0	118	72	20	
WB07	10-30	UGR/LGR	16.5	3.5	6.1	69	23	18	9/07/05
	30-50	LGR	20.5	0.4	0.2	98	52	23	
	50-70	LGR	21	0.05	0.0	52	6	20	
	70-90	LGR	21	0.05	0.0	101	55	20	
	90-110	LGR	21	0.05	0.0	109	63	20	
	110-130	LGR	20	0.2	0.0	105	59	20	
	130-150	LGR	20.2	0.1	0.0	106	60	20	
	150-170	LGR	20.8	0.05	0.0	97	51	20	
WB08	10-30	UGR/LGR	18	2.5	19.5	49	3	20	8/24/05
	32-52	LGR	21	0.05	1.3	48	2	20	
	49-69	LGR	21	0.1	2.0	66	20	30	
	69-89	LGR	21	0.1	2.8	84	38	20	
	89-109	LGR	20	0.5	4.2	91	45	20	
	111.5-131.5	LGR	20.5	0.1	3.4	84	38	24	
	136-156	LGR	20	0.5	4.6	58	12	21	
	156-176	LGR	18.5	0.7	3.7	72	26	23	

Table 4.2

TO-6 Discrete Interval Groundwater Samples August and September 2005

Well No.	20-foot Interval Depth	Rock Unit	Interval Volume	Interval Volumes Purged	Total Purged	Average Purging Rate	Pumping Duration	Sampled	Date
	(fbgs)	Formation	(gal)		(gal)	(gpm)	(hrs, mins)	(Y/N)	
WB05	169-200[a]	LGR	22.3	0	0	n/a	15 min	N	8/19/05
	203-223	LGR	14.4[b]	0	0	n/a	15 min	N	
	268-288	LGR	14.4	0	0	< 1	30 min	N	
	268-288	LGR	14.4	0.6	8.5	0.05	2 hr, 50 min	Y	8/20/05
	290-310	LGR	14.4	1.04	15	0.2	1 hr, 15 min	Y	
	320-340	LGR	14.4	1.07	15.2	0.152	1 hr, 40 min	Y	
	297-309	CC	14.4	13.2	190	6.3	30 min	Y	8/26/05
WB06	225-245	LGR	14.4	0	0	< 1	20 min	N	9/08/05
	260-280	LGR	14.4	12.1	175	6.25	28 min	Y	
	284-304	LGR	14.4	11.1	160	7.3	22 min	Y	
	308-328	LGR	14.4	11.8	170	6.8	25 min	Y	
WB07	200-220	LGR	14.4	1	14.5	0.28	1 hr, 45 min pumping intermittently	Y	9/07/05
	265-285	LGR	14.4	9.03	130	6.5	20 min	Y	
	285-305	LGR	14.4	11.1	160	7.3	22 min	Y	
	310-330	LGR	14.4	12.5	180	5.6	32 min	Y	
WB08	280-300	LGR	14.4	13.2	190	7.3	26 min	Y	8/26/05
	305 – 325	LGR	14.4	13.9	200	7.4	27 min	Y	
	331.5 – 351.5	LGR	14.4	11.3	162	5.4	30 min	Y	

a = This interval from borehole water level surface to 200 feet bgs with top packer disabled.
b = 20 feet interval x 0.72 gal/ft in 4.25-inch diameter hole.
c = low-flow bladder pump instead of submersible pump.

Low concentrations of *trans*-1,2-DCE were detected in the 290–310 foot bgs interval and 416-436 foot bgs interval, at concentrations of 4.94 and 16.4 µg/L, respectively. The presence of *trans*-1,2-DCE and accompanying levels of *cis*-1,2-DCE are indicative of reductive dechlorination.

A low toluene detection of 4.18 µg/L in the 268–288 foot bgs interval is the only toluene detection in the WB DIGW sampling effort. At CSSA, toluene has usually been attributed to sampling equipment since historic detections have been sporadic, inconsistent, and at very low levels.

Table 4.3 CS-WB05 Discrete Interval Sampling Results

Depth Interval	Matrix	PCE	TCE	*cis*-1,2-DCE	*trans*-1,2-DCE	1,1,1-TCA	TCM	DCM	VC	Benzene	Toluene
feet bgs	**soil gas results (ppbv)**										
30-50	air	120	77.1	17.8 **J**	ND	ND	ND	ND	ND	ND	ND
71-91	air	204	167	110	ND	ND	ND	ND	ND	ND	ND
116-136	air	479	439	368	ND	ND	ND	ND	ND	ND	ND
156-176	air	328	157	47.7	ND	0.732 **J**	0.870 **J**	6.00 **J**	1.22 **J**	6.21 **J**	ND
	groundwater results (µg/L)										
268-288	water	31.3	152	286	ND	ND	ND	ND	ND	ND	4.18
290-310	water	160	273	344	4.94	ND	ND	ND	ND	ND	ND
320-340	water	319	427	533	ND	ND	ND	ND	ND	ND	ND
416-436	water	392	375	465	16.4	ND	ND	ND	ND	ND	ND
MCL	water	5	5	70	100	200	80	2	5	5	1000

"ND" =Not Detected above Method Detection Limit (see results reports in Appendix F).

4.2.2 CS-WB06

Six soil-gas samples were collected from CS-WB06 and screened in the field. The three intervals, results from which are presented in **Table 4.4,** were selected for analysis based on field screening results for oxygen and carbon dioxide. VOC concentrations appear to increase with depth in the dry, shallow part of the borehole, then decrease in the smear zone. PCE detections ranged from 540 to 1570 ppbv, TCE detections ranged from 490 ppbv to 1270 ppbv, and *cis*-1,2-DCE concentrations ranged from 520 ppbv to 931 ppbv. The other target VOCs listed in **Table 4.4** were not detected. Water level in the CS-WB06 borehole during sampling was 167 feet bgs.

Four efforts were made to collect DIGW samples from CS-WB06, one of which was unsuccessful. Sampling intervals were selected for their moderate to low gamma values and high resistivity values. The successfully sampled intervals are shown in **Table 4.4**. The interval with inadequate flow was 225-245 feet bgs. Sampling occurred September 8, 2005.

The groundwater interval results show VOC concentrations increasing with depth: PCE increases from 151 µg/L to 337 µg/L, TCE increases from 159 µg/L to 268 µg/L, and *cis*-1,2-DCE increases from 287 µg/L to 435 µg/L. No other target VOCs were detected in CS-WB06.

Table 4.4 CS-WB06 Discrete Interval Groundwater Sampling Results

Depth Interval	Matrix	PCE	TCE	*cis*-1,2-DCE	*trans*-1,2-DCE	1,1-DCE	VC
feet bgs	**soil gas results (ppbv)**						
10-30	air	1270	711	856	ND	ND	ND
50-70	air	1570	1270	931	ND	ND	ND
130-150	air	540	490	520	ND	ND	ND
	groundwater results (µg/L)						
260-280	water	151	159	287	ND	ND	ND
284-304	water	297	268	413	ND	ND	ND
308-328	water	337	268	435	ND	ND	ND
MCL	water	5	5	70	100	7	5

"ND" =Not Detected above Method Detection Limit (see results reports in Appendix F).

4.2.3 CS-WB07

Discrete sampling at CS-WB07 began on September 6, 2005, immediately following FLUTe liner removal, and was concluded on September 7, 2005.

Eight DISG samples were collected from the dry portion of the CS-WB07 borehole (10-170 feet bgs). The water level depth during sampling was 172 feet bgs. The zones listed in **Table 4.5** show the chemical analysis of the four air samples that were submitted for laboratory analysis.

VOC concentrations exhibit a declining trend with depth. The PCE trend is moderate, but the TCE and *cis*-1,2-DCE trends show large declines in the top 50 feet of the shallow subsurface, decreasing from 4,160 ppbv to 937 ppbv and 1,340 ppbv to 229 ppbv, respectively.

Four DIGW samples were collected from CS-WB07. The uppermost sampling interval, 200-220 feet bgs, was pumped intermittently for about 105 minutes to allow for recovery periods. This interval contains the “scissor-tail” resistivity marker horizon used to correlate hydrogeologic strata throughout CSSA. The correlating interval in CS-WB05 proved to be a no-flow zone under the hydrologic conditions present at the time. During periods of low water levels this zone can become a very low-flow to no-flow zone in other areas as well.

The efforts made to sample three more intervals below the first DIGW sampling zone went more quickly, each being purged between an average of 5.6 and 7.3 gpm. The upper interval (200-220 feet bgs) contains VOCs in much lower concentrations than the three lower intervals (**Table 4.5**) with PCE, TCE, and *cis*-1,2-DCE results of 34.7 µg/L, 47.9 µg/L, and 56.1 µg/L, respectively. Results from sampling zones between 265 and 330 feet bgs show PCE concentrations decreasing from 293–221 µg/L and TCE concentrations decreasing from 322-277 µg/L. *Cis*-1,2-DCE concentrations decreased from 361 µg/L to 322 µg/L between 265 and 305 feet bgs before rising to 403 µg/L in the deepest sampling interval.

Table 4.5 CS-WB07 Discrete Interval Groundwater Sampling Results

Depth Interval	Matrix	PCE	TCE	*cis*-1,2-DCE	*trans*-1,2-DCE	1,1-DCE	VC
feet bgs	**soil gas results (ppbv)**						
10-30	air	83.3	4160	1340	ND	ND	ND
30-50	air	25.7	937	229	ND	ND	ND
70-90	air	4.57	106	27.1	ND	ND	ND
110-130	air	21.5	94.3	25.5	ND	ND	ND
	groundwater results (µg/L)						
200-220	water	34.7	47.9	56.1	ND	ND	ND
265-285	water	293	322	361	ND	ND	ND
285-305	water	254	306	322	ND	ND	ND
310-330	water	221	277	403	ND	ND	ND
MCL	water	5	5	70	100	7	5

"ND" =Not Detected above Method Detection Limit (see results reports in Appendix F).

4.2.4 CS-WB08

Discrete interval sampling at CS-WB08 resulted in four DISG samples and three DIGW samples being submitted for laboratory analysis. Field parameters were monitored from eight soil vapor zones. Soil gas samples were collected for field screening from most of the dry portion of the borehole (10 to 176 feet bgs) Samples were not collected from 30-32 feet bgs, 109-111.5 feet bgs, and 131.5-136 feet bgs. These gaps were skipped due to poor borehole integrity interfering with proper packer operation. The uppermost 42 feet of the borehole (10 to 52 feet bgs) offered almost no resistance to the vacuum pump, showing three or less inches (adjusted) of H_2O on the pressure gauge.

The uppermost sampling zone, 10-30 feet bgs, exhibited very high VOC concentrations: PCE concentration of 12,200 ppbv, TCE concentration of 9,520 ppbv, and a *cis*-1,2-DCE concentration of 2,790 ppbv. The remaining sampling intervals also contain high VOC concentrations, with PCE concentrations ranging from 3,310 ppbv to 5,010 ppbv, TCE concentrations ranging from 2,220 ppbv to 3,970 ppbv, and *cis*-1,2-DCE concentrations ranging from 431 to 753 ppbv, all concentrations increasing with depth. VC concentrations ranged from 69.3 ppbv to 509 ppbv (**Table 4.6**).

Contrary to the soil gas results, the three DIGW samples from CS-WB08 showed lower target VOC concentrations than those reported at other WB boreholes. Results show high concentrations of PCE, moderate TCE and toluene concentrations, and very low *cis*-1,2-DCE concentrations (**Table 4.6**). The detected concentrations show slight overall increases with depth. PCE rises from 38.6 µg/L to 53.7 µg/L, TCE increases from 41.8 µg/L to 57.3 µg/L, and *cis*-1,2-DCE increases from 98.8 µg/L to 115 µg/L. *Trans*-1,2-DCE is the only other target VOC detected in the CS-WB08 DIGW samples.

Table 4.6 CS-WB08 Discrete Interval Groundwater Sampling Results

Depth Interval	Matrix	PCE	TCE	*cis*-1,2-DCE	*trans*-1,2-DCE	1,1-DCE	VC
feet bgs	**soil gas results (ppbv)**						
10-30	air	12200	9520	2790	ND	ND	509
89-109	air	3310	2220	431	ND	ND	73.6
138-158	air	4270	2730	506	ND	ND	69.3
156-176	air	5010	3970	753	ND	ND	234
	groundwater results (µg/L)						
200-220	water	38.6	41.8	108	ND	ND	ND
265-285	water	50.9	57.3	98.8	ND	ND	ND
285-305	water	53.7	54.2	115	4.62 **J**	ND	ND
MCL	water	5	5	70	100	7	5

"ND" =Not Detected above Method Detection Limit (see results reports in Appendix F).

4.2.5 CS-B3-MW01

Geophysical logs from the proposed injection well borehole showed that the stratigraphy of the well correlates with the adjacent CS-WB05 well without noticeable vertical displacement. The chemistry of discrete intervals would be assumed to also correlate to nearby CS-WB05 intervals which had been sampled and analyzed. An initial composite groundwater sample was not taken from the well due to its low yield.

SECTION 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The data reinforce conclusions of previous RL83 and TO42 groundwater investigation work. The subsurface at SWMU B-3 contains many dry, hard, impermeable zones that greatly impede or prevent downward contaminant migration. These layers are faulted in sections of the aquifer. Some contaminants have migrated downward from the more heavily impacted middle and upper LGR into the underlying BS and CC via faults and fractures. This downward migration may have also been aided by former open borehole wells, such as the former Well CS-16. Local faulted zones may also allow groundwater to move laterally at a greater rate than through unfaulted subsurface zones.

It is likely that CC contamination in the vicinity of the former Well CS-16 is primarily due to cross-connection associated with its former open borehole construction. Contaminants entering the borehole through middle and upper LGR zones followed the downward flow gradient (as determined by hydrophysical logging) and entered the deeper, highly conductive CC water-bearing zones.

Laboratory reports from the TO-6 discrete interval sampling show VOC detections in every UGR, LGR, and CC zone sampled. The BS was not sampled during this effort. The more affected areas are nearest the plume source areas. Sub-vertical faults likely provide conduits through impermeable layers, allowing the transport of contamination to the main water-bearing zones of the LGR and, through the BS, into the CC.

DIGW samples were obtained from the new WB boreholes. The conventional monitoring well, CS-B3-MW01, was not selected for DIGW sampling because the final screened zone was scheduled to be sampled after final well completion and DIGW sampling was already carried out at the adjacent CS-WB05 well. Laboratory analysis of the groundwater samples indicates that all the WB wells are within the SWMU B-3 plume. VOC contamination is present throughout the unsaturated zone and within the SWMU B-3 aquifer. PCE and TCE were detected well above drinking water maximum contaminant levels (5µg/L) in the LGR and CC. Contaminant concentrations for groundwater are lower at CS-WB08, which is located upgradient from the plume source area. However, VOC concentrations in soil gas at CS-WB08 are far above the levels at the other downgradient WB wells. This may be attributed to CS-WB08 being located near the former SWMU B-3 East Trench.

Discrete samples collected from new wells installed near source areas showed significant concentrations of PCE, TCE, and *cis*-1,2-DCE throughout the LGR and CC at the down- and cross-gradient locations.

Soil gas sample results show PCE ranging from 4.57 ppbv in CS-WB07 to 12,200 ppbv in the upper 30 feet of CS-WB08. TCE trends follow the PCE trends, only somewhat subdued. TCE in soil gas ranges from 77.1 ppbv in the upper portion of CS-WB05 to 9,520 ppbv at the upper portion of CS-WB08. Drinking water MCLs for PCE and TCE were exceeded in all samples from the WB wells. The CS-WB05 CC sample results show concentrations of PCE and TCE at 392 µg/L and 375 µg/L, respectively. Concentrations of *cis*-1,2-DCE show an overall increasing trend with depth in CS-WB05, from 286 to 465 µg/L. Very low detections of *trans*-1,2-DCE were reported in two zones at CS-WB05 and in the deepest discrete groundwater interval at CS-WB08.

The *trans*-1,2-DCE and *cis*-1,2-DCE results indicate that degradation (reductive dehalogenation) of the original contaminating solvents is occurring near the source areas.

The PCE, TCE, and *cis*-1,2-DCE levels in the new WB wells, in addition to data from other nearby monitoring wells, suggest SWMU B-3 plume advancement to the northwest, west, and south from the SWMU B-3 landfill trenches. Advancement of the plume in the northwest direction is opposite the regional groundwater flow trend and is attributed mostly to an artificial gradient created by historical pumping at the former CS-16.

5.2 RECOMMENDATIONS

This phase of the groundwater investigation provided valuable insight into the local character of the Middle Trinity Aquifer, and the extent of SWMU B-3 plume contamination. Continued monitoring of these new wells will provide data to further expand and refine the understanding of plume behavior, which is crucial toward selecting appropriate remediation methods. The new wells are suitably located and constructed for serving their intended purposes.

The Enhanced Anaerobic Biodegradation Pilot Study, including the excavation and removal of continuing source media (buried debris and contaminated soils) at SWMU B-3, the bioreactor construction, the expansion and enhancement of existing soil vapor extraction system, and other interim remedial measures designed for SWMU B-3 under TO-6 should proceed as planned.

APPENDIX A
DEVELOPMENT FORMS, STATE WELL REPORTS, TOTCO DATA, COMPLETION NOTICE LETTER, WESTBAY INSTALLATION REPORT

Borehole Declination Surveys
Camp Stanley Storage Activity
July - September 2005

Depth (ft bgs)	B-3_MW01	WB05	WB06	WB07	WB08
50'	1/4°	1/4°	1/8°	1/2°	1/2°
100'	1/4°	1/4°	1/8°	1/4°	1/4°
150'	1/2°	1/8°	0°	1/4°	3/4°
200'	3/4°	1/4°	1/16°	1/8°	1/2°
250'	1°	1/4°	1/16°	1/2°	1/4°
300'	1/4°	1/8°	1/8°	1/4°	1/2°
350'	TD = 292.5'	3/4°	TD = 333'	TD = 335'	1/2°
400'		1-1/4°			TD = 333'
450'		1-3/4°			
500'		TD = 480'			

(hatched) = backplugged to 287' bgs.

November 28, 2005
WB816

Mr. Scott Pearson
Parsons Engineering-Science Inc**.**
8000 Center Park Drive
Austin, TX 78754

Subject: Completion Report for Westbay Multi-Level Monitoring Wells No. CS-WB05, CS-WB-06, CS-WB07 and CSWB-08, San Antonio TX

Dear Mr. Pearson,

This report summarizes the work carried out by Westbay Instruments Inc. related to the installation of four MP38 monitoring wells at the Camp Stanley Storage Facility in San Antonio, Texas. This work was carried out under Parsons Engineering purchase order No.744223.00003-00. Westbay representative Mr. Darcy Sinclair was on-site from November 7 to 12, 2005. The four MP38 multilevel monitoring wells were successfully installed passing all of Westbay's standard quality assurance tests.

We look forward to working with you in the future. Please call if you have any questions or comments.

Yours truly,

Darcy Sinclair

Encl.: Bound Completion Report for Westbay MP38 wells: CS-WB05, CS-WB06, CSWB07, and CS-WB08.

COMPLETION REPORT

MP38 Monitoring Wells:

CS-WB05, CS-WB06, CS-WB07 and CS-WB08.

Camp Stanley,

San Antonio, TX

Prepared for:

Parsons Engineering-Science Inc.
8000 Center Park Drive
Austin, TX 78754
U.S.A.

Prepared by:

Westbay Instruments Inc.
WB816

November 28, 2005

CONTENTS

APPENDICES

1. Introduction

This report and the attached Appendices document the technical services carried out by Westbay Instruments Inc. under Parsons Engineering-Science Inc. (Parsons) P.O. No.744223.00003-00 A Westbay MP-38 groundwater monitoring system was installed in boreholes No. CS-WB05, CS-WB06, CS-WB07 and CS-WB08 at the Camp Stanley site in San Antonio, Texas.

Installation of the Westbay MP-38 wells was conducted over the period November 7 to 12, 2005. This report documents the installation tasks and related QA checks.

2. Personnel

Westbay technical services representative Mr. Darcy Sinclair was on site from November 7 to 12, 2005 to carry out the installation of the four wells. Assistance during the installation was also provided by personnel from Parsons and drillers contracted to Parsons.

3. Installation

The monitoring wells were installed as indicated below.

(Note: all depths are with respect to top of four- inch PVC casing. Monitoring well reference elevations were not available at the time of writing). We understand that the PVC surface casing at each well was modified by Parsons personnel after the installation work was completed. All depths in this report are referenced to the original top of PVC surface casing, and are not corrected for any later modification.

Table 1, Summary of MP Well Installations

Monitoring Well No.	Installation Date	Borehole Depth (ft)	MP38 Casing Length (ft)	No. Monitoring Zones
CS-WB05	November 11-12, 2005	480	475.2	8
CS-WB06	November 7-8, 2005	333	332.2	5
CS-WB07	November 8-9, 2005	335	333.2	5
CS-WB08	November 9-10, 2005	357	356.2	5

The wells were installed according to the procedure described below.

3.1 Previous Activities

A nominal 4-inch diameter borehole was drilled using an air rotary method. A set of geophysical logs, including video and caliper, were run in each borehole by a subcontractor to Parsons. Fluid was pumped from each open borehole to remove and reduce the effects of drilling and cross flow. On completion of pumping a FLUTe™ liner was installed in each borehole to minimize the effects of cross flow between different horizons. The FLUTe™ liners were removed, and the boreholes were pumped again prior to the installation of the Westbay wells.

3.2 Preparation of Monitoring Well Design

Preliminary monitoring zone locations for the Westbay MP38 wells were sent to Westbay by Mr. Scott Pearson of Parsons. Westbay prepared MP Casing Log/Casing Installation Log, which specifies the location of components in the boreholes, prior to arrival at the site. The logs were reviewed by Mr. Eric Tennyson of Parsons and approved in the field prior to installation of the wells. The MP Casing Log/Casing Installation Logs as approved were used as an installation guide in the field. Field copies of the logs are in the Appendices.

Monitoring wells No. WB-06,WB-07, and WB-08 were each designed with 5 sampling zones and WB-05 was designed with 8 sampling zones. An MP measurement port coupling was included in each zone to provide the capability to measure fluid pressures and collect fluid samples. A pumping port coupling was also included in each zone to provide purging and hydraulic conductivity testing capabilities.

Prior to MP System installation, the MP System casing components were set out near the borehole according to the sequence indicated on the appropriate MP Casing Log/Casing Installation Log. Each casing length was numbered beginning with the lowermost as an aid to confirming the proper sequence of components. The appropriate MP System couplings were attached to the casing sections. Magnetic location collars were attached 2 feet below the top of the MP measurement port in each sampling zone. Pumping ports were positioned at various intervals above the bottom-most packer in each zone.

Each casing component was visually inspected. Serial numbers for each MP packer, MP pumping port and MP measurement port coupling were recorded on the MP Casing Log/Casing Installation Logs. The well component layout was confirmed with the log before the components were lowered into the boreholes.

3.3 Lowering of MP Components

The MP casing components were placed in the well using a SMEAL rig provided by Geoprojects Drilling International (GeoProjects). Each casing joint was tested with a minimum internal hydraulic pressure of 150 psi for one minute to confirm hydraulic seals. The measurement ports were tested with a minimum internal hydraulic pressure of 100 psi for one minute to confirm hydraulic seals. A record of each successful joint test and the placement of each casing component are noted on the MP Casing Log/Casing Installation Logs by check marks.

Clean water was supplied by GeoProjects for testing of joint seals during lowering and for packer inflation.

3.4 Hydraulic Integrity Testing

After the MP casing was lowered into the borehole, the water levels inside the MP casing was monitored at depths different from the open borehole water level for a minimum period of thirty minutes to confirm hydraulic integrity of the casing. The data from the hydraulic integrity tests are shown on the first page of the respective MP Casing Log/Casing Installation Log in the Appendices. Table 2 (below) also lists the data for the hydraulic integrity tests.

<u>Table 2, Summary of Borehole and Westbay water levels</u>

Monitoring Well No.	Borehole water level (ft)	Westbay water level (ft)
CS-WB05	222.38	453.45
CS-WB06	207.25	321.60
CS-WB07	211.60	319.95
CS-WB08	228.60	343.60

3.5 Positioning of MP Components

After the components were lowered into the well, the MP casing string was positioned as indicated on the cover page of the Summary Casing Logs. The top of the four-inch PVC surface casing was used as the borehole datum. The MP casing string was supported in this position while packer inflation was carried out. Summary Casing Logs, which show the final “as-built” locations of the components in each well, are included in the Appendices. The depths of key items in the wells are shown in Tables 3-6.

3.6 Pre-inflation Profiles

A pre-inflation pressure profile was carried out at the well prior to inflating the packers to confirm the proper operation and position of measurement ports and magnetic collars. The data confirmed that the ports operated properly and are positioned correctly. The data for the pre-inflation profiles are located in the Appendices and on the Field Data and Calculation Sheets.

3.7 Inflation of MP System Packers

The MP packers were inflated sequentially beginning at the bottom of the well using clean water. Westbay's model No. 6055 vented inflation tool was used for packer inflation. All of the packers appear to have inflated normally. The data for inflation of each packer are provided on the MP Packer Inflation Records included in the Appendices.

4. Fluid Pressure Measurements

After packer inflation was completed, fluid pressures were measured at each measurement port. At that time, the in-situ formation pressures may not have recovered from the pre-installation activities and potential groundwater pressure increases in monitoring zones may have resulted from packer inflation. This latter effect may be more likely to occur in monitoring zones located in low-permeability geological formations. Longer term monitoring may be required to establish representative fluid pressures.

A plot of the Piezometric levels in all zones in each well is shown on Figure 1 in the respective Appendices. The data were examined to confirm proper operation of the measurement ports and as a check on the presence of annulus seals between monitoring zones. The calculation sheets for the pressure profiles of the MP monitoring wells are also enclosed in the Appendices.

Table 3 - Depths of Key Items for MP Monitoring Well WB-05

Zone No.	Monitoring Interval* (ft)	MP Casing No. (from MP Log)	Packer No.	Packer Serial No.	Nominal Packer Position (ft) ***	Magnetic Collar Depth (ft)	Measurement Port Depth** (ft)	Pumping Port Depth** (ft)
Zone 1	449.0-475.0	1-5				462.0	460.0	465.0
Packer		6	1	14453	444.0	---	---	---
Zone 2	395.0-444.0	7-14				434.0	432.0	437.0
Packer		15	2	14569	390.0	---	---	---
Zone 3	347.0-390.0	16-22				364.0	362.0	237.0
Packer		23	3	14585	342.0	---	---	---
Zone 4	291.0-342.0	24-33				331.0	329.0	334.0
Packer		34	4	13163	286.0	---	---	---
Zone 5	277.0-286.0	35-37				279.0	277.0	282.0
Packer		38	5	14454	272.0	---	---	---
Zone 6	197.0-272.0	39-50				218.0/264.0	216.0/262.0	267.0
Packer		51	6	14286	192.0	---	---	---
Zone 7	114.0-192.0	52-62				184.0	182.0	187.0
Packer		63	7	13161	109.0	---	---	---
Zone 8	32.0-109.0	64-73				101.0	99.0	104.0
Packer		74	8	13162	27.0	---	---	---
casing	0.0-27.0	75-79						

* Note: depths are with respect to original top of 4-inch PVC surface casing before modification.

** Component positions are referenced to the top of the subject MP System coupling.

*** Packer positions are referenced to the top MP System coupling on the packer.

Table 4 - Depths of Key Items for MP Monitoring Well WB-06

Zone No.	Monitoring Interval* (ft)	MP Casing No. (from MP Log)	Packer No.	Packer Serial No.	Nominal Packer Position (ft) ***	Magnetic Collar Depth (ft)	Measurement Port Depth** (ft)	Pumping Port Depth** (ft)
Zone 1	275.0-335.0	1-7	----	----	----	322.0	320.0	325.0
Packer	----	8	1	13169	270.0	----	----	----
Zone 2	189.0-270.0	9-21	----	----	----	209.0/262.0	207.0/260.0	265.0
Packer	----	22	2	13078	184.0	---	---	---
Zone 3	108.0-184.0	23-32	----	----	---	176.0	174.0	179.0
Packer	----	33	3	13168	103.0	---	---	---
Zone 4	35.0-103.0	34-43	----	----	---	95.0	93.0	98.0
Packer	----	44	4	13080	30.0	---	---	---
Zone 5	12.0-30.0	45-49	----	----	---	22.0	20.0	25.0
Packer	----	50	5	13079	7.0	---	---	---
casing	0.0-7.0	51-54	----	----	---	---	---	---

* Note: depths are with respect to original top of 4-inch PVC surface casing before modification.

** Component positions are referenced to the top of the subject MP System coupling.

*** Packer positions are referenced to the top MP System coupling on the packer.

Table 5 - Depths of Key Items for MP Monitoring Well WB-07

Zone No.	Monitoring Interval* (ft)	MP Casing No. (from MP Log)	Packer No.	Packer Serial No.	Nominal Packer Position (ft) ***	Magnetic Collar Depth (ft)	Measurement Port Depth** (ft)	Pumping Port Depth** (ft)
Zone 1	272.0-333.0	1-8	---	---	---	320.0	318.0	323.0
Packer	---	9	1	13084	267.0	---	---	---
Zone 2	190.0-267.0	10-22	---	---	---	210.0/259.0	208.0/257.0	262.0
Packer	---	23	2	13083	185.0	---	---	---
Zone 3	105.0-185.0	24-32	---	---	---	177.0	175.0	180.0
Packer	---	33	3	13082	100.0	---	---	---
Zone 4	29.0-100.0	34-42	---	---	---	92.0	90.0	95.0
Packer	---	43	4	13085	24.0	---	---	---
Zone 5	9.0-24.0	44-46	---	---	---	16.0	14.0	19.0
Packer	---	47	5	13081	4.0	---	---	---
casing	0-4.0	48-50	---	---	---	---	---	---

* Note: depths are with respect to original top of 4-inch PVC surface casing before modification.

** Component positions are referenced to the top of the subject MP System coupling.

*** Packer positions are referenced to the top MP System coupling on the packer.

Table 6 - Depths of Key Items for MP Monitoring Well WB-08

Zone No.	Monitoring Interval* (ft)	MP Casing No. (from MP Log)	Packer No.	Packer Serial No.	Nominal Packer Position (ft) ***	Magnetic Collar Depth (ft)	Measurement Port Depth** (ft)	Pumping Port Depth** (ft)
Zone 1	288.0-356.0	1-9				343.0	341.0	346.0
Packer		10	1	13160	283.0			
Zone 2	208.0-283.0	11-19				230.0/275.0	228.0/273.0	278.0
Packer		20	2	13165	203.0			
Zone 3	130.0-203.0	21-30				195.0	193.0	198.0
Packer		31	3	13164	125.0			
Zone 4	53.0-125.0	32-40				117.0	115.0	120.0
Packer		41	4	13166	48.0			
Zone 5	12.0-48.0	42-47				40.0	38.0	43.0
Packer		48	5	13167	7.0			
casing	0.0-7.0	49-51						

* Note: depths are with respect to original top of 4-inch PVC surface casing before modification.

** Component positions are referenced to the top of the subject MP System coupling.

*** Packer positions are referenced to the top MP System coupling on the packer.

APPENDIX 1

Monitoring Well CS-WB05

Summary Casing Log	- 4 pages
Pre-Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (dated November 12, 2005)	- 1 page
Figure 1, Pre-Inflation Piezometric Pressure Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (dated November 12, 2005)	- 1 page
Figure 2, Post-Inflation Profile	- 1 page
MP Casing Log/Casing Installation Log (field copy)	- 12 pages
MP Packer Inflation Records	- 9 pages

APPENDIX 2

Monitoring Well CS-WB06

APPENDIX 3

Monitoring Well CS-WB07

APPENDIX 4

Monitoring Well CS-WB08

Well Development and Purge Form

WELL DEVELOPMENT RECORD

Camp Stanley Storage Activity
Location identification B3-MW01 (inj well)
Date 23-28 Sept. 05
Time ______

Diameter (Inches)	Volume (Gals/ft)
2	0.16
(4)	0.65
6	1.47
8	2.61
10	4.08
12	5.88
14	8.00

Development Method

(bail) pump surge air lift

other ______

277-287

VOLUME MEASUREMENTS

Casing inside diameter	4	in
Static water level	193.9	ft
Total casing depth	287	ft
Length of water column	93.1	ft
PURGE VOLUME (calculated at bottom)	60.5	gal/vol
Bailer length		ft
Bailer inside diameter		in
BAILER VOLUME	3	gal
Number of bailers for 1 volumes	20	bailers

Purge volume = 93.1 ft water column * .65 gals/ft casing vol. * (1)/2/3/4/5 volumes (*circle one*)= 60.5 gals.

PURGE RECORD

Time	Volume/Bail No.	Temp °F	pH	Elec Cond		Visual Appearance/Odor
9/23	170 gal	bailed dry				cloudy
9-26	100	"				"
9-27	100	"				"
9/28	100	bailed dry	before measurements taken.			[illegible] cloudy

Weather: ______ Sampled by: ZB

Diameter (Inches)	Volume (Gals/ft)
2	0.16
4	0.65
4¼	0.72
6	1.47
8	2.61
10	4.08
12	5.88
14	8.00

Well Development and Purge Form

WELL DEVELOPMENT RECORD

Camp Stanley Storage Activity
Location identification CS-WB05
Date 11-10, 11-11-05
Time 0930 - 1030

Development Method

bail (pump — circled) surge air lift

other ____________________

VOLUME MEASUREMENTS

*Borehole ~~Casing inside~~ diameter 4¼ in
Static water level 219.4 ft bgs
Total ~~casing~~ depth 480 ft
Length of water column 260.6 ft
PURGE VOLUME (calculated at bottom) 188 gal/vol.
Bailer length n/a ft
Bailer inside diameter n/a in
BAILER VOLUME n/a gal
Number of bailers for ____ volumes n/a bailers

Purge volume = 260.6 ft water column * 0.72 gals/ft casing vol. *(1 circled)/2/3/4/5 volumes (*circle one*)= 188 gals.

3 = 563 gal

* Westbay wells must be developed in open hole prior to materials installation. Not feasible to develop from inside casing of MP38 system.

STABILIZATION ~~PURGE~~ RECORD

Time	Volume/~~Bail No.~~	Temp ~~°F~~ °C	pH	Elec Cond µS	Turb. NTU	Visual Appearance/Odor
11-10-05	2250 gal					
11-11-05						
0945		22.7	6.89	576	3.8	clear / none
1000		22.7	6.85	573	3.5	"
1015		22.5	6.83	572	3.4	"
	2655					
total	4905	/188 =	26.1 volumes removed.			

Weather: cloudy, breezy-windy, cool-mild

Sampled by: BT

Diameter (Inches)	Volume (Gals/ft)
2	0.16
4	0.65
6	1.47
8	2.61
10	4.08
12	5.88
14	8.00

Well Development and Purge Form

WELL DEVELOPMENT RECORD

Camp Stanley Storage Activity
Location identification: CS-WB06
Date: 11-6 + 11-7-05
Time: 0200-1023

Development Method

bail (pump) surge air lift

other ______

333.0
209.5
129.5

VOLUME MEASUREMENTS

borehole ~~Casing inside~~ diameter: 4 1/4 in
Static water level: 203.5 ft
Total ~~casing~~ depth: 333 ft
Length of water column: 129.5 ft
PURGE VOLUME (calculated at bottom): 93.24 gal/vol.
Bailer length: ___ ft
Bailer inside diameter: N/A in
BAILER VOLUME: ___ gal
Number of bailers for ____ volumes: ___ bailers

Purge volume = 129.5 ft water column * 0.72 gals/ft casing vol. (1)/2/3/4/5 volumes (*circle one*)= 93.24 gals.

(3) = 279.72

stabilization ~~PURGE~~ RECORD

Time	Volume/~~Bail No.~~	Temp ~~°F~~ °C	pH	Elec Cond (µS)	Turbidity (NTUs)	Visual Appearance/Odor
11-6	290 gal					turbid
11-7-05						
0946		23.4	7.10	590	5.1	Clear
1010		23.6	7.15	588	5.0	"
1021		23.4	7.14	587	5	"
	2436 gal					
Total:	2726	/93.24 =	29.2 volumes out.			

Weather: cloudy, humid, mild

Sampled by: E. Tennyson

Well Development and Purge Form

WELL DEVELOPMENT RECORD

Camp Stanley Storage Activity	
Location identification	CS-WB07
Date	11-7-05
Time	1428-1730 hrs

Diameter (Inches)	Volume (Gals/ft)
2	0.16
4	0.65
6	1.47
8	2.61
10	4.08
12	5.88
14	8.00

Development Method

bail (pump) surge air lift

other ______

335
208.55
126.45

VOLUME MEASUREMENTS

borehole ~~Casing inside~~ diameter	4 1/4	in
Static water level	208.55	ft
Total ~~casing~~ depth	335	ft
Length of water column	126.45	ft
PURGE VOLUME (calculated at bottom)	91	gal /vol
Bailer length	N/A	ft
Bailer inside diameter		in
BAILER VOLUME		gal
Number of bailers for ____ volumes		bailers

Purge volume = 126.45 ft water column * 0.72 gals/ft casing vol. * (1)/2/3/4/5 volumes (*circle one*)= 91 gals.

(3 vol = 273 gal)

stabilization ~~PURGE~~ RECORD

Time	Volume/~~Bail No.~~	Temp ~~°F~~ °C	pH	Elec Cond MS	Turb. (NTU)	Visual Appearance/Odor
1650		23.5	6.99	590	5.2	clear/none
1718		23.3	6.97	586	5.3	"
1724		"	"	585	5.1	"
Total	2366 gal	/91 = 26 volumes out.				

Weather: cloudy, humid, mild

Sampled by: E. Tennyson

Well Development and Purge Form

WELL DEVELOPMENT RECORD

Camp Stanley Storage Activity
Location identification CS-WB08
Date 4/9/05
Time 1045 to 1410

Diameter (Inches)	Volume (Gals/ft)
2	0.16
4	0.65
6	1.47
8	2.61
10	4.08
12	5.88
14	8.00

Development Method

bail (pump) surge air lift

other ______

VOLUME MEASUREMENTS

~~Casing inside~~ borehole diameter	4 1/4	in
Static water level	223.65	ft
Total ~~casing~~ depth	355	ft
Length of water column	131.35	ft
PURGE VOLUME (calculated at bottom)	94.6	gal/vol
Bailer length	N/A	ft
Bailer inside diameter		in
BAILER VOLUME		gal
Number of bailers for ____ volumes		bailers

Purge volume = 131.35 ft water column * .72 gals/ft casing vol. * (1)/2/3/4/5 volumes (*circle one*)= 94.6 gals.

3 ≈ 284 gal

~~PURGE~~ Stabilization RECORD

Time	Volume/~~Bail No~~	Temp °C	pH	Elec Cond µS	Turb. NTUs	Visual Appearance/Odor
1320		22.5	7.10	582	40	started cloudy,
1345		22.8	7.09	578	38	cleared after
1405		"	7.08	568	41	1st hour.
Tot.	2665 gal	or 28.2 volumes.				

Weather: overcast, humid, mild. Sampled by: ET

31168\AU354\GWTABLE.DOC

STATE OF TEXAS WELL REPORT for Tracking #79418

Owner:	**U.S. GOVERMENT**	Owner Well #:	**CS-B3-MW1**
Address:	**25800 RALPH FAIR ROAD** **BOERNE , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 RALPH FAIR ROAD** **BOERNE , TX 78015**	Latitude:	**29° 42' 39" N**
Well County:	**Bexar**	Longitude:	**098° 36' 49" W**
Elevation:	**1240 ft.**	GPS Brand Used:	**GARMIN**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **9/13/2006** Completed: **9/21/2006**
Diameter of Hole:	Diameter: **7 7/8 in From Surface To 292.5 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	Gravel Packed From: **274 ft to 287 ft** Gravel Pack Size: **1/4 GRAVEL**
Annular Seal Data:	1st Interval: **From 0 ft to 267.5 ft with CEMENT-6 (#sacks and material)** 2nd Interval: **From 267.5 ft to 274 ft with BENTONITE-2 (#sacks and material)** 3rd Interval: **From 274 ft to 287 ft with PEA GRAVEL-9 (#sacks and material)** Method Used: **TREMIE** Cemented By: **LEE GEBBERT** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Alternative Procedure Used**
Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**
Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**GEOPROJECTS INTERNATIONAL, INC** **8834 CIRCLE DRIVE**

	AUSTIN , TX 78736
Driller License Number:	**2525**
Licensed Well Driller Signature:	**LEE GEBBERT**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**PLUG BACK WITH BENTONITE-2 FROM 292.5-287**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-17 UPPER GLEN ROSE
17-292.5 LOWER GLEN ROSE

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4 NEW SCH 40 PVC RISER 0-277
4 NEW 304 SSWW RB SCREEN 277-287 0.050

STATE OF TEXAS WELL REPORT for Tracking #74396

Owner:	**U.S. GOVERMENT**	Owner Well #:	**CS-WB05**
Address:	**25800 RALPH FAIR ROAD** **BOERNE , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 RALPH FAIR ROAD** **BOERNE , TX 78015**	Latitude:	**29° 42' 38" N**
Well County:	**Bexar**	Longitude:	**098° 36' 51" W**
Elevation:	**1240 ft.**	GPS Brand Used:	**GARMIN**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **7/26/2005** Completed: **7/29/2005**
Diameter of Hole:	Diameter: **7 7/8 in From Surface To 30 ft** Diameter: **4 1/4 in From 30 ft To 480 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Open Hole**
Annular Seal Data:	1st Interval: **From 0 ft to 30 ft with CEMENT-10 (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **TREMIE** Cemented By: **LEE GEBBERT** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Alternative Procedure Used**
Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**
Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company	**GEOPROJECTS INTERNATIONAL,INC**

Information:	**8834 CIRCLE DRIVE AUSTIN , TX 78736**
Driller License Number:	**2525**
Licensed Well Driller Signature:	**LEE GEBBERT**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

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(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-17 UPPER GLEN ROSE LIMESTONE
17-336 LOWER GLEN ROSE LIMESTONE
336-393 BEXAR SHALE
393-469 COW CREEK LIMESTONE
469-480 HAMMETT SHALE

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4.5 NEW SCH 40 PVC RISER +2.5-30

STATE OF TEXAS WELL REPORT for Tracking #74398

Owner:	**U.S. GOVERMENT**	Owner Well #:	**CS-WB06**
Address:	**25800 RALPH FAIR ROAD BOERNE , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 RALPH FAIR ROAD BOERNE , TX 78015**	Latitude:	**29° 42' 32" N**
Well County:	**Bexar**	Longitude:	**098° 36' 52" W**
Elevation:	**1232 ft.**	GPS Brand Used:	**GARMIN**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **8/1/2005** Completed: **8/3/2005**
Diameter of Hole:	Diameter: **7 7/8 in From Surface To 10 ft** Diameter: **4 1/4 in From 10 ft To 333 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Open Hole**
Annular Seal Data:	1st Interval: **From 0 ft to 10 ft with CEMENT-4 (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **TREMIE** Cemented By: **LEE GEBBERT** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Alternative Procedure Used**
Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**
Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company	**GEOPROJECTS INTERNATIONAL,INC**

Information:	**8834 CIRCLE DRIVE AUSTIN , TX 78736**
Driller License Number:	**2525**
Licensed Well Driller Signature:	**LEE GEBBERT**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

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(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-17 UPPER GLEN ROSE LIMESTONE
17-330 LOWER GLEN ROSE LIMESTONE
330-333 BEXAR SHALE

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4.5 NEW SCH 40 PVC RISER +2.5-10

STATE OF TEXAS WELL REPORT for Tracking #74399

Owner:	**U.S. GOVERMENT**	Owner Well #:	**CS-WB07**
Address:	**25800 RALPH FAIR ROAD BOERNE , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 RALPH FAIR ROAD BOERNE , TX 78015**	Latitude:	**29° 42' 36" N**
Well County:	**Bexar**	Longitude:	**098° 36' 52" W**
Elevation:	**1233 ft.**	GPS Brand Used:	**GARMIN**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **8/4/2005** Completed: **8/11/2005**
Diameter of Hole:	Diameter: **7 7/8 in From Surface To 10 ft** Diameter: **4 1/4 in From 10 ft To 335 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Open Hole**
Annular Seal Data:	1st Interval: **From 0 ft to 10 ft with CEMENT-4 (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **TREMIE** Cemented By: **LEE GEBBERT** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Alternative Procedure Used**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company	**GEOPROJECTS INTERNATIONAL,INC**

Information:	**8834 CIRCLE DRIVE** **AUSTIN , TX 78736**
Driller License Number:	**2525**
Licensed Well Driller Signature:	**LEE GEBBERT**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

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DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-13 UPPER GLEN ROSE LIMESTONE
13-330 LOWER GLEN ROSE LIMESTONE
330-335 BEXAR SHALE

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4.5 NEW SCH 40 PVC RISER +2.5-10

STATE OF TEXAS WELL REPORT for Tracking #74401

Owner:	**U.S. GOVERMENT**	Owner Well #:	**CS-WB08**
Address:	**25800 RALPH FAIR ROAD BOERNE , TX 78015**	Grid #:	**68-20-1**
Well Location:	**25800 RALPH FAIR ROAD BOERNE , TX 78015**	Latitude:	**29° 42' 36" N**
Well County:	**Bexar**	Longitude:	**098° 36' 48" W**
Elevation:	**1252 ft.**	GPS Brand Used:	**GARMIN**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **8/11/2005** Completed: **8/16/2005**
Diameter of Hole:	Diameter: **7 7/8 in From Surface To 10 ft** Diameter: **4 1/4 in From 10 ft To 355 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	**Open Hole**
Annular Seal Data:	1st Interval: **From 0 ft to 10 ft with CEMENT-4 (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **TREMIE** Cemented By: **LEE GEBBERT** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Alternative Procedure Used**
Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**
Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company	**GEOPROJECTS INTERNATIONAL,INC**

Information:	**8834 CIRCLE DRIVE** **AUSTIN , TX 78736**
Driller License Number:	**2525**
Licensed Well Driller Signature:	**LEE GEBBERT**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

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DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-35 UPPER GLEN ROSE LIMESTONE
35-349 LOWER GLEN ROSE LIMESTONE
349-355 BEXAR SHALE

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
4.5 NEW SCH 40 PVC RISER +2.5-10

APPENDIX B
PARSONS TECHNICAL MEMORANDUM, CONSTRUCTION RECOMMENDATIONS FOR PROPOSED WESTBAY MP38 SYSTEM WELLS AT CSSA SWMU B-3

Technical Memorandum

To: Glaré Sanchez, Jeff Aston and Chris Beal, CSSA

From: Parsons Staff

CC: file (744223.07)

Date: November 1, 2005

Re: Construction Recommendations for proposed Westbay® MP38 System Wells at CSSA SWMU B-3

This Technical Memorandum presents construction information and recommendations for the new Westbay wells (WBs) WB05, WB06, WB07, and WB08 at SWMU B-3 located in Camp Stanley Storage Activity (CSSA). These recommendations for the new WBs are for your review and comment. For information on the scope of work beyond WB construction refer to the Draft TO-06 Work Plan and Draft TO-06 Sampling and Analysis Plan.

PROJECT BACKGROUND AND OBJECTIVES

In July and August 2005, Parsons drilled four open boreholes around SWMU B-3 to be completed with Westbay MP38 Systems as part of Task Order 0006. The locations of the existing well boreholes are shown on Attachment 1 to this memorandum. The Westbay systems are multi-port wells capable of monitoring several vertically distinct and separate hydrogeologic zones within one borehole. During the interim design phase of the WB wells, the boreholes have been sealed against vertical groundwater and contaminant migration by FLUTe™ borehole liners. Parsons has, and will, monitor and maintain the appropriate interstitial head levels within the FLUTe liners until the actual WB installations scheduled to begin on 7 November 2005.

The WB wells are intended to monitor volatile organic compound (VOC) contamination and other subsurface conditions in various geologic layers beneath SWMU B-3 as part of a substrate injection pilot study, a bioreactor treatability study, subsequent O&M periods, groundwater pumping tests, and other ancillary groundwater monitoring needs. Well WB05 is completed to the base of the Cow Creek (CC) formation in support of a groundwater pumping test to be performed in December 2005. The focus of the pumping test is to assess the vertical leakage potential of the Bexar Shale (BS) in the vicinity of SWMU B-3 and the CS-16 well cluster, and general aquifer characterization. The pumping tests will also help assess the groundwater flow paths that ultimately led to the contamination discovered in 1991 at Well 16. The remaining wells (WB06, WB07, and WB08) are not specifically tied to the pumping tests, but to SWMU B-3 bioreactor monitoring, and therefore are completed to the base of the Lower Glen Rose (LGR) formation only. A design image of the wells is shown on Attachment 2.

The CC and the bottom of the LGR contain the two main water-bearing zones of the Middle Trinity aquifer and are separated by the Bexar Shale aquitard. Previous work at the CS-MW16 well cluster has demonstrated that contamination in excess of maximum contaminant levels (MCLs) is present within the major water-bearing units of the LGR and CC members. The design of WB05 and implementation of the MW16 pumping test will help determine the nature of how contamination is distributed downward into underlying strata.

Part of the SWMU B-3 Enhanced Anaerobic Bioremediation (EAB) Pilot Study involves injection of an organic substrate into a portion of the LGR formation at SWMU B-3 at the location and depth interval described in the technical memorandum recommending injection well location and injection intervals (see *Parsons Technical Memo* from Gary Cobb, September 2005). WB05 will facilitate monitoring the effects that the substrate has on geochemistry and associated biological activities related to anaerobic dechlorination of PCE and TCE. A conventional monitoring well also suitable for injection purposes (CS_B3-MW01) was installed along the presumed migration pathway between the VOC source area and the MW16 well pair to facilitate injection of the organic substrate. It is believed that prolonged pumping activities associated with groundwater production at the former Well 16 induced groundwater gradient reversals that literally pulled contamination within its sphere of influence toward the pumping well, rather than traveling along its natural flow paths southward and southwestward, and significantly influenced the shape of the resultant VOC plume. Data from groundwater monitoring suggests that absent the continuous pumping activities previously performed at Well 16 groundwater flow would trend more southward rather than northwesterly toward Wells D and 16. Renewing pumping operations at MW16 wells during the EAB injection pilot study will partially recreate the past conditions that originally contributed to the spread of SWMU B-3 contamination and should provide a hydraulic gradient that increases the probability that WB05 will be located ideally between the injection well and Well 16, and thus able to provide appropriate and significant data regarding the performance of the substrate injection. The injected substrate is expected to follow the same general groundwater flow paths under the recreated conditions as the original contamination, enhancing contaminant degradation along the way. The remaining WBs completed into the LGR will complement WB05 primarily in the monitoring of the formation during operation of bioreactor treatment cells planned for construction in the SWMU B-3 excavation scheduled for early 2006.

Drilling locations for the four monitoring wells were selected with the objective of optimizing observations of recharge and flow pathways from SWMU B-3. The possible recharge pathways are intended to represent the flow paths followed by the contaminants when they initially impacted the aquifer. Monitoring in areas of higher contamination, such as those closer to SWMU B-3, should also provide sufficient quantities of data to assess the effects of the enhanced biodegradation resulting from the operation and maintenance of the bioreactor cells throughout the vertical profile of the formation. Well WB08 was drilled in the apparent upgradient location east of SWMU B-3. CS-WB05 was installed between the SWMU B-3 'injection well' and the pilot study's pumping wells (MW16-LGR & -CC). It will be utilized as the main downgradient monitoring point for the substrate injection test and the main observation well for MW16 pumping tests (local aquifer characterization). WBs 06 and 07 will monitor the study's effects in the southward and westward downgradient directions from SWMU B-3, respectively.

SITE CHARACTERIZATION

Geophysical, optical, and Hydrophysical logging (HpL) was conducted by RAS, Inc. following the installation of the boreholes in August 2005. Geophysical and video logs were used to correlate the stratigraphy of individual boreholes and establish a site model, and compare/contrast these results to other geophysical work conducted throughout CSSA. The HpL testing conducted at WB05 primarily identified zones of groundwater flow and potential injection zones within the saturated interval of the formation. The data from this testing was also evaluated to assist in selecting appropriate WB sample port depths. Analysis of the HpL testing completed at WB05 identified the optimum injection zone for CS_B-3_MW01 (see *Parsons Technical Memo* from Gary Cobb, September 2005) at the 278 to 287-foot interval.

Parsons and its subcontractors collected discrete soil-gas and groundwater samples initially from each borehole to screen the subsurface for any VOC contamination emanating from SWMU B-3. In short, every aqueous and air sample collected from the SWMU B-3 boreholes exhibited VOC contamination. From the data it is reasonable to assume that the entire horizon from ground surface to the base of the LGR at SWMU B-3 is contaminated by VOCs. Detected constituents in both the soil-gas and groundwater samples typically included PCE, TCE, and *cis*-1,2,-DCE. To a lesser extent, *trans*-1,2-DCE, 1,1,1-TCA, 1,1-DCE, benzene, chloroform, methylene chloride, and vinyl chloride were reported in some samples. For the purposes of this memorandum, PCE will be used as the indicator constituent when discussing the subsurface contamination, even though multiple organic compounds were detected in each sample. A full tabulation of the sampling results by borehole is provided in Attachment 4.

At WB05, PCE soil-gas concentrations ranged from 120 to 479 parts per billion by volume (ppbv) between the depths of 30 and 176 feet below ground surface (bgs), with the greatest concentrations occurring between 116 to 136 feet bgs. Likewise, PCE soil-gas levels ranged between 540 and 1,570 ppbv between the depths of 10 and 150 feet bgs, with the highest concentration occurring at 150 feet bgs. The least amount of soil-gas contamination was found at WB07, where PCE concentrations were reported between 4.57 and 83.3 ppbv from 10 to 130 feet bgs. At WB07, the highest concentration occurred within the upper 30 feet of strata. The greatest soil-gas contamination was detected at WB08, which is located adjacent to the former SWMU B-3 east trench. PCE concentrations in soil gas ranged from 3,310 to 12,200 ppbv between 10 and 150 feet bgs, with the greatest concentration occurring within the same strata as the landfill (and former east trench) between 10 and 30 feet bgs.

In groundwater, VOCs were ubiquitously reported in all 14 samples (Attachment 4). At WB05, PCE concentrations ranged from 31.3 to 392 micrograms per liter (µg/L) between depths of 268 and 436 feet bgs. At WB05, the VOC concentrations increased with depth, and contamination was found to extend down through the BS into the CC, where the highest concentrations were detected. Likewise, at WB06, reported PCE concentrations in groundwater increased between the depths of 260 and 328 feet bgs, with concentrations ranging between 151 and 337 µg/L. WB07 results indicate that throughout the water column, PCE concentrations ranged between 34.7 and 293 µg/L at depths from 200 to 330 feet bgs. At WB08, while soil-gas results are indicative of the wells proximity to the landfill, the groundwater results suggest that the well is slightly hydraulically upgradient. WB08 PCE concentrations ranged from 38.6 to 53.7 µg/L, and increased with depth between 280 and 351 feet bgs.

DESIGN METHODOLOGY

Multiple factors were considered when designing WB well construction including water-bearing strata, zones of hydraulic distinction, site-specific characterization results in terms of hydrogeology and contaminant distribution, and optimal placement for well components (packer seals and monitoring ports). Finally, the observations and experiences gained from operating similar WB wells located at AOC-65 were also considered during the design phase.

Following prior work performed by the USGS with respect to the Upper Glen Rose (UGR) formation at Camp Bullis and CSSA, the basewide Hydrogeologic Conceptual Site Model (HCSM) has divided the Middle Trinity aquifer into 10 definable zones based upon both stratigraphic and hydrologic character (Parsons, 2005). Six of these zones are in the LGR (A-F), and 4 remaining zones are split equally between the BS and CC members.

At AOC-65, the HCSM model was further subdivided into 17 intervals (1 UGR, 11 LGR, 2 BS, and 3 CC) as monitored by the AOC-65 WB network. While those designs were comprehensive, several years of monthly data from those WB intervals has indicated that some of these individual zones behave in a similar fashion as a group, both from hydraulic and contaminant concentration standpoints. The insight gathered from this monitoring has indicated that combining discrete zones which behave in similar fashion is prudent and economical for future monitoring and generation of meaningful data. Therefore, this approach has been adopted for the WB effort at SWMU B-3.

Site-specific data germane to SWMU B-3 were obtained and reviewed to develop a conceptual monitoring network to meet the goals of the study, which included the EAB Pilot Study and the groundwater pumping tests. The geophysical logging that was performed in each borehole was used to correlate the SWMU B-3 subsurface features with the established HCSM. While some units varied locally with respect to elevation or thickness, the general hydrostratigraphy at SWMU B-3 is consistent with the basewide HCSM and AOC-65 WB observations.

Next, direct measurements of hydraulic properties via HpL, hydraulic profiling (via FLUTe system), straddle packer injection tests, and discrete interval soil-gas and groundwater sampling were reviewed. The findings of these data sets were evaluated with respect to the site hydrogeology. Typical results indicated that soil-gas contamination was present throughout the vadose zone, decreasing in concentration with depth below the SWMU B-3 landfill. Conversely, contaminant concentrations were detected throughout the groundwater column (LGR and CC, BS at SWMU B-3 not yet sampled) showing that concentrations increased with depth. Hydraulic characterization (HpL and FLUTe) confirmed the HCSM model of the primary water-bearing units of the Middle Trinity aquifer, occurring in the basal portion of the LGR and the upper portion of the CC. Very minor water-bearing units were identified above the basal unit, but were generally thin-bedded and very low yielding.

Based on the site-specific data, a conceptual monitoring network of WB intervals was established which addresses the hydrogeologic conditions, and considers locations of identified flow zones and the occurrence of contaminants. The next step was to select packer locations within the boreholes that would provide adequate seals between the intervals to keep them hydraulically separated. That task was accomplished by identifying suitable borehole wall conditions (smooth, narrow, and without cracks or sharp edges) on the geophysical caliper log. All potential packer locations were visually confirmed with data from the Optical Televiewer (OTV) and the downhole analog video. Based on the visual observations, some packer placements were ultimately adjusted from their ideal positions to avoid potentially interfering features and to increase the likelihood of a suitable hydraulic seal.

The final step was to place the sampling and purge ports of each WB well interval. In accordance with WBs standard design recommendation, all WB discrete intervals will have a purging/pumping port 5 feet up from the bottom of the zone (top of bottom packer). Also in accordance with WB recommendations, the intervals will have their sampling port 5 feet above the pumping port. The distance of 5 feet between packer top and the ports is the minimum necessary for proper operation of the WB probe and sampling equipment.

In the basal portion of the aquifer, the measurement/sampling ports were placed adjacent to identified flow paths (vugs, fractures, etc.). Since water levels are known to decline in many zones during dry periods, the sampling ports in upper intervals will be placed as low as feasible in the to minimize the potential for water levels falling below the port, which would preclude sample collection. At monitoring intervals where seasonally declining groundwater levels is less of a concern such as in the basal portion of the LGR, some sampling ports are planned at depths corresponding to a flow-zone identified through the HpL and packer testing.

The selected WB zones will be sufficiently distributed so monitored natural attenuation (MNA) parameters, and changes in contaminant concentrations in various hydrogeologic zones can be monitored and accurately measured and quantified. Contamination within the LGR appears to be ubiquitous around SWMU B-3; therefore contaminant concentrations played a minor role in interval selection, although it is important to note that the presence of contamination throughout the formation measured in the packer test samples suggests that the monitoring wells were properly located for their stated purpose, that of monitoring the effects of the bioreactor in the apparent core of the plume's source area.

WELL COMPLETION

Hydraulic properties of the different geologic layers exert a major influence on the rate and direction of groundwater flow through the formation. Corresponding SWMU B-3 WB intervals all include correlated geologic zones that contain significant permeable layers capable of facilitating groundwater and contaminant movement. While the zone selections are tailored to the site-specific conditions encountered at SWMU B-3, generally speaking, most intervals are assimilations of comparable zones that are discrete in the AOC-65 WBs. The recommended 23 sampling intervals are shown in Attachment 2, and are discussed below. The deeper WB well, WB05, will have 8 monitoring zones. The remaining shallower wells (WB06, WB07, and WB08) will have 5 zones each. Groundwater sampling by WB system is very low-flow and removes only a small amount of water (120 ml per sample). Samples can be collected by WB system from intervals where other conventional methods would fail (*e.g.*, bailer, submersible pump).

Table 1
Comparison of the B-3 Site-Specific Design with Respect to the HCSM and AOC-65 Design

HCSM Model Layer	AOC-65 WB Design	SMWU B-3 WB Design
UGR(D) UGR(E)	UGR01	UGR01 *(plus upper ~10' of LGR[A])*
LGR(A)	LGR01	LGR01
LGR(B)	LGR02	
	LGR03	
LGR(C)	LGR04	LGR02
	LGR05	
LGR(D)	LGR06	
	LGR07	LGR03
LGR(E)	LGR08	
	LGR09	
LGR(F)	LGR10	LGR04 *(WB05 divided into 4A and 4B)*
	LGR11	
BS(A)	BS01	BS01
BS(B)	BS02	
CC(A)	CC01	CC01
	CC02	
CC(B)	CC03	CC02

For the overall WB design at SWMU B-3, the subsurface has been divided into single zone for the UGR, 4 monitoring zones in the LGR, 2 zones for the BS (WB05 only), and 2 zones for the CC (WB05 only). For reference, Table 1 provides an index of the SWMU B-3 zones with respect to the HCSM stratigraphy and equivalent zones at AOC-65. Table 2 summarizes the rationale for zone selections at SWMU B-3. Attachment 3 lists precise positions of all intervals. The paragraphs following summarize the reasoning for zone selections.

Table 2
Summary and Rationale of Discrete Westbay Interval Selections at SWMU B-3

Monitoring Zone	General Description	Specific Results	Rationale
UGR-01	Weathered limestones and evaporites of the basal UGR and upper LGR that easily erode into large voids near the contact (contact approx. 13-17 feet bgs at SWMU B-3). This zone is typically dry through most of the year.	PCE in soil gas ranging between 83 ppbv and 12,200 ppbv at B-3.	Will almost always be dry except during heavy precipitation events, when high concentrations of contaminants will be expected. Thin segment of UGR available below surface casing precluded UGR-only monitoring. Measurement ports are located at the UGR/LGR contact. Lower packer of this zone is 10' below UGR/LGR contact because of large caliper openings. Design will allow for shallow vadose drainage and perched groundwater to sufficiently accumulate for sampling after heavy rainfall. Not monitored at WB05, cased off due to borehole instability.
LGR-01	Low permeable mudstones grading to periodically fossiliferous and moderately porous limestones.	PCE in soil gas ranging between 4.6 ppbv and 3,310 ppbv at B-3.	Monitor horizons containing flowpaths from contaminant source to the saturated zone, and effects of bioreactor on downward moving and perched water.
LGR-02	Low permeable mudstones grading into moderately fossiliferous, grainy limestones containing occasional thin, vuggy, permeable layers.	PCE in soil gas ranging between 21.5 ppbv and 5,010 ppbv at B-3.	As above, and to monitor minor water-bearing zones near base of interval. Zone is mostly to completely saturated during periods of high water levels. Monitoring port is between two of the most permeable layers through which shallow recharge water is transmitted.
LGR-03	Majority is tight, competent limestone, but with several laterally continuous intervals of more permeable, vuggy limestone that have shown to be low-yielding groundwater zones.	PCE > 30 ppb in groundwater. Little to no injection attained during straddle packer test of 20-foot "scissor-tail" resistivity marker zone.	HpL and injection tests showed low-yielding groundwater is available in a vuggy zone generally at an elevation of 1030' MSL. A monitoring port has been placed adjacent to that zone. This LGR-03 interval may partially dewater during droughts, therefore a secondary port has been placed at the base of the zone to ensure groundwater samples can still be obtained during low groundwater conditions.

Table 2
Summary and Rationale of Discrete Westbay Interval Selections at SWMU B-3

LGR-04	Very porous and permeable, fossiliferous limestone, more honey-combed with depth. Can yield high volumes of groundwater.	PCE ranging between 31.8 and 337 ppb in initial discrete water samples.	One of two main water-bearing zones in Middle Trinity Aquifer from which groundwater withdrawals are pumped; main source for local water supply wells. High potential for transmitting contamination. Sample port placed in most contaminated flow path.
BS-01	Poor hydraulic conductivity, shaley limestone and calcareous shale, with silty dolomitic and marl areas. Acts as an aquitard between the LGR and CC.	HpL indicates very low-flow zone. Nearby MW1-BS quarterly groundwater results show periodic TCE detections < lab RL and DCE 0.12-1.3 ppb.	Having very low permeability, the BS still has groundwater storage capabilities and over time exhibits leakage from/into the adjoining LGR and CC. Zone will monitor water in storage and what may be moving through BS via nearby fractures, and response to MW16 pumping test as part of aquifer characterization.
CC-01	High porosity and permeability, portions vuggy and honey-combed, fossiliferous limestone. Main water-bearing portion of the CC.	PCE detected at 392 ppb in initial discrete water sample.	One of two main water-bearing zones in Middle Trinity Aquifer from which groundwater withdrawals are pumped; a source for local water supply wells. Zone will be an important observation point for MW16 pumping test.
CC-02	Dolomitic to shaley limestone, contains permeable zones but generally less porous than CC-01. Permeability and porosity decrease with depth as CC transitions into underlying Hammett Shale.	Not yet sampled at B-3, but exhibits VOC contamination at wells downgradient (WB04) from other AOCs. Zone is expected to be contaminated at B-3.	Will be monitored as part of the CC, may have close interaction with above CC-01.

B3-UGR-01

Due to land surface elevation differences, the UGR at SWMU B-3 is much thinner than at AOC-65. Once the state-mandated minimum surface casing of 10 feet is installed, the remaining open UGR interval can be less than 10 feet. Generally speaking, the SWMU B-3 landfill is excavated into this stratum, thereby making it an important monitoring interval. The zone is characterized by sequences of weathered limestones that are fractured and easily erodible. In fact, borehole stability issues at WB05 made it necessary to use 30 feet of surface casing, effectively eliminating the B3-UGR-01 monitoring zone from that WB well. Under typical conditions, it is expected that this zone will be dry throughout most of the year. However, as a potentially important flow path during high precipitation events and from percolation from the saturated bioreactor cells, the UGR needs to be monitored. During drilling, the UGR interval is quite susceptible to erosion and washout by the rotary action, and often results in a borehole diameter that is too large for the standard WB packer. At SWMU B-3, the best location for UGR-01 packer seals actually does not occur until 10 feet below the UGR/LGR formation contact. The upper seal for this zone will consist of a packer inflated within the surface casing.

Soil-gas packer samples (see Attachment 4) collected from this approximate interval indicated near-surface VOC contamination, with PCE concentrations ranging between 83 and 12,200 ppbv. The vacuum pressures necessary to obtain the UGR-01 samples were generally one-third of the required vacuum needed at lower sampling intervals within B3-LGR-01 and B3-LGR-02. This indicates that the weathered nature of the UGR-01 can exhibit a higher permeability the upper zones of LGR-01 and -02. Below this interval, VOC concentrations in the soil-gas generally decrease with depth throughout the vadose zone. At the time of the investigation, no perched groundwater was encountered in this interval.

The thinness of the UGR coupled with eroded, enlarged borehole diameter made the singular monitoring of the UGR unattainable. The interval design will be open to the washed out portions the UGR and upper LGR. The monitoring port has been placed at the formational contact of the two units. Therefore, the UGR-01 intervals in the SWMU B-3 WBs include the basal portion of the UGR as well as the approximate top 10 feet of the LGR(A) subdivision to increase the likelihood of obtaining some data from this zone throughout the study and bioreactor O&M periods.

B3-LGR-01

The upper half of this unit is characterized by alternating layers of pale yellow mudstones. In contrast, the lower half of this monitoring interval can be fossiliferous, and subsequently exhibits some vuggy porosity. At the AOC-65 piezometers, this unit is known to perch groundwater on a seasonal basis. It is likely that this zone will be dry for part of the year. To maximize the ability to obtain samples from this zone, the monitoring port has been placed at the base of the interval to obtain water samples during depressed groundwater levels. A fracture system was noted at WB06 at a depth of approximately 100 feet below grade. The measurement port has been placed adjacent to this feature in anticipation that it may be a water-bearing structure.

At the time of drilling, no groundwater was encountered in this interval, precluding any HpL results. However, discrete interval soil-gas samples were collected by straddle packer system approximately every twenty feet in each WB borehole. During soil-gas sampling in the LGR-01 interval, some 20-foot sections maintained relatively low vacuum pressure (6 to 20 inches H_2O), indicating potentially high permeability. VOC contamination was detected, with PCE reported as ranging between 4.6 and 3,310 ppbv.

B3-LGR-02

The mudstones of the upper half of this interval can be described as alternating layers of tannish-brown and greenish-gray bioturbated muds with a low percentage allochemical constituents (*e.g.*, fossils). The rock is competent and highly styolitic (susceptible to diagenetic pressure solutioning). The lower half of this unit consists of a more grain-supported limestone, and contains a pervasive bed of permeable vuggy limestone near the bottom third of the interval. At the time of drilling, the static groundwater level at all boreholes was found to coincide with this vuggy permeable layer. The HpL findings indicated that two thin water-bearing zones, approximately 5 feet in thickness and separated by 11 feet, are present in the bottom third of this interval. The interval has been designed such that these low-yielding zones will be near the base of LGR-02 zone, and the monitoring port has been placed between the two intervals of saturation. This will allow for groundwater samples to be obtained to within 10 feet of this zone possibly becoming completely dewatered during droughts.

Multiple subsurface vapor samples were collected from the B3-LGR-02 interval. PCE concentrations ranging between 21.5 to 5,010 ppbv were reported within this interval below SWMU B-3. Because of the low-yielding groundwater characteristics, no samples were recovered using the standard investigation methodologies employed at CSSA.

B3-LGR-03

The HpL testing identified a low-yielding groundwater zone within the top third of interval B3-LGR-03. The identified zone is characterized by a unique geophysical marker, which has been referred to as the "scissor tail" by on-site geologists, referring to a scissor-tail-like resistivity graph pattern. This resistivity feature represents a short sequence of packstone/mudstone/packstone that is more or less uniformly present through most of CSSA. While optical logging indicates that this zone is somewhat vuggy, an injection test performed at this interval indicated very low permeability characteristics, meaning the void spaces are not well connected. Sample collection was attempted from this interval, but none could be obtained with the conventional packer apparatus. The remainder of the interval consists of a 55-foot layer of tan and light brown wackestones with intermittent thin fossiliferous layers and grain-supported rock. The unit is fairly unremarkable overall and does not appear to contain a significant groundwater flow path or permeability.

The design of this zone is unique relative to the other intervals such that 2 measurement ports have been included, rather than one. The rationale is that the "scissor-tail" packstone area is likely the only section in the interval that will produce a sufficient amount of sample quantity utilizing the WB sampling tools. Ideally, it is preferable to have the primary measurement port adjacent to the flowpath, even if it is very low-yielding. However, it is quite feasible that the aquifer will dewater below this elevation during drought periods, rendering that measurement port inoperable. Therefore, a secondary sampling port has been incorporated to the LGR-03 zone near the base of the unit. If the water table declines past the primary port, a groundwater sample can still be obtained from the lower port to characterize the zone for that sampling event. Though the water level may decline significantly in very dry seasons, smaller, multiple seams of groundwater seepage will continue to contribute to the total accumulation in the interval, thus assuring adequate sample quantities even when the ideal target flow zone cannot be directly sampled.

B3-LGR-04

B3-LGR-04 comprises the main groundwater production zone within the Middle Trinity aquifer throughout CSSA. It is composed of a 50 to 60-foot reef complex whose lateral extent appears to extend beneath the entire confines of CSSA. The occurrence of this reef has been well documented within boreholes drilled at CSSA and neighboring areas. The interval is described as a white to tan, very fossiliferous packstone/grainstone with a significant level of moldic porosity in the basal 40 feet. The interval is characterized by its relatively low gamma response and high resistivity response. The vuggy porosity left as a result of fossil dissolution has resulted in voids that range from several millimeters to 5 centimeters in size. Extensive basewide testing through packer tests indicate that the interval is capable of yielding groundwater in excess of 75 gallons per minute (gpm). Where fractures or karstic caverns exist, groundwater production can easily exceed 150, even 300 gpm.

HpL logging and FLUTe profiling has found that over 60 percent of the LGR-04 interval (40 feet, in 5 distinct beds) has a high groundwater yield relative to the rest of the borehole. VOC contamination in groundwater is present throughout the interval at SWMU B-3, and PCE was found in concentrations ranging from 31.8 to 337 µg/L. At each borehole, three discrete interval samples were collected from the B3-LGR-04 interval. The general trend appears to be that total VOC contamination slightly increases with depth in this unit. At each WB well, the measurement port has been placed adjacent to the lower flow path, which generally shows the greatest VOC concentration.

At WB05, the LGR-04 zone has been subdivided into an “A” and “B” interval to facilitate monitoring of the adjacent “injection” well, B-3_MW01 injection zone. The “A” zone is completed at an equivalent depth and length corresponding to the screened interval of the “injection” well. This approach will allow the affects of the substrate injection into the upper horizon of LGR-04 to be closely monitored. This distinction has not been made at the other WB locations because of their long distances from the injection point.

B3-BS-01 (WB05 only)

The BS forms a relatively impermeable aquitard for the overlying LGR water-bearing zones, effectively hampering the hydraulic communication between the LGR and underlying CC members. Otherwise, any significant vertical fluid movement in the BS would be anticipated to be through fractures and faults only. The upper 25 feet of the unit is a dolomitic wackestone that is dark gray in color. In terms of texture, this “dirty limestone” is very similar to the mudstones of interval LGR-03, including the presence of fossils and limited moldic porosity. The gamma count is high in comparison to the overlying LGR-04, and the resistivity of the entire layer is very low. The basal 30 feet of the BS is more characteristic of shale lithology with increasing mud content and a laminated, fissile bedding structure, and has an olive gray appearance.

In WB05 the BS is considered as one zone, BS-01. Data from AOC65-WB04 monitoring indicate only very slight differences between the two BS zones there, so only one monitoring interval is recommended for the BS at WB05. The measurement port was placed adjacent to an extremely low-flowing zone (less than 0.05 gpm) as identified by the HpL testing.

At WB05, the well has penetrated the BS and CC intervals to discretely monitor the response of these zones during the pumping tests, and will help assess the potential of vertical leakage or contaminated groundwater through the BS. During the drilling investigation, it was determined that groundwater production from this interval was too low to warrant an attempt at retrieving a groundwater sample. This monitoring interval will be able characterize the condition of this zone from a contaminant perspective.

B3-CC-01 (WB05 only)

Interval B3-CC-01 is characterized by alternating layers of white and light gray packstones and grainstones. On geophysical logs, the occurrence of the CC Limestone is easily identified by its geophysical signature relative to the BS. The large decrease in gamma count indicates the reduction in the amount of mudstone, and the sharp increase in overall resistivity supports the lithologic change, indicating the capability of increased groundwater storage. Moderate to large amounts of groundwater are expected to be produced from this interval. Both the HpL logging the FLUTe profiling also indicated lesser flow paths throughout this interval at WB05.

One groundwater sample was obtained from this interval at WB05. A PCE concentration of 392 ppb was reported within this interval, and was the highest reported concentration throughout the entire WB05 water column. This zone has also been designed to compliment the efforts of the pumping test. The lower packer has been placed at an elevation consistent with the total depth of the primary pumping well (CS-MW16-CC). The measurement port has been placed at an elevation proximal to the midpoint of the pumping well's screened interval.

B3-CC-02 (WB05 only)

The basal 20 feet of the CC Limestone represents a conformable transition with the underlying Hammett Shale. The grainstones and packstones of unit B3-CC-01 grade into a soft olive gray silty mudstone. Being that the contact is transitional, there are numerous interbeddings between soft shaley members and more competent limestone rock. The increase of shale content is reflected in the geophysical surveys with an increasing gamma count and decreasing resistivity. At this depth the unit is more characteristic of shale rather than limestone. The contact with the underlying Hammett Shale is interpretive due to the transitional nature of the contact.

The CC-02 interval appears to have low porosity and permeability, and will be qualified by the data collected at the measurement port. Hydraulic testing did not indicate any significant flow paths within this interval.

Aerial Photo Date: 2003

N
W E
S

Feet
0 50 100 150 200

Westbay® Well Location
Injection Well Location
Water Well Locations
SWMU Boundary

Attachment 1

Locations of Westbay Wells at SWMU B-3 Camp Stanley Storage Activity, Texas

PARSONS

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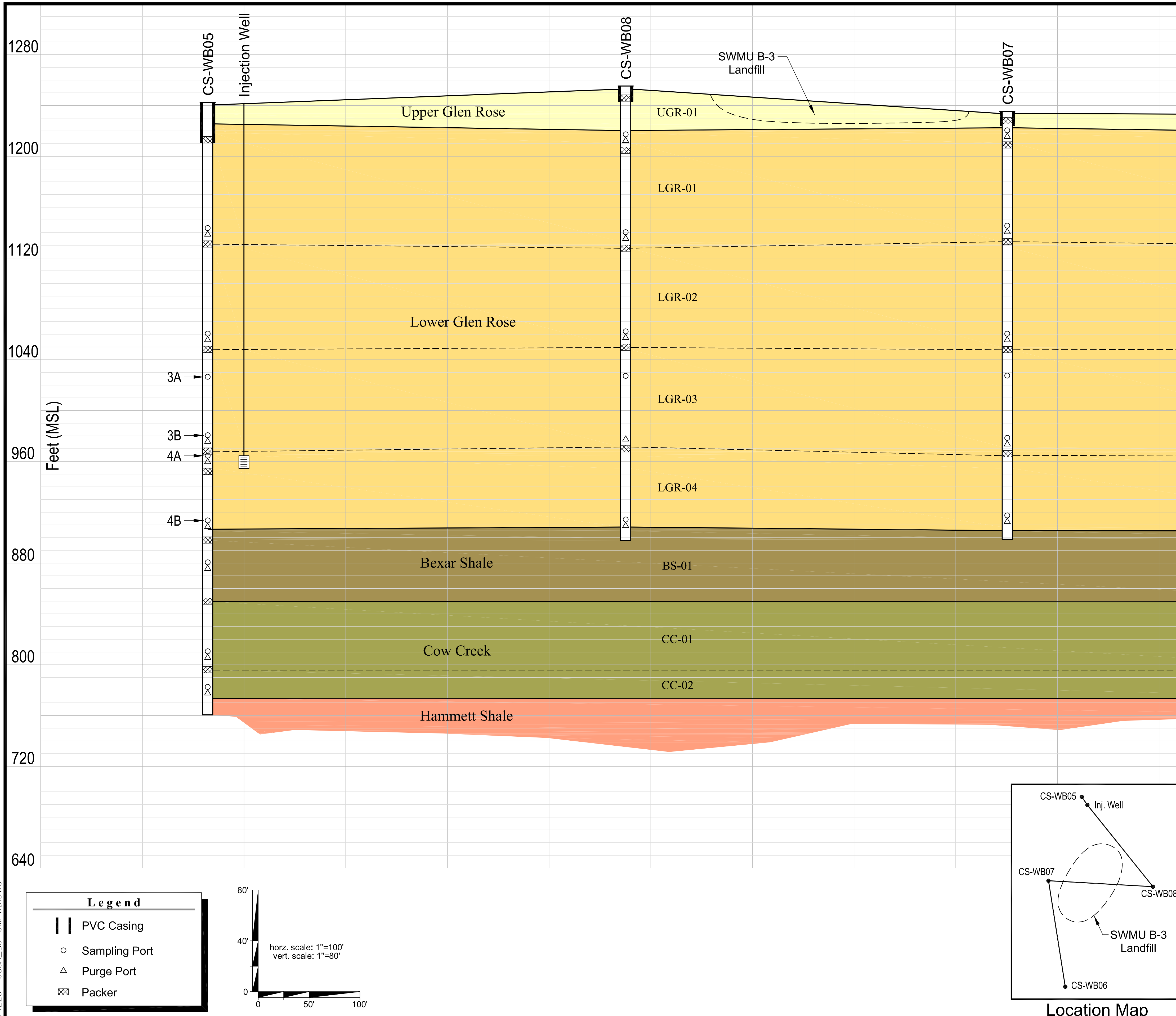

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Attachment 2

Conceptual Multi-port Well Design
SWMU B-3
Camp Stanley Storage Activity

PARSONS

Attachment 3
Westbay MP Monitoring Zones
SWMU B-3
Camp Stanley Storage Activity
October 2005

MP Well	Logger Casing Reference	Zone	Upper Packer	Lower Packer	Monitored Interval Length	Sampling Port		Pumping Port	Corrosponding AOC-65 Westbay Zones
	(above grade)		*(feet BTOC)*	*(feet BTOC)*	*(feet)*	*(feet BTOC)*		*(feet BTOC)*	
						Primary	*Secondary*		
CS-WB05	2	LGR-01	27 - 32	109 - 114	77	99		104	UGR-01, LGR-01, 02, 03
		LGR-02	109 - 114	192 - 197	78	182		187	LGR-04, 05, 06
		LGR-03	192 - 197	272 - 277	75	216	262	267	LGR-07, 08, 09
		LGR-04A	272 - 277	286 - 291	9	277		282	top LGR-10
		LGR-04B	286 - 291	342 - 347	51	329		334	LGR-10, 11
		BS-01	342 - 347	390 - 395	43	362		367	BS-01, 02
		CC-01	390 - 395	444 - 449	49	432		437	CC-01
		CC-02	444 - 449	482	33	460		465	CC-02, 03
CS-WB06	2.5	UGR-01	7 - 12	30 - 35	18	20		25	UGR-01, top LGR-01
		LGR-01	30 - 35	103 - 108	68	93		98	LGR-01, 02, 03
		LGR-02	103 - 108	184 - 189	76	174		179	LGR-04, 05, 06
		LGR-03	184 - 189	270 - 275	81	207	260	265	LGR-07, 08, 09
		LGR-04	270 - 275	335.5	60.5	320		325	LGR-10, 11
CS-WB07	1.75	UGR-01	4 - 9	24 - 29	15	14		19	UGR-01, top LGR-01
		LGR-01	24 - 29	100 - 105	71	90		95	LGR-01, 02, 03
		LGR-02	100 - 105	185 - 190	80	175		180	LGR-04, 05, 06
		LGR-03	185 - 190	267 - 272	77	208	257	262	LGR-07, 08, 09
		LGR-04	267 - 272	336.75	64.75	318		323	LGR-10, 11
CS-WB08	2.5	UGR-01	7 - 12	48 - 53	36	38		43	UGR-01, top LGR-01
		LGR-01	48 - 53	125 - 130	72	115		120	LGR-01, 02, 03
		LGR-02	125 - 130	203 - 208	73	193		198	LGR-04, 05, 06
		LGR-03	203 - 208	283 - 288	75	228	273	278	LGR-07, 08, 09
		LGR-04	283 - 288	357.5	69.5	341		346	LGR-10, 11

Notes:

-All Depths are referenced from Below Top of Casing (BTOC), which is 4.5" ID PVC Surface Casing.

-The Total Depth of the borehole will serve as the lower isolation point for the bottom-most zones.

-Uppermost packers in each borehole will be inflated into the base of the PVC surface casing.

-CS-WB05 does not have a UGR zone due to borehole instability at that depth. Zone was subsequently cased off.

-Interval LGR-03 has an alternate sampling port at bottom of zone for when water level drops below primary port at scissor-tail vugs.

DRAFT

Attachment 4
Results of SWMU B-3 Soil Gas and Groundwater Packer Testing
Camp Stanley Storage Activity - Boerne, Texas
August/September 2005

Well	Medium	Depth (feet bgs)	Analyte	Result	Unit
CS-WB05	Soil Gas	30-50	PCE	120	ppbv
			TCE	77.1	ppbv
			cis-1,2-DCE	17.8 J	ppbv
		71-91	PCE	204	ppbv
			TCE	167	ppbv
			cis-1,2-DCE	110	ppbv
		116-136	PCE	479	ppbv
			TCE	439	ppbv
			cis-1,2-DCE	368	ppbv
		156-176	1,1,1-TCA	0.732 J	ppbv
			1,1-DCE	1.23 J	ppbv
			Benzene	6.21 J	ppbv
			Chloroform	0.870 J	ppbv
			Methylene chloride	6.00 J	ppbv
			PCE	328	ppbv
			TCE	157	ppbv
			Vinyl chloride	1.22 J	ppbv
			cis-1,2-DCE	47.7	ppbv
	Groundwater	268-288	PCE	31.3	µg\L
			toluene	4.18	µg\L
			TCE	152	µg\L
			cis-1,2-DCE	286	µg\L
		290-310	PCE	160	µg\L
			TCE	273	µg\L
			cis-1,2-DCE	344	µg\L
			trans-1,2-DCE	4.94	µg\L
		320-340	PCE	319	µg\L
			TCE	427	µg\L
			cis-1,2-DCE	533	µg\L
		416-436	PCE	392	µg\L
			TCE	375	µg\L
			cis-1,2-DCE	465	µg\L
			trans-1,2-DCE	16.4	µg\L
CS-WB06	Soil Gas	10-30	PCE	1270	ppbv
			TCE	711	ppbv
			cis-1,2-DCE	856	ppbv
		50-70	PCE	1570	ppbv
			TCE	1270	ppbv
			cis-1,2-DCE	931	ppbv
		130-150	PCE	540	ppbv
			TCE	490	ppbv
			cis-1,2-DCE	520	ppbv
	Groundwater	260-280	PCE	151	µg\L
			TCE	159	µg\L
			cis-1,2-DCE	287	µg\L
		284-304	PCE	297	µg\L
			TCE	268	µg\L
			cis-1,2-DCE	413	µg\L
		308-328	PCE	337	µg\L
			TCE	268	µg\L
			cis-1,2-DCE	435	µg\L

Attachment 4
Results of SWMU B-3 Soil Gas and Groundwater Packer Testing
Camp Stanley Storage Activity - Boerne, Texas
August/September 2005

		Depth (feet bgs)	Analyte	Result	Unit
CS-WB07	Soil Gas	10-30	PCE	83.3	ppbv
			TCE	4160	ppbv
			cis-1,2-DCE	1340	ppbv
		30-50	PCE	25.7	ppbv
			TCE	937	ppbv
			cis-1,2-DCE	229	ppbv
		70-90	PCE	4.57	ppbv
			TCE	106	ppbv
			cis-1,2-DCE	27.1	ppbv
		110-130	PCE	21.5	ppbv
			TCE	94.3	ppbv
			cis-1,2-DCE	25.5	ppbv
	Groundwater	200-220	PCE	34.7	µg\L
			TCE	47.9	µg\L
			cis-1,2-DCE	56.1	µg\L
		265-285	PCE	293	µg\L
			TCE	322	µg\L
			cis-1,2-DCE	361	µg\L
		285-305	PCE	254	µg\L
			TCE	306	µg\L
			cis-1,2-DCE	322	µg\L
		310-330	PCE	221	µg\L
			TCE	277	µg\L
			cis-1,2-DCE	403	µg\L

CS-WB08	Soil Gas	10-30	PCE	12200	ppbv
			1,1-DCE	320	ppbv
			TCE	9520	ppbv
			Vinyl chloride	509	ppbv
			cis-1,2-DCE	2790	ppbv
		89-109	PCE	3310	ppbv
			TCE	2220	ppbv
			Vinyl chloride	73.6	ppbv
			cis-1,2-DCE	431	ppbv
		138-158	1,1-DCE	45.7 J	ppbv
			PCE	4270	ppbv
			TCE	2730	ppbv
			Vinyl chloride	69.3	ppbv
			cis-1,2-DCE	506	ppbv
		156-176	1,1-DCE	135	ppbv
			PCE	5010	ppbv
			TCE	3970	ppbv
			Vinyl chloride	234	ppbv
			cis-1,2-DCE	753	ppbv
	Groundwater	280-300	PCE	38.6	µg\L
			TCE	41.8	µg\L
			cis-1,2-DCE	108	µg\L
		305-325	PCE	50.9	µg\L
			TCE	57.3	µg\L
			cis-1,2-DCE	98.8	µg\L
		331.5-351.5	PCE	53.7	µg\L
			TCE	54.2	µg\L
			cis-1,2-DCE	115	µg\L
			trans-1,2-DCE	4.62 J	µg\L

APPENDIX C
RAS REPORT, RAS WELL LOG MONTAGES, GEOCAM CS-B3-MW01 GEOPHYSICAL LOG, FLUTE CS-WB05 CONDUCTIVITY PROFILE

RAS
Integrated Subsurface Evaluation
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November 15, 2005

Mr. Scott Pearson
Parsons Engineering Science, Inc.
8000 Centre Park Drive, Suite 200
Austin, Texas 78754

RE: Geophysical, Hydrophysical and Straddle Packer Report
Camp Stanley, San Antonio, Texas

Dear Mr. Pearson:

Attached please find RAS's Report presenting results from our Geophysical, Hydrophysical and Wireline Straddle Packer testing work conducted at the Camp Stanley Army Training Center in San Antonio, Texas.

We appreciate the opportunity to work with you on this project and look forward to receiving your comments.

Please call with any questions.

Best Regards,
RAS, Inc.

William H. Pedler
President

GEOPHYSICAL, HYDROPHYSICAL and WIRELINE STRADDLE PACKER REPORT

Camp Stanley Army Training Center
San Antonio, Texas

Prepared for:

Geoprojects International, Inc.
8834 Circle Drive
Austin, Texas 78736

Under Contract to:

Parsons Engineering Science, Inc.
8000 Centre Park Drive, Suite 200
Austin, Texas 78754

Prepared by:

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November 2005

TABLE OF CONTENTS

TABLE OF CONTENTS

Page No.

Appendix B

Well CS-WB-05

Appendix C

Well CS-WB-05

LIST OF ACRONYMS

List of Acronyms	Definition
AFC	Ambient flow characterization
BOBP	Bottom of bottom packer
BOTP	Bottom of top packer
DI	Deionized Water
DX	Distance in millimeters of focal point from camera depth reference ring in SCBFM
EM	Electromagnetic
EMPLX	Emplacement, or flushing, of borehole fluids with deionized water
FEC	Fluid Electrical Conductivity
G	Natural Gamma
GPM	Gallons Per Minute
HPL	Hydrophysical Logging
ND	Non – directional flow
NxHpL™	Advanced Hydrophysical Logging
PAE	Pumping after emplacement
SAE	Slug test after emplacement
SCBFM	Scanning Colloidal Borescope Flowmeter
Sd	Specific Discharge
T	Temperature
TD	Total Depth
TOBP	Top of bottom packer
TOC	Top of Casing
TOTP	Top of top packer
TP	Technical Procedures
V*	In-hole Horizontal Velocity

GEOPHYSICAL, HYDROPHYSICAL
and
WIRELINE STRADDLE PACKER
REPORT

Camp Stanley Army Training Center
San Antonio, Texas

Prepared for:

Geoprojects International, Inc.
8834 Circle Drive
Austin, Texas 78736

Under Contract to:

Parsons Engineering Science, Inc.
8000 Centre Park Drive, Suite 200
Austin, Texas 78754

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November 2005

Executive Summary

During the period from August 15 through August 24, 2005, RAS, Inc., of Golden, Colorado conducted borehole logging and testing in four borings located at the Camp Stanley Army Training Center in San Antonio, Texas. This work was performed for Geoprojects International under their contract with Parsons Engineering Science, Inc. The objective of this work was to employ borehole geophysical, hydrophysical and wireline straddle packer testing methods in selected borings in advance of installing multi-level monitoring wells in these borings as part of a groundwater investigation at Camp Stanley.

RAS applied natural gamma, electromagnetic induction (EM), 16-64 resistivity, single point resistance (SPR), analog video, optical borehole imaging (OBI), and three-arm caliper tools in four borings CS-WB-05, CS-WB-06, CS-WB-07, and CS-WB-08. In addition, wireline straddle packer (WSP) and hydrophysical logging (HPL) were conducted in CS-WB-05. While not originally identified in the work scope, hydrophysical logging was additionally applied to quickly identify zones to subsequently test with the WSP system. The purpose of the testing was to evaluate lithologic and groundwater flow characteristics of the subsurface.

Analysis of the data collected and presented in this report suggest the following:

1) The OBI logs and other geophysical testing in all four boreholes indicate that there are sufficient fractures and dissolution features such that multiple, but discrete, pathways for flow are possible. However, the detailed hydrophysical and WSP tests conducted in CS-WB-05 also indicate that the mere presence of such features does not mean that flows are occurring or likely.

2) Based on the geophysical logging results in the four boreholes, there may be a rough correlation between a slightly depressed gamma response, slightly elevated induction log response, and the occurrence of organic contaminants, primarily between 260 to 350 feet below the top of casing. However, given the weak correlation and the lack of hydrophysical or WSP testing in CS-WB-06, CS-WB-07, and CS-WB-08, the relationship should be considered tentative.

3) The hydrophysical testing suggested the presence of a specific downhole flow component in CS-WB-05. This downflow suggests a general potential for downward migration of water at least in the local area. Under the ambient conditions in CS-WB-05, inflows of 0.75 gpm occurred between 297 feet to 307 feet below TOC with an outflow of 0.75 gpm occurring between 432 feet and 450 below the TOC. It is possible that leakage or vertical flow in the aquifer is occurring in one area (such as documented in CS-WB-05) but not in all areas of the study site.

4) The relative pressure test results documented in CS-WB-05 suggest that the deepest productive interval near 432 to 450 feet below TOC had a hydraulic head difference

that was 19 feet lower than the static water level in the borehole. This significant head difference would not be likely unless the hydraulic communication between the overlying formations was limited and/or there was significant nearby pumping from the deeper formations. In the absence of more detailed information from other boreholes in the area describing the hydraulic behavior of the formations, it is difficult to fully interpret the reasons or significance for the relative pressure difference.

5) The wireline straddle packer testing in CS-WB-05 suggested that not all apparent groundwater bearing zones are sufficiently productive to sustain limited pumping or slug testing. Many portions of the formation may exhibit very low flow rates. In situations where flows are too low, the presence of contaminants originating out of the halo surrounding pathways that are remote from the borehole may be the source of contaminants encountered in a borehole. Testing is required to tell the difference.

6) The OBI documented extensive occurrence of dissolution features and fractures that were generally filled with fine grained sediments and tended to be hydraulically nonproductive. The general occurrence of similar features at roughly the same depths in other boreholes cannot be taken to automatically infer hydraulic connection between boreholes at these intervals. Given the frequency of features, hydraulic tests are needed to define the existence of specific pathways.

7) In CS-WB-08, the surface contamination (soil gas results) was much higher in relative terms than at the other boreholes. In addition, the groundwater contamination levels were significantly lower in CS-WB-08 than in the other boreholes. If more or less spatially uniform vertical leakage was widespread, then it would be reasonable to expect locally high groundwater contamination in or around CS-WB-08.

1.0 Introduction

This report has been prepared and issued by RAS, Inc. (RAS), as subcontractor to GeoProjects International, Inc., to describe the results of RAS's geophysical, hydrophysical, and straddle packer testing at the Camp Stanley Army Training Site in San Antonio, Texas. The field activities described in this report were conducted in accordance with the plan outlined by Parsons Engineering Science unless otherwise described in this document. The purpose of this testing was designed to gain a better understanding of the groundwater flow and the potential for contaminant transport in the vicinity. Specifically, the logging was conducted to provide information regarding the stratigraphy and lithology in the wells, to characterize the aquifer hydraulics, and to evaluate the nature and pattern of karst features. This report details methods, testing results, and concluding remarks and suggestions from analyses of test data.

RAS's investigation involved logging and testing four existing Camp Stanley borings drilled as part of an investigation of groundwater contamination. This testing program involved using geophysical and hydrophysical logging, analog video, and straddle packer testing, all of which were selected on the basis of their appropriateness for the site and well conditions and to meet the stated objectives of characterizing the physical and hydraulic nature of the karst system underlying the site. The geophysical methods included natural gamma, electromagnetic (EM) induction, galvanic resistivity (16-64 inch normal and SPR), three-arm caliper, and optical borehole imaging (OBI) of the borehole sidewalls. Natural gamma, (EM) and galvanic resistivity were applied to characterize and correlate lithologic properties such as limestone, siltstone, claystone, weathered (karst) limestone and competent limestone units while the caliper log was used to verify construction of surface casing and diameter variations in the open hole sections. The hydrophysical logging method was applied to identify water-bearing intervals, quantify associated flow rates during ambient and pumping conditions, and select depths for depth specific estimates of hydraulic conductivity. Straddle packer testing was conducted on intervals selected from the hydrophysical data to conduct depth-specific evaluations of formation pressure, hydraulic properties, and collect interval specific water samples.

The four borings investigated (CS-WB-05, CS-WB-06, CS-WB-07, CS-WB-08) were pre-existing borings were made available for testing with RAS's logging equipment. Boring CS-WB-05 was nominally 4.25 inches in diameter with 4-inch PVC casing to ~30 feet and a total depth of about 480 feet. CS-WB-06 was nominally 4.25 inches in diameter with 4-inch PVC casing to about 12 feet and total depth of about 352 feet. CS-WB-07 was nominally 4.25 inches in diameter with 4-inch PVC casing to about 12 feet and total depth of about 340 feet. CS-WB-08 was nominally 4.25 inches in diameter with 4-inch PVC casing to about 12 feet and total depth of about 360 feet.

Prior to logging each borehole, the geophysical logging tools were decontaminated and calibrated prior to logging. Each boring was logged with the video camera. Work on these first days also included review of site safety procedures and site conditions. Once boring CS-WB-05 was geophysically logged, the boring was then logged using the hydrophysical method. Based on the results from hydrophysical and geophysical imaging logs, the straddle packer system was used to isolate and conduct hydrogeologic tests to determine hydraulic conductivity values for the selected test intervals.

Procedures regarding tool use and data acquisition at this site were controlled according to RAS's Technical and Operating Procedures. These Technical Procedures stipulate steps for acquiring quality data which can be credibly used for understanding the site. While summarized discussion of procedures has been included in the write-up of this report, a full copy of these Technical Procedures has been included as Appendix E to this report for reference.

Due to the amount of data collected and the interrelationship of these data, results from testing are presented for each well in large color montages which form an integral part of this report. These montages include side-by-side integrated illustrations of the geophysical, hydrophysical (as applicable), lithologic, straddle packer (as applicable) and well construction data, and are included in Appendix A. The most detailed data collection and subsequent analysis was conducted in CS-WB-05. Hydrophysical and wireline straddle packer data and figures are presented in Appendix B as backup to the summarized conclusions in the written report. A table summarizing the hydrophysical and wireline straddle packer results from CS-WB-05 is presented in Appendix C. A CD-ROM with all original data, including field notes, and calibration details is included in Appendix D (these are not presented in paper form). Technical procedures are presented in Appendix E.

2.0 Methodology

As part of this investigation, geophysical, hydrophysical and wireline straddle packer testing methods were employed at Camp Stanley to characterize the geological formation, lithology and stratigraphy as well as to directly evaluate the depths of water bearing zones and associated groundwater flow. The geophysical methods employed were natural gamma, EM induction, resistivity, optical televiewer, borehole video, and three-arm caliper. The hydrophysical method involved the application of RAS's multiple sensor NxHpL™ temperature and fluid electrical conductivity logging tool for direct evaluation of the groundwater regime under ambient and stressed conditions. Based on the results of the hydrophysical testing and review of the geophysical data, a downhole straddle packer was deployed to isolate and further characterize the hydraulic properties of the identified water bearing features.

These methods were selected based on their applicability for the geologic regime, well construction conditions and industry acceptance of these methods. The availability of open sections in the boreholes provided the opportunity to apply fracture imaging technologies (video and OBI). The hydrophysical method can be applied in both cased and open hole environments and requires fluid over the interval(s) of interest, which was present in the subject borehole where this method was applied. The straddle packer method was applied in CS-WB-05 at depths selected from the geophysical and hydrophysical data.

There are several means which were used at the site to ensure quality data and correct tool operation as fully described in the Technical Procedures. In brief, tools were calibrated in the shop prior to mobilizing for the project to verify conformance with expected settings. Once on the project site, calibrations were again verified both pre- and post-logging using various field jigs and standardized fluids. Calibration forms documenting these procedures were completed and are included with the field notes on CD-ROM (Appendix D) for this project. Manual confirmation of accurate depth readings was also conducted and upon arrival at each wellhead, all depths are referenced to top of casing (TOC). One of the most important and easiest methods to control data quality and tool function is to run a repeat section of each log in each well which was done in all cases as standard protocol.

2.1 Geophysical Logging Methods

2.1.1 Natural Gamma

Natural Gamma or gamma logs are the most widely used for the identification of lithology and for stratigraphic correlation because they provide useful data under the greatest range of borehole conditions and for a wide range of rock types. Gamma logs do not measure lithology directly; instead they use a downhole scintillometer to measure the amount of natural radioactive isotopes that occur in the rocks. While rocks can be characterized according to their gamma intensity, knowledge of the local geology is needed to accurately identify lithology. Correlation among stratigraphic units is also a common application as the gamma measurement is often included on multi-parameter tools.[1] At the Camp Stanley site, the gamma and induction measurements were acquired at the same time from the same tool and generally were among the first measurements acquired in each well. The natural gamma tool was calibrated in the factory but was not calibrated in the field because gamma calibration requires use of a radioactive source and commensurate licenses from the US Nuclear Regulatory Commission.

2.1.2 Electromagnetic Induction

While various kinds of resistivity and induction logs are useful for lithologic purposes, standard resistivity probes require conductive fluid in uncased wells. The EM induction tool provides reliable measurements in air or PVC-cased holes and is little affected by borehole fluids which pointed to its applicability at this site. The basic induction system uses low frequency (about 20 kHz) electromagnetic signals to stimulate eddy currents in the formation several borehole diameters away from the borehole. These eddy currents set up secondary magnetic fields which induce a voltage in the receiving coil of the tool. The magnitude of the received current is proportional to the electrical conductivity of the rock which can then be used to identify formations.[2] Calibration of the induction tool followed the manufacturer's (Century Geophysical) specifications and are outlined in detail in the Technical Procedures. In brief, prior to logging, the tool is placed in a calibrated ring of known resistivity. Then the tool is held up in the air (which has near-zero conductivity). Readings of the tool are then verified to these calibrated and known values.

2.1.3 Galvanic Resistivity (16-64 inch Normal, Single Point Resistance)

The 16-64 inch normal logs refer to quantitative resistivity logs made with four electrodes that employ spacings between 16 and 64 inches to investigate different volumes of material around the borehole. Formation resistivities are measured by sending current into the formation and measuring the ease of the electrical flow through it; the voltages are measured between the measure electrodes. A current of constant intensity is passed between two electrodes and the resultant potential difference is measured between two other electrodes. The distance between the electrodes is referred to as the spacing (16-inch spacing for the short normal and 64-inch spacing for the long normal). Generally, the longer the spacing, the deeper the instrument measures into the formation. As resistivity is a function of the dimensions of the material being measured and is an intrinsic property of that material, normal resistivity curves can be interpreted quantitatively when they are properly calibrated. The resistivity of the formation depends upon resistivity of the formation water, amount of water present, and pore structure geometry. As the response of long-normal resistivity logs is affected significantly by bed thickness and the single point resistance log is not affected by bed thickness, it is desirable to run the single point as an aid to the interpretation of the normal logs.[3,4]

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[1] *Keys, W.S., 1997, A Practical Guide to Borehole Geophysics in Environmental Investigations.* (ISBN 1-56670-232-1, 1997).
[2] Ibid
[3] Ibid

Single point resistance (SPR) logs cannot be used for quantitative measurements, but they can be very useful for lithologic information. Single point resistance logs measure the resistance in ohms between an electrode in the well and an electrode at the surface or between two electrodes in the well. Because no provision is made for determining the length or cross sectional area of the travel path of the current, the measurement is not an intrinsic characteristic of the rock or sediment between the electrodes. SPR logs are useful for obtaining information on lithology and the interpretation is generally straightforward. SPR logs deflect in the proper direction in response to the resistivity of the materials near the electrode regardless of bed thickness and thus have a high vertical resolution.[5]

2.1.4 Borehole Video

The borehole video is essentially a downhole television camera which provides either an axial or radial view of the borehole. The equipment employed at Camp Stanley allowed for an axial view utilizing a fish eye lens and light source that gives a view looking down the borehole. The radial view allows for viewing of the side of the borehole wall. This system is very useful for examining the condition of casing, screens and borehole lithologic and other parameters both above and below water level, assuming fluid conditions are sufficiently clear to allow viewing. Above water level, water can be seen entering a well and cascading down the wall. Although changes in lithology, bedding and fractures can be seen with a video, these features may not be as conspicuous as on BHTV logs.

2.1.5 Three-arm Caliper

Caliper logs provide a continuous record of borehole diameter and are widely used for logging at environmental sites. Caliper logs are essential to guide the interpretation of other logs because many types of logs are affected by changes in well diameter.[6] They are also useful for providing information on well construction, such as identifying breaks or obstructions, and borehole breakouts. The three-arm caliper tool employs three mechanical arms that are extended to the borehole wall using a "worm gear" type assembly. The arms are extended after the tool is lowered to the bottom of the zone of interest. The extended arms press against the borehole wall and the average diameter is recorded. The caliper log can be useful to test the appropriateness of subsequent logging with respect to preventing loss or damage to downhole tools and to the wells themselves. Interpretation of the caliper tool is based on direct evaluation of borehole diameter size and variations throughout the tested interval. Calibration of the caliper tool involves measuring tool readouts with two rings of known size and verifying tool output.

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[4] Schlumberger, *Log Interpretation Principles/Applications,* Schlumberger Educatonal Services, 1987
[5] Keys, W.S., *A Practical Guide to Borehole Geophysics in Environmental Investigations*, CRC Press 1997.
[6] Ibid.

2.1.6 Optical Televiewer

The optical imaging tool generates a continuous, oriented 360° image of the borehole wall. This instrument uses a downhole CCD camera which views a reflection of the borehole wall in a conic mirror. The package includes an orientation device with a precision 3-axis magnetometer and 3 accelerometers. These attributes allow for accurate borehole deviation data to be obtained and precise orientation of the image. The purpose of using this optical tool is as an alternative to the acoustic televiewer as it can provide detailed, oriented, structural information in air filled portions of the borehole. Application includes fracture detection and evaluation, detection of thin beds and bedding dip, and lithology characterization.

2.2 Hydrophysical Logging

Advanced hydrophysical logging (NxHpL™) is based on replacing the native formation water in a wellbore with environmentally safe deionized water and then profiling the fluid column with RAS's proprietary fluid electrical conductivity and temperature multi-sensor arrayed hydrophysical logging tool.[7] The deionized water is used to create a low electrical conductivity background in the well for subsequent observation of electrically contrasting formation fluids which enter the well over time either by pumping or native formation pressure. As formation fluids have a higher fluid electrical conductivity than the deionized water, when these fluids enter the wellbore, the locations of entry can be readily identified with the hydrophysical logging tool. By logging during ambient and at least one stressed (pumping or slug test) condition, the velocities of flows at the identified producing zones can be quantified. Prior to and at the completion of testing, the tool was calibrated at the wellhead by placing the sensor array in known fluid electrical conductivity solutions. These solutions are independently calibrated for site-specific conditions and verify that the tool values are consistent with the known calibration solutions.

At each well, the first step is to acquire a baseline temperature/fluid electrical conductivity log to provide a background profile to use as reference for subsequent testing. Fluid electrical conductivity (FEC) signatures are measured and evaluated as background readings. Temperature is used to compensate for any temperature variations in the fluid column during the period of testing.

Following the baseline log, the wells are evaluated for characterization of ambient flow. For this step of the testing, formation water in the wellbore was replaced or diluted with deionized water, and the borehole was left undisturbed to allow any natural flow to occur. This natural, or ambient, flow is driven by the local horizontal hydraulic gradient.

Prior to the test period and throughout all NxHPL™ testing, water levels were monitored

[7] Throughout this report, the terms Hydrophysical and NxHpL™ are used interchangeably and refer to application of the Hydrophysical method using RAS's advanced instrumentation.

and recorded. An example and description of the drawdown and pumping data is given below in annotated Figure 1. Ambient flow evaluation is reported for the period after the water surface, or drawdown, has returned to near pre-dilution elevation. Actual drawdown and pumping data from the wells tested at the Camp Stanley site have been included in Appendix C.

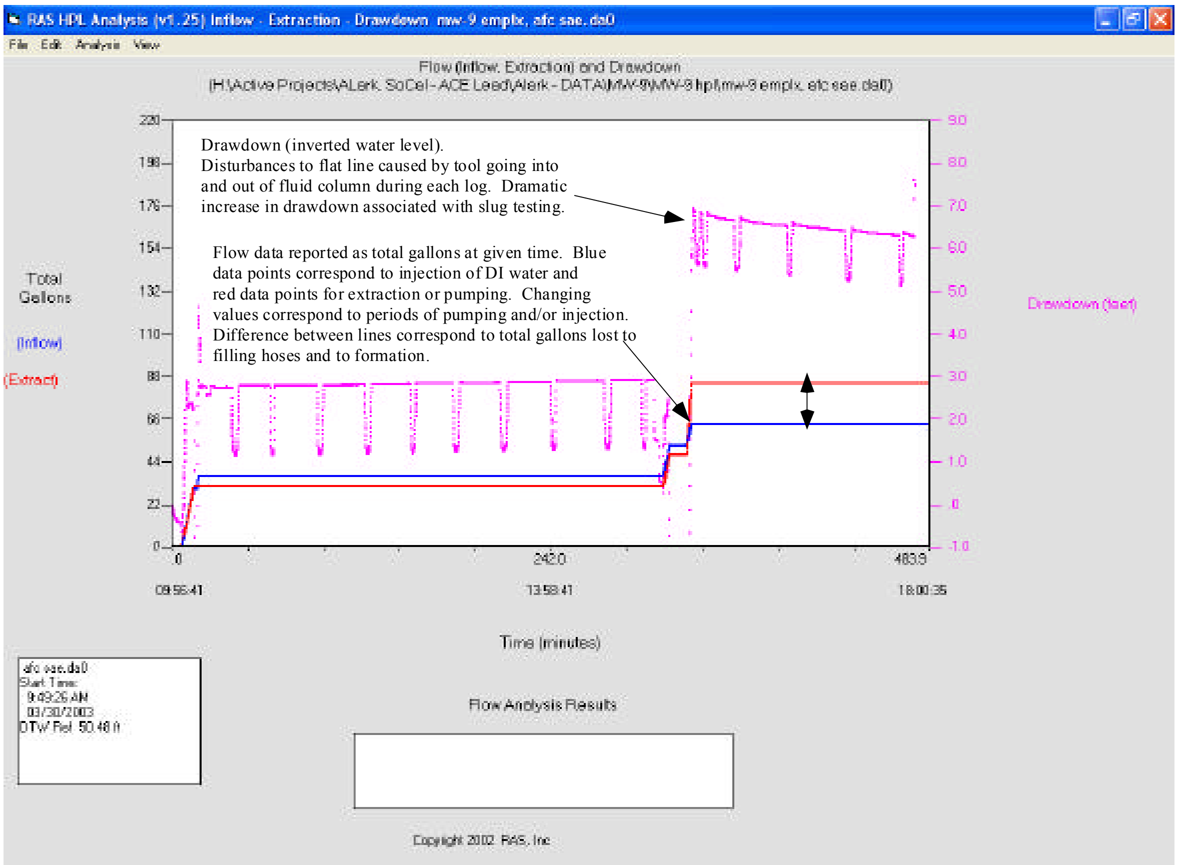

Figure 1. Example of Drawdown and Pumping Data Obtained During Hydrophysical Testing

Figure 1 presents an example and description of drawdown and pumping data obtained during hydrophysical testing, and this image should be used to understand figures and data from the Camp Stanley (Appendix B). A series of FEC and temperature logs is then conducted to identify FEC changes in the fluid column associated with ambient flow. Please refer to the annotated Figure 2 for ambient flow characterization below for a description of these data.

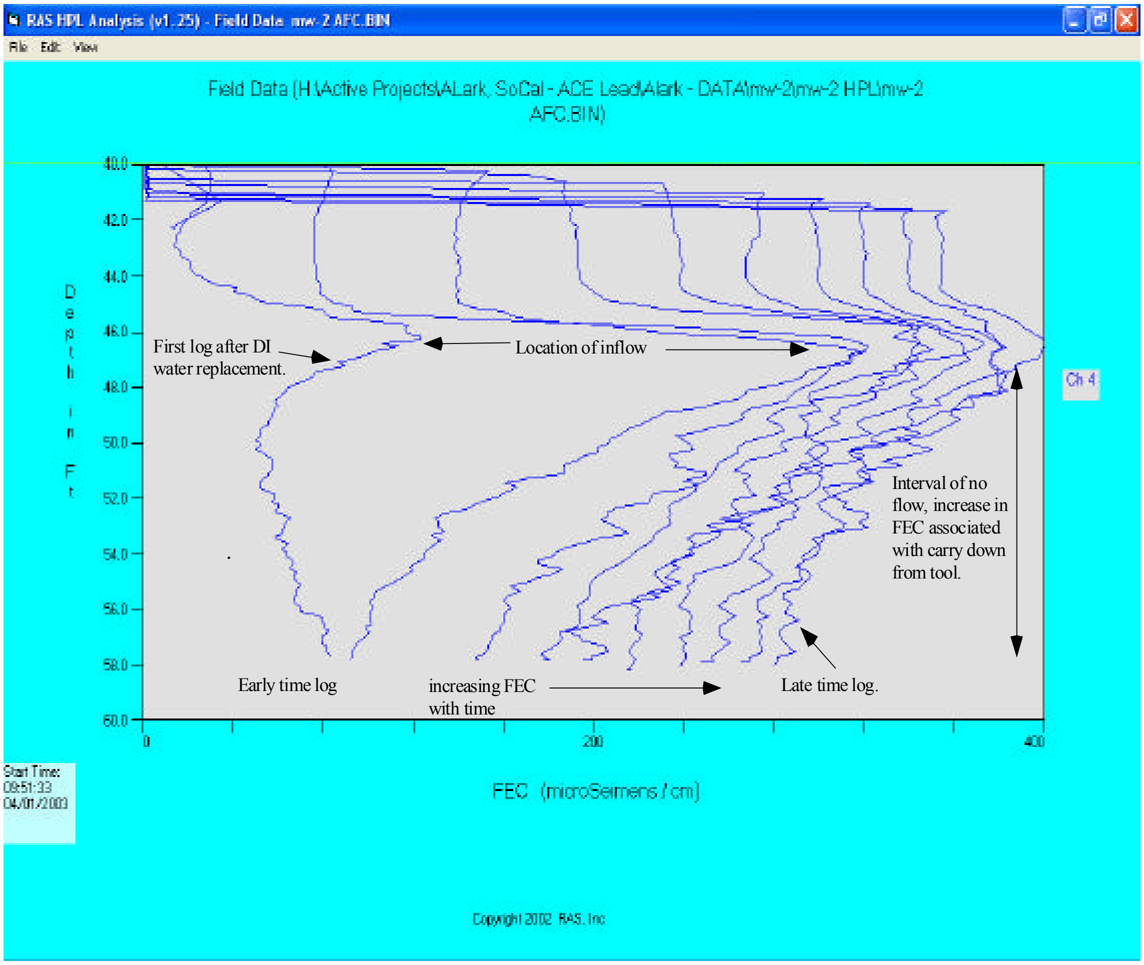

Figure 2. Example Data Set Illustrating Ambient Flow Characterization During Hydrophysical Logging

Given the relatively high transmissivities in CS-WB-05, pumping during injection testing procedures were conducted in these wells. These procedures involve replacing the borehole fluids with deionized water and pumping at a constant rate during injection of deionized water to induce changes in the borehole fluid column.

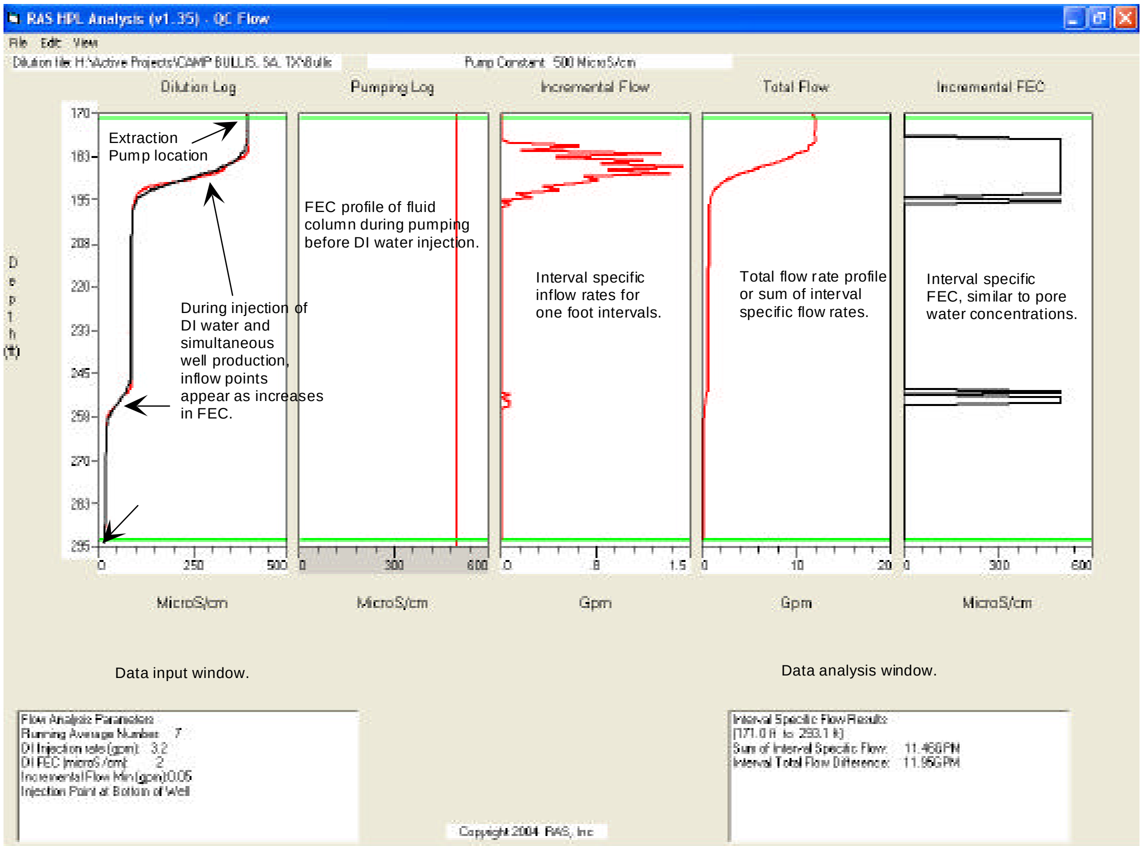

Figure 3. Example data set illustrating Hydrophysical Logging while Pumping During Injection

Analysis of the resulting hydrophysical data was performed using the methods described by Pedler and Urish (1988), Tsang and Hale (1988), Pedler et al. (1990, 1992) and Lowe et al, (1989). Analysis of the hydrophysical data for ambient flow consisted of two parts. The first part is the centroid and integral analysis as described by Lowe et al, 1989. This analysis is also employed for the logging data derived from pumping during injection procedures. This analysis can be briefly described as the first moment analysis, or straight integration, of the FEC logs while the centroid (or center of mass) evaluation is described as the second moment analysis. An annotated figure for these analyses is presented in Figure 4. Note that for easier understanding, previous figures for the NxHpL™ results have displayed the results from only one of the four FEC sensors, however, for analysis, the data from all sensors is displayed.

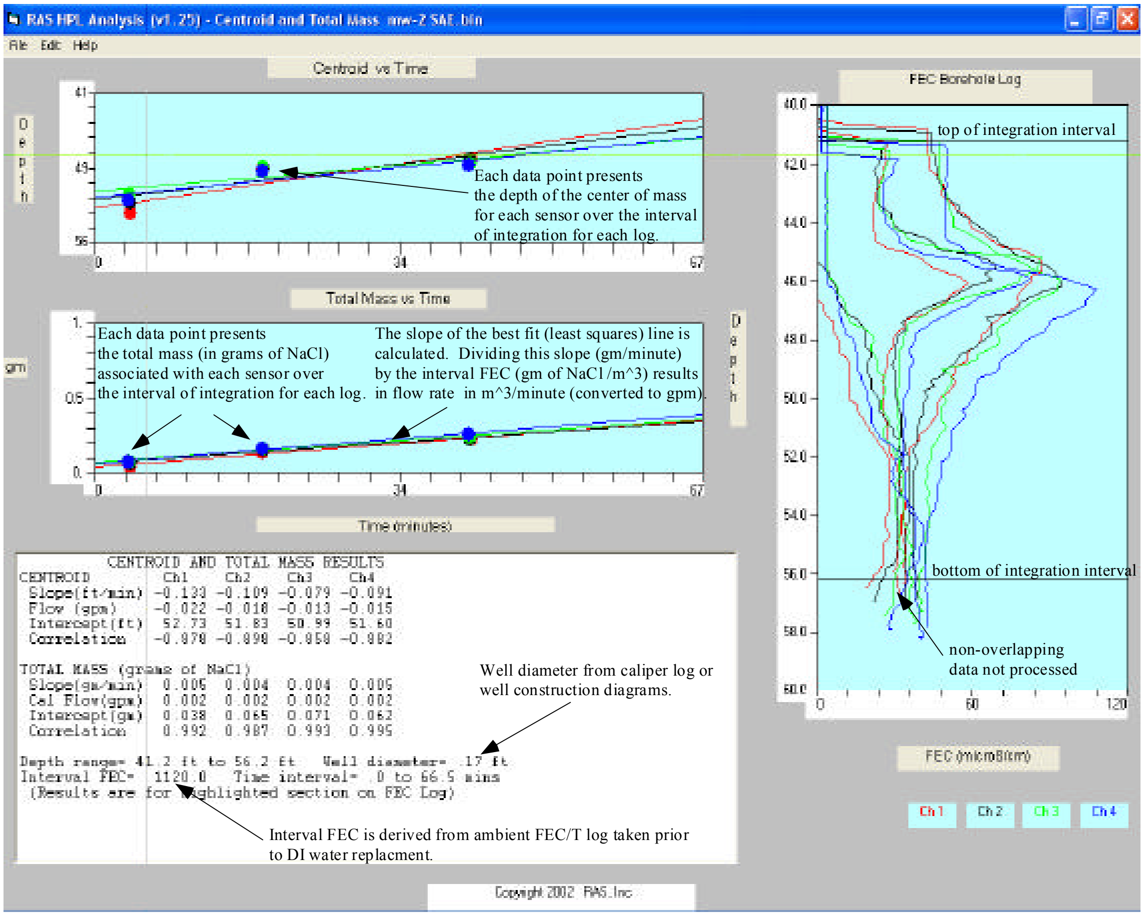

Figure 4. Example of Hydrophysical Data Interpretation

2.3 Wireline Straddle Packer Testing

To procure interval specific groundwater samples and further characterize the hydraulic properties of the identified water bearing fractures identified by the geophysical, hydrophysical and imaging data, RAS employed its straddle packer system at selected intervals within the wells. This straddle packer system utilizes three pressure transducers; one above, below and within the tested interval. The packer system incorporates downhole digitizing of the data from the three pressure transducers and real time display of the pressure transducer data. The real time display helps to ensure the integrity of the packer seal and confirms isolated hydraulic testing.

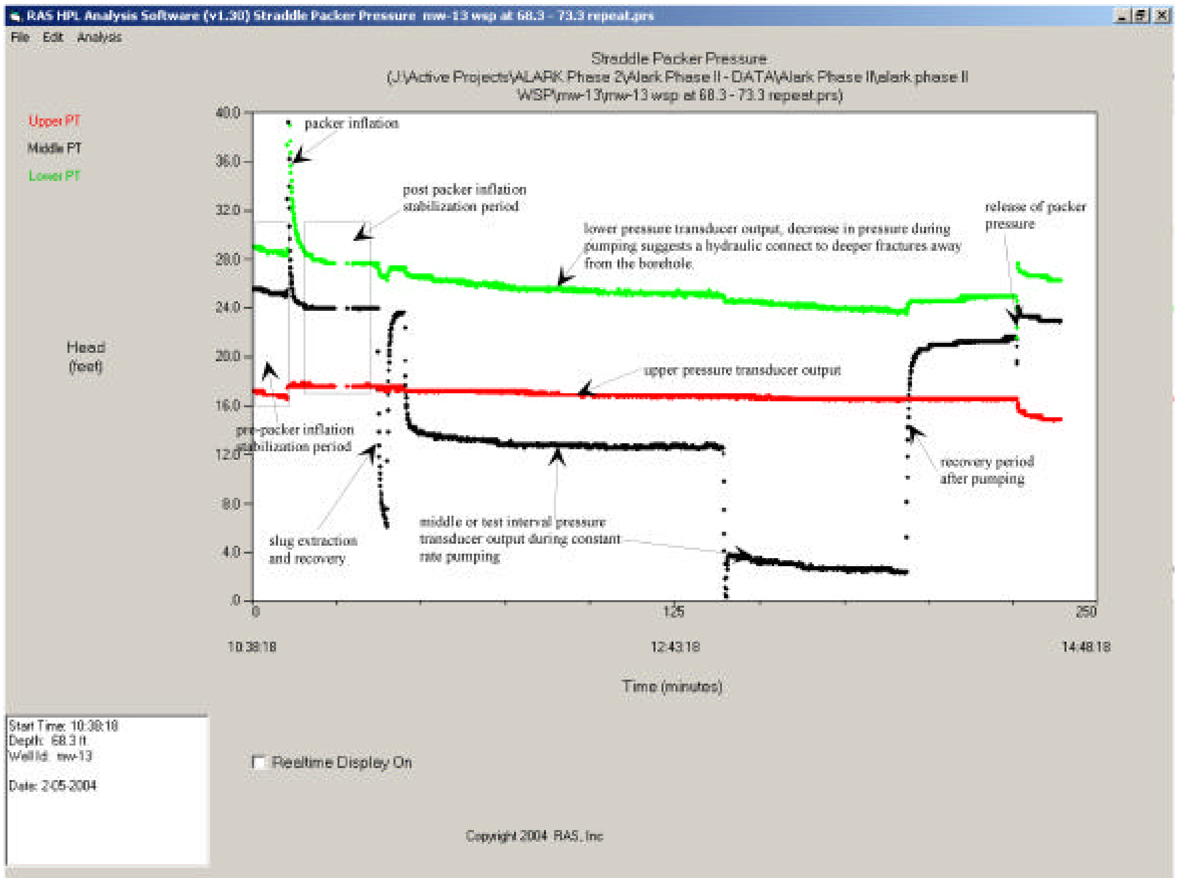

Figure 5. Example Straddle Packer Pressure Data

In summary, the straddle packer system is lowered to the test depth, and pressure conditions are allowed to stabilize prior to packer inflation. During this period and throughout all testing, pressure data from the three pressure transducers are reviewed in real time and recorded to disk. This pre-inflation pressure monitoring is important as these values are compared to the post-inflation levels to evaluate ambient formation pressure. After stable pressure values are observed (or the allotted time has expired), the packers are pneumatically inflated and the post-inflation pressure conditions are allowed to stabilize. After this stabilization period, pumping is initiated. During extraction procedures, close attention is paid to the upper and lower pressure transducers for any pressure leakage which may be associated with a bad packer seal. While small decreases in pressure observed by these pressure transducers would be expected in a hydraulically connected fracture system, large changes in pressure and those which are contemporaneous with the middle (or test interval) pressure transducer are indicative of a leak at the packer.

Typically, an appropriate constant rate of extraction is initiated and the pressures are monitored until a sufficient volume of fluid is extracted and a sample is collected. The volume extracted is typically equivalent to three times the volume which has been packed off. The rate of extraction is generally estimated from the results gained from hydrophysical logging. At the conclusion of pumping, the pressure recovery curve is recorded and the pressure is then released from the packers. Constant rate extraction data can be analyzed for aquifer hydraulic properties. See Figure 5.

3.0 Individual Borehole Results

These discussions regarding the individual well results are intended to be read together with the data montages which present significant additional detail regarding the analysis of tests conducted.

3.1 Borehole CS-WB-05

3.1.1 Geophysical Intepretation

On August 15 and 16, 2005, RAS conducted borehole imaging and geophysical logging in CS-WB-05. On August 15, the first log to be run in this well was the three-arm caliper log followed by the optical imaging tool (OBI). Logging was continued in CS-WB-05 with the 16-64-inch normal resistivity tools. On August 16, the borehole video log was run followed by the natural gamma and electromagnetic induction logging. Standard calibration and quality assurance procedures were applied for these tools and methods, and all tools calibrated within accepted limits.

In CS-WB-05, the uncased, open portion of the borehole was saturated with groundwater from about 169 feet below the ground surface (BGS) during testing. The OBI logs displayed an abundance of karst features including vugs, dissolution enhanced bedding planes and other dissolution features through most of the open hole interval. The massive, or portions of the formation with limited direct evidence of dissolution activity, was rather limited, only occurring at depths of 144 – 148, 163 – 167, and 462 – 467 feet. These massive portions account for 13 feet of the 450 feet of open hole in the boring. The open hole portion of the boring, from 30 ft to the total depth of 480 feet, varied in diameter from 4.375 to 5.875 inches as indicated by the caliper log with the largest diameter noted at 136 – 138 ft.

In general, the gamma response appears to be the inverse of the EM induction response. The correlated inverse response is most evident where there appears to be a concentration of weathered bedding features and vugs and other dissolution features. Once below the water level in the boring there appears to be a slight shift or increase in the response of both the gamma and EM. Between 265 and 313 feet, there is a generalized drop in the gamma activity that is not well correlated with the EM response. Within the same general interval, resistivity increases somewhat (285 – 335 feet). Between the depths of 286 and 330 feet, the diameter of the borehole increases from about 4.75 inches to 5.875 inches in the upper part of the interval and then narrows to approximately 4.75 inches. Collectively, the increase in borehole diameter and resistivity along with the drop in gamma activity are correlated with the upper quantified ambient flow zone producing 0.75 gpm. Below 335 feet in depth, gamma activity has already increased to a peak value of 300 at a depth of 336 feet at the same point where resistivity begins a rapid drop and EM induction begins to decline. Between 340 and 395 feet, resistivity remains uniform and gamma varies between 100 to 200 API units while the EM drops to between 5 and 10 ohm/m. From 395 feet to near 470 feet in depth, gamma and EM induction exhibit their strong inverse correlation. Overall the gamma log is fairly uniform without the very large jumps characteristic of fundamental changes in lithology.

The OBI logs are revealing as to the subsurface structure as well. The upper 50 feet of the boring appears less affected by dissolution features than the rest of the borehole. The gamma activity seems to increase somewhat in areas where there is a greater frequency of karst weathering features such as vugs and the weathered bedding. The increase gamma activity which is associated with the dissolution features could be more directly associated with increases in clay mineral content that commonly accumulate in karst features. Between 95 to 125 feet in depth, the gamma activity seems to increase somewhat, but the frequency of karst vugs and similar features is about the same as the rock above and below the interval; consequently, the increased gamma response may indicate a generally more argillaceous limestone matrix. Below about 290 feet in depth, the frequency of dissolution features increases dramatically with fairly large karst features in evidence.

3.1.2 Flow Evaluation and Contaminant Characterization

On August 17 - 24, 2005, hydrophysical and wireline straddle packer (WSP) testing were conducted in CS-WB-05. Hydrophysical logging was initiated on August 17, with the acquisition of an ambient fluid electrical conductivity and temperature log. This log is run first to establish baseline conditions and was followed by emplacement of the borehole fluids with deionized water. Hydraulic conditions in this well indicated that testing under ambient conditions was most applicable (see Section 2.0 Methodology, where details are provided on application of the hydrophysical technology). Hydrophysical testing under ambient conditions involved replacing borehole fluids with deionized water followed by logging under ambient or non-stressed conditions until hydraulically conductive intervals were identified and associated flow rates were quantified. The hydrophysical data indicated inflow intervals under ambient conditions at 168 to 173, 205 to 218 and 297 to 307 feet below top of PVC casing (ftbtopvcc) and one outflow interval from 432 to 450 (TD) feet.. However, analysis of the ambient data indicates only two intervals over which flows could be quantified. The interval from 297 to 307 feet had an inflow rate of 0.75 gpm under ambient conditions, and the interval from 432 to 450 had an outflow rate of 0.75 gpm.

WSP testing was conducted over three intervals identified by the hydrophysics to determine formation hydraulic characteristics. Water quality samples were collected from four intervals using the WSP prior to hydraulic characterization. Hydraulic characteristics were determined by conducting injection tests using potable water. Tests were conducted on five intervals including from 168 to 188 feet, 198 to 218 feet, 230 to 250 feet, and 268 to 288 feet; the interval from 203 to 223 feet was pressure tested and the interval was confirmed, as suggested by HPL, as a no flow zone. Interval specific transmissivities were determined for the three segments from 168 feet to 188 feet, 198 to 218 feet, and 268 to 288 feet. The calculated transmissivities were 190 ft^2/day, 110 ft^2/day, and 6.1 ft^2/day respectively. For the segment from 230 to 250 feet, only an upper end estimate of transmissivity of about 0.01 ft^2/day or greater was possible due to formation leakage likely from above/below the tested zone; the interval is effectively a no flow zone.

As part of the hydraulic testing, relative formation pressures were also noted. Formation pressures relative to static hydraulic head as measured in the open borehole provide insight into the dynamics of potential flows within the formation. During the WSP test process, the local formation pressures are noted when the segment to be tested is isolated after packer inflation. If the post packer inflation formation pressures rise relative to the static pressures in the borehole, it suggests that the segment of the formation is likely to contribute flows to the borehole under ambient conditions. Conversely, if the pressure falls relative to static borehole pressures then the formation segment will likely receive flow from the borehole. Four segments were tested including intervals from 198 to 218 feet, 268 to 288 feet, 320 to 340 feet, and 343 to 450 feet. The upper three intervals all posted positive relative pressures varying between +1.0 to +2.4 feet of head greater than static pressures, but the segment from 343 to 450 feet indicated a negative relative pressure difference equivalent to -19.1 feet of head.

Water samples were also collected as part of the WSP testing phase. Samples were collected from the intervals at 268 to 288 feet and 320 to 340 feet and were sent to a third party laboratory for testing. The sample results indicated concentrations of TCE at 152 ug/L, PCE at 31.3 ug/L, and cis-1,2 DCE at 286 ug/L in the interval from 268 to 288 feet. Concentrations of TCE at 427 ug/L, PCE at 319 ug/L, and cis-1,2 DCE at 533 ug/L were encountered in the interval from 320 to 340 feet.

The montage for CS-WB-05 also summarizes data collected by RAS and others as well as indications of water bearing zones and organic contaminants, including chlorinated organics such as TCE, PCE, and their degradation products. Water bearing zones were identified at the depths from 168-173, 184-189, 205-218, 278-287, 289-297, 303-309, 321-333, 336-340, 358-362, and 432-450 feet below TOC. The contaminants were documented by samples collected at a number of depth intervals, both in soil gas and groundwater samples. Table 3.1.2 summarizes the principal organic contaminants encountered in CB-WS-05. A comprehensive summary table indicating results from hydrophysical, packer testing and sampling is presented in Appendix C of this report.

CS-WB-05 Organic Contaminant Summary

Depth Below TOC	Sample Type	TCE	PCE	cis-1,2 DCE	Units
30 -50	Soil Gas	77.1	120	17.8J	ppbv
71 – 91	Soil Gas	167	204	110	ppbv
116 – 136	Soil Gas	439	479	368	ppbv
156 – 176	Soil Gas	157	328	47.7	ppbv
--------	--------	------			-----
268 – 288	Groundwater	152	31.3	286	ug/L
290 – 310	Groundwater	273	160	344	ug/L
320 – 340	Groundwater	427	319	533	ug/L
416 – 436	Groundwater	375	375	465	ug/L

Table 3.1.2

3.2 Borehole CS-WB-06

3.2.1 Geophysical Interpretation

On August 17, 2005, RAS conducted borehole imaging and geophysical logging in CS-WB-06, which had a maximum depth of 352 feet. The first log to be run in this well was the three-arm caliper log followed by the optical borehole imaging log. Logging was continued in CS-WB-06 with the 16-64-inch normal resistivity tool. The borehole video was then run followed by the natural gamma and electromagnetic induction. Standard calibration and quality assurance procedures were applied for these tools and methods, and all tools calibrated within accepted limits. At the time of testing, depth to water was 170 feet below ground surface. This water level results in the open hole section being unsaturated from bottom of casing (12 ft) to water level (170 ft).

Overall, the caliper log indicated a regular fairly smooth borehole that, over the majority of the boring, slowly tapers from 4.75 inches to 4.50 inches in diameter near the bottom of the boring. However, above a depth of 65 feet, the boring is somewhat ragged with a maximum diameter of about 7.25 inches just below the casing at about 14 feet in depth.

The gamma and EM induction logs appear to be inversely correlated but there is so little variation in the overall trends of the two logs that the relationship is not very evident. While the gamma log shows variations of about 60 API units (60 to 120) over short distances, the only real deviation from the gamma pattern is the subdued but very uniform gamma expression of about 60 API units that occurred from 274 feet to 306 feet BGS. However, an equivalent, but inverse, response in the EM induction is not apparent. The gamma response below 306 feet BGS increases suddenly to about 150 CPS and continues between 80 to 200 API units to the end of logging.

The resistivity logs are unremarkable with a fairly uniform profile. Resistivity increases somewhat below 275 feet BGS and appears to be associated with an increase in the degree of vuggy dissolution features evident in the OBI logs. The OBI logs showed that the distribution of dissolution features intercepted by the borehole are relatively uniformly distributed with sets of weathered bedding features occurring as well as small to medium vugs to a depth of about 275 feet BGS. Below a depth of 275 feet the frequency of dissolution features appears to increase significantly along with a number of large voids.

No hydrophysics or WSP testing were conducted in CS-WB-06 during this phase of work.

3.2.2 Contaminant Characterization

Samples were collected by others to document contaminant species and concentrations in CS-WB-06. A range of organic contaminants was encountered including chlorinated organics such as TCE, PCE, and their degradation products. The contaminants were documented by others in six intervals in CS-WB-06 as summarized in Table 3.2.2.

CS-WB-06 Organic Contaminant Summary

Depth Below TOC	Sample Type	TCE	PCE	cis-1,2 DCE	Units
10.5 – 32.5	Soil Gas	711	1270	856	ppbv
52.5 – 72.5	Soil Gas	1270	1570	931	ppbv
132.5 – 152.5	Soil Gas	490	540	520	ppbv
--------	--------	------			-----
262.5 – 282.5	Groundwater	159	151	287	ug/L
286.5 – 306.5	Groundwater	268	297	413	ug/L
310.5 – 330.5	Groundwater	268	337	435	ug/L

Table 3.2.2

3.3 Borehole CS-WB-07

3.3.1 Geophysical Interpretation

On August 17, 2005, RAS conducted borehole imaging and geophysical logging in CS-WB-07, the maximum depth of which was 340 feet. Overall, the geophysical logs appeared to be very similar to those collected from CS-WB-06. The first log to be run in this well was the three-arm caliper log followed by optical borehole imaging. Logging was continued in CS-WB-07 with the 16-64-inch normal resistivity tools. The borehole video log was then run followed by the natural gamma and electromagnetic induction. Standard calibration and quality assurance procedures were applied for these tools and methods, and all tools calibrated within accepted limits. At the time of testing, the depth to water was 165 feet below the ground surface. This water level results in the open hole section being unsaturated from bottom of casing (12 ft) to water level (165 ft).

Overall the caliper log indicates a regular fairly smooth borehole that, over the majority of the boring, slowly tapers from 5.25 inches to 4.50 inches in diameter near the bottom of the boring. However, above a depth of 65 feet the boring is somewhat ragged with a maximum diameter of about 7.25 inches just below the casing at about 14 feet in depth. In addition, near the bottom of the borehole at a depth of 333 feet BGS the caliper indicated a sudden jump in borehole diameter of just over 7.50 inches in association with either relatively large dissolution features, or washed out rock of compromised strength.

The gamma and EM induction logs appear to generally be inversely correlated but there is so little variation in the overall trends of the two logs that the relationship is not very evident. The EM induction log acquires a subtle increase at the water surface that is not present in CS-WB-06. The gamma log shows variations of about 60 API units (60 to 120) over short distances. The only significant deviations from the gamma pattern is the subdued but very uniform gamma expression of about 40 CPS that occurred from 273 feet to 308 feet below top of PVC casing, and three to four short intervals that are similar above 90 feet. However, an equivalent response in the EM induction is not apparent. The gamma response below 306 feet increases suddenly to about 120 and continues between 120 to 200 to the bottom of the borehole.

The resistivity logs are unremarkable with a fairly uniform profile. Resistivity increases somewhat below 270 feet and appears to be associated with an increase in the degree of vuggy dissolution features evident in the OBI and video logs. However, the long normal resistivity profile fails to shift with the rest of the resistivity suite.

The OBI logs showed that the distribution of dissolution features intercepted by the borehole are relatively uniformly distributed with sets of weathered bedding features occurring as well as small to medium vugs to a depth of about 155 feet. Below a depth of 155 feet the frequency of dissolution features appear to increase significantly along with a number of large voids. The frequency of weathered bedding features is much higher in the bottom 90 feet of the boring as are the occurrence of large voids.

3.3.2 Contaminant Characterization

Samples were collected by others to document contaminant species and concentrations in CS-WB-07. A range of organic contaminants were encountered including chlorinated organics such as TCE, PCE, and their degradation products. The contaminants were documented by others in six intervals in CS-WB-07 as summarized in Table 3.3.2.

CS-WB-07 Organic Contaminant Summary

Depth Below TOC	Sample Type	TCE	PCE	cis-1,2 DCE	Units
12 – 32	Soil Gas	4160	83.3	1340	ppbv
32 – 52	Soil Gas	937	25.7	229	ppbv
72 – 92	Soil Gas	106	4.57	27.1	ppbv
112 – 132	Soil Gas	94.3	21.5	25.5	ppbv
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202 – 222	Groundwater	47.9	34.7	56.1	ug/L
267 – 287	Groundwater	322	293	361	ug/L
287 – 307	Groundwater	306	254	322	ug/L
312 - 332	Groundwater	277	221	403	ug/L

Table 3.3.2

3.4 Borehole CS-WB-08

3.4.1 Geophysical Interpretation

On August 16, 2005, RAS conducted borehole imaging and geophysical logging in CS-WB-08, and the maximum depth was 360 feet. The first log to be run in this well was the three-arm caliper log followed by optical borehole imaging. Logging was continued in CS-WB-08 with the 16-64-inch normal resistivity tools. The borehole video log was then run followed by the natural gamma and electromagnetic induction logging. Standard calibration and quality assurance procedures were applied for these tools and methods, and all tools calibrated within accepted limits. At the time of testing, the depth to water was 179 feet below the ground surface. This water level results in the open hole section being unsaturated from bottom of casing (12 ft) to water level (179 ft).

Overall, the caliper log indicated a regular fairly smooth borehole that, over the majority of the boring, slowly tapers from 4.75 inches to 4.50 inches in diameter near the bottom of the boring. However, above a depth of 85 feet the boring is somewhat ragged with a maximum diameter just over 6.25 inches at a depth of about 30 feet.

The gamma and EM induction logs appear to be inversely correlated but there is so little variation in the overall trends of the two logs that the relationship is not very evident. While the gamma log shows variations of about 80 API units (50 to 130) over short distances, the only major deviation from the gamma pattern is the subdued but very uniform gamma expression of about 50 API units that occurred from 287 feet to 326 feet BGS. However, an equivalent inverse response in the EM induction log is not apparent. The gamma response below 326 feet increases suddenly to about 125 and then continues to rise to about 200 near the end of logging; at the bottom of the borehole the gamma response jumps to 300 API units. There are a number of short spikes in the gamma response that are coupled with an EM response scattered along the profile; where the spikes occur above the water level the EM response tends to be more robust.

The resistivity logs are unremarkable with a fairly uniform profile. The long normal profile is particularly uniform when measured against the intermediate and short resistivity profiles.

The OBI logs showed that the distribution of dissolution features intercepted by the borehole are variably distributed. The rock in the upper 45 feet appears to be beset by a reasonably high frequency of dissolution features in the form of small to large vugs and voids with a high frequency of weathered bedding features as well. Between 45 to 85 feet the frequency of dissolution features drops significantly with occasional weathered bedding features and a lower density of small and medium sized vugs, but with a few large voids indicated. Then, from 85 to 110 feet the frequency of large vugs and weathered bedding features increases significantly before returning to a lower frequency of such features below 110 feet and extending to 179 feet. The high frequency of weathered bedding features and medium to large vugs then extends from 179 to 245 feet in depth before the density of dissolution features drops again. However, below 293 feet the density and frequency of large dissolution features becomes high and includes a number of large voids as well.

3.4.2 Contaminant Characterization

Samples were collected by others to document contaminant species and concentrations in CS-WB-08. A range of organic contaminants were encountered including chlorinated organics such as TCE, PCE, and their degradation products. An interesting contrast in contaminant distribution is evident in the borehole. The shallow soil gas contamination is relatively high compared to soil gas concentrations in other boreholes. Yet the underlying groundwater contamination is lower than in the other boreholes. This suggests that the highly dissolution riddled rock under the site provides complex pathways that are not necessarily vertical. The contaminants were documented by others in six intervals in CS-WB-08 as summarized in Table 3.4.2.

CS-WB-08 TCE Contaminant Summary

Depth Below TOC	Sample Type	TCE	PCE	cis-1,2 DCE	Units
12.5 – 32.5	Soil Gas	9520	12200	2790	ppbv
91.5 – 111.5	Soil Gas	2220	3310	431	ppbv
140.5 – 160.5	Soil Gas	2730	4270	506	ppbv
158.5 – 178.5	Soil Gas	3970	5010	753	ppbv
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282.5 – 302.5	Groundwater	41.8	38.6	108	ug/L
307.5 – 327.5	Groundwater	57.3	50.9	98.8	ug/L
334 –354	Groundwater	54.2	53.7	115	ug/L

Table 3.4.2

4.0 Concluding Remarks and Suggestions

Based on the results of RAS's hydrophysical and wireline straddle packer testing in CS-WB-05, the geophysical logging of all four boreholes, review of water sampling results, and compiling geologic logging information supplied by others, the following are offered for your consideration:

1) The hydrophysical testing indicated a specific downhole flow component in CS-WB-05 that suggests a general potential for downward migration of water at least in the local area. Under the ambient conditions in CS-WB-05, inflows of 0.75 gpm occurred between 297 feet to 307 feet below TOC with an outflow of 0.75 gpm occurring between 432 feet and 450 below the TOC. The OBI logs in all four boreholes indicate that there are sufficient fractures and dissolution features present such that multiple, but discrete, pathways for flow are possible. However, the detailed hydrophysical testing, WSP tests and OBI logging results also indicate that the mere presence of such features does not indicate that flows are occurring in any specific set of features. It is possible that leakage or flow is occurring in one area (such as documented in CS-WB-05) but not in all areas.

2) Based on the geophysical logging results there may be a rough correlation between a slightly depressed gamma response, slightly elevated induction log response, and the occurrence of organic contaminants in certain intervals. Organic contaminants were encountered in all boreholes between 260 and 350 feet below TOC. However, in CS-WB-05 contamination was also documented in a deeper segment of the borehole that included the ambient outflow zone from 432 to 450 feet below TOC. The data suggests that contaminated flows originating from shallower intervals with higher hydraulic heads are migrating deeper to zones where lower hydraulic head conditions exist. In all four boreholes contaminated groundwater was documented near the 285 to 305 foot depth interval where a weak correlation between a depressed gamma response and slightly elevated EM induction response was noted in all of the boreholes. The interval is also where the 0.75 gpm ambient inflow zone in CS-WB-05 is located. However, due to the lack of information describing the specific flow characteristics of potential productive intervals in all four boreholes, it is difficult to do more than speculate that the distribution of contamination at depth is the result of flows that are horizontal and are not related to wide spread vertical communication with shallower groundwater.

3) The relative pressure test results documented in CS-WB-05 indicated that the lowest productive interval near 432 to 450 feet below TOC had a hydraulic head difference that was 19 feet lower than the static water level in the borehole. This significant head difference would not be likely unless the hydraulic communication between the overlying formation was limited and/or there was significant near by pumping from the deeper formations. In the

absence of more detailed information describing the hydraulic behavior of the formations, such as that collected in CS-WB-05, it is difficult to fully interpret the available information.

8) The WSP testing in CS-WB-05 documented that not all apparent groundwater bearing zones (i.e. those identified with hydrophysical testing) are sufficiently productive to sustain pumping or slug testing. Many portions of the formation may exhibit very low flow rates. WSP testing is aimed at defining flows that are greater than what might be sustained by discharges from a very fine grained formation matrix, or from dissolution pockets with limited storage and connectivity. Diffusive flows into the formation (sediment filled karst carbonates), with or without contaminants, are probable in the general vicinity of transmissive pathways within the formation. When the pathways are encountered directly by the borehole, flow rates can be measured or are otherwise indicated by hydrophysical testing. In situations where flows are too low to be indicated, the presence of contaminants originating out of the halo surrounding the pathways may be the source of contaminants encountered in a borehole. Testing is required to tell the difference.

9) The OBI documented extensive occurrence of dissolution features and fractures that were generally filled with fine grained sediments and tended to be hydraulically nonproductive. The general occurrence of similar features at roughly the same depths in other boreholes cannot be taken to automatically infer hydraulic connection between the intervals. Given the frequency of features, hydraulic tests are needed to define the existence of specific pathways.

10) In CS-WB-08 the surface contamination (soil gas results) was much higher in relative terms than at the other boreholes. In addition the groundwater contamination levels were significantly lower in CS-WB-08 than in the other boreholes. If more or less spatially uniform vertical leakage was widespread, then it would be reasonable to expect locally high groundwater contamination in or around CS-WB-08.

11) The water level CS-WB-05 is significantly lower than in adjacent and shallower wells making it appear anomalous. However, the lower water level appears reasonable given the data showing the down well flows under current ambient conditions. CS-WB-05 is quite a bit deeper than the other wells and documents a part of the groundwater flow system untapped by the other boreholes. Based on the data it can not be determined if the deeper outflow zone (lower hydraulic head) is the result of a generally higher transmissive zone under the site that acts as a drain under ambient conditions, or if the condition is temporary because of the influence of remote pumping from the interval. What is clear is that the deeper zone is somewhat isolated from the overlying aquifer as documented by the -19.0 ft relative head difference.

5.0 Limitations

Water levels have been measured in the wellbores at the times and under the conditions stated in the report. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall and other factors different from those prevailing at the time measurements were made.

Except as noted within the text of the report, no quantitative laboratory testing was performed to verify the calibration of the logging tool. Where such analyses have been conducted by an outside laboratory, RAS, Inc. has relied upon the data provided, and has not conducted an independent evaluation of the reliability of these data.

Conclusions and recommendations contained in this report may be based in part upon various types of chemical data and are contingent upon their validity. These data have been reviewed and interpretations made in the report. As indicated within the report, these data are developed based on the field calibration of the logging tool. Where more specific information is necessary, the tool measurements should be verified based on quantitative lab analyses of grab samples obtained directly from the wellbore. Moreover, it should be noted that the variations in the types and concentrations of groundwater constituents and variations in their flow paths may occur due to seasonal water table fluctuations, past site practices, the passage of time, and other factors. Should additional chemical data become available in the future, these data should be reviewed by RAS, and the conclusions and recommendations presented herein modified accordingly.

The values for bedrock hydraulic conductivity, if given in this report, should be viewed as "equivalent hydraulic conductivities", which are computed based on an assumed, or equivalent, interval length and a uniformly pervious porous media behavior. This industry standard approach has several limitations, which are well documented in the current literature. In addition, the accuracy of the equivalent hydraulic conductivities when presented herein is subject to the applicability of the boundary condition assumptions inherent in the permeameter/slug test/pumping test analysis method used.

RAS's logging was performed in accordance with generally accepted industry practices involving similar studies at the same time and in the same general area. RAS has observed that degree of care and skill generally exercised by others under similar circumstances and conditions. Interpretation of logs from the newly developed techniques, Scanning Colloidal Borescope Flowmeter, Hydrophysical Logging ("NxHpL®") and Wireline/Straddle Packer Testing ("WSP®") (whether made directly from visual observations or by data processing or otherwise), or interpretation of test or other data, and any recommendation or hydrogeologic description based upon such interpretations, are opinions based upon inferences from measurements, empirical relationships and assumptions. These inferences and assumptions require engineering judgment, and therefore are not scientific certainties. As such, other professional engineers or analysts may differ as to their interpretation. Accordingly, RAS cannot and does not warrant the accuracy, correctness or completeness of any such interpretation, recommendation or hydrogeologic description.

All technical data, evaluations, analysis, reports, and other work products are instruments of RAS's professional services intended for one time use on this project. Any reuse of work product by Client for other than the purpose for which they were originally intended will be at Client's sole risk and without liability to RAS. RAS makes no warranties, either express or implied. Under no circumstances shall RAS or its employees be liable for consequential damages.

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APPENDIX A

INTEGRATED DATA MONTAGES

APPENDIX B

HYDROPHYSICAL
AND
WIRELINE STRADDLE PACKER
DATA AND FIGURES

WELLBORE CS-WB-05

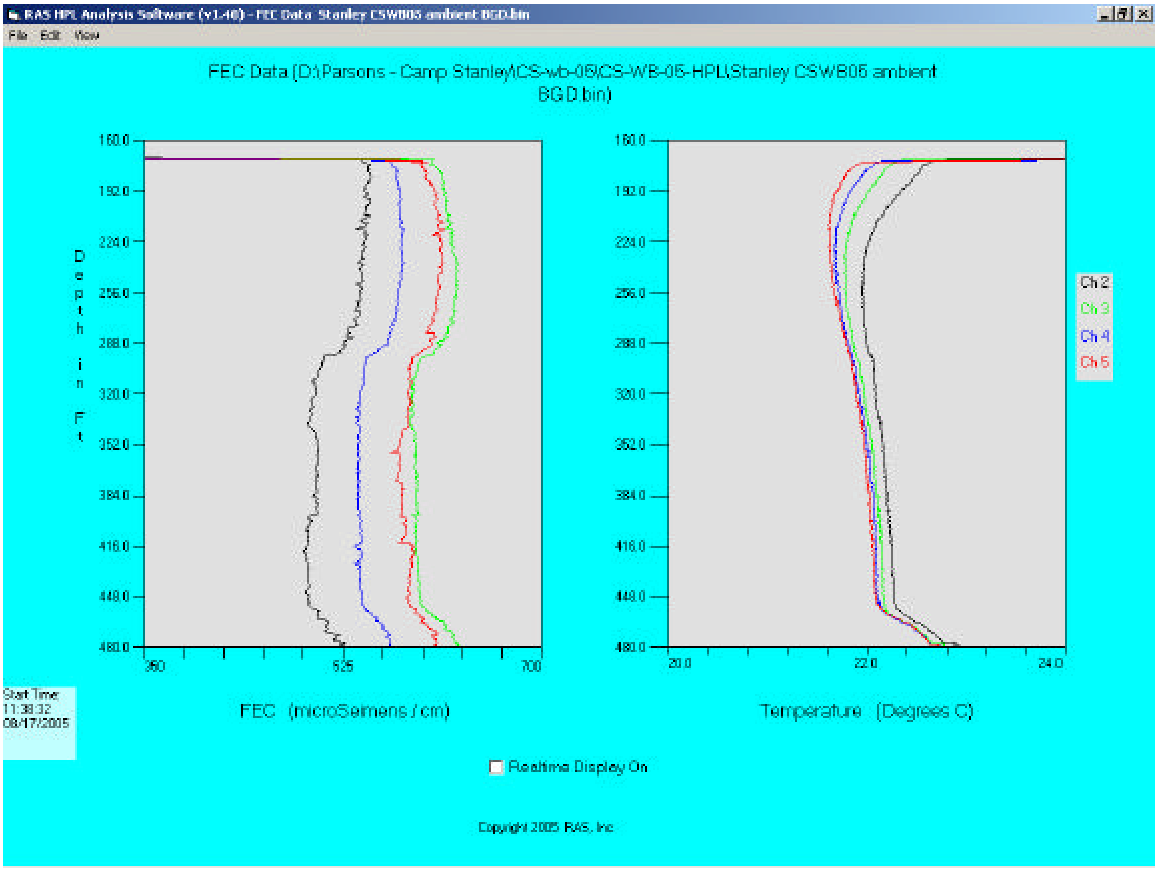

Figure CS-WB-05: 1. Ambient Fluid Electrical Conductivity and Temperature Log. One water type of 490 to 630 µS/cm was apparent.

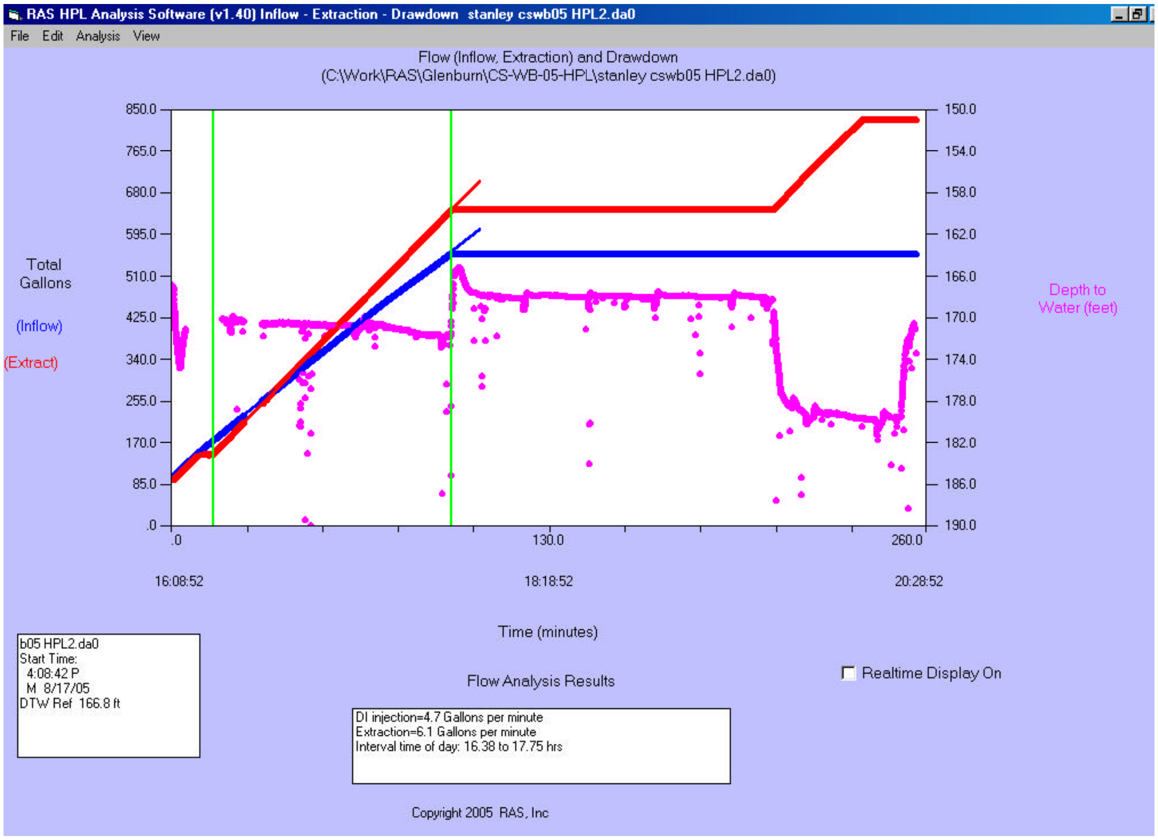

Figure CS-WB-05: 2. Pumping, Injection and Pressure History. Emplacement was conducted from 1540 to 1745 hours. Total Extraction = 39.3 gallons. Total Injection = 33.5 gallons. Pumping During Injection was conducted from 1638 to 1743 hours, during which time 3 logs were acquired. Borehole pressure conditions were reasonably stable after approximately 5 minutes. Ambient Flow Characterization was conducted from 1746 to 1935 hours, during which time 5 logs were conducted. Pumping After Emplacement was conducted from 1936 to 2019 hours, during which time 2 logs were acquired. Pump was at the well bottom and injection was at the surface.

APPENDIX B – WELL CS-WB-05
HYDROPHYSICAL AND STRADDLE PACKER DATA AND FIGURES
ALL DEPTHS REFERENCED TO TOP OF PROTECTIVE PVC CASING

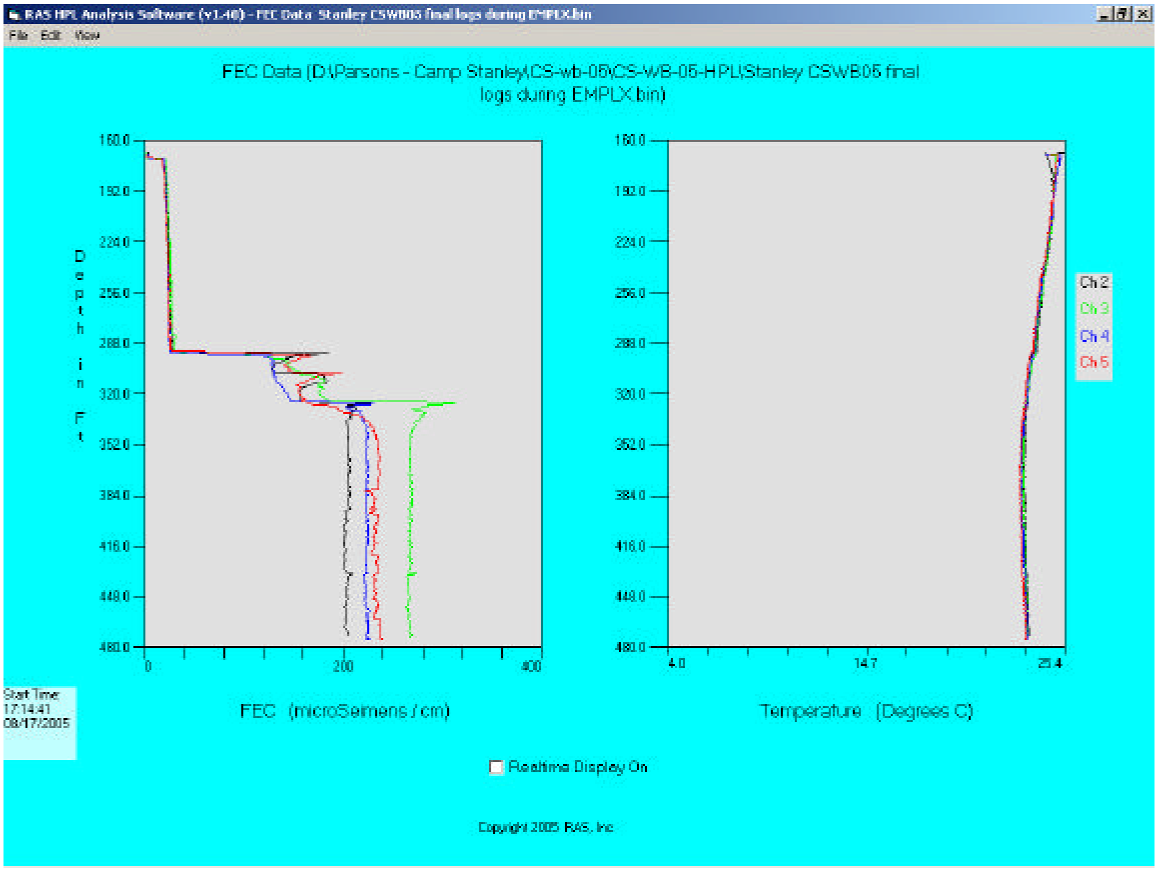

Figure CS-WB-05: 3. Pumping During Injection Log. Emplacement occurred from 1540 to 1745 hours. Pumping during injection data set, processed below.

APPENDIX B – WELL CS-WB-05
HYDROPHYSICAL AND STRADDLE PACKER DATA AND FIGURES
ALL DEPTHS REFERENCED TO TOP OF PROTECTIVE PVC CASING

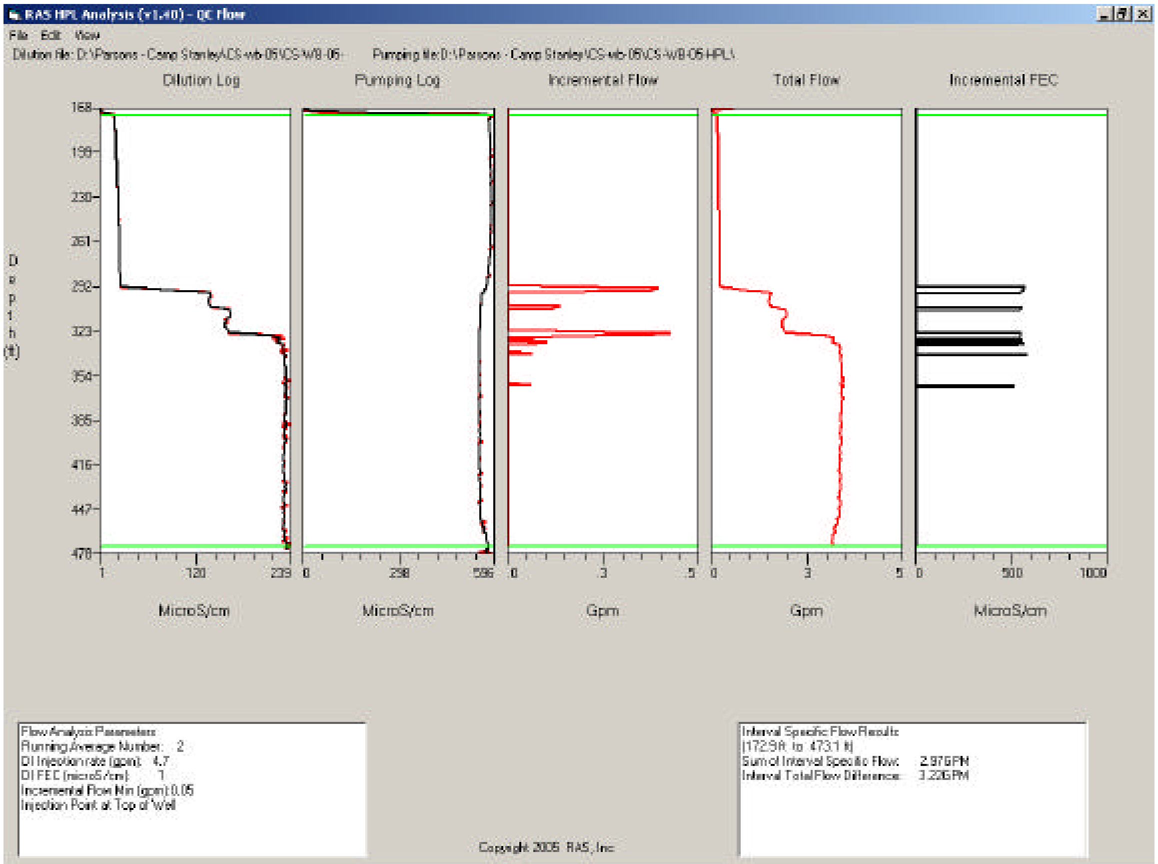

Figure CS-WB-05: 4. PDI Logs and Analysis. Results of analysis suggest inflow at the following intervals: 289 to 297, 303 to 309, 321 to 333, 336 to 340 and 358 to 362 feet below TOC.

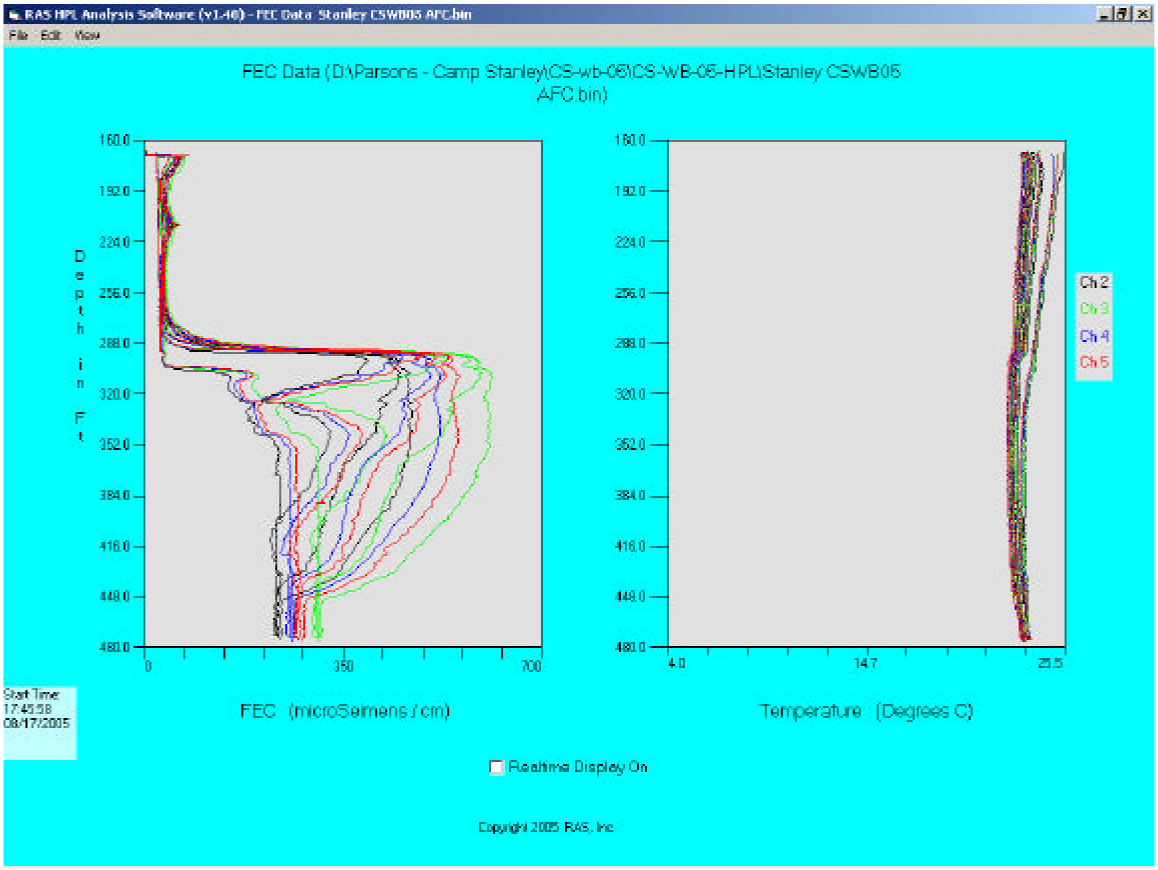

Figure CS-WB-05: 5. Ambient Flow Characterization. Presented data includes four channels, down logs only. Data suggest inflowing intervals are from 168 to 173 and 205 to 218 feet below TOC and outflowing intervals are from 432 to 450 (TD) feet below TOC.

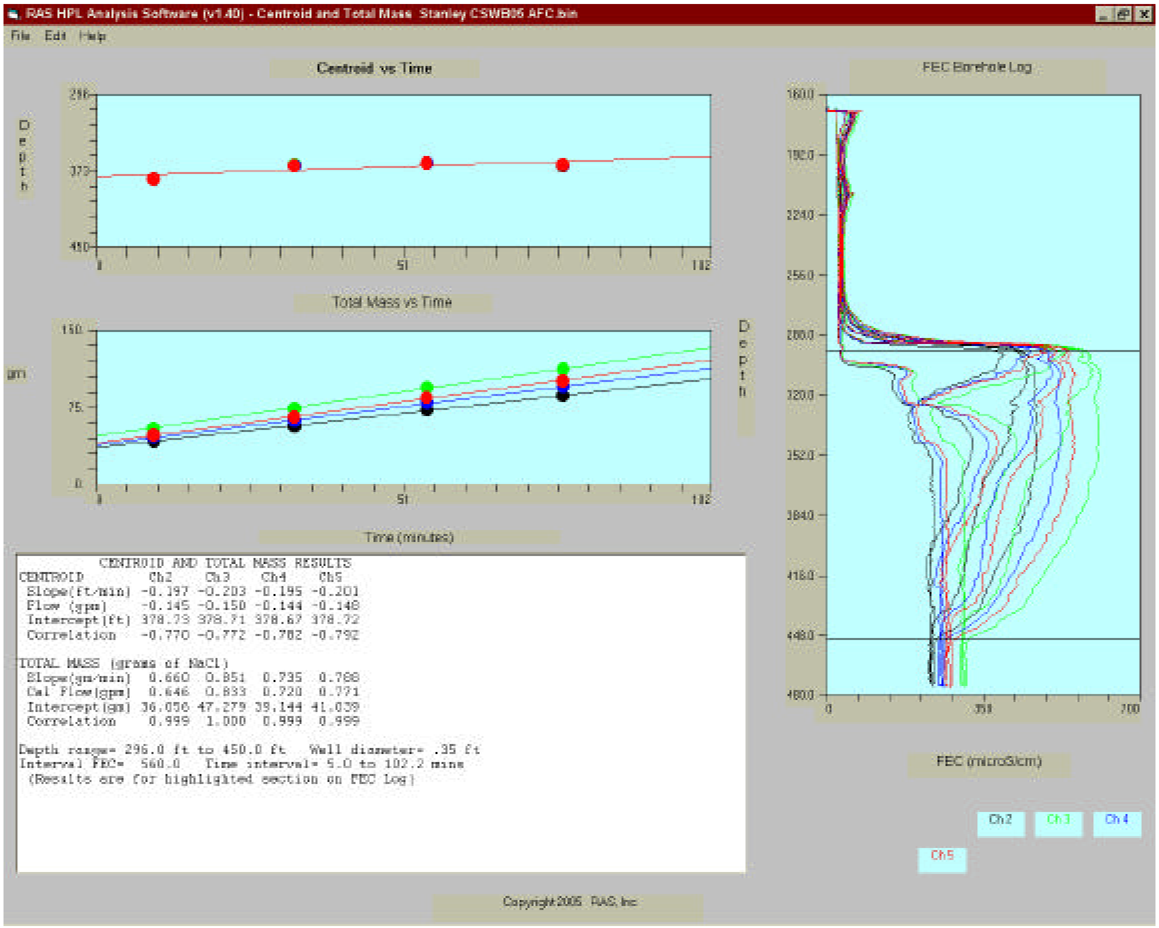

Figure CS-WB-05: 6. Results of Centroid and Integral Analysis of Ambient Flow Data. Integration Interval from 296 to 450 feet. Data suggest inflow at an interval from 297 to 307 feet below TOC. Data suggest a flow rate of 0.75 gpm.

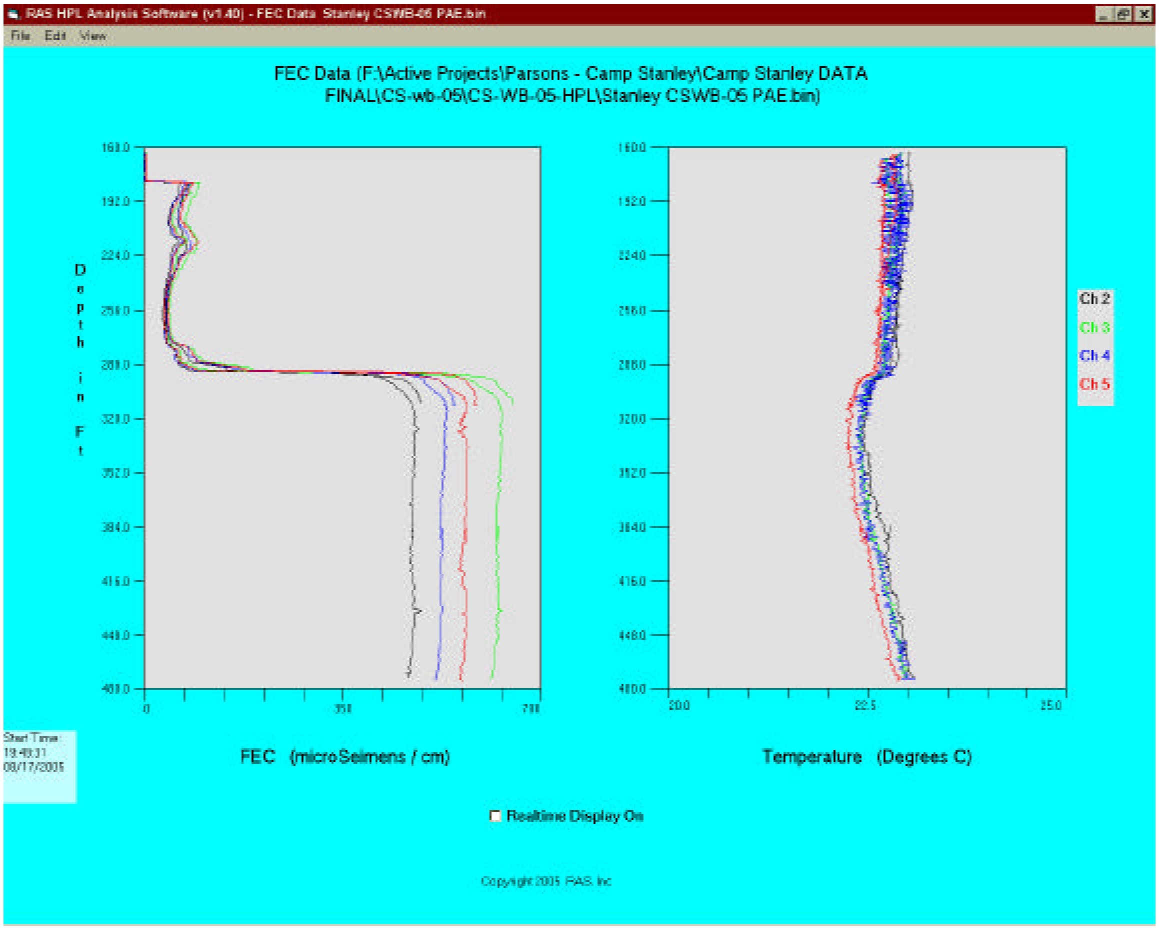

Figure CS-WB-05: 7. Pumping after emplacement.

APPENDIX B – WELL CS-WB-05
HYDROPHYSICAL AND STRADDLE PACKER DATA AND FIGURES
ALL DEPTHS REFERENCED TO TOP OF PROTECTIVE PVC CASING

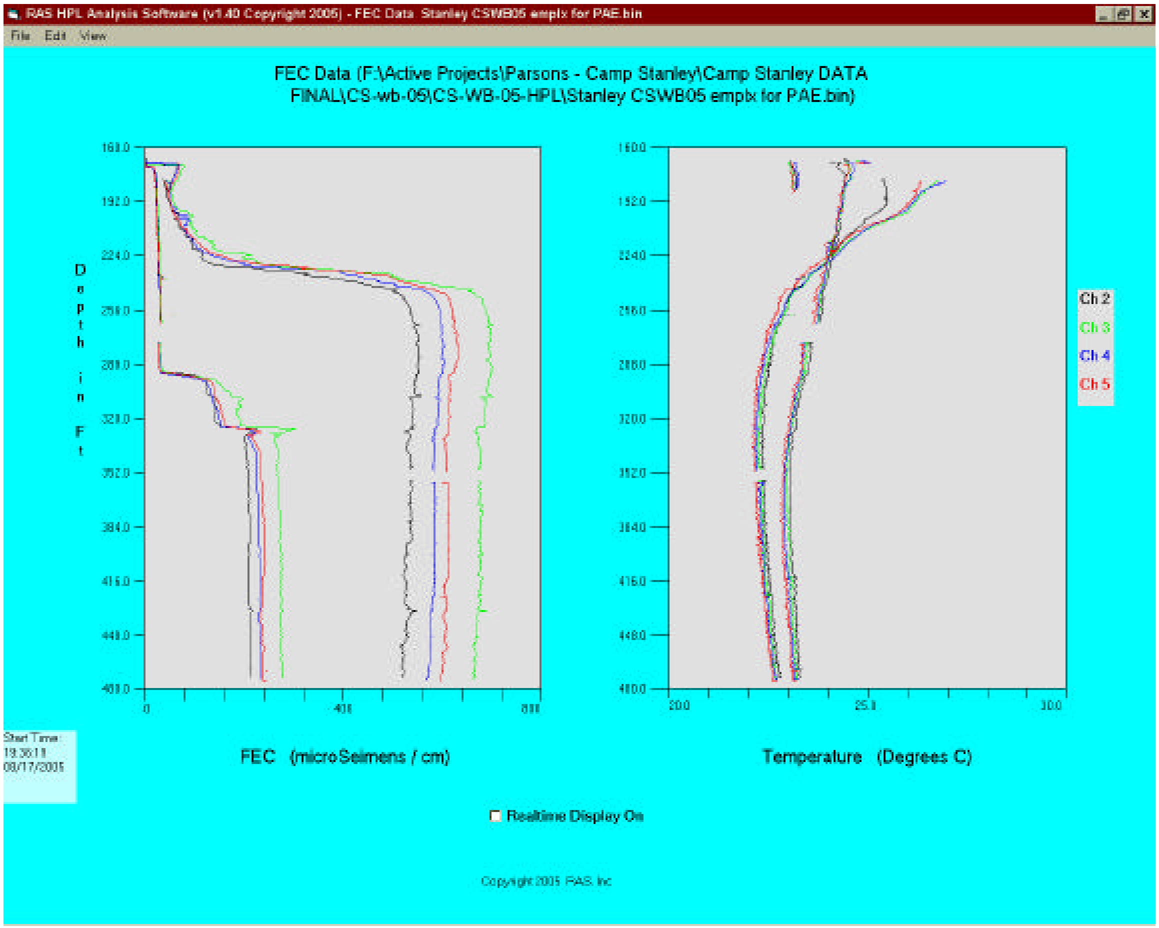

Figure CS-WB-05: 8. Emplacement for PAE.

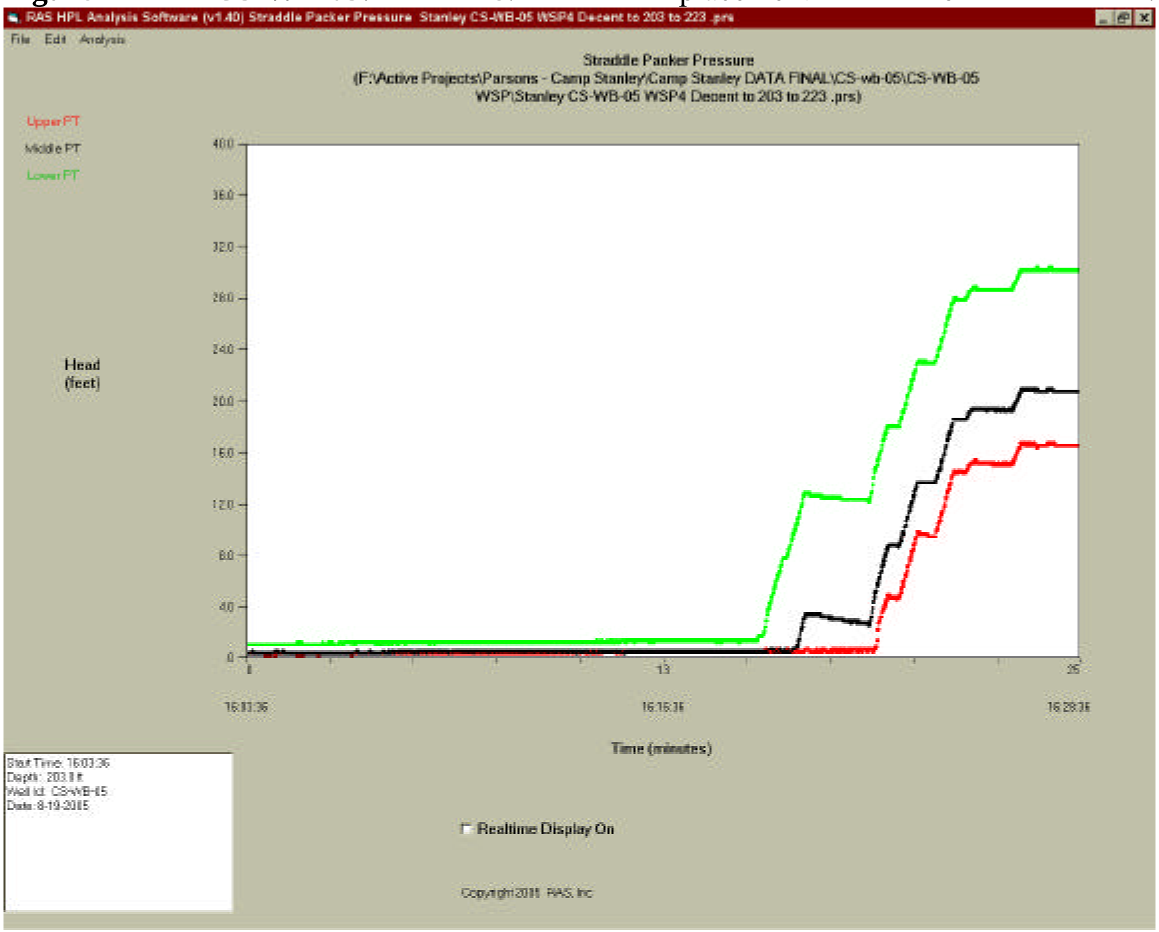

Figure CS-WB-05: 9. Summary Straddle Packer Testing, Descending to 203 (BOTP) ft below TOC. Data used only for confirmation of pressure transducer and telemetry response.

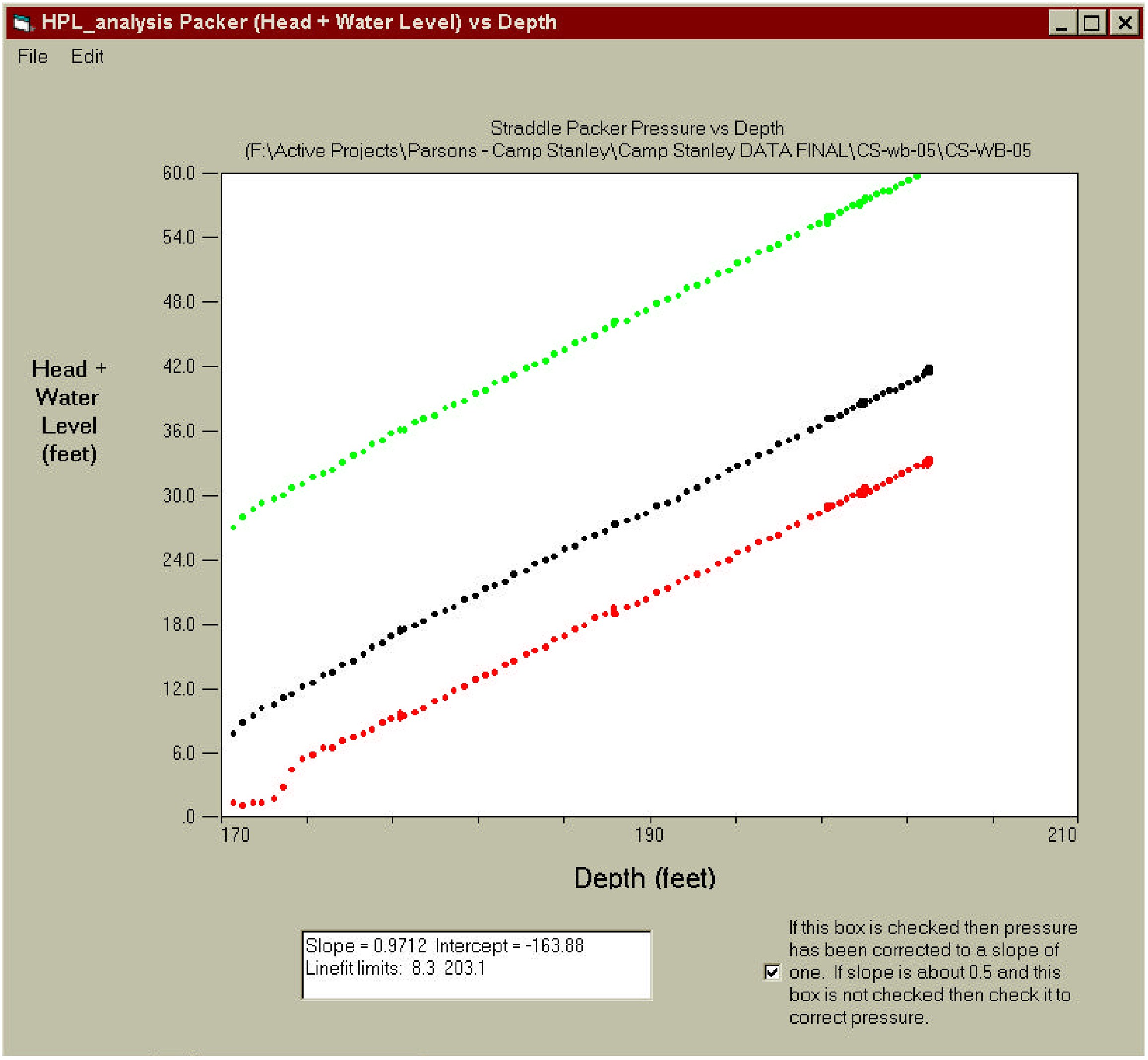

Figure CS-WB-05: 10. Summary Straddle Packer Testing. Descending to 203 (BOTP) ft below TOC. Pressure versus Head analysis.

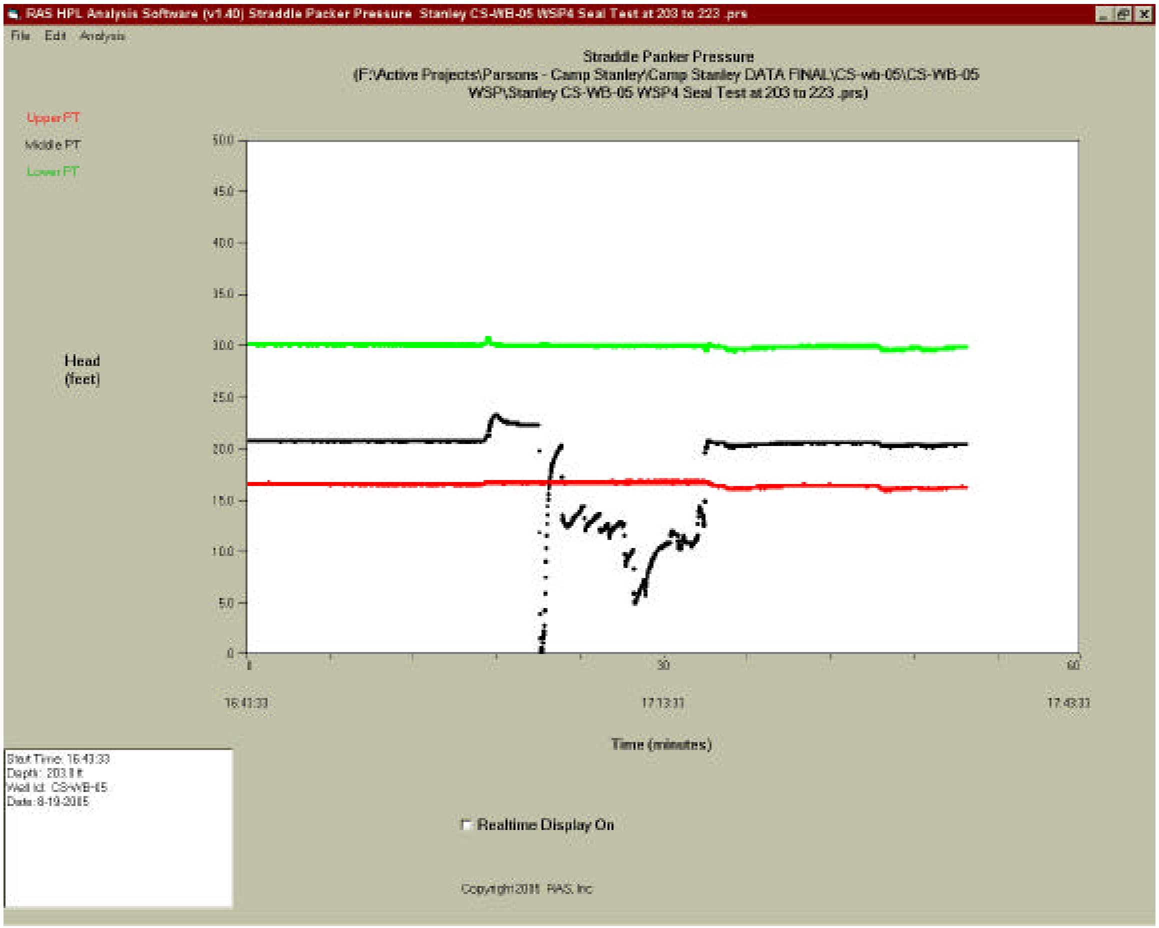

Figure CS-WB-05: 11. Summary Straddle Packer Testing. Seal test at 203 (BOTP) to 223 (TOBP) feet below TOC.

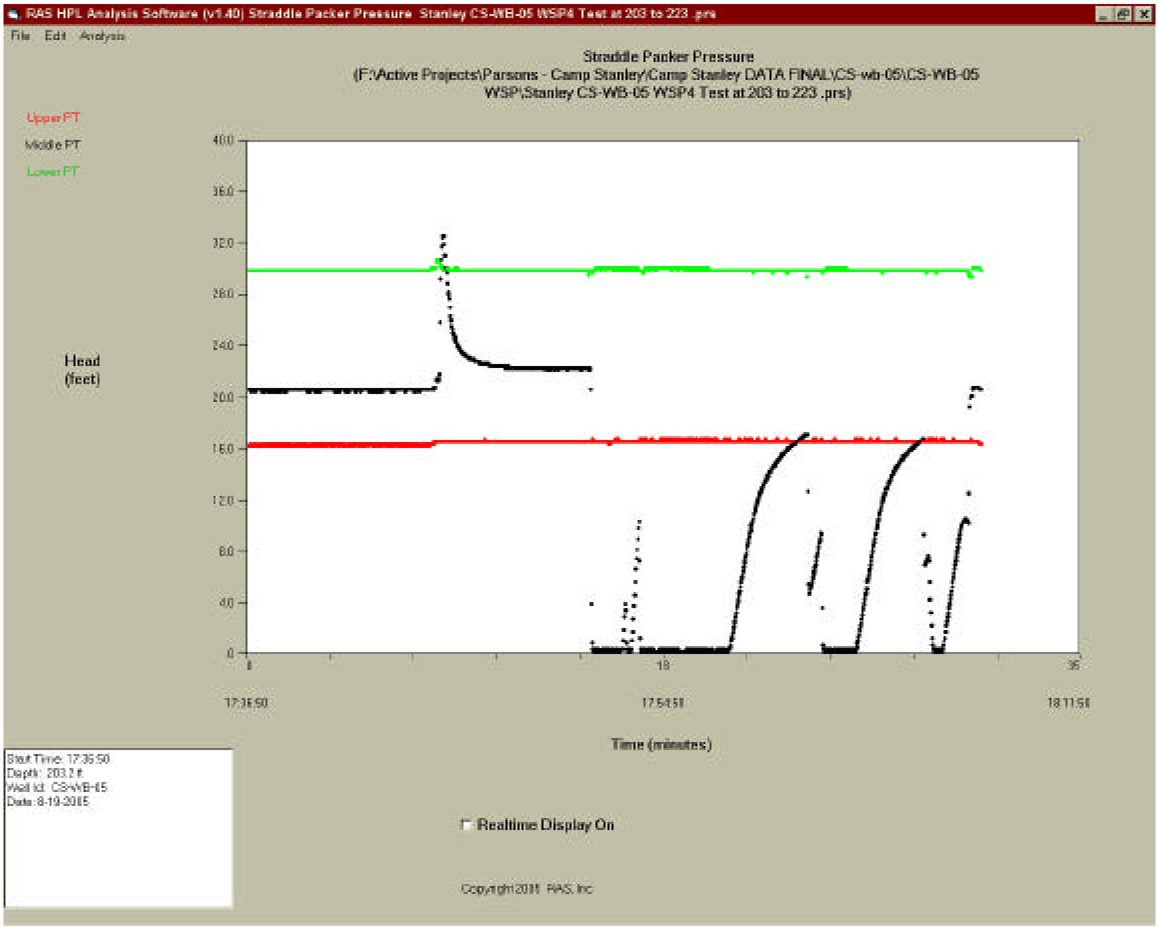

Figure CS-WB-05: 12. Summary Straddle Packer Testing. Tested interval 203 (BOTP) to 223 (TOBP) feet below TOC. Pumping was initiated at 1744 hours, but pump problems and lightning necessitated termination of testing. Formation fluid pressure for the interval approximately 1.7 feet above open hole hydrostatic at this interval. Based on rising head data for two slug tests, interval transmissivity 4.2-5.0 e+2 feet^2 per day.

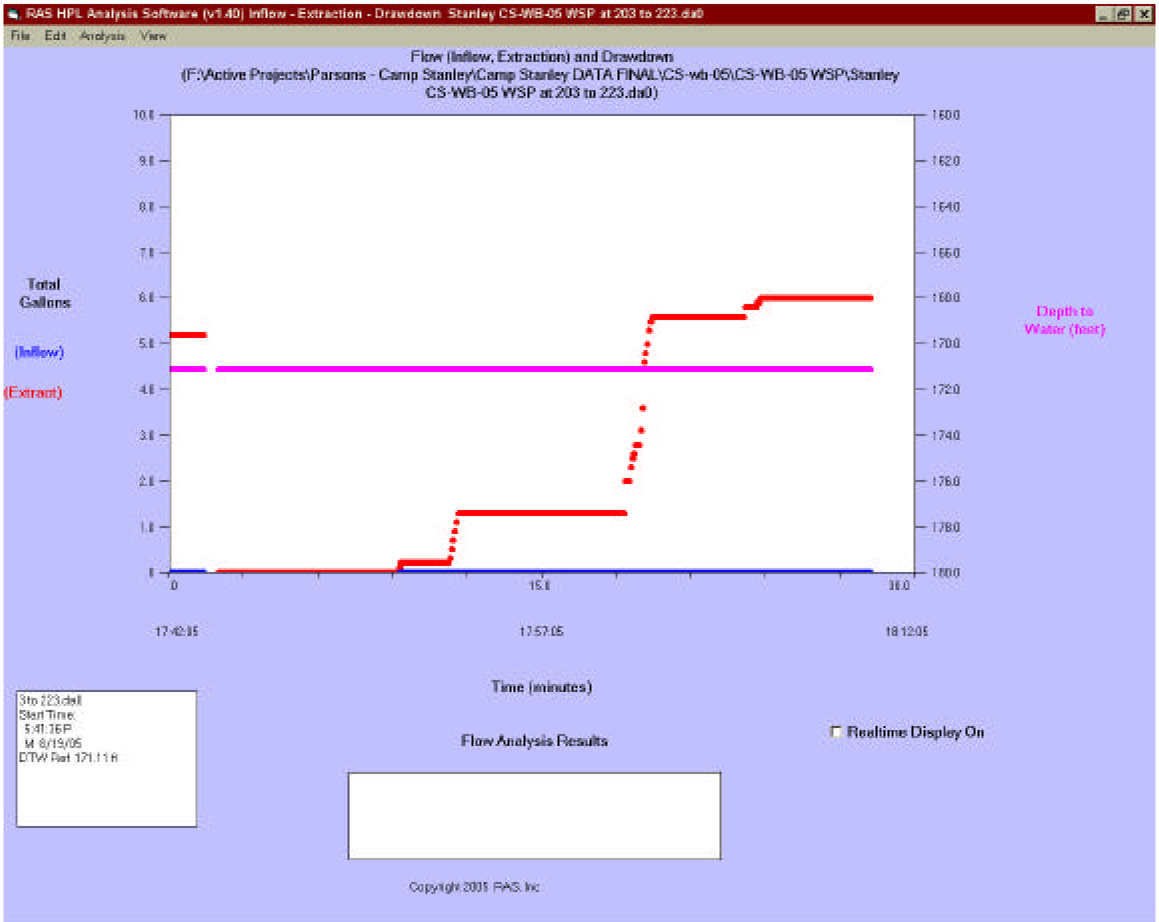

Figure CS-WB-05: 13. Water Level and Injection Data During Injection Testing. Extraction interval 203 (BOTP) to 223 (TOBP) feet below TOC. Pump performance affected by very low yield of interval.

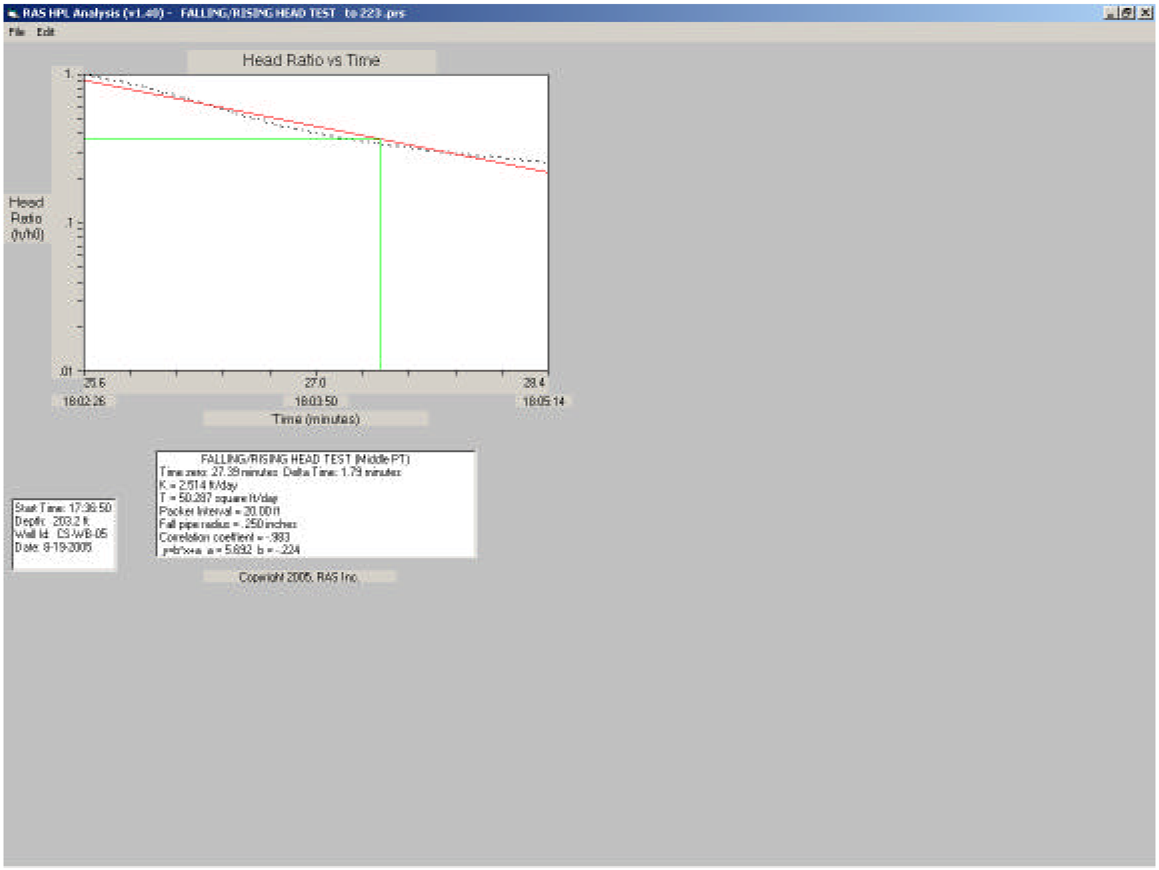

Figure CS-WB-05: 14. Falling Head Test. 203 feet below TOC.

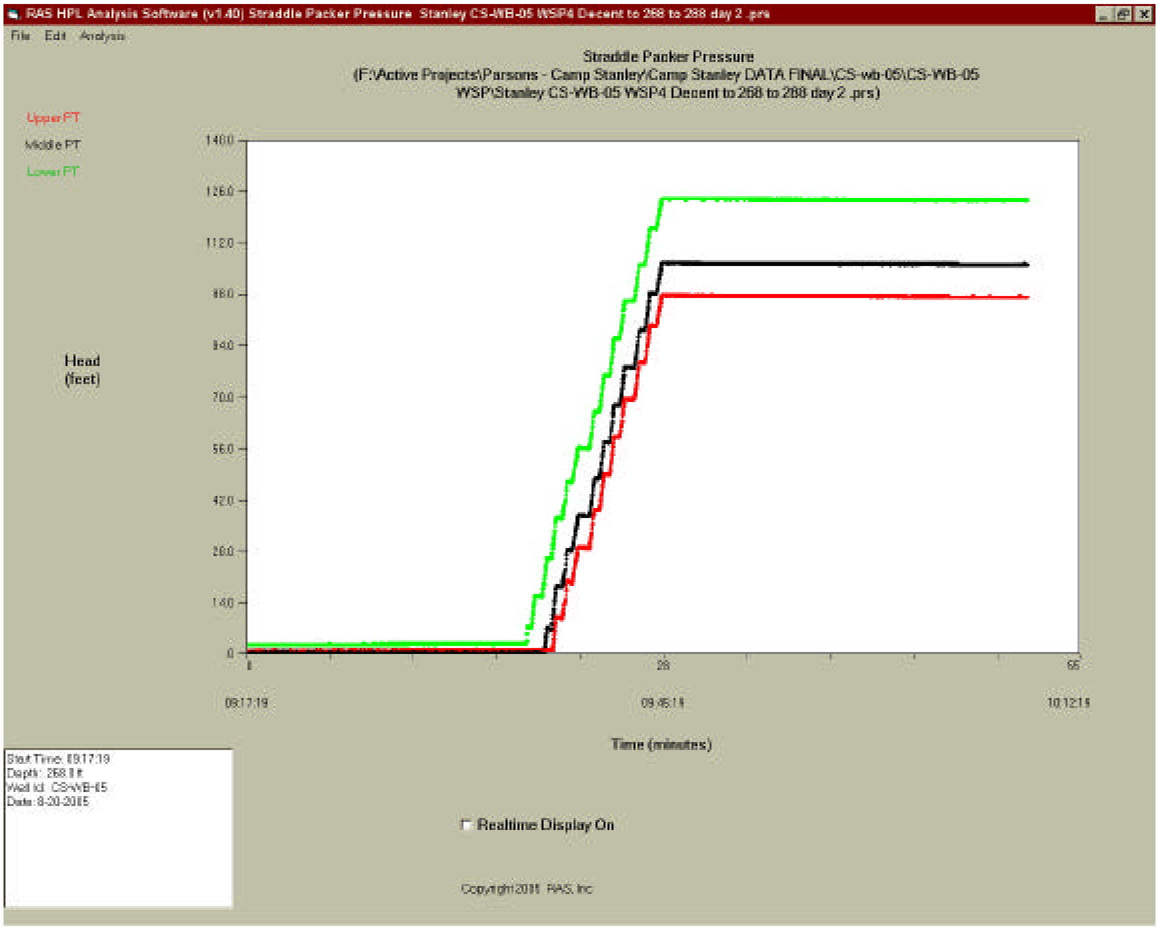

Figure CS-WB-05: 15. Summary Straddle Packer Testing. Descending to 268 (BOTP) ft below TOC. Data used only for confirmation of pressure transducer and telemetry response.

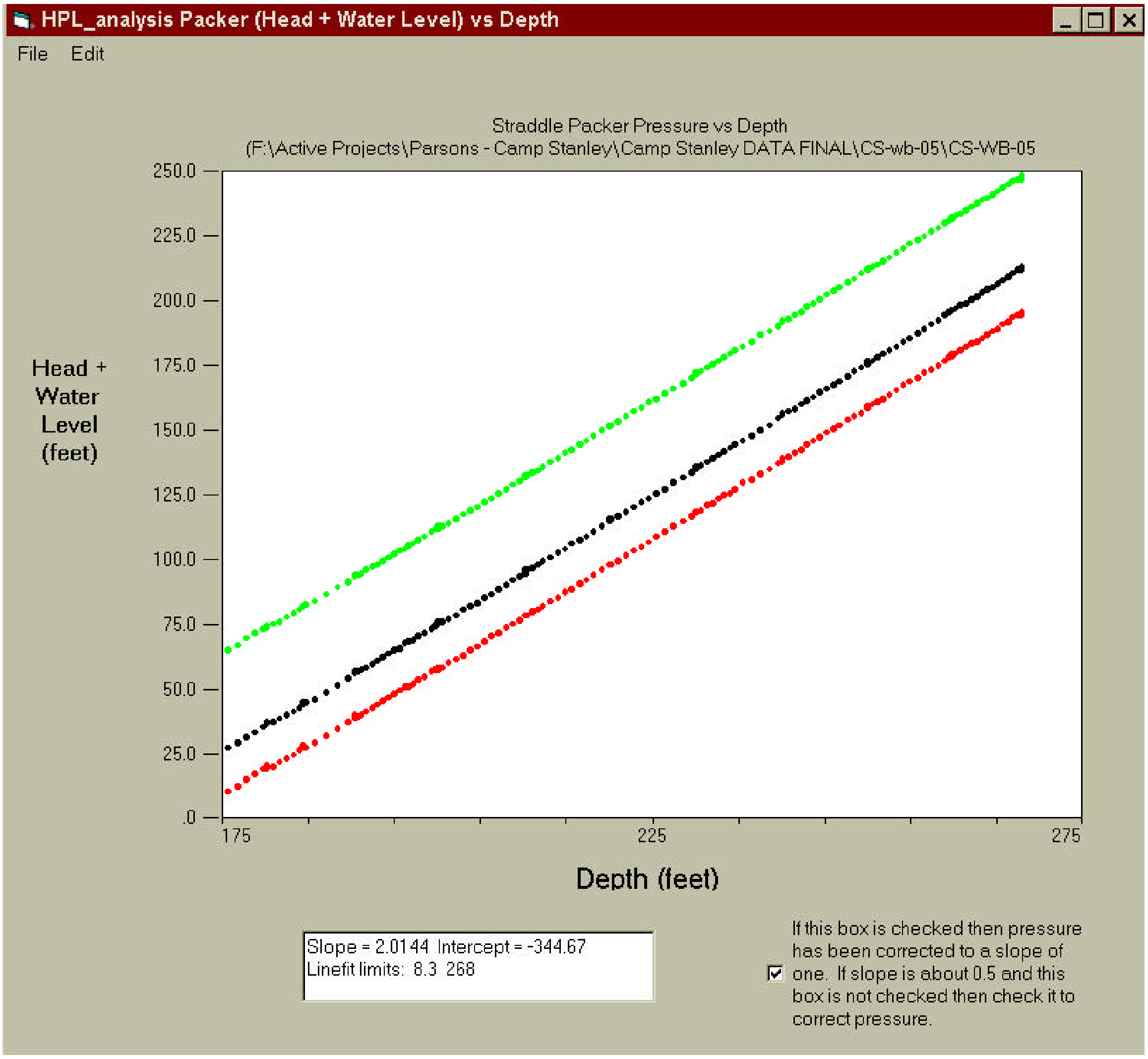

Figure CS-WB-05: 16. Summary Straddle Packer Testing, Descending to 268 (BOTP) ft below TOC. Pressure versus Head analysis.

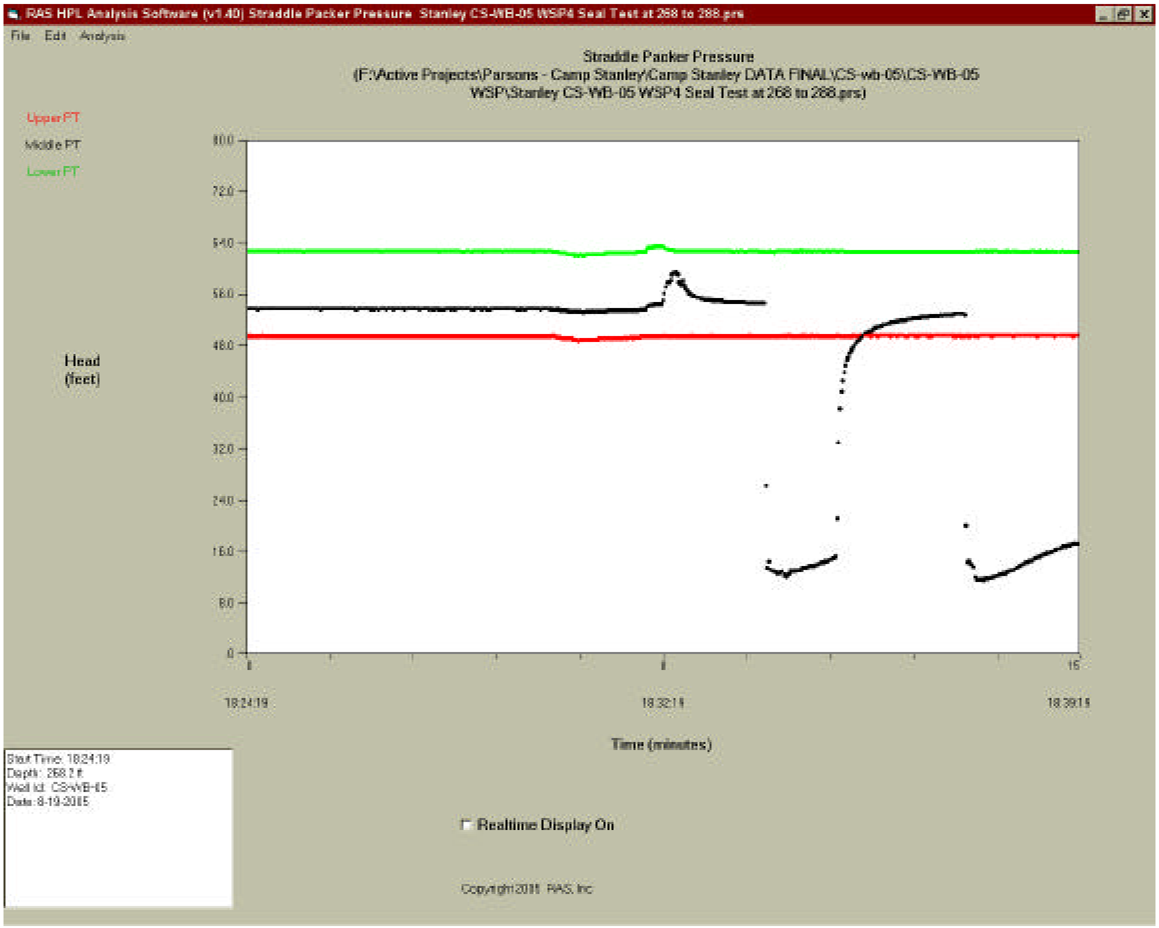

Figure CS-WB-05: 17. Summary Straddle Packer Testing. Seal Test at 268 (BOTP) to 288 (TOBP) ft below TOC. Data suggests test interval formation fluid pressure 1.0 foot greater than open hole hydrostatic pressure.

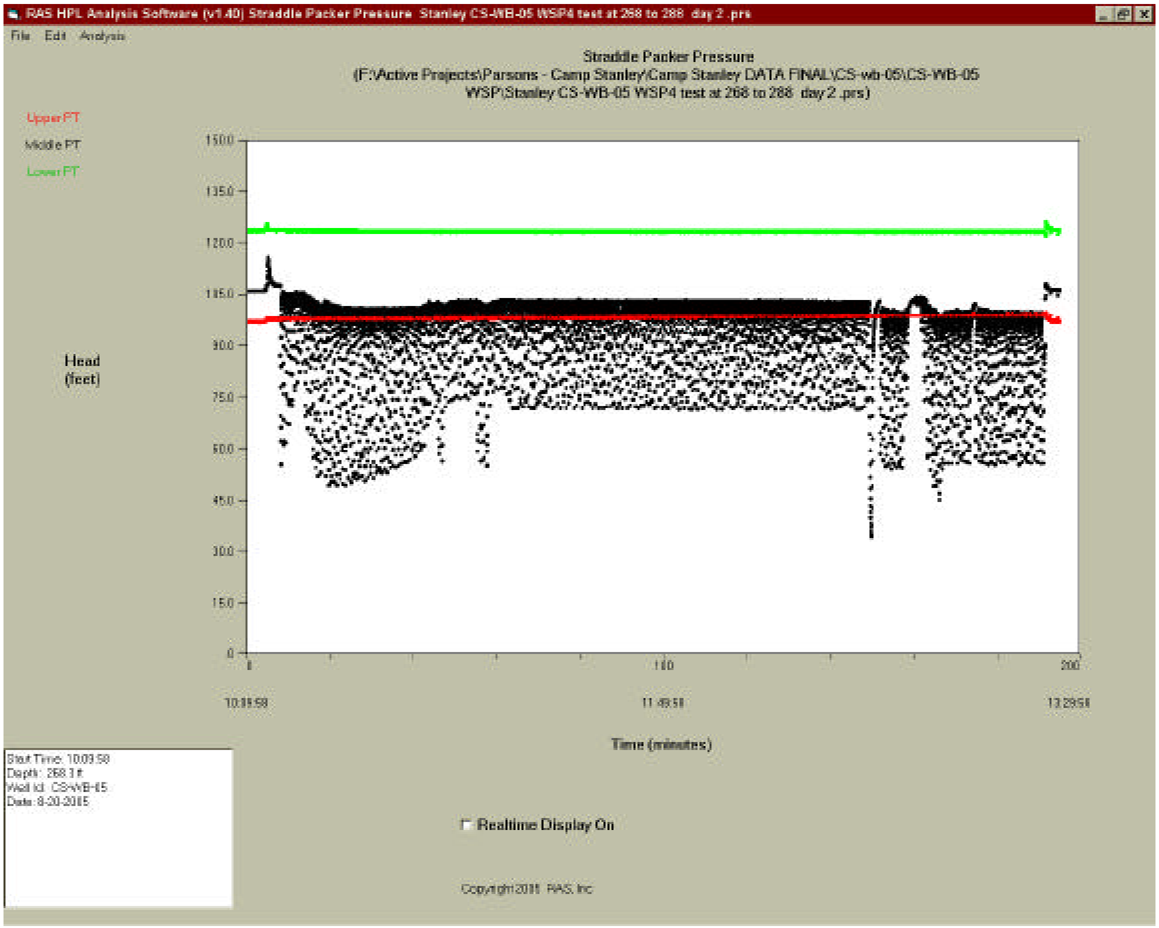

Figure CS-WB-05: 18. Summary Straddle Packer Testing, Tested interval was 268 (BOTP) to 288 (TOBP) feet below TOC. Packer was inflated at 1015. Pumping was initiated at 1017. Pumping was terminated at 1321. Packer was deflated at 1323. Bladder type pump was employed for sample collection, and cyclic nature of bladder pump operation caused shatter of pressure data in the test interval. Lack of pressure variations in upper and lower PT indicate an excellent seal was obtained and a viable sample collected.

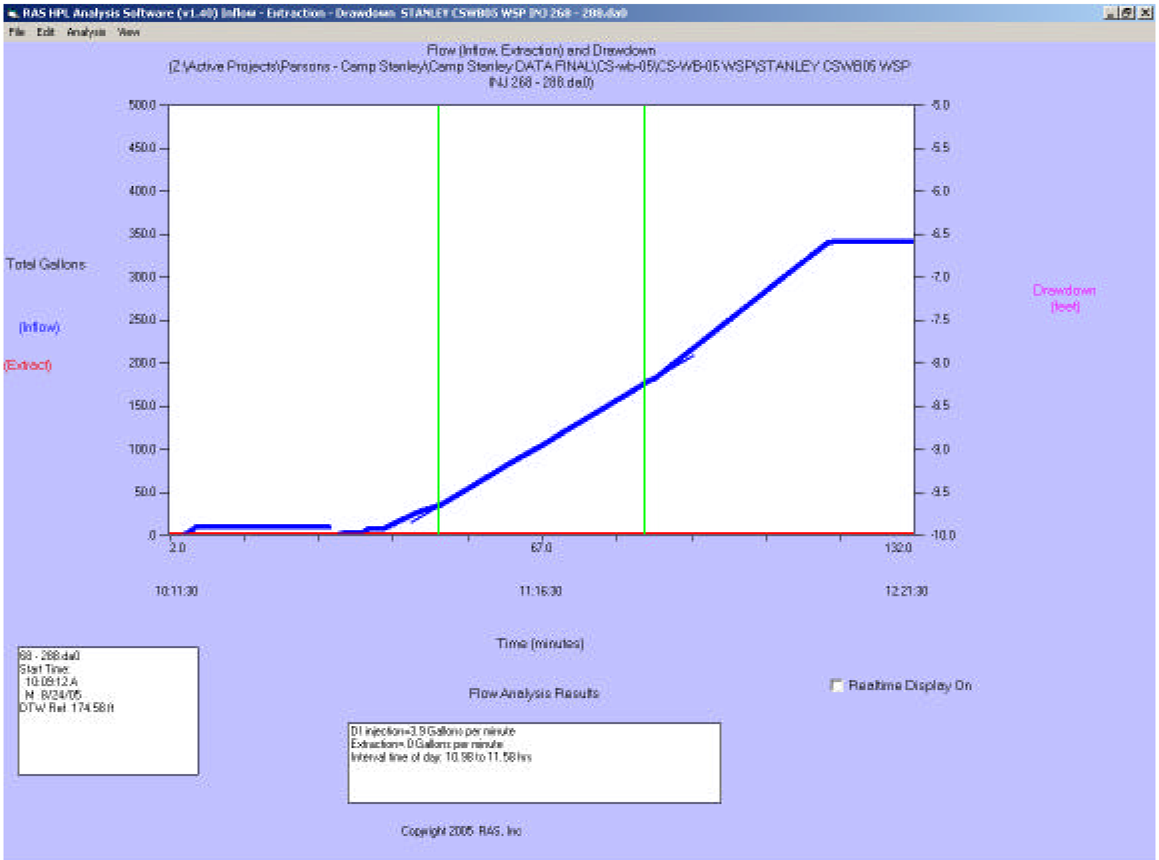

Figure CS-WB-05: 19. Water Level and Injection Data During Injection Testing. Injection testing at 268 (BOTP) to 288 (TOBP) feet below TOC. Average injection rate from digital flowmeter recorded for first injection test was observed at 3.9 gpm.

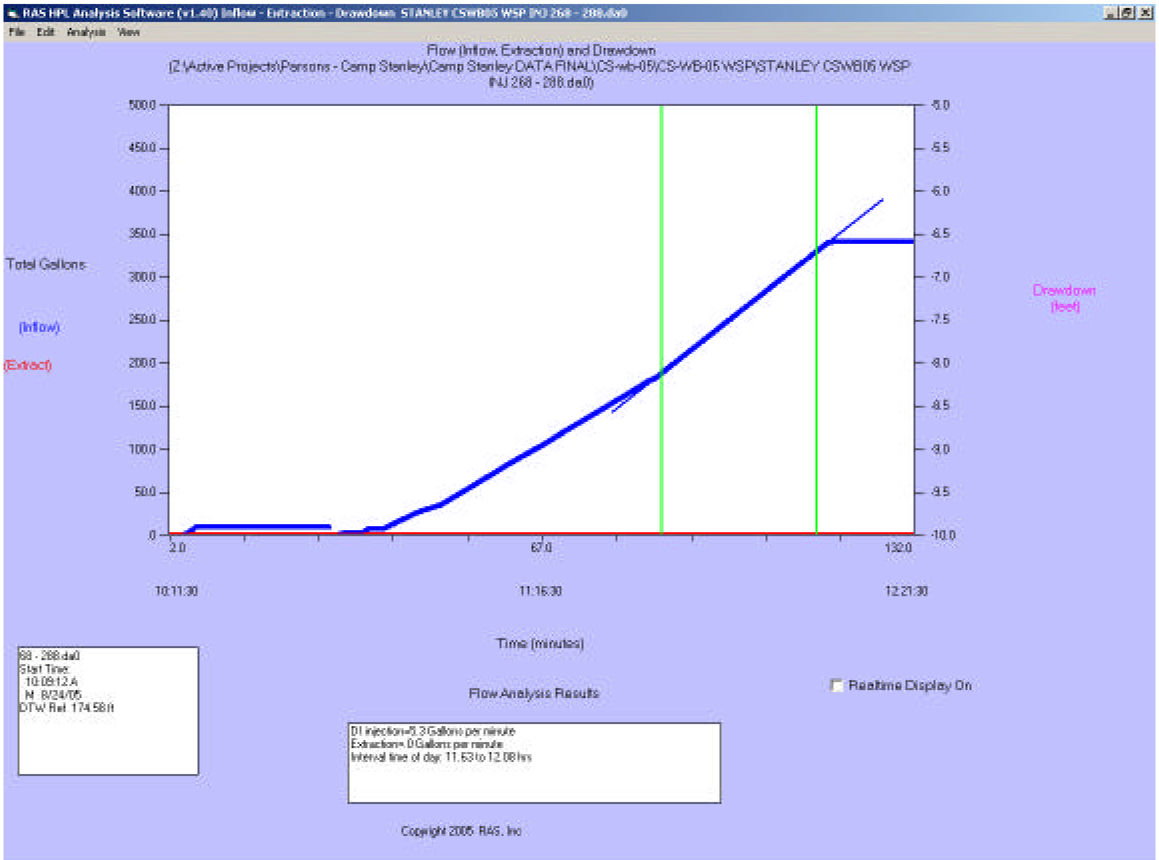

Figure CS-WB-05: 20. Water Level and Injection Data During Injection Testing. Injection testing at 268 (BOTP) to 288 (TOBP) feet below TOC. Average injection rate from digital flowmeter recorded for second injection test was observed at 5.3 gpm.

APPENDIX B – WELL CS-WB-05
HYDROPHYSICAL AND STRADDLE PACKER DATA AND FIGURES
ALL DEPTHS REFERENCED TO TOP OF PROTECTIVE PVC CASING

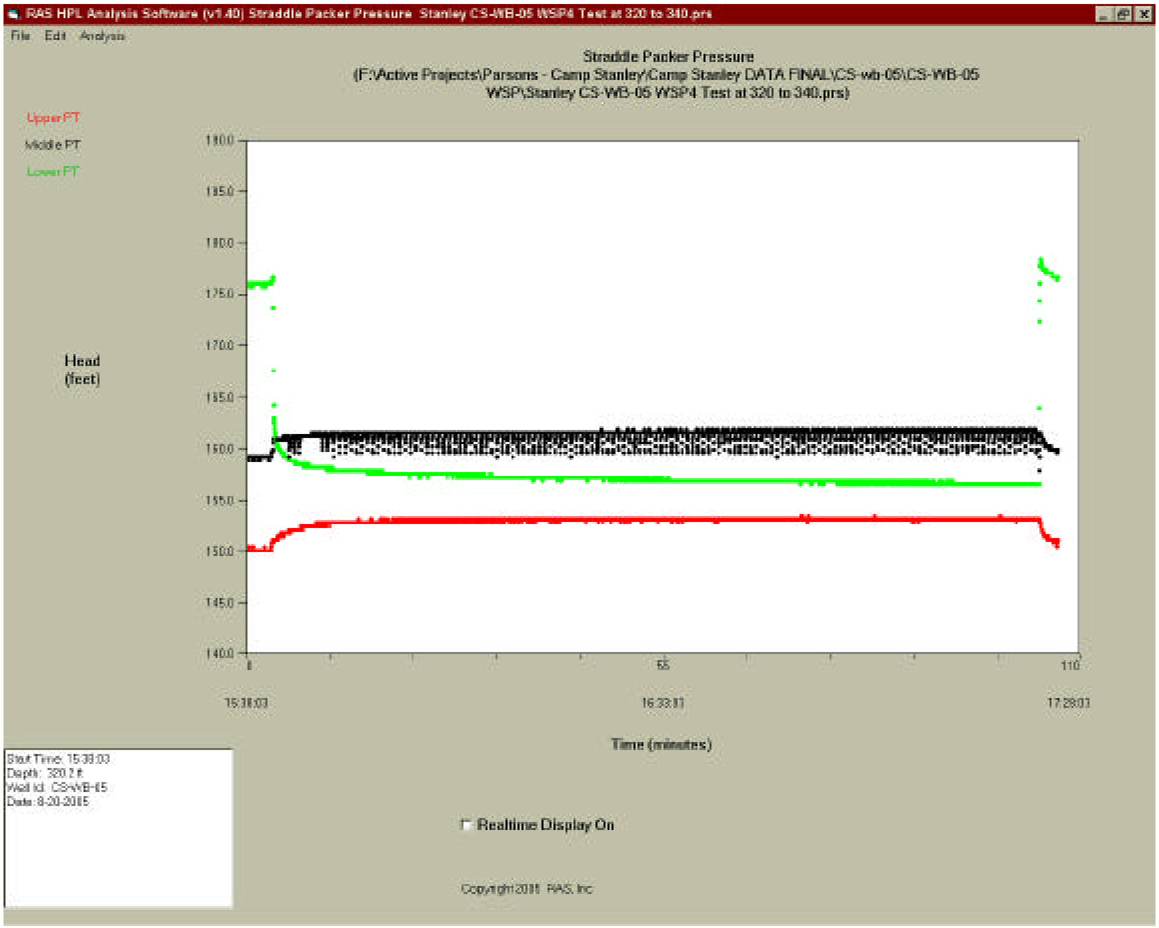

Figure CS-WB-05: 21. Summary Straddle Packer Testing. Tested interval 320 (BOTP) to 340 (TOBP) feet below TOC. Inflate Packer 1540. Initiate pumping 1541. Terminate pumping 1722. Deflate packer 1723. Pressure responses suggest that the formation fluid pressure for the water bearing intervals below 342 feet are approximately 19.1 feet lower that hydrostatic pressure. Also that that formation fluid pressure for the test interval 320 to 340 is approximately 2.4 feet greater that hydrostatic pressure at this interval and that all of the water bearing intervals above 318 feet have a formation fluid pressure 3.1 feet greater than hydrostatic pressure at this interval. These pressure relations are confirmed by the strong downward vertical flow observed by the hydrophysical logging results.

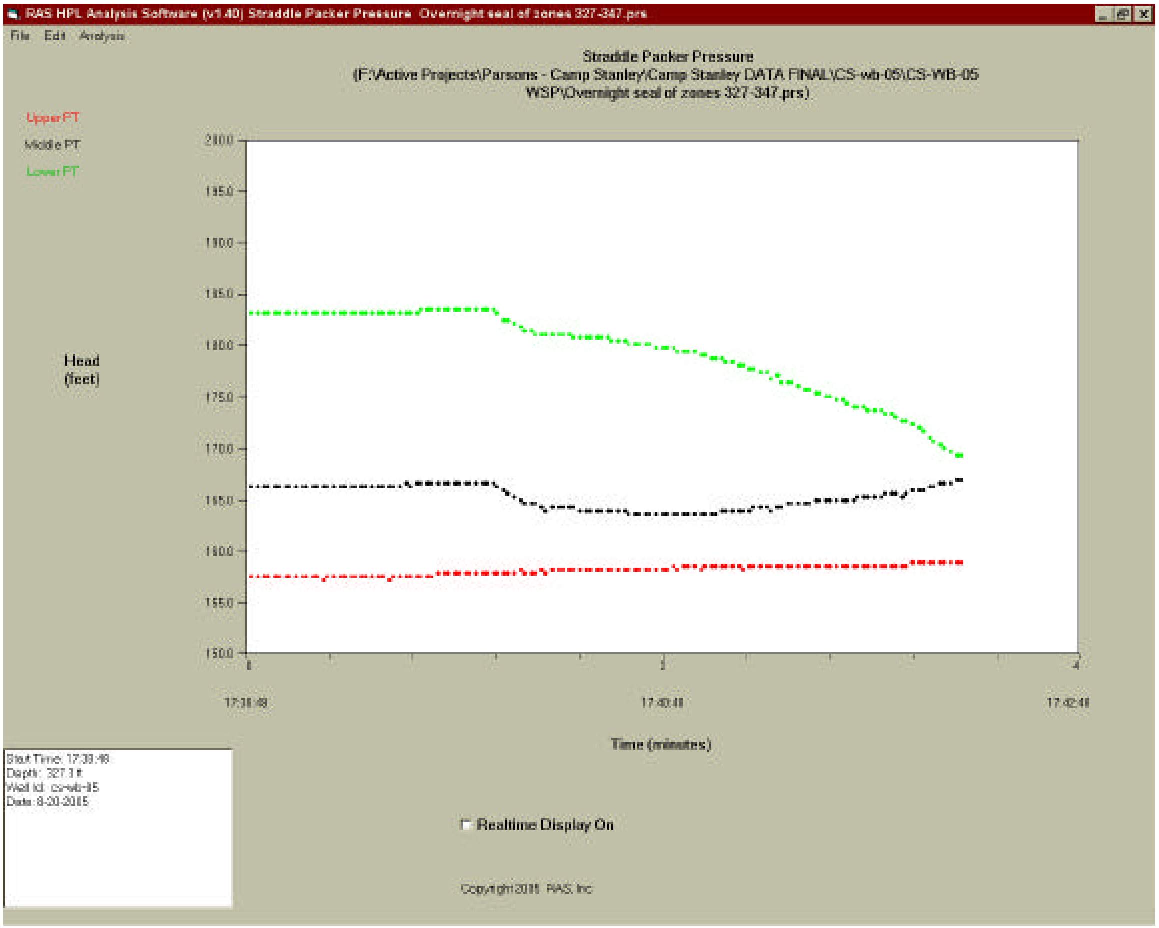

Figure CS-WB-05: 22. Summary Straddle Packer Testing. Seal test at 327 (BOTP) to 347 (TOBP) feet below TOC. Packer hung up at 327 feet below TOC and not freed until 8/22/2005.

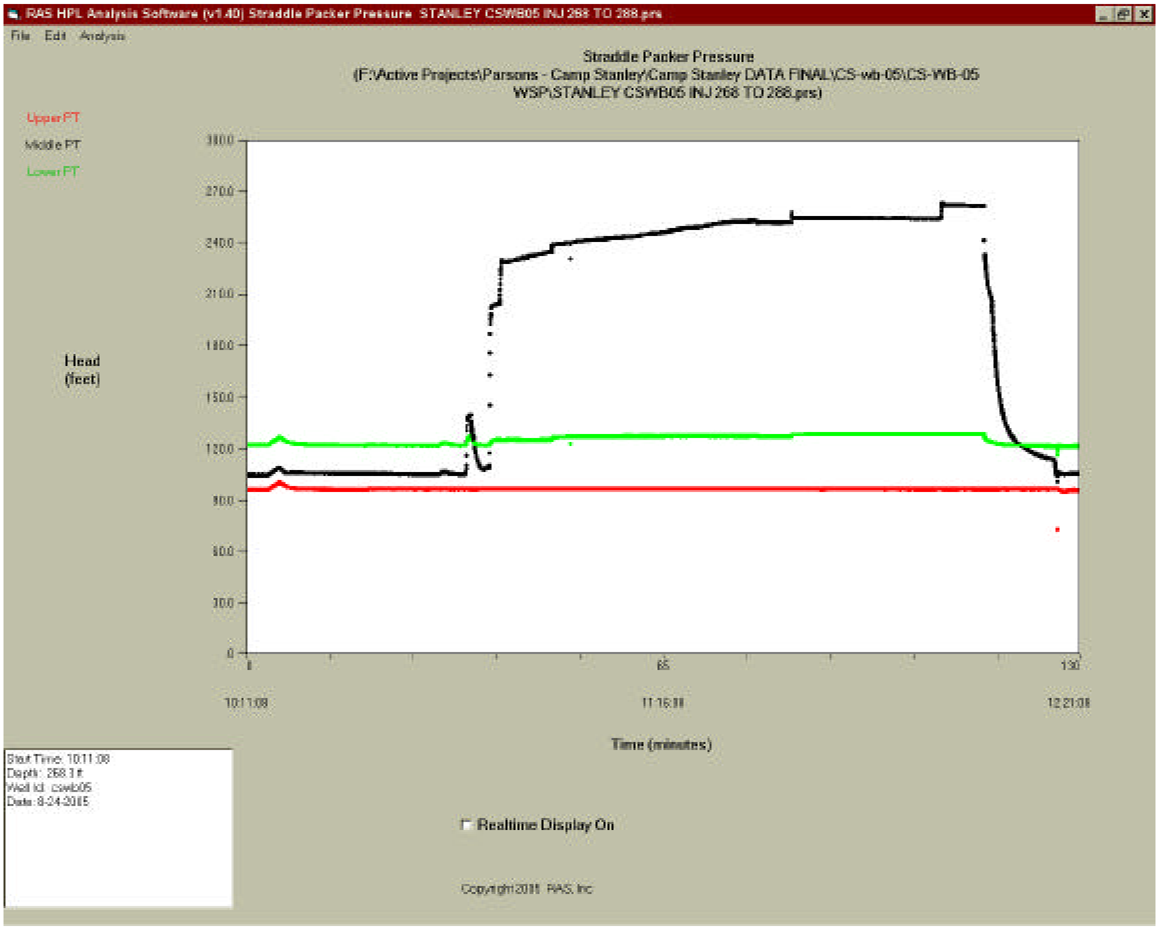

Figure CS-WB-05: 23. Summary Straddle Packer Testing. Injection testing at 268 (BOTP) to 288 (TOBP) feet below TOC. Inflate Packer 1030. Initiate Injection 1048. Terminate Injection 1206. Deflate Packer 1218. Seal at top packer appears good, but slight increase in pressure noted for interval below bottom packer. Maximum allowable inflation pressure exceeded injection pressure, precluding leaks directly around packer, however, the increase in pressure suggest some leakage through formation. Transmissivity estimates should, therefore, be considered upper range estimates.

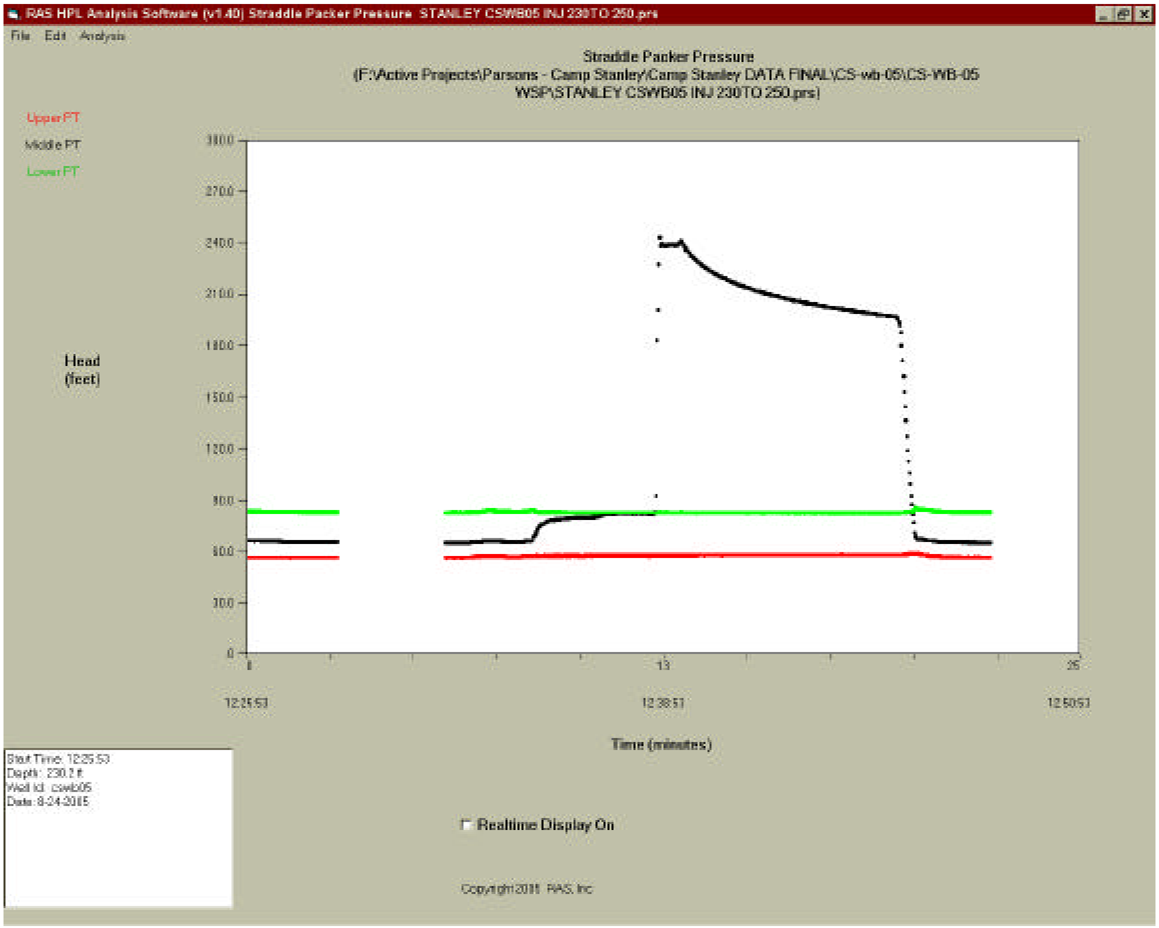

Figure CS-WB-05: 24. Summary Straddle Packer Testing. Injection testing at 230 (BOTP) to 250 (TOBP) feet below TOC. Test to confirm suggested no flow from HPL.

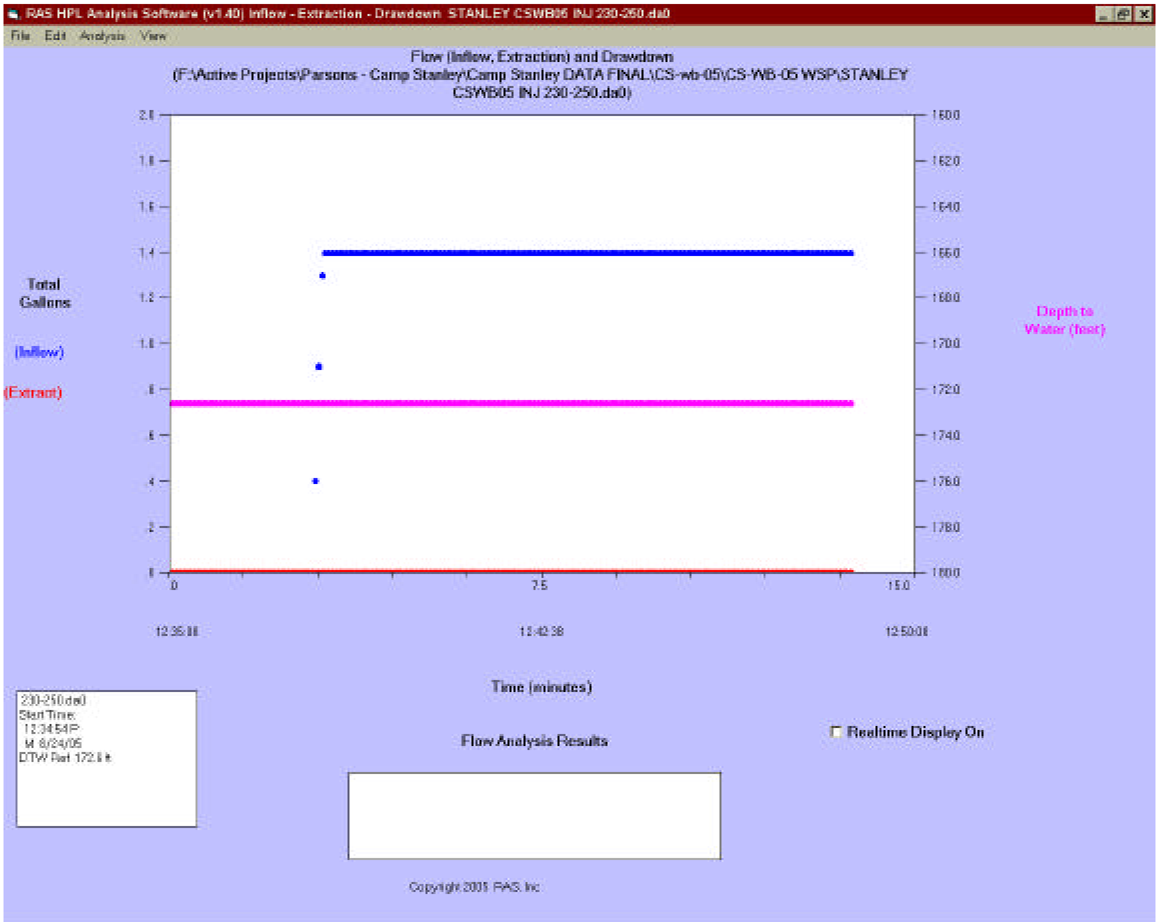

Figure CS-WB-05: 25. Water Level and Injection Data During Injection Testing. Injection testing at 230 (BOTP) to 250 (TOBP) feet below TOC. Average injection rate from digital flowmeter recorded for first injection test was observed at 1.4 gpm.

APPENDIX B – WELL CS-WB-05

HYDROPHYSICAL AND STRADDLE PACKER DATA AND FIGURES
ALL DEPTHS REFERENCED TO TOP OF PROTECTIVE PVC CASING

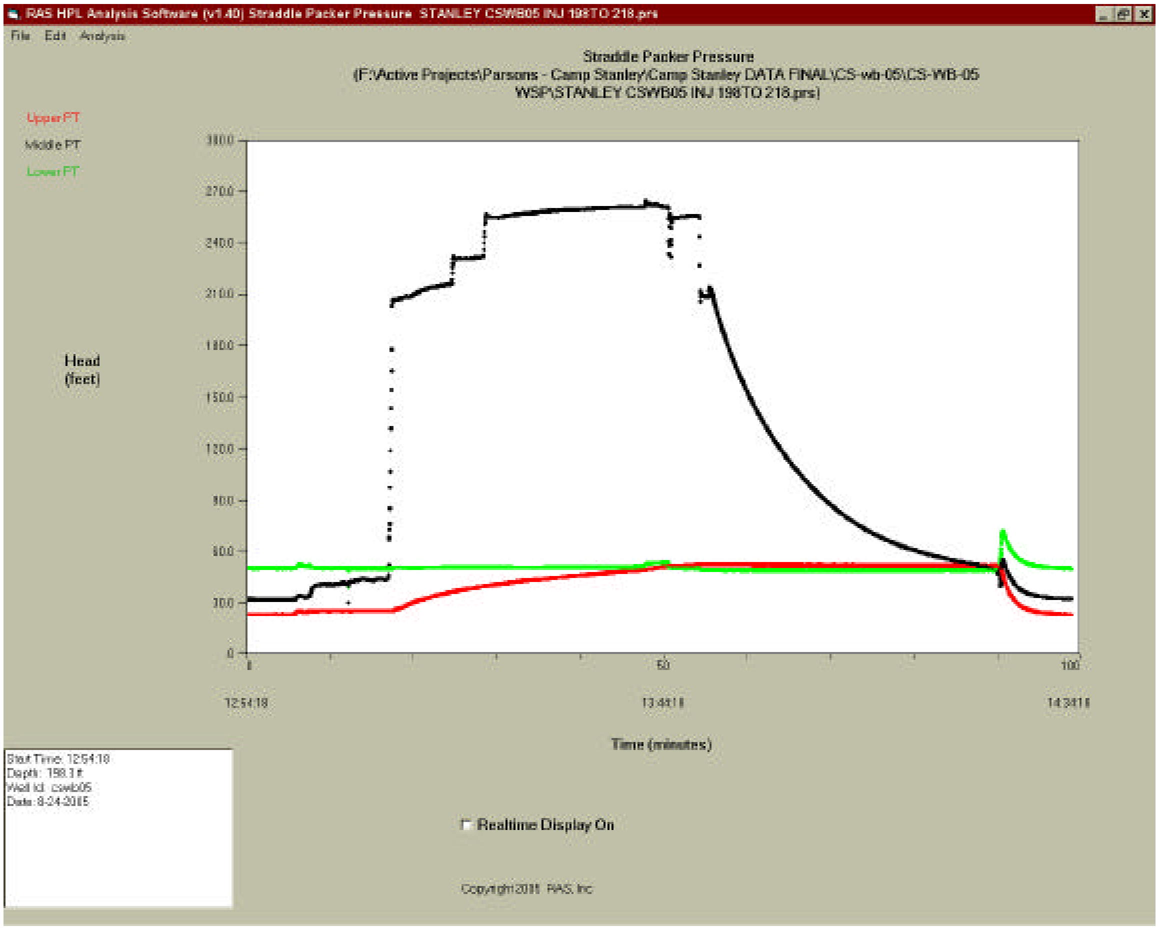

Figure CS-WB-05: 26. Summary Straddle Packer Testing. Injection testing at 198 (BOTP) to 218 (TOBP) feet below TOC. Inflate Packer 1302. Initiate Injection 1311. Terminate Injection 1348. Initiate Falling Head Test 1350. Terminate Falling Head Test 1424. Deflate Packer 1425. Inflation pressure of packers at 140 psi (~320 feet head) and greater than injection pressure, suggesting injection fluid did not leak around packer elements. Increase in pressure above top packer during injection and maintaining pressure increase after termination of injection suggests minor leak in injection line. Based on rate of increase in pressure and borehole diameter, an estimate of leakage rate was made (~0.5 gpm) and a correction was made to injection rate. No increase in pressure noted for interval below bottom packer and no leakage suspected.

APPENDIX B – WELL CS-WB-05

HYDROPHYSICAL AND STRADDLE PACKER DATA AND FIGURES

ALL DEPTHS REFERENCED TO TOP OF PROTECTIVE PVC CASING

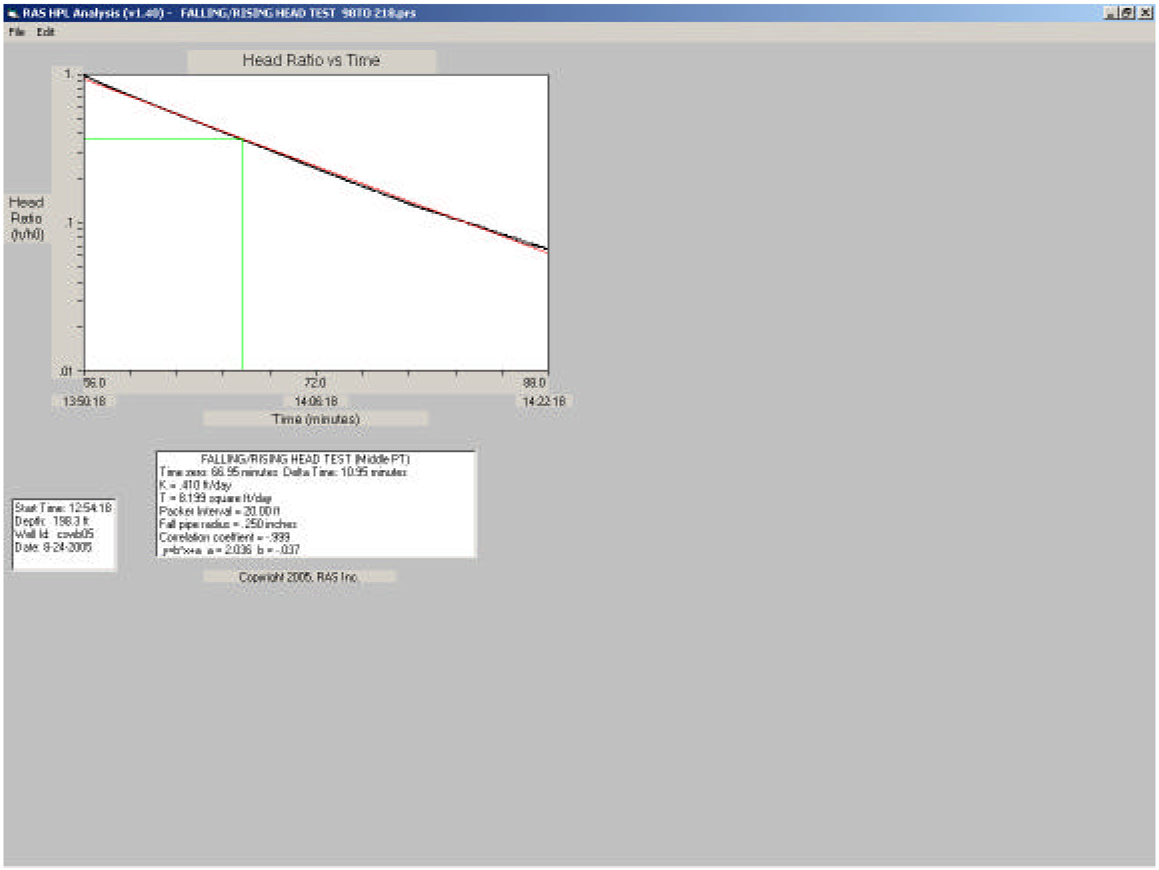

Figure CS-WB-05: 27. Falling Head Test at 198 feet below TOC.

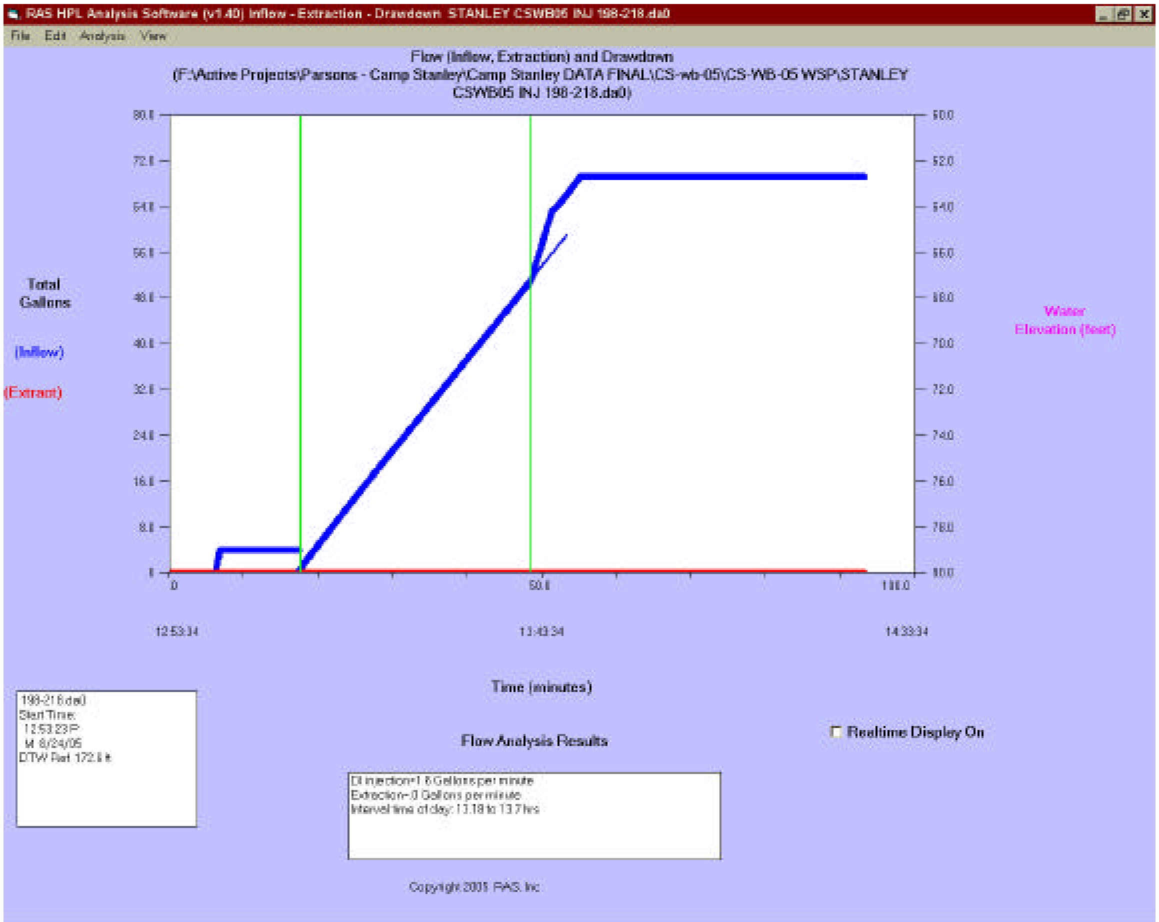

Figure CS-WB-05: 28. Water Level and Injection Data During Injection Testing. Injection testing at 198 (BOTP) to 218 (TOBP) feet below TOC. Average injection rate from digital flowmeter recorded for first injection test was observed at 1.6 gpm.

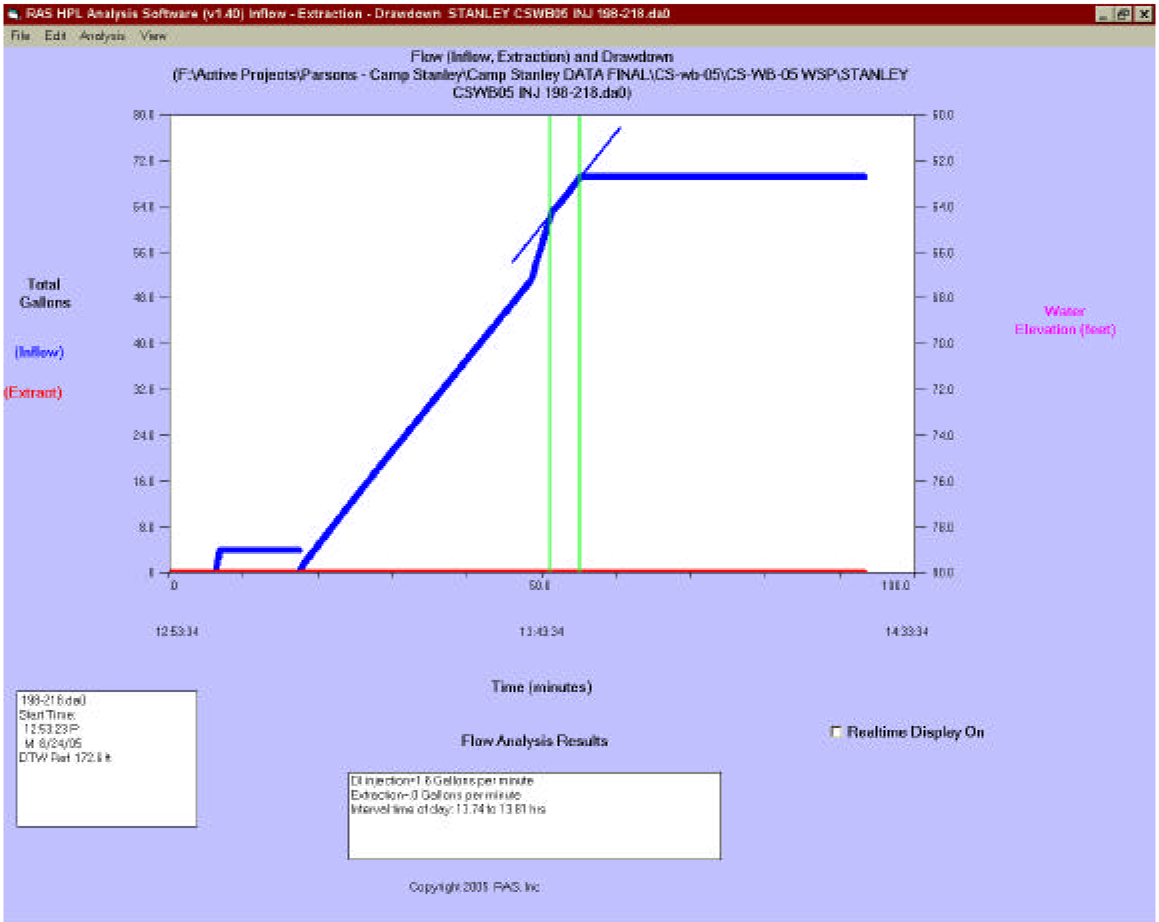

Figure CS-WB-05: 29. Water Level and Injection Data During Injection Testing. Injection testing at 198 (BOTP) to 218 (TOBP) feet below TOC. Average injection rate from digital flowmeter recorded for second injection test observed at 1.6 gpm.

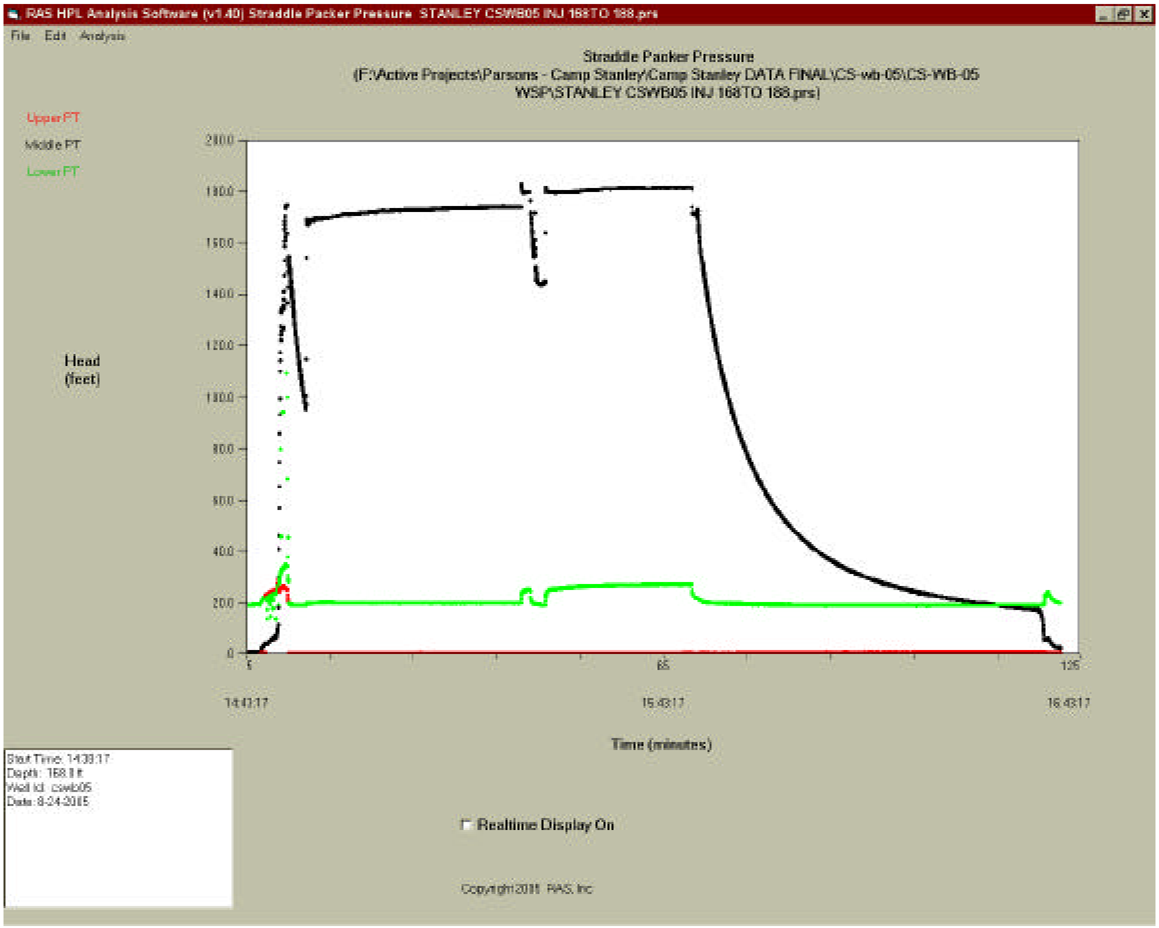

Figure CS-WB-05: 30. Summary Straddle Packer Testing. Injection testing at 168 (BOTP) to 188 (TOBP) feet below TOC. Inflate Packer 1447. Initiate Injection test 1 1452. Terminate Injection test 1 1523. Initiate Injection test 2 1526. Terminate Injection test 2 1637. Initiate Falling Head Test 1548. Terminate Falling Head Test 1637. Deflate Packer 1638.

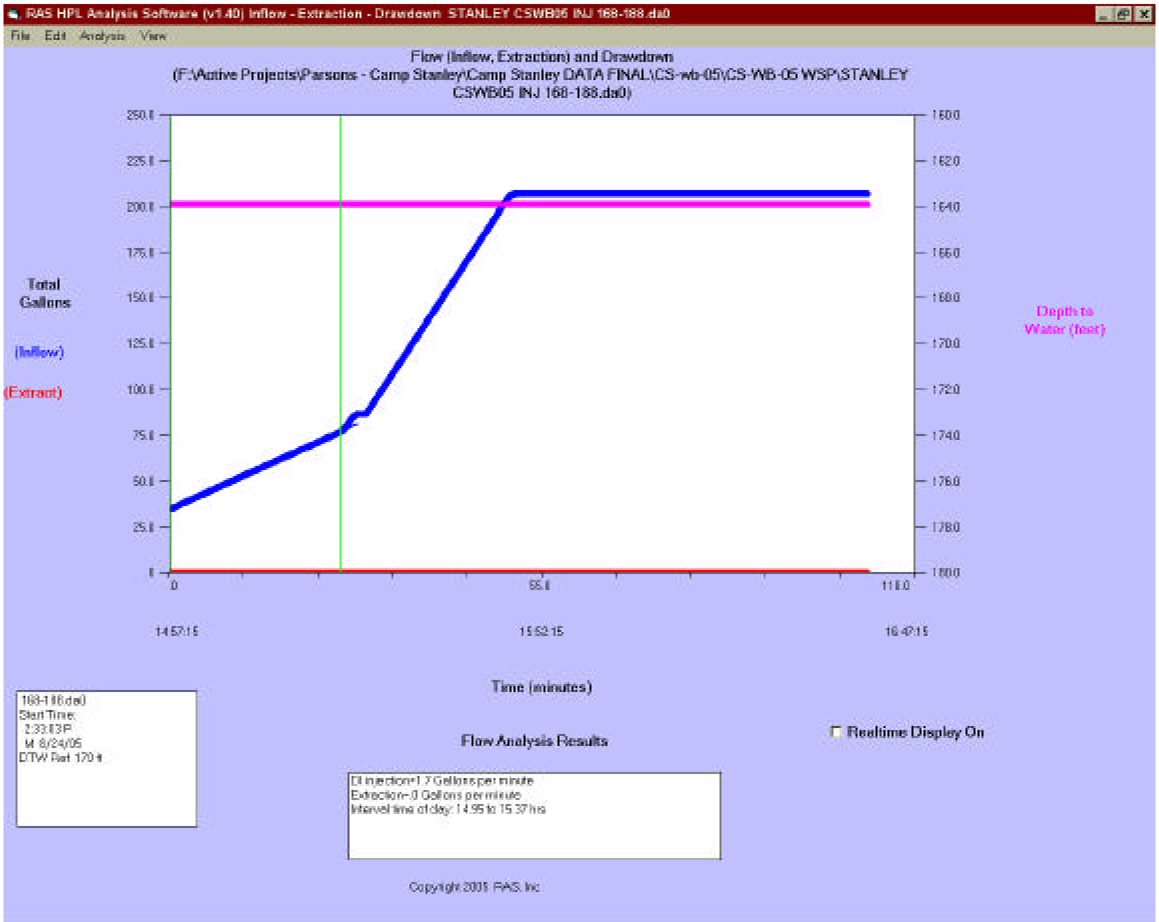

Figure CS-WB-05: 31. Water Level and Injection Data During Injection Testing. Injection testing at 168 (BOTP) to 188 (TOBP) feet below TOC. Average injection rate from digital flowmeter for first injection test was observed at 1.7 gpm.

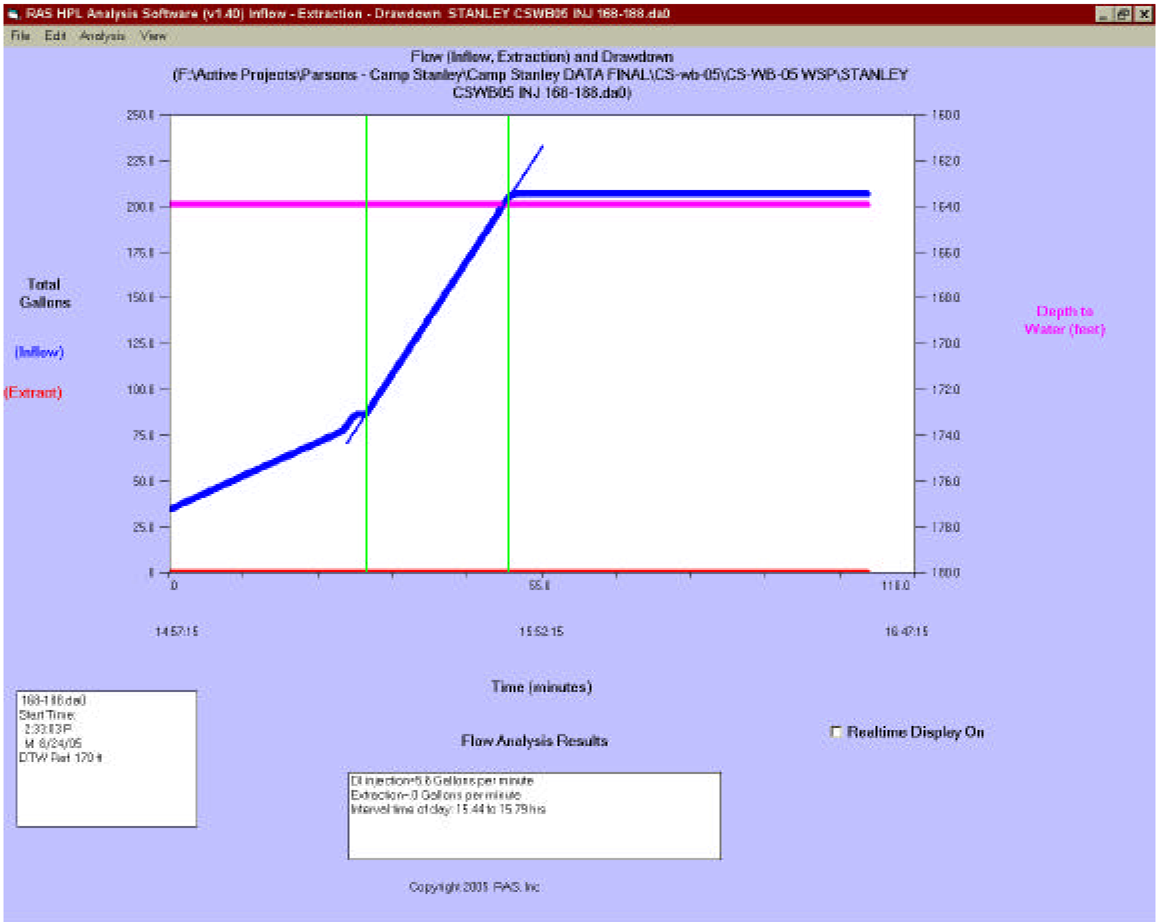

Figure CS-WB-05: 32. Water Level and Injection Data During Injection Testing. Injection testing at 168 (BOTP) to 188 (TOBP) feet below TOC. Average injection rate from digital flowmeter recorded for second injection test observed at 5.6 gpm.

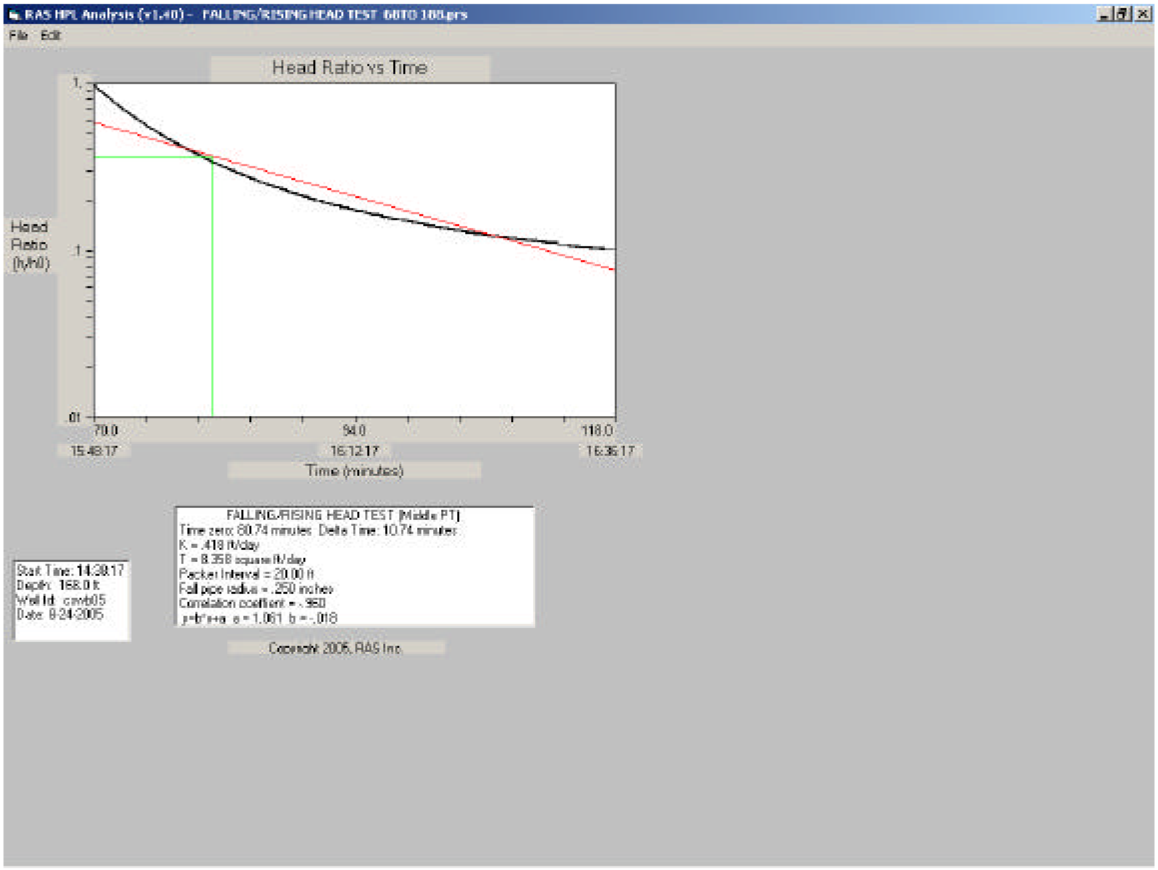

Figure CS-WB-05: 33. Falling Head Test at 168 feet below TOC.

APPENDIX C

SUMMARY TABLE

WELLBORE CS-WB-05

APPENDIX C – WELL CS-WB-05

SUMMARY TABLE

ALL DEPTHS REFERENCED TO TOP OF PROTECTIVE PVC CASING

Well No. & Inflow or Test Interval Depth (ftbgs)	Interval Specific Flow Rate, Velocity and Specific Discharge During Ambient Flow Conditions			Ave Interval Specific Flow Rate During Pumping after Emplacement (gpm)	Straddle Packer Drawdown (ft)/ Ave Interval Specific Flow Rate During Pumping (gpm)	Estimated Interval Specific Transmissivity (ft^2/day)[1]	Interval Specific Concentration (ppb) (TCE)	Formation Pressure Relative to Hydrostatic (+ greater) (- less than)
	Q (gpm)	v* (ft/day)	Sd (ft/day)					
WB-05								
AFC								
297 to 307 (inflow)	(+)0.75							
432 to 450 (outflow)	(-)0.75							
Water Bearing Intervals: 168-173, 184-189, 205-218, 278-287, 289-297, 303-309, 321-333, 336-340, 358-362, 432-450								
Straddle Packer								
168 to 188 (inj)					174'@1.2-1.7gpm	1.9E+0		
198 to 218 (inj)					221'@1.1gpm	1.1E+0		
203 to 223								+1.7
230 to 250 (inj)					NA	NA (est >1E-2)		NA
268 to 288 (inj)					148'@3.9gpm	6.1E+0	152	+1.0
320 to 340							427	+2.4
343 to 450								-19.1
Other Packer Testing								
290 to 310							273	
416 to 436							375	

WB-05 Summary Table 1. Hydrophysical and Wireline Straddle Packer Results**.**

[1] Estimates of hydraulic conductivity are based on Hvorslev (1951) or Theim (1906) as referenced in the body of the report.

APPENDIX D

CD-ROM

FIELD DATA, LOGS AND REPORT

APPENDIX E

TECHNICAL PROCEDURES

DRAFT

RAS, Inc., Integrated Subsurface Evaluation
311 Rock Avenue
Golden, Colorado 80401 (303) 526-4432
PedlerRAS@aol.com
www.rasinc.org

Wireline Straddle Packer for Aquifer Characterization

TP 5

Prepared by:	William H. Pedler	Date:	5-09-2005
Reviewed by:		Date:	
Approved by:		Date:	

TP 5
Revision History

Revision Level	Issue Date	Change Summary
0	5/2000	New procedure.
1	7/8/2002	Initial revisions for Wireline Straddle Packer
2	1/2/2003	Revisions for fluid extraction testing and sampling
3	7/27/04	Considerations when using pipe for discharge, heavy packer

Table of Contents

1.0 SCOPE

1.1 Background

Packer testing is an integral part of the hydraulic characterization program. This program is intended to provide the data necessary to build both discrete feature and continuum simulations of the groundwater flow system.

The identification of conducting features and the characterization their properties is critical to building these models. A feature is any geologic entity which conducts water preferentially over its surrounding materials. Features may reflect a diversity of geologic origin including individual strata (as in a classic confined aquifer), single fractures, fracture zones, fault zones, or sedimentary subunits (e.g. coarse clastic channels).

Hydraulic characterization of boreholes has four major components:

- Flow logging to identify conductive features and provide approximate information on their conductive properties;
- Borehole geophysics and imaging to assist in understanding the geologic nature of the conductive feature (stratigraphic, lithologic, or structural);
- Packer testing to measure the conductive properties of the feature and infer information on its hydraulic geometry, and

This procedure describes the packer testing component of the program. The definition of packer testing for this work is simply any hydraulic test that isolates a portion of a borehole for testing using packers. Packers are inflatable glands which achieve a temporary, local isolation of a feature identified by flow logging. Once the packers isolate a section of borehole, the hydraulic test then consists of withdrawing or injecting water from the interval and observing the pressure responses. A single-well packer test is one which measures pressure responses only in the pumping well. A test which monitors pressure in other boreholes is a multi-well or interference test.

There are many variations on packer testing depending on the manner of injection or withdrawal. All methods, however, have a common basis for analysis in the diffusion equation of groundwater flow. The knowledge of total mass and rate of water injection or withdrawal is necessary to interpret hydraulic information from the pressure responses. Although constant rates or constant pressures of pumping are desirable, some form of test analysis is possible as long as the experiment includes careful measurement of both flow rates and pressures.

1.2 Purpose

The objective of packer testing is a determination of hydraulic properties.

The hydraulic properties reflect both flow capacity and the storage capacity of the features. *Transmissivity* (L^2/T) and *storativity* (dimensionless) are properties of the feature as a whole. *Hydraulic conductivity* (L/T) and *specific storage* (1/L) are properties of the materials within the feature.

1.3 Analysis Methods <<***to be revised as appropriate***>

Analysis of the pressure and flow data from the wireline staddle packer by one or more of the following methods:

Hvorslev Falling Head Analysis – This approach (Hvorslev, 1951) was applied to data collected during falling head data where sufficient recovery was observed (at least 50% recovery).

$$T = KL = \frac{r^2 \ln(L/R)}{2LT_o}$$

where: T is transmissivity, K is hydraulic conductivity, L the length of the tested interval, R is the radius of the tested interval, r is the radius of the fall pipe, and T_o is the time it takes the water level to fall or rise to 37 percent of the initial reading.

Permeameter Analysis – This approach (Fetter, 1980) was applied to data that was collected during falling head type tests and were the change in pressure during the test period was insufficient for application of Hvorslev's equation for falling head tests.

$$K = \frac{dt^2 L}{dc^2 t} \ln\left(\frac{ho}{h}\right)$$

where: *dt* and *dc* are the standpipe and borehole diameters; *L* is the length of the packed interval; *ho* and h, the initial and final head values and *t* the period of testing.

Theim Analysis – This approach (Theim, 1906) was applied to data collected during constant injection testing. Two injection rates are typically conducted and the arithmetic mean of this analysis on each data set is reported.

$$T = KL = \frac{Q}{2p\Delta h_w} \ln \frac{r_e}{r_w}$$

where: T is transmissivity, K is hydraulic conductivity, L the length of the tested interval, r_w is the radius of the tested interval, r_e is the effective pumping radius, of the fall pipe, Δh_w is the differential pressure (injection minus formation) and Q the injection rate.

1.4 Applicability

The applicability of this procedure is governed by the following assumptions:

- All tests will be performed by methods which limit the injection of water into the rock in order to minimize alteration of water chemistry.
- Packer tests are only performed on higher conductivity features for which *wellbore storage* can be overcome within reasonable time periods (thirty minutes or less). The hydraulic properties of lower conductivity features and materials are obtained from the flow logging.

Within these bounds, this procedure is applicable to constant rate pump tests and slug tests. Different types of packer testing may be required at later stages of the project; at such time necessary revisions and/or additions would be made to this procedure.

Constant-rate injection or pumping tests use either injection tubing or a submersible pump mounted in the packer interval or installed in the packer test piping to inject/produce water at a constant, or nearly constant rate. As discussed above, the pressure drawdown and the recovery after termination of injection/pumping provide a basis for test analysis.

Slug tests involve an instantaneous or rapid removal or introduction of a measured volume of water from or to the well. A PVC displacement slug or a bailer are common means of removing or introducing the water slug from or to the test piping.

The choice of constant rate injection/withdrawal or slug tests will depend on the expected transmissivity of the test zone as estimated from the flow logging of the borehole. Tests using either method will be analyzed for hydraulic property and geometry information. The transmissivity cutoffs for using constant rate withdrawal versus slug test will depend on expected information than can be obtained within a four-hour period of time. Longer tests may be performed to investigate major features (such as faults) or where interference monitoring is involved. The type of test selected for a particular interval of a borehole and guidance on the required test period durations will be given by a SWI which supplements this procedure.

2.0 REFERENCES

1) Theim, G. *Hydrolgische Methoden.* Leipzig: Gebhart, 1906, p 56.

2) Fetter, C.W., *Applied Hydrogeology,* Macmillan Publishing Co., 1988, p 129.

3) Hvorslev, M.J., (1951) *Time Lag and Soil Permeability in Ground Water Observations*, Waterways Experimental Station, Corps. Of Engineers, US Army.

3.0 DEFINITIONS

Packer Testing. Any hydraulic test that isolates a portion of a borehole for testing using packers. Packers are inflatable glands which achieve a temporary, local isolation of an interval of a borehole.

Packer Test Program A series of packer tests completed in one or more boreholes during a specific time period.

Hydrophysical Logging The use of DI water and fluid electrical conductivity logging to identify conductive features and provide approximate information on their conductive properties.

Pressure Transducer A device which converts the pressure exerted on the transducer to an electronic signal (e.g. voltage, current or frequency). The electronic signal can be measured by a Data Logging System and by the use of appropriate calibration constants be converted into the pressure exerted on the transducer.

Flowmeter A device which converts a volumetric (e.g. cubic meters per second) or mass (e.g. kilograms per second) flow rate passing through it into an electronic signal (e.g. voltage, current or frequency). The electronic signal can be measured by a Data Logging System and by the use of appropriate calibration constants be converted into the flow rate passing through the flowmeter.

Data Logging System An automated data acquisition system capable of measuring the electronic signals generated by the pressure transducers and flowmeters and recording the value of the signals to an digital computer file. The system may allow control of the data acquisition rate, presentation of the data as printouts or graphs, downloading the data in a variety of units and formats and other ancillary functions.

Wireline or Drill Rods/Tubing The means for lowering and raising the packer assembly in the borehole and containing the water level of the packered interval. Drill rods are threaded, steel rods normally used for drilling. Tubing also consists of threaded, steel tubes, however these are not necessarily used for drilling and may have special, more watertight threads than drill rods.

Packer Assembly The various pieces of downhole equipment which are assembled together to create an assembly of two inflatable packers separated by perforated straddle pipe which can be used to isolate a length of borehole. The downhole equipment includes inflatable packers, perforated straddle pipe, subs, crossovers, inflation line and other equipment.

Electro-submersible Pump A down hole pump powered by electricity to extract water from a borehole.

Water Level Measuring Device An electronic water level sonde.

Bailer A device for removing water from a borehole, drill rods or tubing. It consists of a hollow tube with a non-return valve (or similar) on the lower end such that water may flow up into the tube but not out of the bottom.

Field Analysis The analysis of packer test data, on-site, during or soon after the packer test. The analysis may use a variety of analysis methods ranging from hand calculations or manual type curve matching through to the use of sophisticated computer analysis. The purpose of the analysis is to evaluate the quality of the data and derive early estimates of some parameters. Field analysis results for a packer test will be superseded at a later time by the results of a detailed evaluation and analysis.

4.0 REQUIREMENTS

4.1 Prerequisites

Prerequisites for packer testing :

- approved list of borehole intervals to be tested (selected from borehole logging information and other data review and analysis).
- Specific Work Instruction from the Geosciences Discipline Lead or his designee to the Packer Testing Field Team Leader. This work instruction will describe the implementation and other pertinent details of the planned testing program. This work instruction could include

details of the operation of a specific piece of equipment (e.g. data logger, inflation pressures for packers etc.), specific time periods for each packer test (e.g. duration of constant rate pumping for each proposed test interval) or other information or instruction considered necessary by Geosciences Discipline Lead or his designee.

- tools, material and equipment necessary for the test as described below.

4.2 Tools, Material, Equipment

All pressure data will be collected using electronic pressure transducers and recorded using a data logging system. The transducers will be selected such that the range will not exceed eight times the expected maximum pressure. All pressure transducers will be calibrated to traceable standards as provided by the manufacturer. Pressure transducers will be located within the test interval to eliminate any frictional pressure loss effects in the measurements. Pressure transducers will be located above and below the test interval, in addition to the packered test section.

Flow rate measurements will be taken continuously during constant rate withdrawal tests. The flowmeters will be selected such that the flow is no more than 80% nor less than 10% of the full scale capacity of the meter. Flowmeters will have electronic readouts and will be continuously recorded with the pressure transducers using an automated data acquisition system. Flowmeters will be calibrated to traceable standards.

The expected flow rates for each test will be estimated on the basis of the hydrophysical logging results. Electro-submersible pumps will be selected which are suitable for the expected flow rates.

The required specification of the various pieces of testing equipment will be specified in procurement documents and/or SWI as necessary.

Equipment for constant rate testing :

- Wireline drawworks
- Wireline straddle packer assembly or pipe mounted packer assembly
- Injection line and flow regulation equipment
- pressure transducers
- flowmeters
- data logging system

- water level measuring device
- stopwatch
- graduated cylinder or similar volume measuring device of suitable accuracy
- test data sheets and notebook

Equipment for slug tests:

- wireline system and drawworks
- wireline straddle packer assembly or pipe mounted packer assembly
- pressure transducers
- data logging system
- solid PVC slug of length and diameter appropriate for tubing diameter and rope (or bailer and rope)
- water level measuring device
- test data sheets and notebook

4.3 Precautions and Limits

The readings from pressure instruments will be checked against water level measurements at least once during each test as a check on instrument performance.

Digital Flow meters will be checked against flow measurement to a graduated cylinder or another known volume at least once prior to testing.

On-site analysis may be carried out to check that the collected data is appropriate for subsequent detailed analysis. The evaluation of the data based on this analysis may be used to make a decision to repeat a test on a specific borehole interval.

5.0 RESPONSIBILITIES

6.0 DETAILED PROCEDURE

6.1 Constant Rate Withdrawal/Injection

In this procedure an electro-submersible pump is used to remove water from a packered interval of a borehole at a constant rate. For constant injection rate testing, a surface injection pump will be used. Measuring the changing pressure as the water is pumped out/in allows the collection of a dataset which can be analyzed as described in Sections 1.2 and 1.3 above.

The following is an outline of the procedures to be followed to conduct a constant rate withdrawal test. This will be supplemented by a Specific Work Instruction providing additional details on each particular packer test, as described in Section 4.1 above. Any deviations from this procedure or the specifications of the SWI shall be recorded by the Test Supervisor.

Constant rate withdrawal/injection test :

1. Record well number, time, and date; unlock any protective casing and clean out man-hole as necessary.

2. Obtain an accurate static water level measurement.

3. Down-hole packer assembly will be constructed. A function check of the pressure transducers and data logging system will be completed. Pressure testing of the packer assembly may be completed if appropriate. Additional systems checks once the packer assembly is submerged should be conducted (pump check, pressure transducer operation during descent, clear discharge/injection lines, packer inflatation, data acquisition system, tool telemetry, etc.)

4. The packer assembly will be attached to wireline, airline and injection tubing and lowered to the required depth interval. If more than one interval are to be tested in the same borehole the sequence of testing will be specified in the SWI.

5. When the packer assembly is at the required depth the data logging system will be initiated. A borehole water level measurement will be taken and the measurement checked against the pressure transducer reading.

6. The data logging system will be set to record data at short intervals (say every 15 seconds) in order to observe hydrostatic pressure changes prior, during and after inflation of the packers. Hydrostatic pressure data will be recorded for a minimum of 30 minutes prior to inflation,

continuously during inflation and a minimum of 30 minutes after inflations

7. The packers will be inflated to the required pressure using either air or water. These details will be specified in the SWI. Packer inflation pressure will be monitored and manually recorded. Inflation pressure will be recorded not less than one reading every 10 minutes during the period of packer element inflation.

8. The water level of the packered section will be allowed stabilize to the satisfaction of the Test Supervisor. Observation of the pressures recorded by the data logging system should show that the water level to be either static or changing slowly prior to proceeding. It is anticipated that this phase of the test should not take longer than 30 minutes. However, if significant variations, as determined by Test Supervisor, are observed this period may be extended.

9. During this stabilization period the pressure in the section below the packer will be observed (as monitored by pressure transducer) and the water level in the borehole annulus will be observed (as monitored by pressure transducer), in addition, regular manual measurements of the annulus water level will be taken (to confirm pressure transducer). These observations and or measurements will be continued throughout the test to allow evaluation of the integrity of the packer seal.

10. The data logging system will be set to collect data at a high rate (say once every 2-3 seconds) in order to collect frequent data during the early time of the test. Thereafter the rate of data collection may be reduced, at the Test Supervisor's discretion, as the rate of pressure change reduces.

11. Extraction (or injection) will be started at the required rate.

12. Check the flow rate recorded by the data logging system against flow to a graduated cylinder or other known volume at least once every hour during the constant rate pumping period. Or confirm injection rates prior to testing.

13. Monitor the water level, adjusting the equipment to maintain a constant flow as necessary.

14. If it is possible to download data from the logging system while it is operating, at an appropriate point during the test period data may be downloaded and subjected to field analysis. This will allow a judgment of whether the data is sufficient for detailed analysis and whether a further slug test is necessary.

15. If formation fluid sampling is required, a volume of formation water equivalent to a minimum of three test interval volumes will be withdrawn prior to sample collection.

16. Once the testing period and fluid sampling is completed to the satisfaction of the Test Supervisor the pumping may be stopped. The period of pumping may be specified by SWI. Alternatively the Test Supervisor may decide to stop pumping if on-site analysis indicates that an adequate data set has been collected. In some cases pumping may have to be stopped because the water level is drawing down close to the level of the pump. Prior to stopping injection the data logging system will be set to collect data at a high rate (say once per second) in order to collect frequent data during the early time of the recovery period of the test. Thereafter the rate of data collection may be reduced, at the Test Supervisor's discretion, as the rate of pressure change reduces.

17. Turn off the pump and monitor the recovery of the water level.

18. Once the recovery period is completed to the satisfaction of the Test Supervisor the test may be terminated. The period of recovery or the total duration of the testing for the packered interval may be specified by SWI. Alternatively the Test Supervisor may decide that recovery is sufficiently complete if on-site analysis indicates that an adequate data set has been collected or 80% recovery has been reached.

19. If the test is terminated at this point, the packers will be deflated. Once the packers are fully deflated the annulus water level will be measured and cross checked against the transducer readings collected by the data logging system. The data logging system will be stopped and the pump and packer assembly removed from the borehole.

20. Prior to installation or demobilization, the packer assembly, discharge line, power and air lines, and wireline will be properly decontaminated using deionized water and alconox soapy mix, and triple rinsing with deionized water.

6.2 Slug Test

In this procedure pulse injection is used to suddenly raise (slug-in test) the water level of a packered interval of borehole. Measuring the changing pressure as the water level recovers allows the collection of a dataset which can be analyzed as described in Sections 1.2 and 1.3 above.

The following is an outline of the procedures to be followed to conduct a slug test. This will be supplemented by a Specific Work Instruction providing additional details on each particular packer test, as described in Section 4.1 above. Any deviations from this procedure or the specifications of the SWI shall be recorded by the Test Supervisor.

Phase 1: Slug-in test

1. Record well number, time, and date; unlock any protective casing and clean out man-hole as necessary.

2. Obtain an accurate static water level measurement.

3. Down-hole packer assembly will be constructed. A function check of the pressure transducers and data logging system will be completed. Pressure testing of the packer assembly may be completed if appropriate. Additional systems checks once the packer assembly is submerged should be conducted (pump check, pressure transducer operation during descent, clear discharge/injection lines, packer inflatation, data acquisition system, tool telemetry, etc.)

4. The packer assembly will be attached to wireline, airline and injection tubing and lowered to the required depth interval. If more than one interval are to be tested in the same borehole the sequence of testing will be specified in the SWI.

5. When the packer assembly is at the required depth a function check of the pressure transducer and data logging system will be completed. A borehole water level measurement will be taken and the measurement checked against the pressure transducer reading.

6. The data logging system will be set to record data at short intervals (say every 15 seconds) in order to observe pressure changes during the inflation of the packers.

7. The packers will be inflated to the required pressure using either air or water. These details will be specified in the SWI.

8. The water level of the packered section will be allowed stabilize to the satisfaction of the Test Supervisor. Observation of the pressures recorded by the data logging system should show that the water level to be either static or changing slowly prior to proceeding. It is anticipated that this phase of the test should not take longer than 30 minutes.

9. During this stabilization period the pressure in the section below the packer will be observed and the water level in the borehole annulus will be observed or regular measurements of the annulus water level will be taken (if not monitored by pressure transducer). These

observations and or measurements will be continued throughout the test to allow evaluation of the integrity of the packer seal.

10. The data logging system will be set to collect data at a high rate (say once per second) in order to collect frequent data during the early time of the test. Thereafter the rate of data collection may be reduced, at the Test Supervisor's discretion, as the rate of pressure change reduces.

11. The injection pump will be briefly initiated so as to create a near instantaneous pressure pulse. The Injection line will be opened to atmospheric pressure immediately after pulse injection

12. Monitor the recovery of the water level.

13. If it is possible to download data from the logging system whilst it is operating, at an appropriate point during the test period data may be downloaded and subjected to field analysis. This will allow a judgment of whether the data is likely to be amenable to later detailed analysis and whether a further slug test is necessary.

14. Once the test has recovered to the satisfaction of the Test Supervisor the test may be terminated or the second phase of the test may be initiated. Usually at least 80% recovery will be required, however, if the SWI specifies a limited test period the test may be terminated at the expiration of this period. Alternatively the Test Supervisor may decide to terminate the test prior to 80% recovery if on-site analysis indicates that an adequate data set has been collected.

15. If the test is terminated at this point, the packers will be deflated. Once the packers are fully deflated the annulus water level will be measured and cross checked against the transducer readings collected by the data logging system. The data logging system will be stopped and the packer assembly removed from the borehole.

7.0 RECORDS

The Test Supervisor is responsible for ensuring that full and detailed records are collected for all packer tests.

Each test will be given a unique identifier which will be part of all records associated with that test.

Test Data Sheets will be completed to record details of the borehole, the test interval, the equipment and its depth locations during the test, and the test procedure. Examples of Test Data Sheets are given in Appendix A, although final

Test Data Sheets will be produced to be compatible with the equipment procured and the specific test procedures associated with this equipment.

Each data logging file will be assigned a unique file name and will be copied to two clearly labeled floppy disks as back-up as soon as is reasonably practical following the completion of the test. Any plots produced during the test by the data logging system shall be clearly labeled to identify the portion of the test they represent.

Any data analysis files produced during the test shall be copied to two clearly labeled floppy disks as back-up as soon as is reasonably practical following the completion of the test. Any plots or documents produced during the test by the on-site data analysis shall be clearly labeled to identify the portion of the test they represent.

The Test Supervisor shall produce a short report (which may be in memo or letter form) giving details of the test as soon as practical after the completion of the test. This report will, at a minimum, give an overview of the test (including test interval, test method and test equipment), describe any problems encountered and present the results of any on site analyses. The Test Data Sheets, plots of the test data, analysis plots or printouts or other detailed information may be attached to the report as appendices. The report shall be submitted to the Geosciences Discipline Lead and he shall copy the report to other members of the project team as appropriate.

All test records and data files shall be maintained in accordance with the Project's QA Records procedure, Reference 2.2, and appropriate records shall be copied to the Project Database Administrator for input to the Project Database and subsequent records management in accordance with the Project Data Management Plan, Reference 2.3.

APPENDIX A TEST DATA SHEETS

TP 5 : TEST DATA SHEET 1

PACKER TEST DETAILS

UNIQUE TEST IDENTIFIER	
BOREHOLE NO.	
TEST NO	
TEST TYPE	

BOREHOLE DATA

Borehole No.	
Depth of casing (ft)	
Total Borehole Depth (ft)	
Elevation of Borehole datum point (ft)	

TEST INTERVAL DATA

Depth of Top of Interval (ft)	
Depth of Bottom of Interval (ft)	
Length of Interval (ft)	
Nominal Borehole Diameter (in)	

PRESSURE TRANSDUCER DATA

	Depth (ft)	Serial #
Transducer P1 - above test section		
Transducer P2 - test interval		
Transducer P2 - below test interval		

NAME	SIGNATURE	DATE	PAGE
			of

TP 5 : TEST DATA SHEET 2

PACKER TEST ASSEMBLY DETAILS

UNIQUE TEST IDENTIFIER	
BOREHOLE NO.	
TEST NO	
TEST TYPE	

DESCRIPTION OF ITEM	SERIAL #	DIAMETER (in)	LENGTH (ft)	DEPTH TO BASE (ft)

NAME	SIGNATURE	DATE	PAGE
			of

TP 5 : TEST DATA SHEET 3

PACKER TEST LOG

UNIQUE TEST IDENTIFIER	
BOREHOLE NO.	
TEST NO	
TEST TYPE	

DATE	TIME	ACTION

NAME	SIGNATURE	DATE	PAGE
			of

RAS, Inc., Integrated Subsurface Evaluation
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Technical Procedure and Work Instructions for *Electrical Properties* Logging

TP-16

Prepared by: ____ Date: _7-6-2002__
William H. Pedler

Reviewed by: ____ Date: __________

Approved by: ____ Date: __________

TP-16
Revision History

Revision Level	Issue Date	Change Summary
0	July 7, 2002	New procedure.

Table of Contents

1.0 SCOPE

1.1 Purpose

1.1.1 This procedure provides instructions for performing electrical logging for the Project and to assure the accuracy, validity, and applicability of the methods used.

1.1.2 This procedure further describes the components of electrical logging sondes, the principles and limits of the methods used, the methods used for calibration and performance verification of the equipment, and the requirements for data acceptance and for documentation.

1.1.3 This procedure includes by reference those sections of TP-13 which are common to all measurements.

1.1.4 In applying this procedure to electrical logging measurement, the requirements of this procedure shall supersede those stipulated in TP-13.

1.2 Applicability

1.2.1 This procedure applies to electrical properties measured using either normal resistivity probes or induction probes.

1.2.2 This procedure applies to all Client and contractor personnel who perform work referred to in paragraph 1.1 or who use data obtained from this procedure if it is deemed to potentially affect public health and safety related to a nuclear waste repository.

1.2.3 All data derived from this procedure that are presented to support the Project, and any equipment calibrations or recalibrations that may be required shall be in accordance with this technical procedure. Deviation from these procedures shall be permitted only under the conditions set forth in Section 6 of TP-13.

2.0 REFERENCES

2.1 Keys, W. Scott, and MacCary, L.M., Application of Borehole Geophysics to Water-Resources Investigations: USGS, Techniques of Water-Resources Investigations, Book 2, Chapter E1.

2.2 Hearst, J.R., and Nelson, P.H., Well Logging for Physical Properties, McGraw Hill, 1985.

2.3 Standard Guide for Planning and Conducting Borehole Geophysical Logging, ASTM Designation D 5753-95, October, 1995.

3.0 DEFINITIONS

Definitions shall be in accordance with ASTM D 5753-95. In addition, definitions common to all logging procedures are provided in TP-13.

3.1 Electrical properties logging involves measurements of the resistivity (or conductivity) of the formation surrounding a borehole, and of the SP or spontaneous potential difference as a function of depth in the hole.

3.2 Resistivity is defined as the ratio of voltage to current per unit distance per unit area. The units are typically ohm-meters. Conductivity is the inverse of resistivity.

3.3 Single point resistance is the ratio of voltage to current in ohms.

3.4 Spontaneous potential (SP) is the voltage difference between a point on a logging probe and a surface reference electrode. The source of this voltage difference is the sum of a number of effects.

3.5 Induction logging is a technique whereby formation resistivity is measured by inducing an oscillating field in the formation and measuring its effect on coils inside the logging tool. Because this does not require a direct electrical connection between the probe and the formation, induction logs can be run in non-conductive fluids (including air), and in boreholes cased with fiberglass or other insulating material.

3.6 Normal resistivity is a technique whereby formation resistivity is measured by delivering current to the formation directly and measuring the voltage difference between pairs of electrodes. This technique requires a direct electrical connection between the formation and the electrodes.

3.7 Recording equipment - Data from the electrical properties probe is sent to the surface as electrical signals which are translated into engineering units and recorded along with depth to produce an electrical log of the hole. The log data is recorded digitally as engineering values and displayed while the log is being run.

3.3 Personnel

Personnel are as defined in TP-13.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 No prerequisites are required for induction logging other than as stipulated in TP-13.

4.1.2 SP and normal resistivity logs require conductive fluids in the borehole.

4.1.3 A section of insulated wireline is typically required above the logging sonde in order to obtain accurate measurements.

4.2 Tools, Material, Equipment

4.2.1 Measurement apparatus

4.2.2 Standardization apparatus, or access to a standardization borehole

4.2.3 Calibration

4.2.4 Field validation/calibration

4.3 Precautions and Limits

4.3.1 Temperature and pressure limits are specified in the operations manuals of the specific logging sondes. Within those limits, temperature (in particular) can affect the measured response. This effect should be quantified for each tool so that temperature corrections can be applied to the data as necessary.

4.3.2 The range within which a given device is accurate is different for the different measurement techniques. This range shall be specified for each device, and the appropriate device shall be selected for the borehole under investigation.

4.3.3 The properties of the borehole fluid influence the response of electrical resistivity logs in what is commonly known as "Borehole Effects". As the hole diameter increases, these effects become more pronounced. These effects have been quantified, and log data shall be corrected based on standard techniques.

Because SP and single-point resistance are point measurements, they are typically not affected.

4.3.4 The geometry of the logging probe (for example, the positions of the source and measurement electrodes of resistivity type probes or the excitation frequency and coil spacing of induction type probes) affects the measurement values.

4.3.4.1 The ability of a given measurement to accurately measure resistivity across a thin bed is a function of the geometry and of the resistivity contrast and bed thickness.

4.3.4.2 The distance away from the borehole which influences a given measurement is a function of the geometry and the radial distribution of electrical properties.

Because SP and single-point resistance are point measurements, they are typically not affected.

4.3.5 Sources of error.

4.3.6 The log shall be recorded with the tool moving **up** the borehole.

4.4 Acceptance Criteria

Electrical resistivity and single-point resistance values shall be accepted for use based on the expectation that the results will be interpreted quantitatively.

SP shall be accepted based on the expectation that the results will be used qualitatively.

4.4.1 Repeat sections for all measurements shall be similar to the main log, such that features visible in each match in depth (see depth error criterion for re-zero) and in the value of the measured data (see validation criterion).

4.4.2 Depths of features in the log shall agree with other logs, if run.

4.4.3 Rezero shall be within required tolerances.

4.4.4 Calibration of resistivity and resistance shall be within required tolerances for repeatability and the span of the logged values measured in the borehole.

4.4.5 Log shall have reasonable values consistent with experience.

5.0 DETAILED PROCEDURE

Electric logs are typically recorded with a 0.1 foot sample interval.

Electric logs are used to obtain information on the electrical properties of the hydrogeologic section including the soil, rock and groundwater.

Electric logs are typically run as one of a suite of logs during a single visit to a well site. Procedures prior to and upon arrival as described here pertain only to the specific requirements of Electric logs. Where they do not conflict with the procedures detailed here, all of the procedures specified in TP-13 shall also be adhered to.

5.1 SP/normal resistivity/Single-point resistance

This type of electric probe is a simple Werner Array comprised of a current electrode, two measure electrodes spaced at 16 and 64 inches from the current electrode, and a surface electrode. The single point resistance (SPR) is derived from Ohm's law based on voltage changes between the current electrode and the surface electrode while maintaining a constant current. Spontaneous potential (SP) is a passive voltage potential between the current electrode and the surface electrode. The normal resistivities reflect the voltage drop from the current electrode to the respective measure electrodes spaced at 16 and 64 inches from the current electrode. This voltage drop is converted to resistivity based on Ohm's law that assumes a spherically shaped electrical field between the current electrode and the measure electrodes.

5.2 Induction logs

Induction logs contain one or more coils through which a high frequency alternating current is passed to induce a magnetic field surrounding the tool. The positions of these coils and the frequency of the excitation signal determine the geometry of the induced field. This field then induces a current flow in the formation that can be detected at the tool and analyzed to determine the electrical resistivity of the formation.

5.1 Prior to arrival

No added procedures are necessary beyond those detailed in TP-13.

5.2 On arrival

No added procedures are necessary beyond those detailed in TP-13.

5.3 While Logging

5.3.1 Verify the integrity of the wireline.

5.3.2 Attach electric logging probe to the logging cable. If necessary, separate the tool from the end of the wireline with a length of insulated cable.

5.3.3 Perform a pre-log calibration.

The purpose of pre-log validation is to adjust conversion factors to achieve desired accuracy for the range of

The pre-log validation also provides data for comparison to a post-log validation check.

5.3.4 Set wireline depth zero at the measurement point. Since multiple measurements are taken on a single lowering of the electrical logging sonde, select an appropriate depth zero point and record on the Tool Description Form the location of that point and of all of the points at which electrical measurements are made. The depth zero should be taken with tension on the wireline similar to that expected while logging, to prevent slack in the cable from biasing the datum.

5.3.5 Lower electrical logging sonde to bottom of interval to be logged.

5.3.6 Stipulate a maximum logging speed.

5.3.7 Perform repeat log of a minimum of 50 feet of hole. Tool operation is verified by observing slow variations in the values of the logged data.

5.3.8 Record log of complete hole. Tool operation shall be verified as above.

5.3.9 Return sonde to surface.

5.3.14 Check tool zero.

5.3.15 Perform a post-log validation.

5.4 Prior to departure - no additional requirements beyond TP-13.

6.0 RECORDS

Records shall be provided as detailed in TP-13.

6.1 Form TP-CAL-ELEC.

7.0 APPENDICES

7.1 Form TP-CAL- ELEC.

Form TP-CAL- ELEC. Appendix 7.1

Resistivity Logging Probe Checkout/Calibration

Tool Model:______________

Engineer______________ Location______________Unit No. ______
Date______

Model S/N____________ Module S/N_____________Acquire Int.S/N:________

Cable Resistance (1) ________ (2) _______ (3) _______ (4) _______ (A) ______

File Name________________________

Caliper Calibration:

16" Resistivity	Measured w/Meter	Ohm-M
Shorted	__________________	__________________
2 Ohm Resister	__________________	__________________
20 Ohm Resister	__________________	__________________
100 Ohm Resister	__________________	__________________

64" Resistivity	Measured w/Meter	Ohm-M
Shorted	__________________	__________________
2 Ohm Resister	__________________	__________________
20 Ohm Resister	__________________	__________________
100 Ohm Resister	__________________	__________________

SP(Spontaneous Potential)

Shorted(Module on)	__________________	__________________
+100 mV	__________________	__________________
-100 mV	__________________	__________________

Comments:

DRAFT

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Technical Procedure and Work Instructions for *Natural Gamma* Logging

TP-18

Prepared by: ______________________ Date: Wednesday, October 15, 2003

William H. Pedler

Reviewed by: ______________________ Date: __________

Approved by: ______________________ Date: __________

TP-18
Revision History

Revision Level	Issue Date	Change Summary
0	10/15/03	New procedure.

Table of Contents

1.0 SCOPE

1.1 Purpose

1.1.1 This procedure provides instructions for performing natural gamma measurements for the Project and to assure the accuracy, validity, and applicability of the methods used.

1.1.2 This procedure further describes the components of natural gamma logging, the principles and limits of the methods used, the methods used for calibration and performance verification of the equipment, and the requirements for data acceptance and for documentation.

1.1.3 This procedure also provides standards for data traceability.

1.1.4 This procedure includes by reference those sections of TP-13 measurements which are common to all measurements.

1.1.5 In applying this procedure to natural gamma measurement, the requirements of this procedure shall supersede those stipulated in TP-13.

1.2 Applicability

1.2.1 This procedure applies to natural gamma acquired using scintillation detectors.

1.2.2 This procedure applies to all Client and contractor personnel who perform work referred to in paragraph 1.1 or who use data obtained from this procedure.

1.2.3 All data derived from this procedure that are presented to support the Project, and any equipment calibrations or recalibrations that may be required shall be in accordance with this technical procedure. Deviation from these procedures shall be permitted only under the conditions set forth in Section 6.3.

2.0 REFERENCES

2.1 Keys, W. Scott, and MacCary, L.M., Application of Borehole Geophysics to Water-Resources Investigations: USGS, Techniques of Water-Resources Investigations, Book 2, Chapter E1.

2.2 Hearst, J.R., and Nelson, P.H., Well Logging for Physical Properties, McGraw Hill, 1985.

2.3 Standard Guide for Planning and Conducting Borehole Geophysical Logging, ASTM Designation D 5753-95, October, 1995.

3.0 DEFINITIONS

Definitions shall be in accordance with ASTM D 5753-95. In addition, definitions common to all logging procedures are provided in TP-13.

3.1 Natural gamma probe

Natural gamma ray logs (also known as gamma ray or gamma logs and hereafter called gamma logs) measure gamma ray radiation naturally emitted from the nucleus of some atoms. Specifically these atoms consist of isotopes of potassium (potassium 40), uranium 238 daughter products and thorium 232 daughter products.

3.2 Recording equipment - Data from the natural gamma probe is sent to the surface as electrical signals which are translated into engineering units and recorded along with depth to produce a natural gamma log of hole size. The log data is recorded digitally as raw counts and as engineering values and displayed while the log is being run.

3.3 Personnel

Personnel are as defined in TP-13.

4.0 REQUIREMENTS

4.1 Prerequisites

No prerequisites are required other than as stipulated in TP-13, Standard logging procedures.

4.2 Tools, Material, Equipment

4.2.1 Natural gamma measurement apparatus.

4.2.2 Standardization apparatus, and/or access to a standardization borehole. Calibration of the gamma tool in a standardized borehole is typically conducted by the geophysical tool manufacturer and considered optional in these TP's.

4.3 Precautions and Limits

The natural gamma ray log may be recorded in either cased or open holes that are fluid or air filled. The gamma measurement can be run in holes with temperatures ranging from x to y, and pressures below z. Even within this range, the performance of the gamma ray measurement may be affected by temperature and pressure.

4.3.1 Casing may attenuate the gamma values.

4.3.2 Borehole fluid properties may result in attenuation of the gamma signal or, if the fluid is radioactive, may cause an increase in the measured value.

4.3.3 Excessive borehole size, often caused by air drilling, may degrade natural gamma ray log results because the formation will be further from the probe in areas of hole enlargement.

4.3.4 Natural gamma logging is a statistical measurement. The uncertainty is a function of the number of naturally emitted gamma rays striking the detector.

4.3.5 The sensitivity of a gamma log is a function of logging speed - faster logs result in poorer vertical resolution, and degrade precision and accuracy.

4.3.6 The log shall be recorded with the tool moving up the borehole.

4.4 Acceptance Criteria

This log shall be accepted for use based on the expectation that the results will be interpreted quantitatively.

4.4.1 Repeat section shall be similar to the main log, such that features visible in each match in depth (see depth error criterion for re-zero) and in gamma ray log value (see validation criterion).

4.4.2 Depths of features in the log agree with other logs, if run.

4.4.3 Rezero is within required tolerances.

4.4.4 Calibration check is within required tolerances for linearity, repeatability, and span of logged hole size.

4.4.5 Log shows reasonable values consistent with experience.

5.0 DETAILED PROCEDURE

Natural gamma ray logs (also known as gamma ray or gamma logs and hereafter called gamma logs) measure gamma ray radiation naturally emitted from the nucleus of some atoms. Specifically these atoms consist of isotopes of potassium (potassium 40), uranium 238 daughter products and thorium 232 daughter products.

Natural gamma logs are typically recorded with a 0.1 foot sample interval.

Gamma logs provide formation clay and shale content and general stratigraphic correlation in sedimentary formations. In general, the natural gamma ray activity of clay-bearing sediments is much higher than that of quartz sands and carbonates. Gamma logs are also used in hard rock environments to differentiate between different rock types and in mining applications for assessment of radioactive mineralization such as uranium, potash, etc.

Gamma logs are also used as one of a group of measurements run on a single sonde, to allow depth matching of logs between logging runs.

Natural gamma logs are typically run as one of a suite of logs during a single visit to a well site. Procedures prior to and upon arrival as described here pertain only to the specific requirements of gamma-ray logging. Where they do not conflict with the procedures detailed here, all of the procedures specified in TP-13 shall also be adhered to.

5.1 Prior to arrival

In addition to the procedures detailed in TP-13, the following specific calibration procedure are typically performed by the geophysical tool manufactured and presented here only for optional consideration.

OPTIONAL

5.1.1 Calibrations shall be performed at regular intervals in established test pits at various locations in the United States (e.g. Denver Federal Center calibration pits, DOE uranium calibration pits located in Grand Junction or Casper, Wyoming or the API test pits in Houston, Texas). The calibration procedure shall be qualified for this project prior to acceptance of the log data. This requirement will be at the option of the client. For most applications, standardized calibration at the manufacturer will be sufficient.

5.1.2 Calibration checks using calibration check sleeves shall be performed before leaving for the survey location, before entering every borehole, after exiting every borehole, and upon return to the logging operator's home base at the completion of the project.

The purpose of a calibration check is to insure the sensitivity of the gamma probes. The calibration check is performed by placing a small radioactive calibration sleeve over the scintillation detector and recording the resulting gamma rays in counts per second.

5.1.2.1 With the probe turned on and stabilized, record the background level of gamma activity.

5.1.2.2 Place the calibration check sleeve over the scintillation detector and record the level of gamma ray activity. This level shall be the sum of the background plus the known contribution of the calibration sleeve.

5.1.2.3 Record the results of the calibration check on Form-??.

5.2 On arrival

No added procedures are necessary beyond those detailed in TP-13.

5.3 While Logging

5.3.1 Verify the integrity of the wireline following procedures detailed in TP-13.

5.3.2 Attach gamma probe to the logging cable

5.3.4 Perform a pre-log calibration check (see 5.1.2).

The purpose of a pre-log calibration check is to compare the measured value to a known standard.

The pre-log calibration check also provides data for comparison to a post-log validation.

5.3.6 Set wireline depth zero at the midpoint of the scintillation detector**.** If multiple measurements are taken on a single lowering, select an appropriate depth zero point and record on the Tool Description Form the location of that point and of the caliper measurement point. The depth zero should be taken with tension on the wireline similar to that expected while logging, to prevent slack in the cable from biasing the datum.

5.3.7 Lower sonde to bottom of interval to be logged.

5.3.9 Perform a repeat log of a minimum of 50 feet of hole. Tool operation is verified by observing variations in the gamma signal with depth.

5.3.11 Record log of complete hole. Tool operation is verified by observing variations in the gamma signal with depth.

5.3.13 Return sonde to surface.

5.3.14 Check tool zero.

5.3.15 Perform a post-log validation, as detailed above.

5.4 Prior to departure - no additional requirements beyond TP-13.

6.0 RECORDS

Records shall be provided as detailed in TP-13.

6.1 Gamma Calibration Form TP-GAM-1.

7.0 APPENDICES

7.1 Gamma Calibration Form TP-GAM-1.

Form TP-GAM-1 Appendix 7.1

Engineer______________ Location______________Unit No. ______
Date______

Probe Type S/N_________ Module S/N___________Acquire Int.S/N:________

Cable Resistance (1) ________ (2) _______ (3) _______ (4) _______ (A) ______

Multimeter Model:_______________ S/N:_________

File Name: :______________________________

Denver Federal Center Test Pit Information

Test pit B1 Natural Gamma CPS____________ File Name_____________

Test pit B2 Natural Gamma CPS____________ File Name_____________

Test pit B3 Natural Gamma CPS____________ File Name_____________

Medium Density Test Pit Information

3” well Natural Gamma CPS____________ File Name_____________

5” Well Natural Gamma CPS____________ File Name_____________

8” Well Natural Gamma CPS____________ File Name_____________

12” Well Natural Gamma CPS____________ File Name_____________

High Density Test Pit Information

3” well Natural Gamma CPS____________ File Name_____________

Comments:

DRAFT

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Hydrophysical Logging for Aquifer Characterization

TP-19

Prepared by: ______________________ Date: 7-8-2002

William H. Pedler

Reviewed by: ______________________ Date: __________

Approved by: ______________________ Date: __________

TP-19

Revision History

Revision Level	Issue Date	Change Summary
0	11/2/2005	New procedure.
1	11/03/03	Includes procedures for Depth Specific Sampling

Table of Contents

1.0 SCOPE

1.1 Purpose

The purpose of this procedure is to assure the accuracy, validity, and applicability of the methods used to record hydrophysical logs in a previously drilled borehole. This procedure provides a guide for the Client's contractor to perform the described activity. From this procedure the Client can evaluate these activities for meeting the requirements of the Project.

This procedure describes the components of Hydrophysical logging, the principles of the methods used and their limits. It also describes the detailed methods to be used for calibration, operation and performance verification of the equipment. In addition, it defines the requirements for data acceptance, documentation, and control; and it provides a means of data traceability.

1.2 Applicability

This procedure applies to all personnel contractor personnel who may perform work or use data obtained from this procedure if it is deemed to potentially affect public health and safety related the Project

2.0 REFERENCES

2.1 Tsang, C.F., F.V. Hale, and P. Hufschmied, "Determination of. Fracture Inflow Parameters with a Borehole Fluid Conductivity Logging Method," Water Resources Research, Vol. 26, No., 4, 561-578, April 1990.

2.2 Pedler, W.H., Head, C.L. and Williams, L.L., "HydrophysicalLogging: A New Wellbore Technology for Hydrogeologic and Contaminant Characterization of Aquifers," Proceedings of the Sixth National Outdoor Action Conference, National Groundwater Association, May 11-13, 1992.

2.3 Hvorslev, M.J. Time lag and soil permeability in ground water observations waterways experiments station Corps of Engineers, U.S. Army, 1951.

2.4 Work instructions as called out herein.

2.5 Technical procedure TP-13.

3.0 DEFINITIONS

3.1 Hydrophysical Logging: Technology for evaluating hydrologic conditions surrounding a borehole.

Specifically, The Hydrophysical (HPL) logging method uses repeat logs of FEC and temperature to analyze and determine the location of hydraulically conductive intervals within a wellbore. The results can be used in conjunction with drawdown data obtained during active pumping to determine interval specific hydraulic conductivity or transmissivity. The technique can also be used to characterize ambient (non-pumping) flow conditions.

3.2 FEC: Fluid electrical conductivity.

3.3 Standard Reference Solution: A solution of known electrochemical properties, calibrated to a known FEC, to be used for calibration of HpL Sonde.

3.4 HPL Sonde: Wireline logging tool which measures FEC and temperature for use during Hydrophysical Logging.

3.6 Emplacement - The process of replacing ambient fluids in a borehole with deionized water.

3.7 Injection line - Either flexible tubing or rigid pipe used for emplacement.

3.8 Affected Interval: That interval in a borehole into which fluids flow during inflow or out of which fluids flow during outflow.

During ambient testing, the affected interval is defined as the zone between the deepest productive interval in a given well and the water surface.

During active pumping or DI emplacement, the affected interval is defined as the zone between the deepest hydraulically active interval in a given well and the inlet of the extraction pump.

3.9 Low yield well: Any well having a specific capacity less than 0.1 gallon per minute per foot of drawdown.

3.10 Moderate yield well: Any well having a specific capacity between 0.1 gallon per minute and 4.0 gallons/minute per foot of drawdown.

3.11 High yield well: Any well having a specific capacity greater than 4.0 gallons per minute per foot of drawdown.

3.12 Specific capacity is defined as the rate of fluid influx of a borehole, in units of flow rate per unit drawdown.

3.13 Slug test: Method for testing flow in a well which involves rapid extraction of a finite fluid volume to produce a one-time, sudden, finite decrease in fluid level in the well, and monitoring subsequent fluid recovery.

3.14 Pumping test: Method for testing flow in a well which involves continuous extraction of fluid at a constant rate to maintain a fixed decrease in fluid level in the well, while monitoring fluid extraction rate and water level. In HpL testing, a pumping test may also include simultaneous fluid injection at a fixed rate.

7.1 Deionized (DI) water: Water with a very low concentration of dissolved species and having typically between 5 and 25 µS/cm conductivity.

7.2 Discrete Point Fluid Sampler: Down hole logging tool that is used to collect a depth specific fluid sample lowered to a depth pre-selected by hydrophysical logging results.

3.17 Personnel

3.17.1 Principal Investigator (PI): Responsible for assuring full compliance with this procedure. PI shall require that all personnel assigned to work under this procedure have the necessary technical training, experience, and personnel skills to adequately perform this procedure.

The PI is also responsible for overall operations and data quality.

The PI shall determine whether the data and procedures meet the acceptance criteria.

3.17.2 If necessary due to field conditions, the PI may perform the duties of the Logging Engineer and/or the Technician.

3.17.3 If necessary due to field conditions, the Logging Engineer may perform the duties of the Technician.

4.0 <u>REQUIREMENTS</u>

4.1 <u>Prerequisites</u>

4.1.1 Borehole of appropriate size and completion methodology.

In open bedrock boreholes, casing shall be installed through the overburden and grouted at the rock/alluvium interface to inhibit water leakage into the borehole from the saturated alluvium. For cased boreholes, the well shall be fully cased and gravel packed with single or multiple screened intervals.

The diameter of the borehole shall be 4 inches or greater. For boreholes which require higher pumping rates (> 4 gpm) a 4 inch diameter pump may be required. For use with a 4 inch diameter pump, the diameter of the borehole shall be 6 inches or greater.

For newly drilled wells, cuttings and drill fluids shall be removed from the affected fractures by standard well development procedures.

4.1.2 Source of DI water. If DI water is prepared at the site, the pre-treated water shall be potable and less than 1000 µS/cm FEC.

4.1.3 Surface injection and submersible extraction pump(s) for HPL testing.

4.2 Tools, Material, and Equipment

Typical field equipment includes for shallow (less than 300 feet total depth):

- Fluid management system
  - Back Pressure Regulator or orifices
  - Rubber hose (0.75-inch i.d.) for injection
  - Submersible Pump
  - Evacuation Line
  - Storage tanks (as required) with inlet/outlet valves
  - Surface Pump
  - Fluid management manifold/Monitoring Panel
  - Mechanical hose spoolers (pump, injection)
  - Data Acquisition System (for recording volumes, flow rates, time)
  - Wireline System
  - Cable
  - Power supply
    - Wireline winch unit
    - Boom and drawworks
  - Depth encoder
  - Water level indicator
  - Computer System
  - NxHpl™ Logging tool
  - Downhole Fluid Sampler

- Deionized water (prepared with wellbore fluids or transported on-site)
- Appropriate water sample containers (typically provided by client)
- Steam Cleaner (for logging/sampling tools)
- Deionizing Units

4.2.2 For wells greater than 300 feet total depth, an independent pumping system and standard wireline logging truck is required. This includes:

Wireline System, Cable, Power supply, Wireline winch unit, Boom and drawworks, Depth encoder, Water level indicator, Computer System, Hydrophysical Logging tool, and Downhole Fluid Sampler.

4.2.3 RAS independent pumping system includes:

Fluid management system, Back Pressure Regulator or orifices, 1" galvanized pipe for injection lines, 2" galvanized pipe for evacuation lines, Submersible Pump, Storage tanks (as required) with inlet/outlet valves, Surface Pump, Fluid management manifold/Monitoring Panel, and Data Acquisition System (for recording volumes, flow rates, time).

4.2.4 Deionized water (prepared with wellbore fluids or transported onto the site).

4.2.3 Standard reference solutions: A minimum of 4 prepared solutions for calibration check of FEC measurements by the HpL sonde.

4.2.4 Surface flow meters may be provided by the client.

4.2.5 Steam cleaning equipment, if required.

4.3 <u>Precautions and Limits</u>

7.1.1 The operational temperatures and pressures for the RAS's advanced, multi FEC/T arrayed hydrophysical tool are:

- Maximum operating pressure is approximately 1,000 PSI.
- Maximum practical operational temperature is 80^{O}C.

4.3.2 Hydrophysical tests require that the borehole fluid be emplaced with deionized water. Improper emplacement of the DI water or its subsequent contamination can drastically affect the quality of the test.

4.3.3 The minimum borehole size is 4”. Larger boreholes (6” or greater) may be required to utilize 4” diameter pumps if it is necessary to achieve flow rates higher than approximately 4 gpm. This may occur when testing of a high yield well.

4.3.4 The Hydrophysical technique requires a fluid filled borehole.

7.1.1 Bridges, constrictions in the borehole diameter, will make it impossible to lower the tool into the borehole and difficult to retrieve the tool.

4.4 Acceptance Criteria

7.1.1 Forms shall be filled out as called for in this Technical Procedure.

7.1.2 Field calibration checks shall meet the criteria outlined in TP-13.

7.1.3 Evaluation of the test procedure and data for acceptability shall be the sole responsibility of the PI.

5.0 DETAILED PROCEDURE

When logging for hydrologic purposes only, as in this procedure, FEC and temperature measurements are sufficient to characterize the well.

5.1 Before Arrival On Site

5.1.1 Examine any previously obtained wireline logs, noting in particular conditions which may cause tool sticking or variations in data quality.

5.1.2 Note depths of water table, surface casing, hole size changes, and hole bottom for use in calibrating depth measurements during logging.

5.1.3 The PI shall discuss hole conditions with the drillers, or review drilling reports for information which may affect the design of the HpL tests.

5.1.4 The PI shall review recent field activities carried out in the borehole of interest which may impact hydrology or fluid chemistry within the interval affected by the HpL tests. This includes but is not limited to any pump tests, interference tests, or load tests.

5.1.5 The PI shall also review all pre-existing hydrogeological data from the site and develop a preliminary testing plan, based on all information which can allow determination of whether the well will be low, moderate, or high yield.

5.1.6 Evaluate water quality and determine if it is necessary to provide an external water source for DI water.

5.1.7 Prepare a list of materials requirements, including pump(s) if necessary, tubing, measurement equipment, and the necessity to provide a source of DI water.

5.1.8 Each measurement device which affects quality shall be calibrated prior to use.

5.2 Upon Arrival On-Site

In addition to the requirements of TP-13:

5.2.1 The well site shall be clear of all equipment within a 25 foot radius of the well head.

5.2.2 Calibration documents for all quality affecting measurement devices shall be made available to the site manager upon request.

5.3 Verify on site conditions

5.3.1 Review well construction details and record available site conditions, well conditions and flow yield information, verify the previously designed testing program.

5.3.2 Review and record additional wellbore construction/site details recorde the following information:

Ambient depth-to-water, depth of casing, depth of well, lithology (if available), estimated well yield and any available drawdown data, and type and concentration of contamination (if any).

5.3.3 Prepare deionized (DI) water. Consult with DI water tank firm for assistance if necessary. If DI water has not been transported to the site, surface or groundwater may be used if it is of suitable quality. Generally, source water containing less than 1000 micro Siemens per centimeter (μS/cm) and less then 20 ppb VOCs will not significantly affect the deionizing units, but this should be confirmed with the DI water firm. If the groundwater from the well under test cannot be used for DI water generation, then DI water must be transported to the site and containerized at the wellhead.

Depending on the amount of Hydrophysical testing to be performed (ambient and/or active) the typical volume of DI water required for each borehole is approximately three times the volume of the standing column of formation water in the wellbore per type of Hydrophysical characterization.

If preparation takes place on site, pump the source water through a pre-filter, to deionizing units, and into the storage tanks.

Monitor the FEC of the DI water in-line to verify homogeneity; the target value is 5 to 25 µS/cm. Record the results.

5.3.4 A pre-survey calibration check of the HPL sonde shall be performed.

5.4 Conduct ambient FEC/Temperature log

5.4.1 Set datum on the depth encoder with the FEC sensor on the tool as 0 depth at the top of casing. If no space is available at the wellhead, measure 10 feet from the FEC sensor up the cable (using measuring tape) and reference with a wrap of electrical tape. Lower the tool down the hole to the point where the tape equals the elevation at the top of the casing and reference that as 10 feet depth on the depth encoder.

5.4.2 Place the top of the tool approximately 3 feet below the free-water surface to allow it to achieve thermal equilibrium. Monitor the temperature output until thermal stabilization is observed at approximately ± 0.2 °C. The rate of change of temperature shall be less than 1 °C/minute.

5.4.3 After thermal stabilization of the logging tool is observed, log the ambient conditions of the wellbore (temperature and FEC). During the logging run, the data shall be plotted in real time in log format on the computer screen and the data string shall be simultaneously recorded on the hard drive.

Log the ambient fluid conditions in both directions (i.e. record down and up). The ideal logging speed is 5 feet per minute (fpm).

5.4.4 At the completion of the ambient FEC/Temperature test, the recorded data shall be backed up *immediately* to floppy disk (high density disk) or CD-R.

At completion of the ambient log, place the tool approximately 10 feet below the free water surface. The tool may remain there during equipment set up as long as borehole conditions permit. The Logging Engineer under PI direction may choose to remove the logging tool from the well during installation of the pumping equipment.

5.4.5 Measure and record ambient depth.

5.5 Conduct ambient flow characterization

Ambient flow characterization consists of a time series of FEC logs recorded after DI water emplacement. Continuous logging of the interval of interest is required. In addition to the logging results, pressure and flow data shall be recorded throughout the test in digital form and periodically in field notes.

5.5.1 DI Emplacement Procedure.

DI water is injected at the bottom of the well. Water is extracted from the top to maintain a constant water level in the well, to minimize disturbance to the local hydrologic system. The HpL sonde is used during emplacement to monitor the position of the DI water front as it moves up the well. A pressure transducer placed immediately below the extraction pump is used to monitor the water level in the well.

5.5.1.1 Attach back pressure regulator or orifice, if used, and weighted boot, to end of emplacement line and secure. Insure that the injection line is of adequate length to reach the bottom of the wellbore.

5.5.1.2 Lower the flexible emplacement line to the bottom of the well allowing one foot of clearance from the well bottom to the outlet of the injection line.

5.5.1.3 Lower tool about 10 feet below the water surface. The tool will be stationed beneath the submersible pump during non-logging times.

5.5.1.4 Lower submersible pump in the well to a depth just above the logging tool. Record approximate depth of the pump location.

5.5.1.5 Lower a pressure transducer a minimum of 5 feet below the bottom of the pump.

(The sequence of 5.5.1.3 through 5.5.1.5 may be changed as required at the discretion of the PI or Logging Engineer.)

5.5.1.6 Record all initial readings of gauges at elapsed time 0.0 minutes.

5.5.1.7 Mark hoses with a round of electrical tape for reference. In addition, establish datum for tool depth to the nearest foot and mark on wire with wrap of tape. Reset datum on optical encoder for this depth.

5.5.1.8 Pump DI water to the bottom of the wellbore using the surface pump and the injection riser. Simultaneously use the submersible pump to maintain a stable, elevated total head by extracting groundwater from near the free water surface. The injection and extraction rates should be approximately the same. When groundwater from the subject well is used for DI water generation, generate DI water from the extracted formation water and recirculate to the well bottom via the solid riser.

5.5.1.9 Throughout this procedure, the water level and flow data shall be recorded digitally. In addition, a hand-held water level meter shall be used to periodically record the elevated total head. All flow data shall be periodically recorded to field notes.

5.5.1.10 Evaluate the rate at which the DI water advances up the well. In the event that it is necessary to modify the rate of injection/extraction, the PI shall oversee the change.

If borehole conditions permit (i.e. the absence of constricted borehole intervals), the logging tool is used to monitor the advancement of the fluid up the borehole as it displaces the standing formation water. Draw the logging tool up the wellbore in successive increments as the DI water is emplaced. The logged FEC value changes from that of the ambient fluid to that of DI water at the depth of the DI water interface. Continuous profiling may also be performed to monitor the progress of DI water emplacement.

5.5.1.11 Monitor and record the electrical conductivity of the fluid expelled from the extraction pump during emplacement procedures. Record these values and the times at which they were measured.

5.5.1.12 Emplacement is complete when DI water, or sufficiently diluted formation water, is observed from the evacuation pump or when logging tool stationed near the pump indicates DI water or sufficiently diluted formation water.

5.5.1.13 Upon completion, turn off the evacuation pump. Then turn off the injection line.

5.5.1.14 If a pumping rig is used, check valves shall be installed in the extraction line to ensure that fluid is not drawn back into the well when the pump is turned off. In this case, leave the emplacement line, the extraction pump, the pressure transducer, and the HpL sonde in the well.

5.5.1.15 If appropriate, the extraction line shall be removed from the well immediately after emplacement is complete.

5.5.1.16 Record volumes of extracted and injected fluids. Calculate the volume of DI water lost to the formation: $V_{injected} - V_{extracted} = V_{lost}$. This value will be negative if there is a net flow into the well.

5.5.2 After DI emplacement is complete, perform continuous FEC/Temperature logging until 80% saturation is observed in the affected interval, or until 5 hours of logging has been performed.

5.6 Characterize the well for additional testing

The RAS PI shall determine at this time (based on all information available, including the data obtained in 5.5) whether the well is characterized by a low, intermediate, or high yield. If the PI feels that enough information is available to define the well type, testing shall proceed with item 5.8. If the PI determines that additional testing is needed, it shall proceed so as to minimize disturbance to the aquifer(s) under test.

5.6.1 Conduct a slug test.

5.6.1.1 Rapidly extract 1-2 ft of fluid from the well.

5.6.1.2 Monitor and record the fluid level as it recovers.

5.6.1.3 If the fluid recovers more slowly than 1 foot/minute the well is of a low yield type. Skip the remainder of 5.6.1 and initiate 5.7.

5.6.2 Conduct a second slug test at a higher drawdown.

5.6.3 If necessary , conduct a controlled, short term well production test (pump test) to further characterize the overall hydraulics of the wellbore.

5.6.3.1 Select the pumping rate as follows: The rate(s) of pumping are determined by drawdown information previously obtained or at rate(s) appropriate for the wellbore diameter and saturated interval thickness. The appropriate extraction rate is a function of length of saturated interval, borehole diameter, and previous well yield knowledge. The appropriate pumping procedures to be employed are also dictated by the length of the exposed rock interval. In general, the extraction flow rate should be sufficient to induce adequate inflow from the producing intervals. The concern is that the extraction flow rate does not cause extreme drawdown within the well i.e. lowering the free water surface to the depth of the shallowest conductive interval.

5.6.3.2 Treat extracted water as follows: On-site pre-treatment of groundwater using activated carbon, can be conducted prior to DI water generation, if there is a contaminated groundwater source. In addition, on-site treatment can also be considered to handle extracted fluids that would require containerization and treatment prior to disposal.

5.6.3.3 While extraction proceeds, manually record elapsed time of pumping, depth to water determined using a hand-held water level indicator, total gallons extracted, and extraction flow rate. This provides a manual back-up of the data recorded digitally during the test.

5.6.3.4 Continue pumping until at least three wellbore volumes have been extracted from the wellbore, or a stabilized water level elevation is obtained. Record wellbore volume.

5.7 Review data obtained during the pumping test to determine pumping / logging procedures.

Extraction procedures for detection and characterization of hydraulically conductive intervals are determined based on the pumping test information. The emplacement, testing and pumping procedures will differ depending upon well yield and determined lengths of intervals of interest. In wellbore situations where intervals of interest are small (less than 30 feet) and hydraulic characteristics observed during drilling and preliminary hydraulic testing indicate hydraulically conductive intervals with extremely low flow rates (i.e. <0.10 gpm/foot of drawdown), a slug testing procedure may be employed. In wellbore cases where the preliminary hydraulic testing indicates low to moderate total yield (i.e. 0.10 < Q < 4 gpm/foot of drawdown), constant low flow rate pumping after DI water emplacement procedures may be employed. In wellbore situations where intervals of interest are large, and high total yield (i.e. > 4 gpm/foot of drawdown) is observed, constant pumping during DI water injection procedures shall be employed.

5.8 DI water emplacement

After the PI has determined the test protocol, the fluid in the well shall be replaced again with DI water, following the procedure outlined in 5.5.1 above.

5.9 Conduct active flow testing

5.9.1 Low yield active test procedure:

If the well is of low yield type, proceed as follows:

5.9.1.1 Perform a slug test in accordance with procedures developed by Hvorslev (1951). Rapidly extract a small volume of water from near the free water surface using the extraction riser and pump. A drop in piezometric head of 2-10 feet should be adequate for the initial test. Record the rise in the free water surface with time using the pressure transducer, and develop a conventional time-lag plot. Log the well continuously with the HpL sonde to monitor changes in the fluid column.

5.9.1.2 The completion of the slug test shall be defined as follows: Either (a) 80% of the head disturbance has decayed, or (b) a 20-hour time period has elapsed, whichever occurs first.

5.9.1.3 Repeat the DI emplacement procedure 5.8 and the low yield active test procedure 5.9.1 with successive increases in the drop of piezometric head (or volume extracted) associated with each slug test. Let the wellbore recover and record the rise in the free water surface. Repeat logging of the wellbore fluid after the free water surface has recovered to a satisfactory elevation.

5.9.1.4 The number of repetitions shall be determined by the PI in the field after review of previous results.

5.9.1.5 Record digitally the data from the pressure transducer throughout the test. Periodically manually record the borehole fluid level.

5.9.2 Moderate yield active test procedure:

Time Series Hydrophysical Logging During Continuous Pumping After DI water Emplacement

5.9.2.1 The PI shall select a pumping rate such that drawdown of the free water surface produced during pumping shall not overlap any identified water producing interval.

5.9.2.2 Maintain a constant flow rate from the evacuation pump and record the total volume of groundwater evacuated from the wellbore. Employ a continuous reading pressure transducer (or equivalent device) to monitor and record digitally the depressed total head during pumping, along with the associated pumping rate. Manually record depth to water and the flow data.

5.9.2.3 Conduct HydroPhysical logging continuously. The number of logging runs and the length of time required to conduct all logging is a function of the particular hydraulic conditions.

5.9.2.4 Logging and pumping shall continue until the FEC of the fluid in the affected interval is more than 80% the FEC of the formation water.

5.9.2.5 This process may be repeated, at the PI's discretion, starting with DI emplacement procedure 5.6 and the moderate yield active test procedure 5.7.2, increasing the pumping rate.

5.9.2.6 The number of repetitions is determined in the field after review of previous results.

5.9.2.7 Record digitally the data from the pressure transducer and from the extraction line flow meter throughout the test.

5.9.3 High yield active test procedure.

Time Series Wellbore Fluid Logging During Continuous Pumping and Simultaneous DI Water Injection

5.9.3.1 The RAS PI shall select a pumping rate such that drawdown of the free water surface produced during pumping does not overlap any identified water producing interval.

5.9.3.2 Maintain a constant flow rate from the evacuation pump and record this rate and the associated drawdown. During this period, conduct HydroPhysical logging until reasonably similar Hydrophysicallogs are observed and a reasonably stable drawdown is achieved.

5.9.3.3 After reasonably similar downhole fluid conditions are observed and simultaneous with extraction pumping, inject DI water at the bottom of the well at a constant rate of 10 to 30% of that employed for extraction. Increase the total rate of extraction to maintain total formation production reasonably similar to that prior to DI water injection (i.e. increase the total extraction by amount equal to the DI water injection rate).

5.9.3.4 Continuous logging shall be conducted until stabilized and consistent diluted FEC logs are observed. A minimum of 6 downward logs shall be recorded in the stable, diluted condition prior to terminating the test.

5.9.3.5 After stabilized and consistent FEC logs are observed, terminate DI water injection. Reduce the total extraction flow rate to the net formation rate and conduct continuous logging. Conduct logging until stable and consistent FEC values are observed.

5.9.3.6 Record digitally the data from the pressure transducer and from the extraction and injection line flow meters throughout the test.

5.9.3 If inflow characterization at a second pumping rate is desired, the following procedure shall be followed:

5.9.3.1 Terminate DI injection.

5.9.3.2 Increase the extraction rate to the new value.

5.9.3.3 Follow the procedures detailed in 5.9.3.1 to 5.9.3.6.

5.9.4 Although pumping and testing procedures vary depending upon wellbore hydraulics and construction detail, there are several requirements which are common to all of the active tests described above.

5.9.4.1 Periodically record the total volume and flow rate of well fluids extracted and the total volume and flow rate of DI water injected. Use a continuous reading pressure transducer or similar device to monitor the depressed total head during pumping. Manually record the depressed total head (piezometric surface) periodically, with the associated pumping and injection data.

5.10 Depth Specific Sampling

At the conclusion of hydrophysical testing, downhole, depth specific sampling can be conducted. The contamination concentration values derived from the collected samples, in conjunction with the hydrophysical logging results, can be used to estimate the interval specific contaminant concentration for the sampled hydraulically conductive intervals.

5.10.1 Pumping at the same formation production rate as employed during hydrophysical testing is initiated, or maintained.

7.1.1 Periodic FEC/Temperature logs are conducted during pumping until stable logs are observed and any residual DI water has been pumped out of the well.

7.1.2 Based on review of the hydrophysical logging results, the location of the water bearing intervals are identified and sampling depths are selected. Typically, the sampling depth is located 5-10 above an identified water bearing interval.

7.1.3 Prior to each sampling run, the inside of the sampler barrel and petcock are thoroughly cleaned with deionized water and Alconox soap, rinsed with DI water and dried off.

7.1.4 The sampler ports are closed at the surface. The operator will physically confirm that the ports are closed prior to placing in the wellbore.

7.1.5 Depth datum for the location of inlet port is referenced to same datum as hydrophysical logging.

7.1.6 The sampler is lowered to the selected depth, opened for at least 5 minutes to insure complete filling, closed and withdrawn to the surface. At the surface, the ASDE is recorded and the sampler is decanted into laboratory containers and reassembled.

7.1.7 Prior to each sampling run, the inside of the sampler barrel and petcock are thoroughly cleaned with deionized water and Alconox soap, rinsed with DI water and dried off.

7.1.8 Procedures 5.10.6 through 5.10.8 repeated until all selected intervals sampled.

5.11 Post-log calibration

Carry out post-log calibration, following procedures in TP-FEC.

5.12 Departure from site

5.12.1 Turn all pumps off. Clean evacuation line and outside of pump as required by site-specific procedures.

5.12.2 Remove the tool from the well. Clean the wireline and the tool as required by site-specific procedures.

5.12.3 Remove the injection line from the well. Clean the injection line as required by site-specific procedures.

5.12.4 Store the pumps and logging tools properly for transport.

5.12.5 Place cover on well and lock (if available).

6.0 RECORDS

Records of the data obtained from each measurement shall be produced as follows:

6.1 Paper copies of HpL logs shall be provided as shown in Appendix 7.9.

6.2 Digitally acquired flow, pressure, and head data shall be recorded along with on-site calibration data.

6.3 Forms shall be completed as detailed in this procedure and in TP-13.

6.3.1 As provided by contractor.

6.4 Exceptions shall be handled as detailed in TP-13.

6.5 Field Modifications shall be handled as detailed in TP-13.

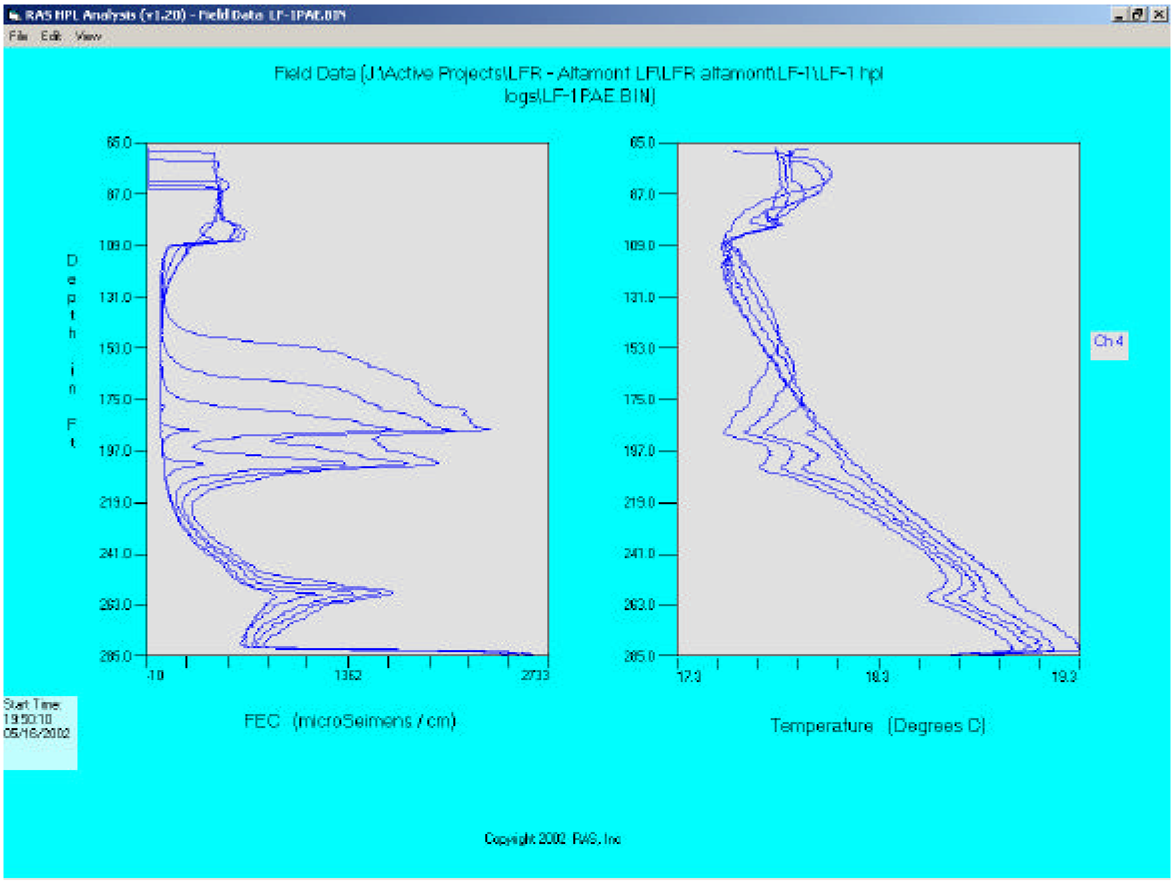
7.0 APPENDICES

7.1 Typical HpL log data.

7.2 Forms as provided by Contractor

Typical HpL Log Data

Appendix 7.1



WELL: NAME WB-05
PROJECT: CAMP STANLEY
SAN ANTONIO, TEXAS

RAS Integrated Subsurface Evaluation
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email: PedlerRAS@aol.com • www.rasinc.org

LEGEND

GEOPHYSICAL LOGS

Gamma
Standard gamma ray (includes K, U, and Th)

Hole Size
Caliper - Drillhole diameter from three arm caliper

Resistivity
Induction Resistivity
Short Normal Resistivity 16" spacing
Long Normal Resistivity 64" spacing
Lateral Resistivity
Single Point Resistance

All Geophysical Logs conducted in completed well condition.

MISCELLANEOUS NOTES:

1. Ground elevation: XXXX feet. Top of casing elevation: XXX feet
2. All depths referenced to top of casing.
3. Coordinates of well by surveyed location (NAVD88)
   Northing: XXXXXCX Easting: XXXXXX
4. XXXXXXXXXXXXX
5. XXXXXXXXXXXXX
6. Geophysical logging conducted by RAS, Inc. on 08/15 & 08/16/2005.
7. Hydrophysical logging conducted by RAS, Inc. on 08/18/2005.

WELL: NAME WB-06
PROJECT: CAMP STANLEY
SAN ANTONIO, TEXAS

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email: PedlerRAS@aol.com • www.rasinc.org

LEGEND

GEOPHYSICAL LOGS

Gamma
Standard gamma ray (includes K, U, and Th)

Hole Size
Caliper - Drillhole diameter from three arm caliper

Resistivity
Induction Resistivity
Short Normal Resistivity 16" spacing
Long Normal Resistivity 64" spacing
Lateral Resistivity
Single Point Resistance

All Geophysical Logs conducted in completed well condition.

MISCELLANEOUS NOTES:

1. Ground elevation: XXXX feet. Top of casing elevation: XXX feet.
2. All depths referenced to top of casing.
3. Coordinates of well by surveyed location (NAVD88): Northing: XXXXXX Easting: XXXXXX
4. XXXXXXXXXXXXX
5. XXXXXXXXXXXXX
6. Geophysical logging conducted by RAS, Inc. on 08/18/2005.
7. XXXXXXXXXXXXXXXXXXX

Depth (feet below TOC)	Geophysics		Well Construction	Geology	Elevation (feet above MSL)	Image Analysis				Depth (feet below TOC)
	Gamma (API units) Caliper (inches)	Induction Resistivity (ohm-m) Short Normal Resistivity (ohm-m) Long Normal Resistivity (ohm-m) Lateral Resistivity (ohm-m) Single Point Resistance (ohms)		Lithology		Optical Log	Karst Frequency (per foot)	Karst Aperture (mm)	Geophysically & Hydrophysically Derived Lithology and Well Construction	

Modified 09/14/2005

WELL: NAME WB-07
PROJECT: CAMP STANLEY
SAN ANTONIO, TEXAS

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LEGEND

GEOPHYSICAL LOGS

Gamma
Standard gamma ray (includes K, U, and Th)

Hole Size
Caliper - Drillhole diameter from three arm caliper

Resistivity
Induction Resistivity
Short Normal Resistivity 16" spacing
Long Normal Resistivity 64" spacing
Lateral Resistivity
Single Point Resistance

All Geophysical Logs conducted in completed well condition.

MISCELLANEOUS NOTES:

1. Ground elevation: XXXX feet. Top of casing elevation: XXX feet.
2. All depths referenced to top of casing.
3. Coordinates of well by surveyed location (NAVD88):
   Northing: XXXXXX Easting: XXXXXX
4. XXXXXXXXXXXXX
5. XXXXXXXXXXXXX
6. Geophysical logging conducted by RAS, Inc. on 08/19/2005.
7. XXXXXXXXXXXXXXXX

WELL: NAME WB-08
PROJECT: CAMP STANLEY
SAN ANTONIO, TEXAS

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email: PedlerRAS@aol.com • www.rasinc.org

LEGEND

GEOPHYSICAL LOGS

Gamma
Standard gamma ray (includes K, U, and Th)

Hole Size
Caliper - Drillhole diameter from three arm caliper

Resistivity
Induction Resistivity
Short Normal Resistivity 16" spacing
Long Normal Resistivity 64" spacing
Lateral Resistivity
Single Point Resistance

All Geophysical Logs conducted in completed well condition.

MISCELLANEOUS NOTES:

1. Ground elevation: XXXX feet. Top of casing elevation: XXX feet.
2. All depths referenced to top of casing.
3. Coordinates of well by surveyed location (NAVD88):
   Northing: XXXXXX Easting: XXXXXX
4. XXXXXXXXXXXXX
5. XXXXXXXXXXXXX
6. Geophysical logging conducted by RAS, Inc. on 08/18/2005.
7. XXXXXXXXXXXXXXXX

GEO CAM

Water Well Logging & Video Recording Services

Geo Cam, Inc. 2038 Adobe Trail San Antonio, TX 210-495-9121

Borehole: **WELL NO. CS-B3_MWO1**

Logs: **Gamma, Resistivity, Caliper, SP, SPR**

Project: **CS-B3_MWO1 - CAMP STANELY** Date: 09-15-05

Client: **GEO PROJECTS INTERNATIONAL INC.** County: BEXAR

Location: **N 29* 42' 38.5" W 98* 36' 50.6"** State: TX

BOREHOLE DATA

Drilling Contractor: GEO PROJECTS **Driller T.D. (ft) : 292.5**

Elevation: NA Logger T.D. (ft) : 291.9

Depth Ref: GROUND LEVEL Date Drilled: 09-15-05

BIT RECORD				CASING RECORD		
RUN	BIT SIZE (in)	FROM (ft)	TO (ft)	SIZE/WGT/THK	FROM (ft)	TO (ft)
1	7 7/8"	0	292.5	NA		
2						
3						

Drill Method: AIR ROTARY Weight: **Fluid Level (ft) :** 173

Hole Medium: Mud Type: Time Since Circ:

Viscosity: Rm: at: Deg C

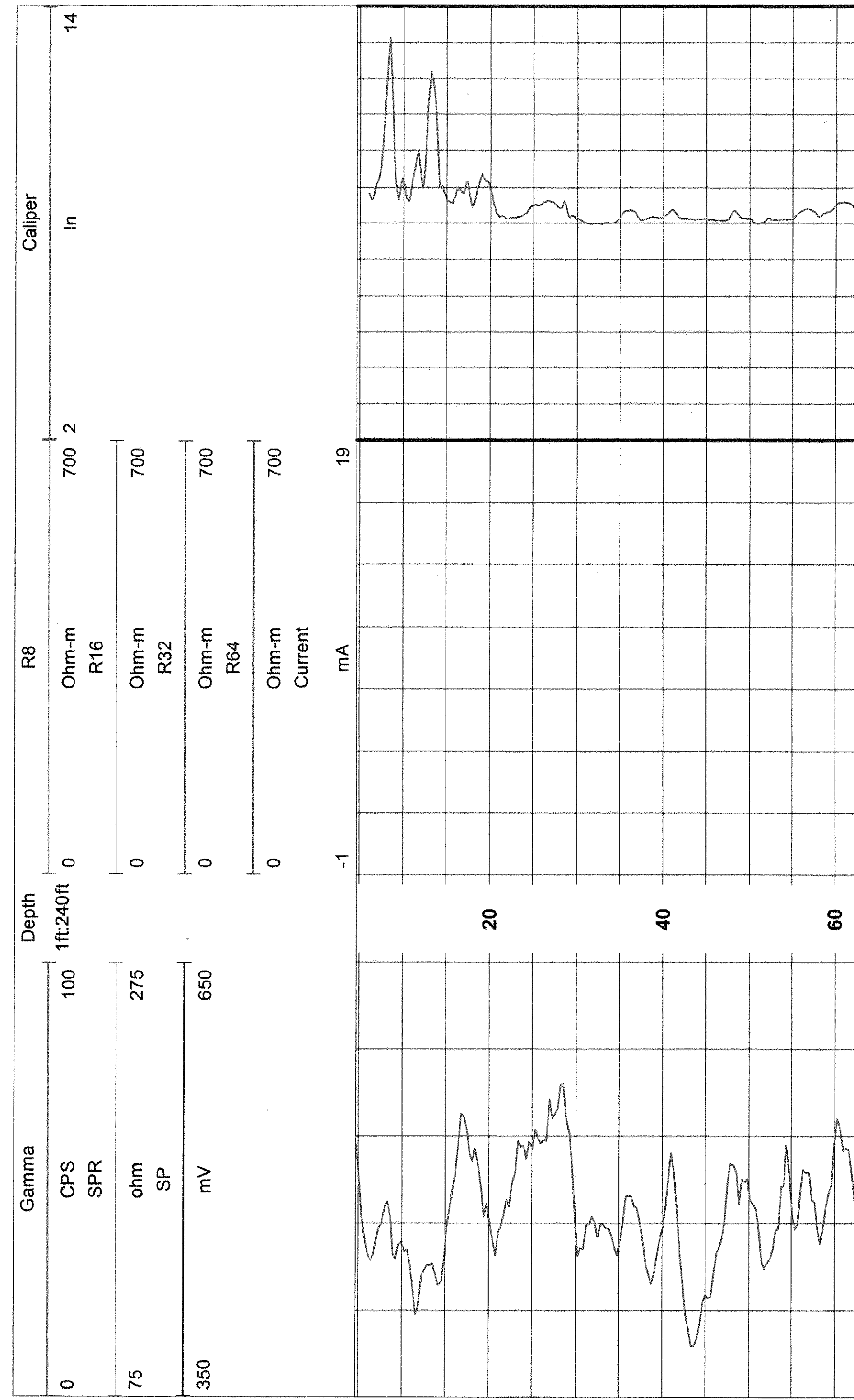
GENERAL DATA

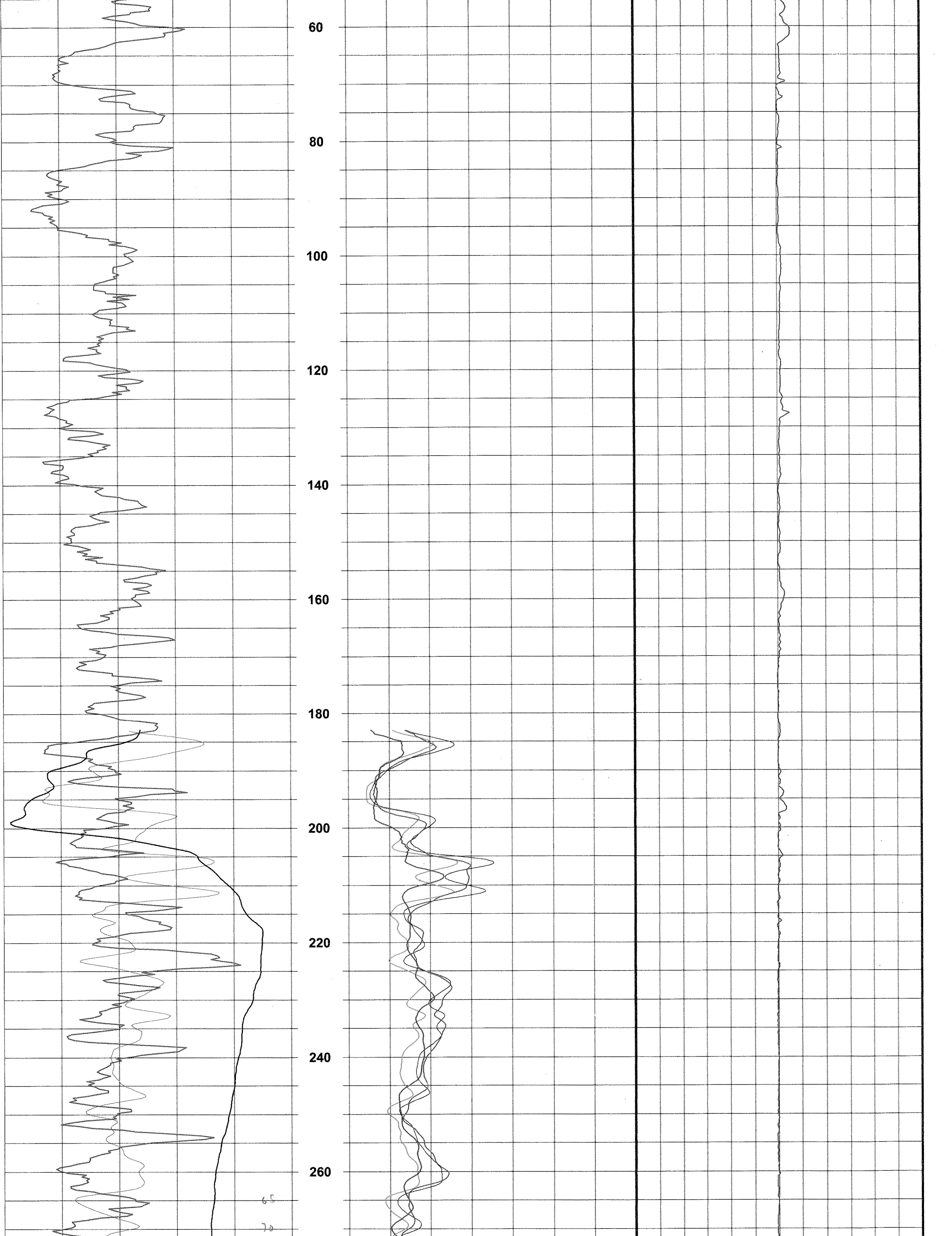
Logged by: Kelly Tuten Unit/Truck: 04

Witness: Lee Gabbert

LOG TYPE	RUN NO	SPEED (ft/min)	FROM (ft)	TO (ft)	FT./ IN.
GAMMA	2	16	286	5	20
RESISTIVITY, SP, SPR	2	16	290	173	20
CALIPER	1	17	291	6	20

Comments:

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80
100
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140
160
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200
220
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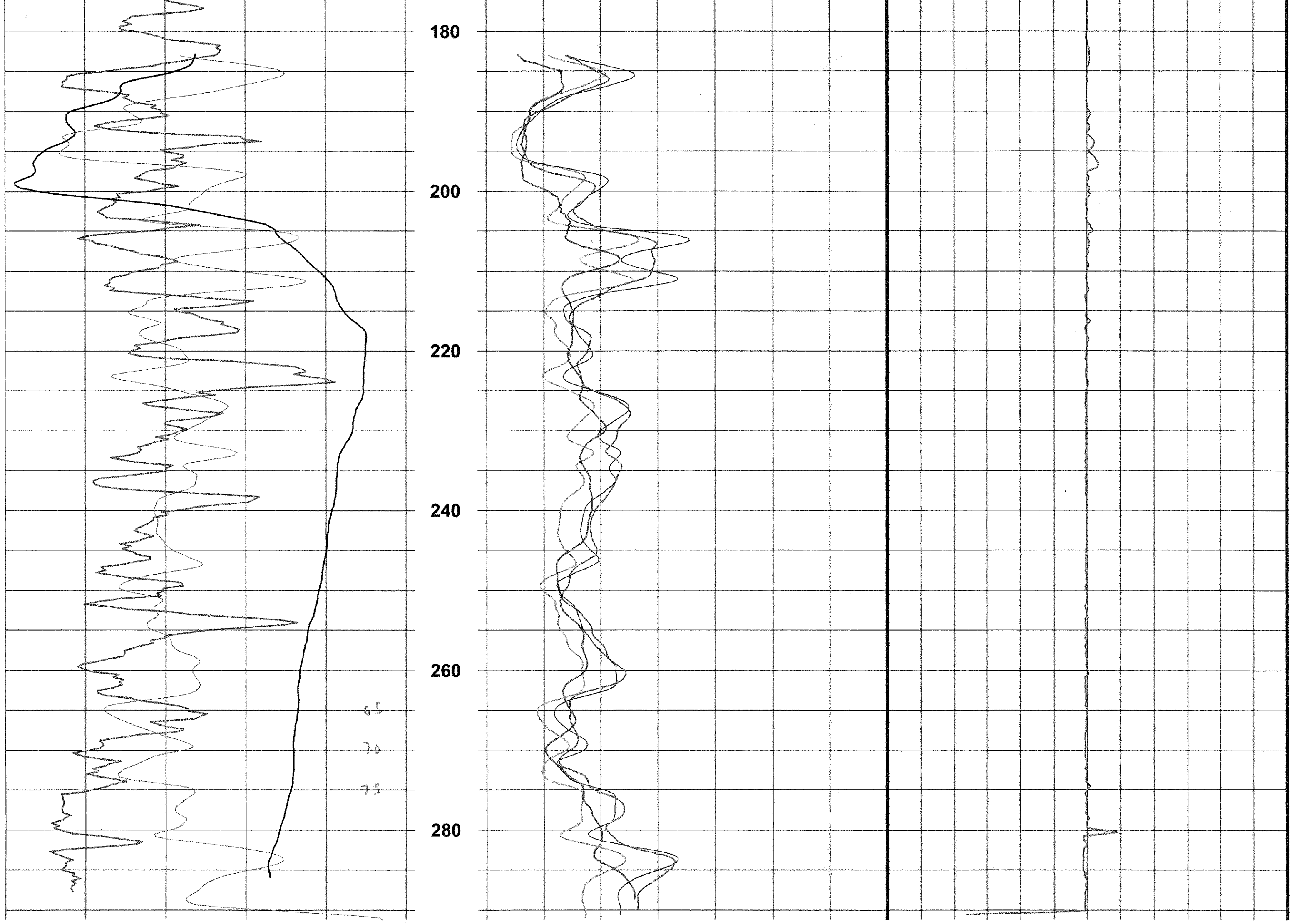
260


180
200
220
240
260
280

Camp Stanley FLUTe profiling results from measurement made on 7/29/05

hole depth= 480 ft., diam. = 4.5", water table is 174 ft, casing is 30 ft below surface
data taken over 1.47 hrs. starting about 3pm.

The liner was filled with water and released from about 215 ft. The liner velocity then overshoots and drops to a steady state at about 223 ft.
Results in general: large conductive zone ~238 ft., relatively tight to 277 ft. , permeable zone to 328 ft, with high permeability at ~331 ft., tight from 333 to 400 ft., permeable zone from there to 457 ft, conductivity from there to 480 ft of 6.95 e-06 cm/s

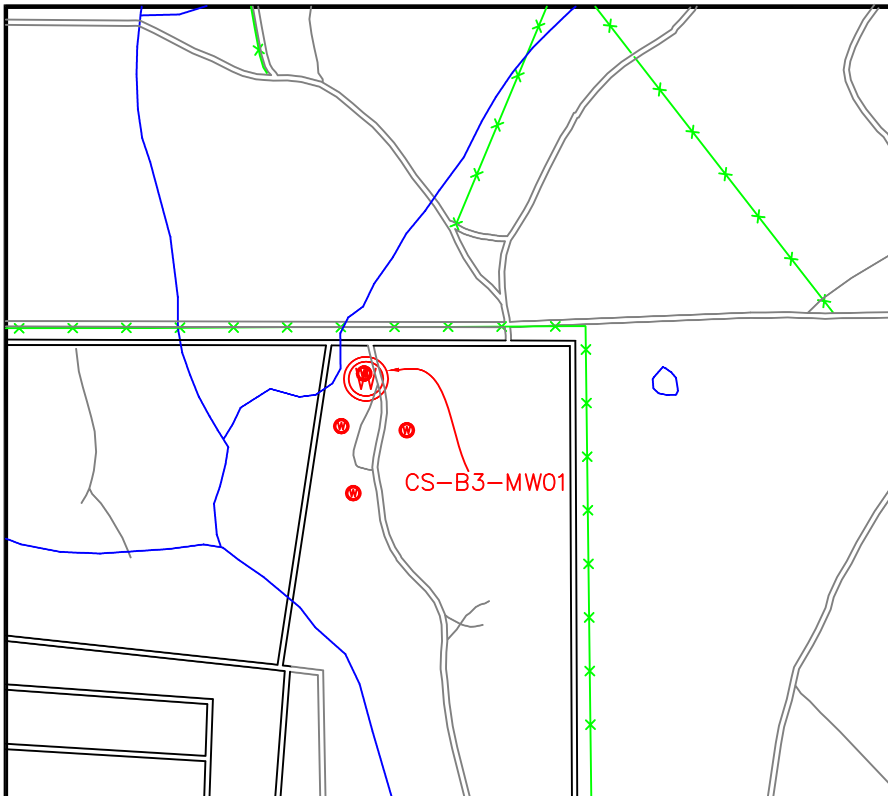
TEST INFO		
UGR/LGR	20	-1
UGR/LGR	20	30
LGR/BS	334	-1
LGR/BS	334	30
BS/CC	394	-1
BS/CC	394	30
Water Level	174	-1
	174	30
Steady-State	229	-1
	229	30

This plot uses the conductivity distribution measured to estimate the drill water flow. The total flow of 25 gal was the rate described and defined as the maximum flow seen at the bottom of the hole. This calculation assumes that the formation conductivity measured is associated with a water production capacity.
That is realistic in that the flow measured was in progress until sealed by the liner.

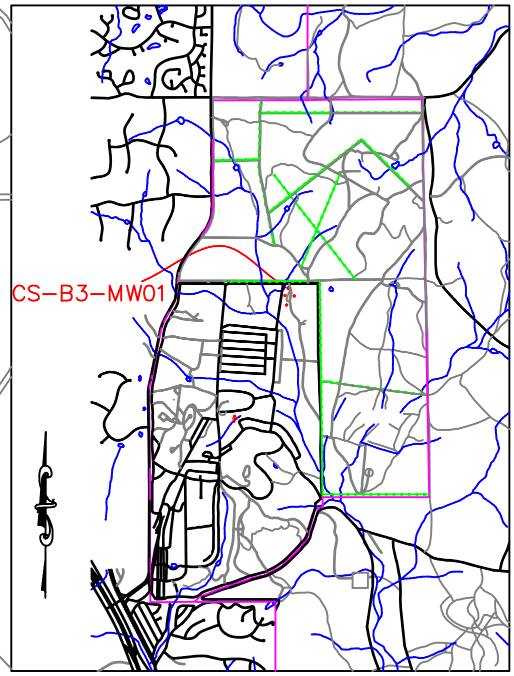
Remaining conductivity in 23 ft of open hole below the liner
6.95e-06 cm/sec based upon a final velocity of 0.00268 ft/sec with a driving head of 18.9 psi (43 ft).

Measurements performed for Parsons with Scott Pearson as technical lead.
The effective liner velocity with depth is the Yellow curve (monotonic V/dH, smoothed over N)
The end of the liner is submerged at about 321 ft. The velocity oscillations at shallower depths are due to stick/slip drag in the liner above the water table.
The oscillations are relatively benign for this measurement, the deepest water table measurement to date. After the liner submerges at 321 ft, the data is very clean.

APPENDIX D
WELL SURVEY DATA



CAMP STANLEY STORAGE ACTIVITY



DATUM

Horizontal: NAD83
Vertical: NAVD88,
Geoid 03
Coordinates: UTM
Zone 14

NORTHING
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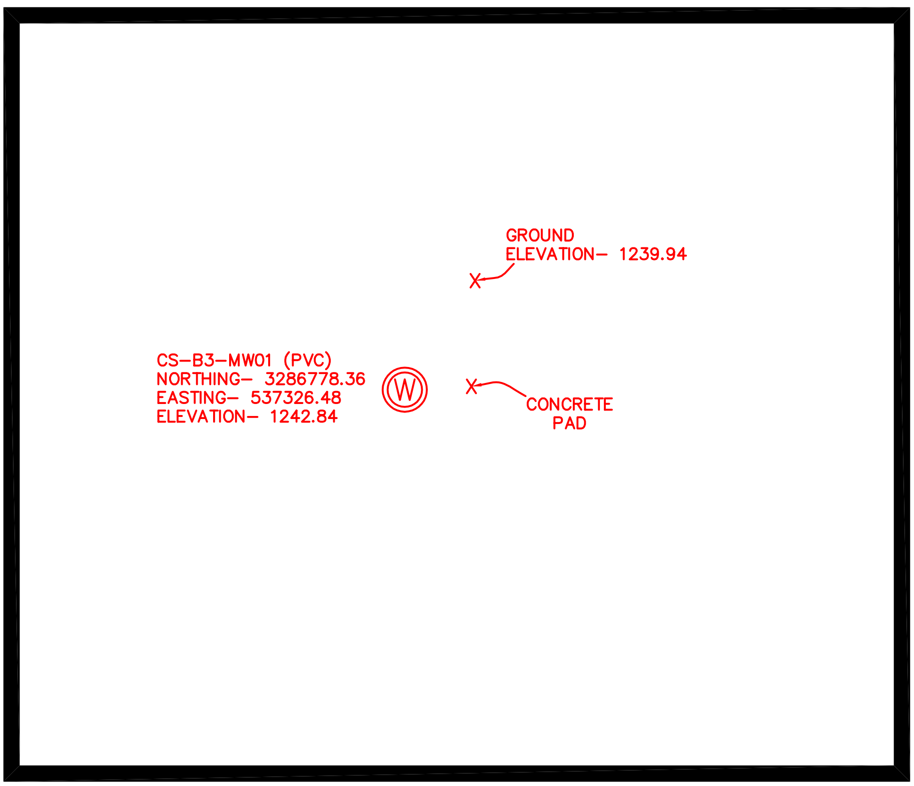
EASTING
537326.48 (METERS)
ELEV: 1242.84 (FEET)



BAKER
SURVEYING &
ENGINEERING, INC.
PH. (830)833–2250
FAX. (830)–833–2257
U.S. HWY 281 N.
BLANCO, TEXAS 78606–5356

Prepared for:

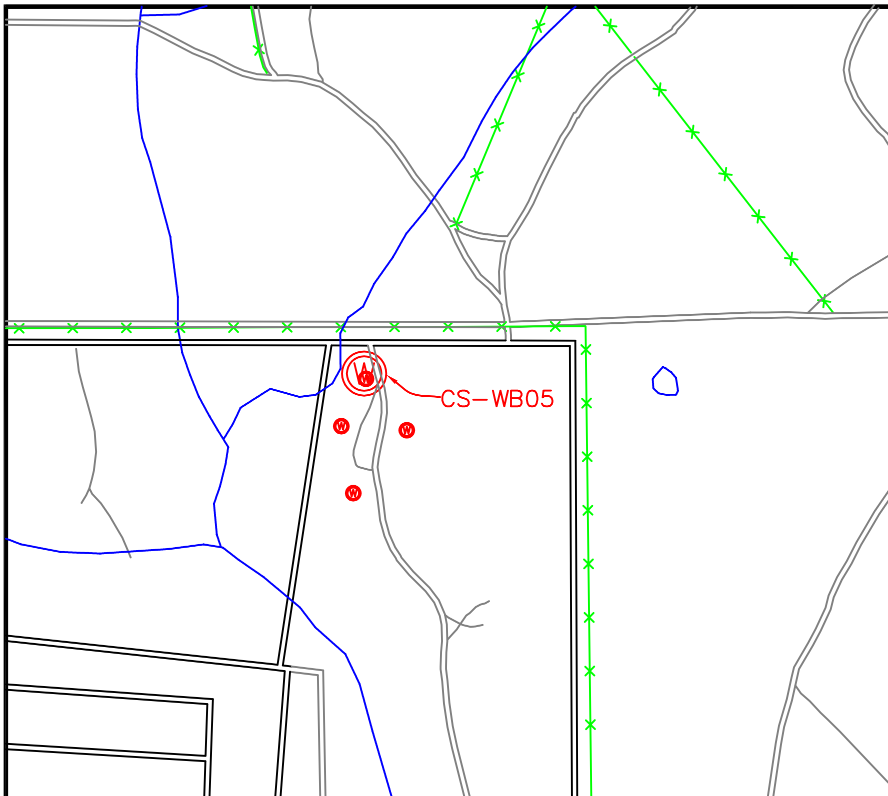
Parsons

901 NE Loop 410, Suite 610
San Antonio, Texas 78218
210–805–2282
Fax: 210–828–2655

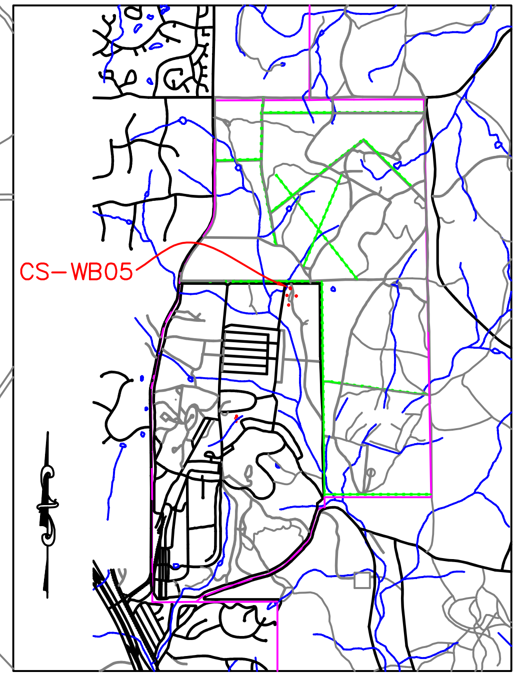
GPS Survey of Permanent Control Points

CS-B3-MW01

PROJECT NO.: 06–034
DWG No.: H:\Draw 2006\06–034 PARSONS\DWG\06–034 PARSONS.DWG



CAMP STANLEY
STORAGE ACTIVITY



N.T.S.

DATUM
Horizontal: NAD83
Vertical: NAVD88,
Geoid 03
Coordinates: UTM
Zone 14

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EASTING
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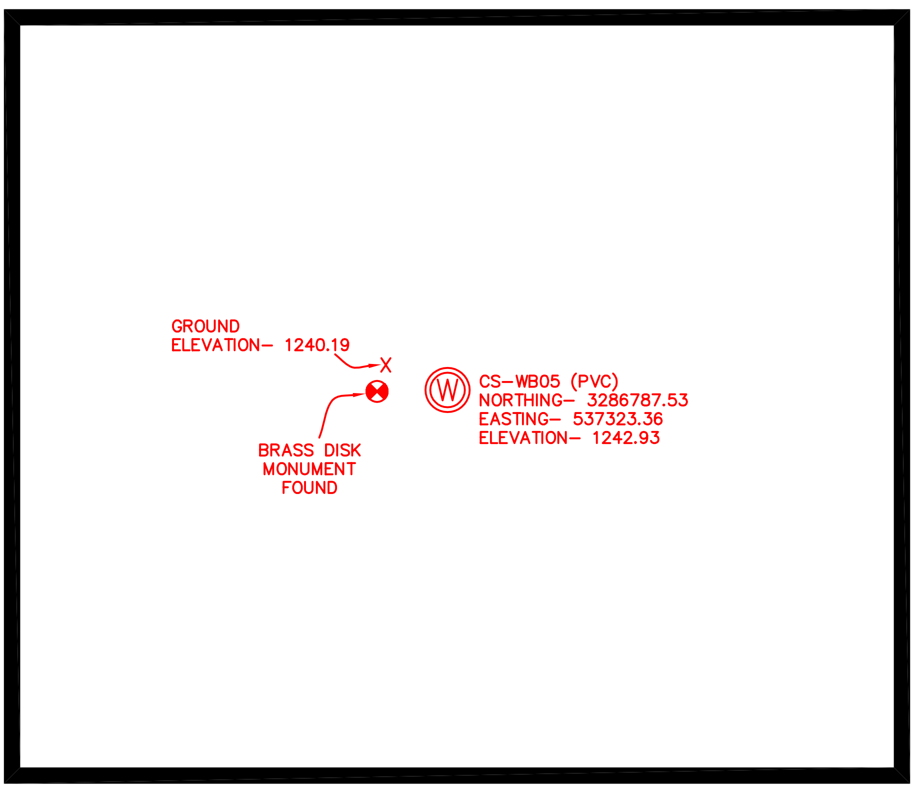
ELEV: 1242.93 (FEET)



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BLANCO, TEXAS 78606-5356

Prepared for:

Parsons

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San Antonio, Texas 78218
210-805-2282
Fax: 210-828-2655

GPS Survey of Permanent Control Points

CS-WB05

PROJECT NO.: 06-034
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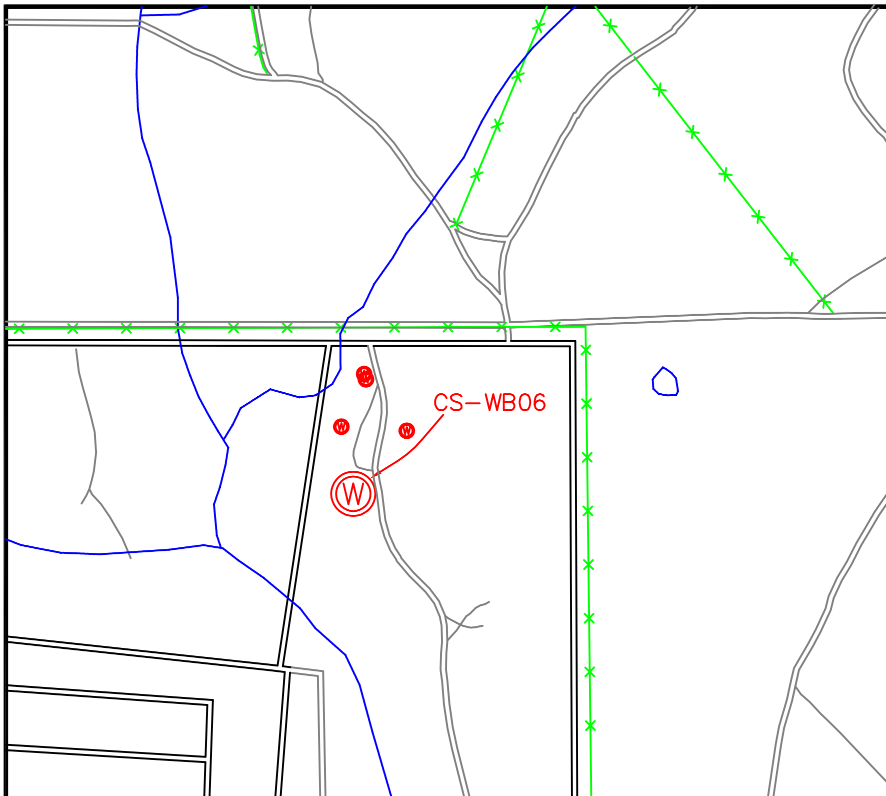
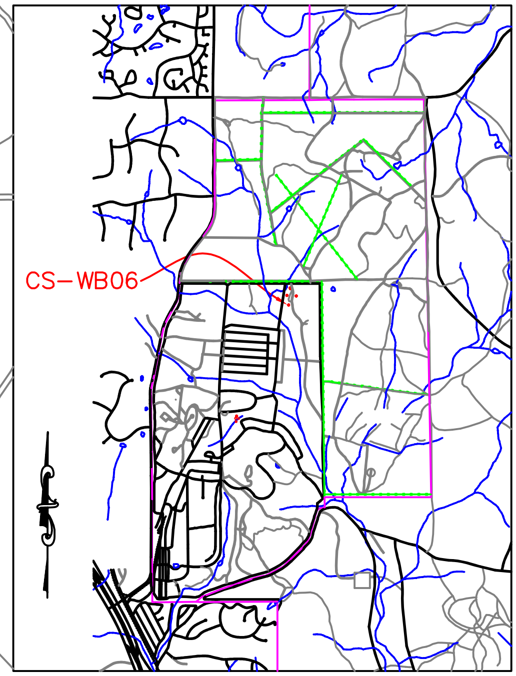
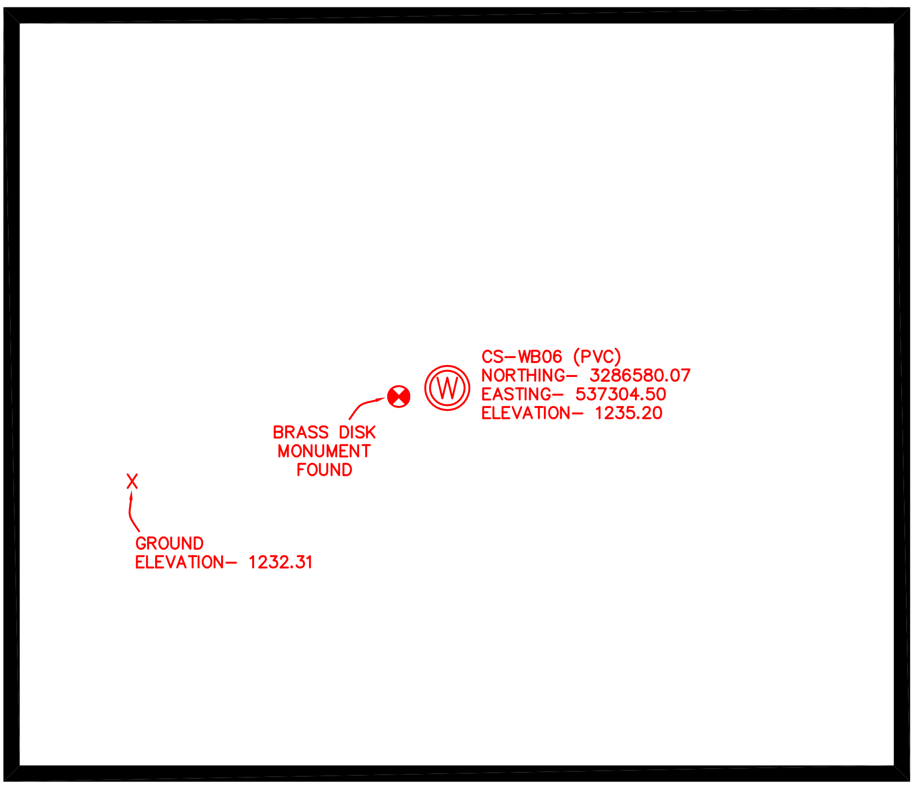


CAMP STANLEY STORAGE ACTIVITY





DATUM

Horizontal: NAD83
Vertical: NAVD88, Geoid 03
Coordinates: UTM Zone 14

NORTHING
3286580.07 (METERS)
EASTING
537304.50 (METERS)
ELEV: 1235.20 (FEET)

BAKER
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BLANCO, TEXAS 78606-5356

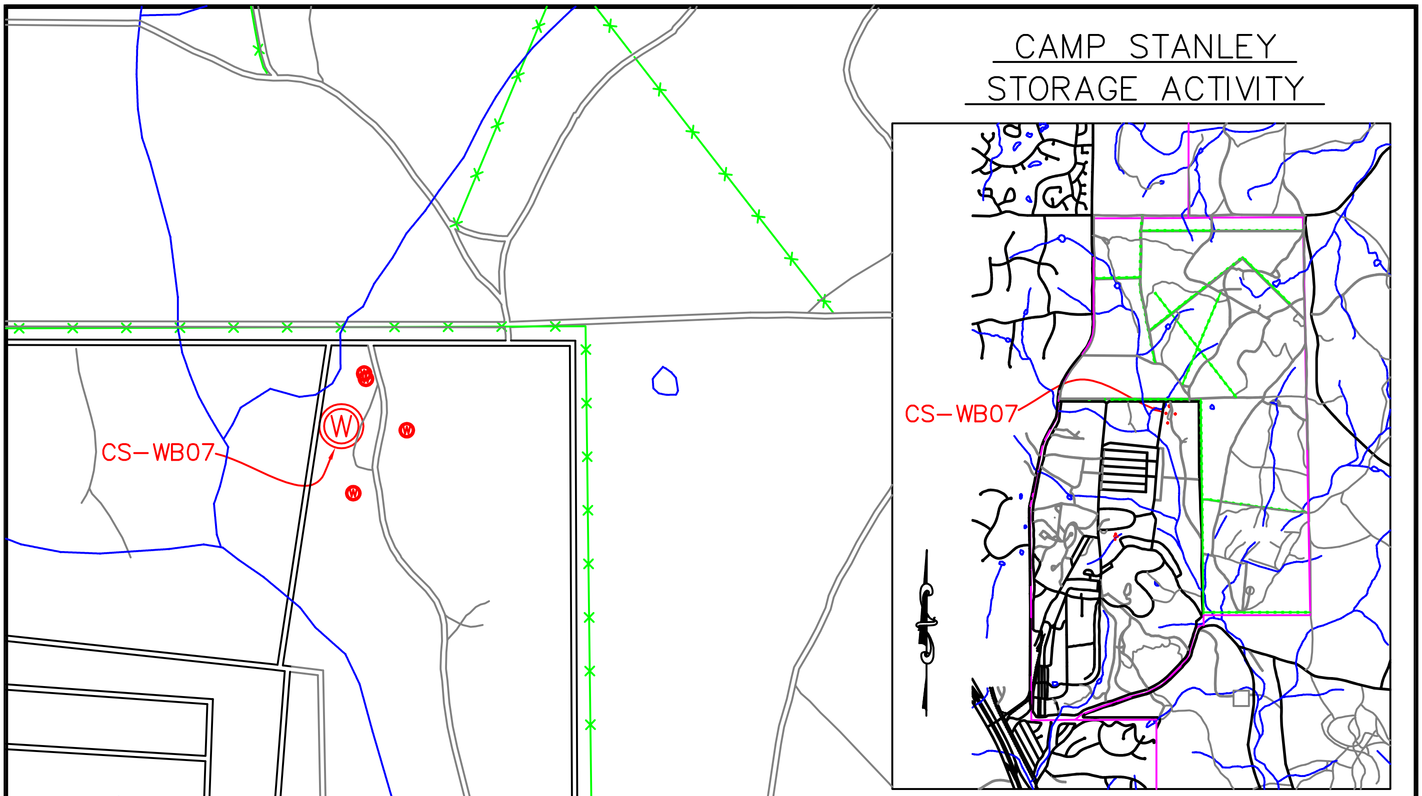
Prepared for:

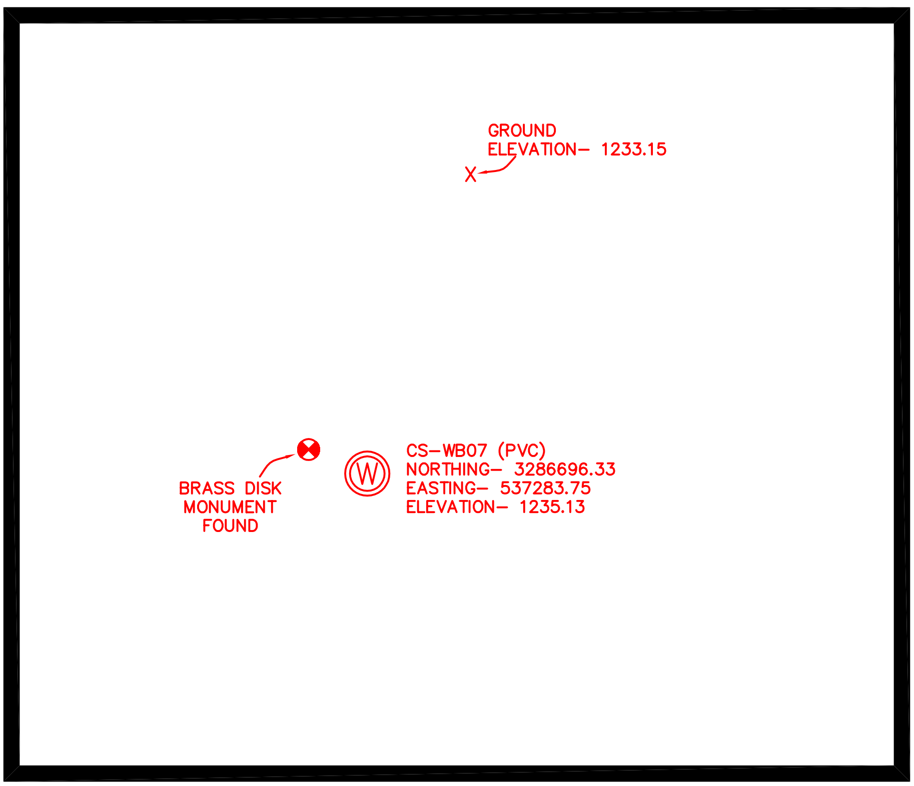
Parsons
901 NE Loop 410, Suite 610
San Antonio, Texas 78218
210-805-2282
Fax: 210-828-2655

GPS Survey of Permanent Control Points

CS-WB06

PROJECT NO.: 06-034
DWG No.: H:\Draw 2006\06-034 PARSONS\DWG\06-034 PARSONS.DWG





DATUM

Horizontal: NAD83

Vertical: NAVD88, Geoid 03

Coordinates: UTM Zone 14

NORTHING
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EASTING
537283.75 (METERS)

ELEV: 1235.13 (FEET)

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SURVEYING & ENGINEERING, INC.
PH. (830)833-2250
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U.S. HWY 281 N.
BLANCO, TEXAS 78606-5356

Prepared for:

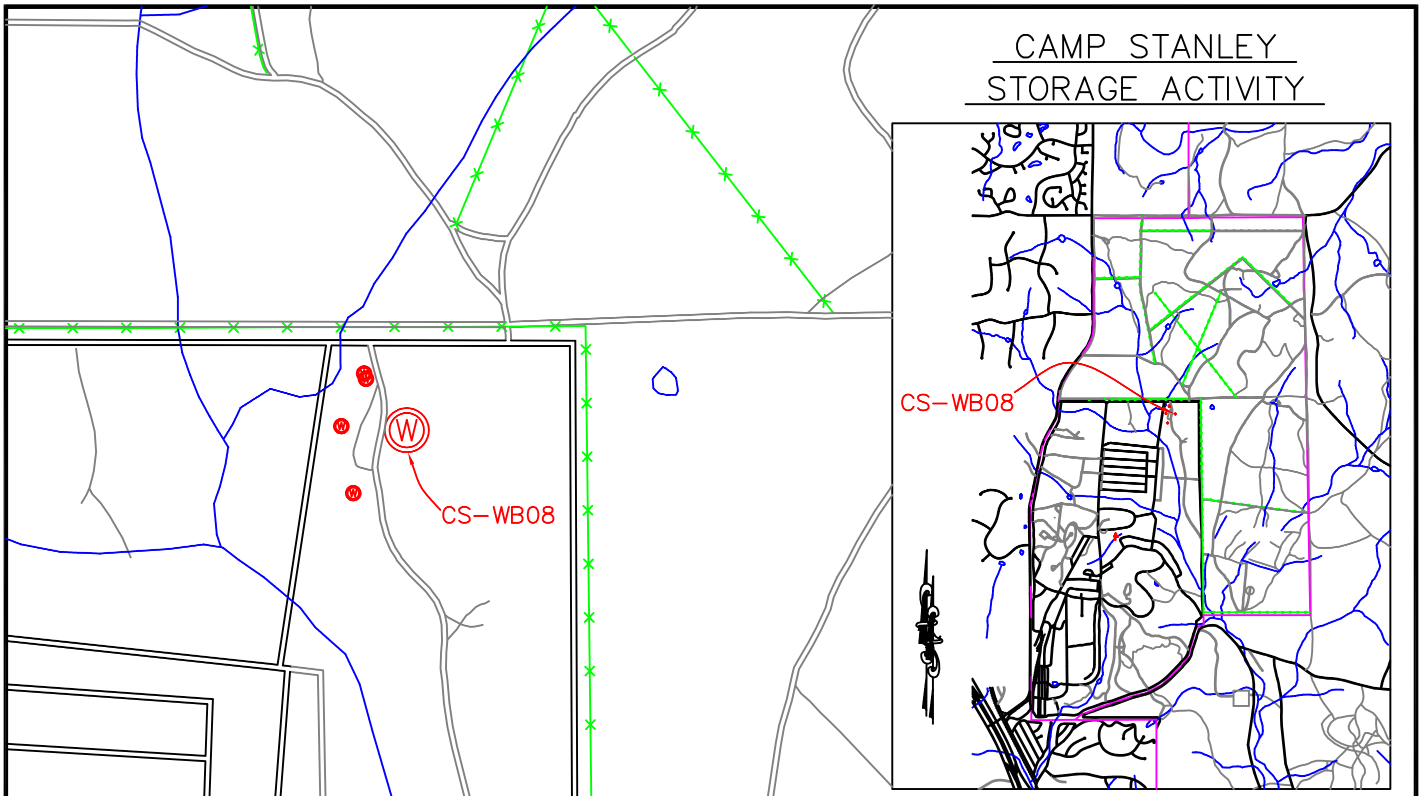
Parsons

901 NE Loop 410, Suite 610
San Antonio, Texas 78218
210-805-2282
Fax: 210-828-2655

GPS Survey of Permanent Control Points

CS-WB07

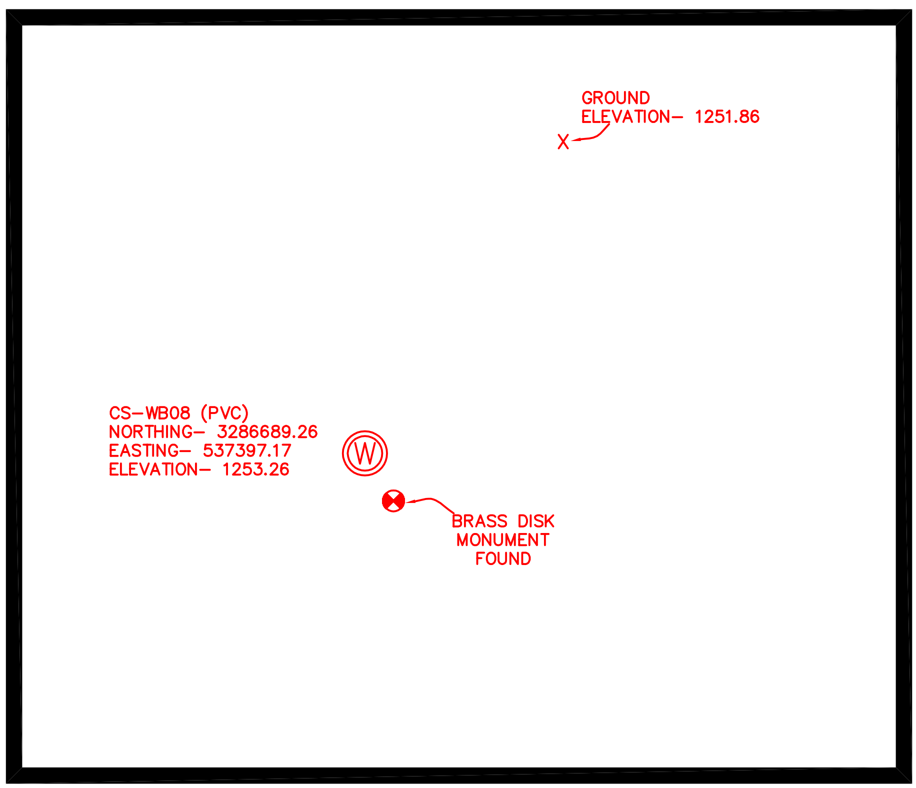
PROJECT NO.: 06-034
DWG No.: H:\Draw 2006\06-034 PARSONS\DWG\06-034 PARSONS.DWG



DATUM

Horizontal: NAD83
Vertical: NAVD88,
Geoid 03
Coordinates: UTM
Zone 14

NORTHING
3286689.26 (METERS)
EASTING
537397.17 (METERS)
ELEV: 1253.26 (FEET)



BAKER
SURVEYING &
ENGINEERING, INC.
PH. (830)833–2250
FAX. (830)–833–2257
U.S. HWY 281 N.
BLANCO, TEXAS 78606–5356

Prepared for:

Parsons

901 NE Loop 410, Suite 610
San Antonio, Texas 78218
210–805–2282
Fax: 210–828–2655

GPS Survey of Permanent Control Points

CS-WB08

PROJECT NO.: 06–034
DWG No.: H:\Draw 2006\06–034 PARSONS\DWG\06–034 PARSONS.DWG

APPENDIX E
PARSONS TECHNICAL MEMORANDUM, LOCATION AND CONSTRUCTION RECOMMENDATIONS FOR THE PROPOSED INJECTION WELL AT SWMU B-3.

PARSONS

Technical Memorandum

To: Jeff Aston and Chris Beal, CSSA

From: Gary Cobb

CC: file (744223.04)

Date: September 9, 2005

Re: Location and Construction Information for the Proposed Injection Well at SWMU B-3

This Technical Memorandum presents location and construction recommendations for the planned injection well B3-MW01 at SWMU B-3. These recommendations for the injection well are submitted for your review and comment.

Parsons was contracted to perform a Pilot Study to evaluate enhanced anaerobic bioremediation as a remedial option for groundwater contaminants at SWMU B-3 at Camp Stanley Storage Activity. The Pilot Study will involve injection of an organic substrate into the Lower Glen Rose formation at SWMU B-3 and monitoring the effects of the substrate on anaerobic contaminant biodegradation rates. The location selected for the Pilot Study is the area between the suspected source area at the SWMU B-3 landfill and well CS-MW16 to the northwest where contaminants are present in the groundwater (see Figure 1, attached). An injection well (B3-MW01) will be installed along the migration pathway between the suspected source and well CS-MW16 to facilitate injection of the organic substrate. One of the Westbay monitoring wells (CS-WB-05) being installed to monitor SWMU B-3 will be utilized as the downgradient monitoring point for the study.

In selecting the location and depth for the injection well, the hydraulic properties, contaminant concentrations, and stratigraphic position for the injection zone were considered. The hydraulic properties influence the rate and direction of groundwater flow, contaminant migration, and migration of the substrate within the injection zone. Contaminant concentrations within the zone should be sufficiently high so changes in concentration due to increased biodegradation can be accurately measured and quantified. Stratigraphic considerations include adequate depth below the water table to ensure the zone will remain saturated during the study, and zone thickness is no more than 30 feet to minimize the volume of substrate required for the study.

To aid in determining location of the injection well and selection of the zone within the formation for injection of the substrate, geophysical and hydraulic testing was performed on the borehole drilled for Westbay well CS-WB05. Results of that testing were used to select potential injection zones and determine the necessary separation distance between the injection well and Westbay well CS-WB05, which will be used as a downgradient monitoring point for the study. Borehole testing included:

- Geophysical borehole logging: Caliper, electric, electromagnetic, natural gamma, video, and optical televiewer logging to determine physical properties of the rock material and identify stratigraphic zones within the formation;
- Hydrophysical testing: To identify the permeable zone within the saturated interval of the formation to provide preliminary estimates of groundwater flowrates within the permeable zones; and
- Hydraulic testing: Packer testing on selected intervals within the formation was done to assess hydraulic properties of the zones and to collect discrete interval groundwater samples

to determine contaminant concentrations within each zone. A 20-foot packer spacing was used for the hydraulic testing.

Injection Zone Selection

From Parsons' evaluation of the borehole geophysical logging, depths to the LGR(d), LGR(e), and LGR(f) hydrostratigraphic units were determined to be 153, 212, and 274 feet below ground surface (bgs), respectively (see attached geophysical log). As discussed in the Draft Work Plan for Enhanced Anaerobic Biodegradation Pilot Study at SWMU B-3 (Parsons, July 2005), the desired depth for the injection well is within the LGR(d) or LGR(e) hydrostratigraphic zone to ensure the zone would remain saturated for the duration of the study. As discussed in the Draft Work Plan, injection into the lower portion of the LGR(f) interval is not preferred because the thickness and high permeability of this interval would require large volumes of substrate to create conditions conducive to enhancing natural biodegradation processes. Therefore, in Parsons opinion, an injection zone within the LGR(d), LGR(e) and upper portions of the LGR(f) hydrostratigraphic intervals should be considered for the injection zone. Additionally, the zone selected for the injection should be separated from permeable zones immediately above or below so the substrate can be placed into the desired zone with minimal loss into adjacent layers.

Results of the hydrophysical testing identified four probable permeable zones above the lower LGR(f) interval, 168-173 feet,, 184-189 feet, 205-218 feet, and 278-287 feet (see attached preliminary hydrophysics results). Water level in the boring was at 169 feet bgs during hydrophysics testing; as a result, Parsons believes the upper interval in the hydrophysics data (168-173 feet) may be the result of water entering the borehole from minor saturated zones above the water table. Additionally, because of its proximity to the water table, there is a high probability that the 184-189-foot zone might not remain saturated for the entire study period and, therefore, would not be suitable as the injection zone. Parsons believes the 205-218 and 278-287-foot intervals represent the best options for the injection zone.

Injection packer tests were performed at four intervals in the CS-WB05 borehole: 162-182 feet, 198-218 feet, 230-250 feet, and 268-288 feet. Preliminary analysis of the recovery data for intervals at 198-218 feet and 268-288 feet indicates that the hydraulic conductivities of the 198-218 foot and 268-288 foot intervals are approximately 0.58 and 2.7 ft/day, respectively (see attached calculation sheets). Injection test results of the 230-250 foot interval indicate this interval is very impermeable, so additional analysis of this zone was not performed. Also, injection test results for the 162-182 foot zone were not analyzed since this zone is too close to the water table.

To establish hydraulic properties, discrete interval packer testing was performed on specific zones in the CS-WB05 borehole. Groundwater samples were collected from 268-288 foot, 290-310 foot, and 320-340 foot intervals and submitted for VOC analysis (see Table 1, attached). An attempt to collect a sample from the 198-218 foot depth, was not successful due to low groundwater yield for that interval. Results of the sample collected from 268-288 feet contained PCE (31.3 µg/L), TCE (152 µg/L), cis-1,2-DCE (286 µg/L), and toluene (4.18 µg/L). Although the concentrations are not as high as in deeper intervals, contaminant concentrations in the 268-288 foot interval appear adequate for the pilot study objectives.

Based on the stratigraphic position, hydraulic conductivity estimates, and contaminant concentrations, Parsons believes the 278-288 foot interval is best suited for the substrate injection. The 205-218 foot interval appears less suitable for injection due to its lower permeability and uncertainties in contaminant concentrations. Therefore, Parsons recommends the injection well be constructed with a 10-foot screen interval set from 277-287 feet bgs.

Injection Well Location

Location of the injection well involved evaluating the following criteria:

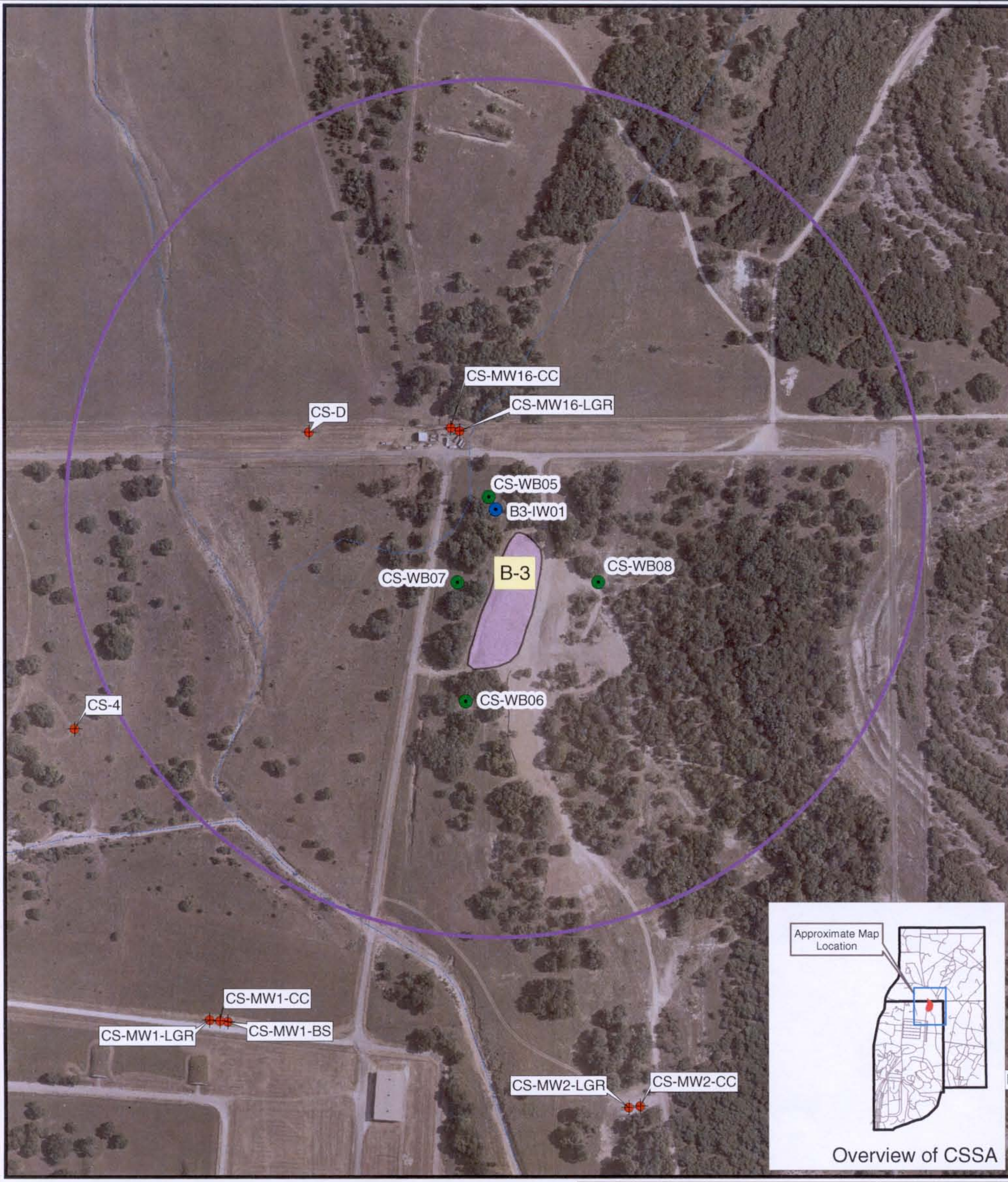
- Groundwater gradient: The injection well should be situated hydraulically upgradient of Westbay well CS-MW05 which will be used for monitoring purposes during the study; and

- Interwell spacing: A suitable distance between the injection well and downgradient monitoring well CS-WB05 should be determined to ensure that the desired results are obtained during the study.

One of the primary concerns of correctly locating the injection well is that the well must be hydraulically upgradient of the planned downgradient monitoring point, CS-WB05. Since natural groundwater gradients in the immediate area are not well defined and general knowledge about groundwater conditions at CSSA indicate that groundwater gradients may change with seasonal groundwater fluctuations, predictions of the natural gradients that will be present during the study are problematic. Pumping groundwater is one means of establishing and controlling local groundwater gradients. Monitoring well CS-MW16-LGR, located approximately 200 feet northwest of the planned pilot study, is cased to 200 feet and open hole from 200 to 325 and is equipped with a submersible pump. Therefore, Parsons recommends that well CS-MW16-LGR be pumped during the study to establish groundwater gradients within the aquifer and induce groundwater flow toward the pumping well. Also, since the gradient will be toward the pumping well, the injection well should be installed in line with well CS-WB05 and CS-MW16-LGR to ensure groundwater from the injection well will flow to the downgradient Westbay well.

Determining the well spacing between the injection well and Westbay well CS-WB05 requires consideration of the injection process and groundwater flow rates. The organic substrate injected into the formation will consist of a vegetable oil emulsion and water mixture. Parsons recommends the injection well be far enough away from the Westbay well to prevent the oil mixture from migrating to the Westbay well and potentially impacting the use of that well for monitoring purposes. The current plan is to inject the oil mixture at an approximate 15-foot radius from the injection well. Based on the planned substrate injection depth and allowing for uncertainties in aquifer hydraulic estimates, the interwell spacing should be no less than 25 feet to prevent potential impacts to the Westbay well.

The other consideration for interwell spacing is that the downgradient well should be within or on the fringe of the reaction zones that will be established downgradient of the substrate injection location. Based on experience, an appropriate interwell spacing can be established by estimating the distance groundwater will migrate in 30 days. The 30-day groundwater travel time estimate generally provides a reasonable means for establishing placement of downgradient monitoring points since size of the anaerobic biodegradation reaction zone is a function of groundwater migration rates. Estimates of groundwater velocity can be made using the hydraulic conductivity of the injection zone (2.7 ft/day) along groundwater gradients and a conservative porosity estimate of 5 percent. Estimating groundwater gradients that will be established during pumping of well CS-MW16-LGR are difficult without detailed groundwater modeling. Because groundwater gradients across the CSSA site generally range from 0.004 to 0.007, the gradients established by a pumping well at a distance of 200 feet could easily be 0.01 or greater. Using a gradient of 0.01, estimated groundwater velocities would be approximately 0.54 ft/day, which results in a 30-day travel time of 16.2 feet. Since this distance is less than the 25-foot recommended setback, Parsons believes this distance should be doubled to provide adequate safety to the Westbay well and allow for reasonable groundwater migration rates. Therefore, Parsons recommends injection well B3-MW01 be located approximately 35 feet upgradient of well CS-WB05 and in line with wells CS-WB05 and CS-MW16-LGR.



Aerial Photo Date: 2003

- Existing Monitoring Well Locations
- Proposed Westbay® Well Location
- Proposed Injection Well Location
- 1/4 Mile Radius around Proposed Injection Well
- Creeks (Dashed where intermittent)
- SWMU Boundary

N / W / E / S

400 200 0 400 Feet

Figure: 1

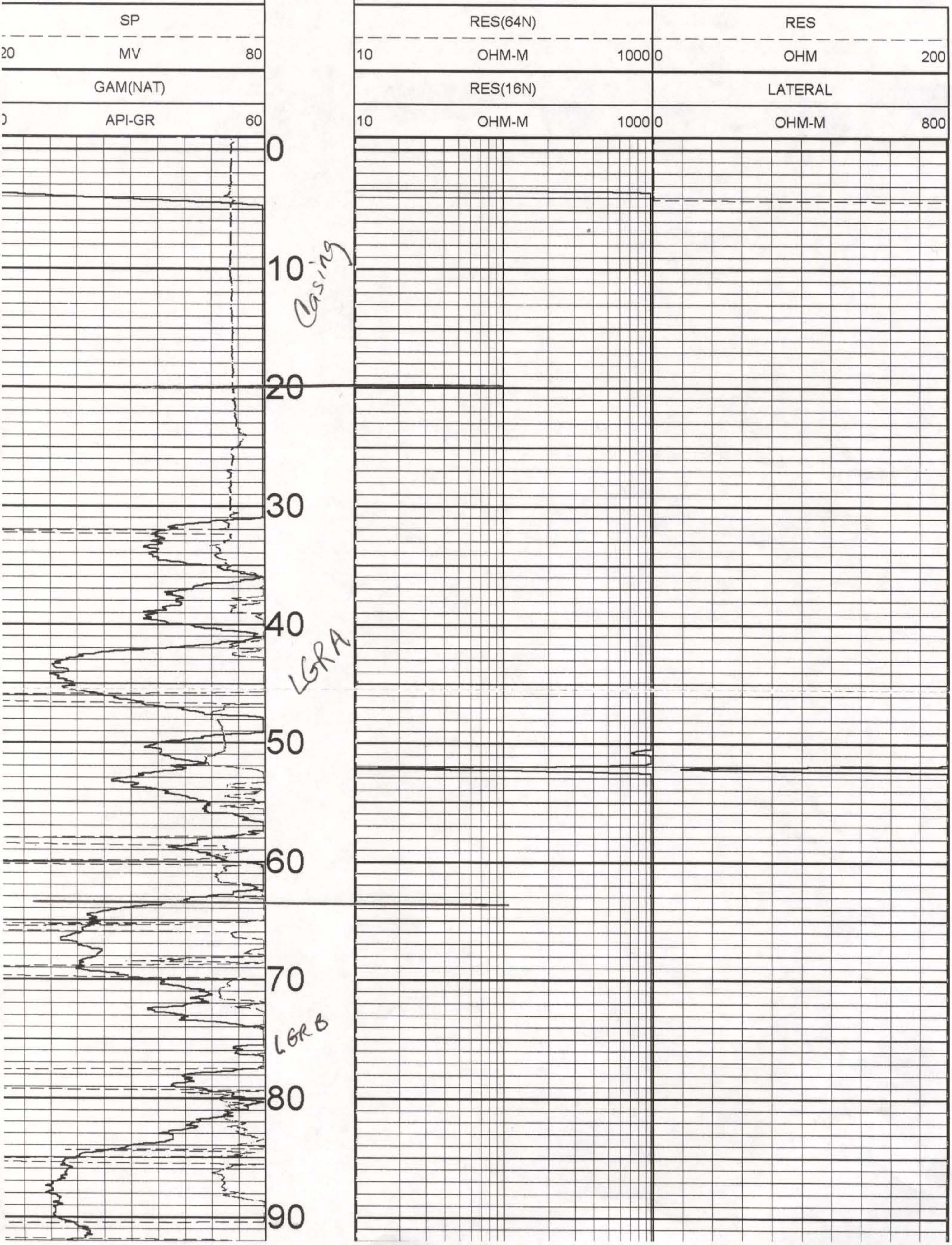
Well Location Map

Camp Stanley Storage Activity

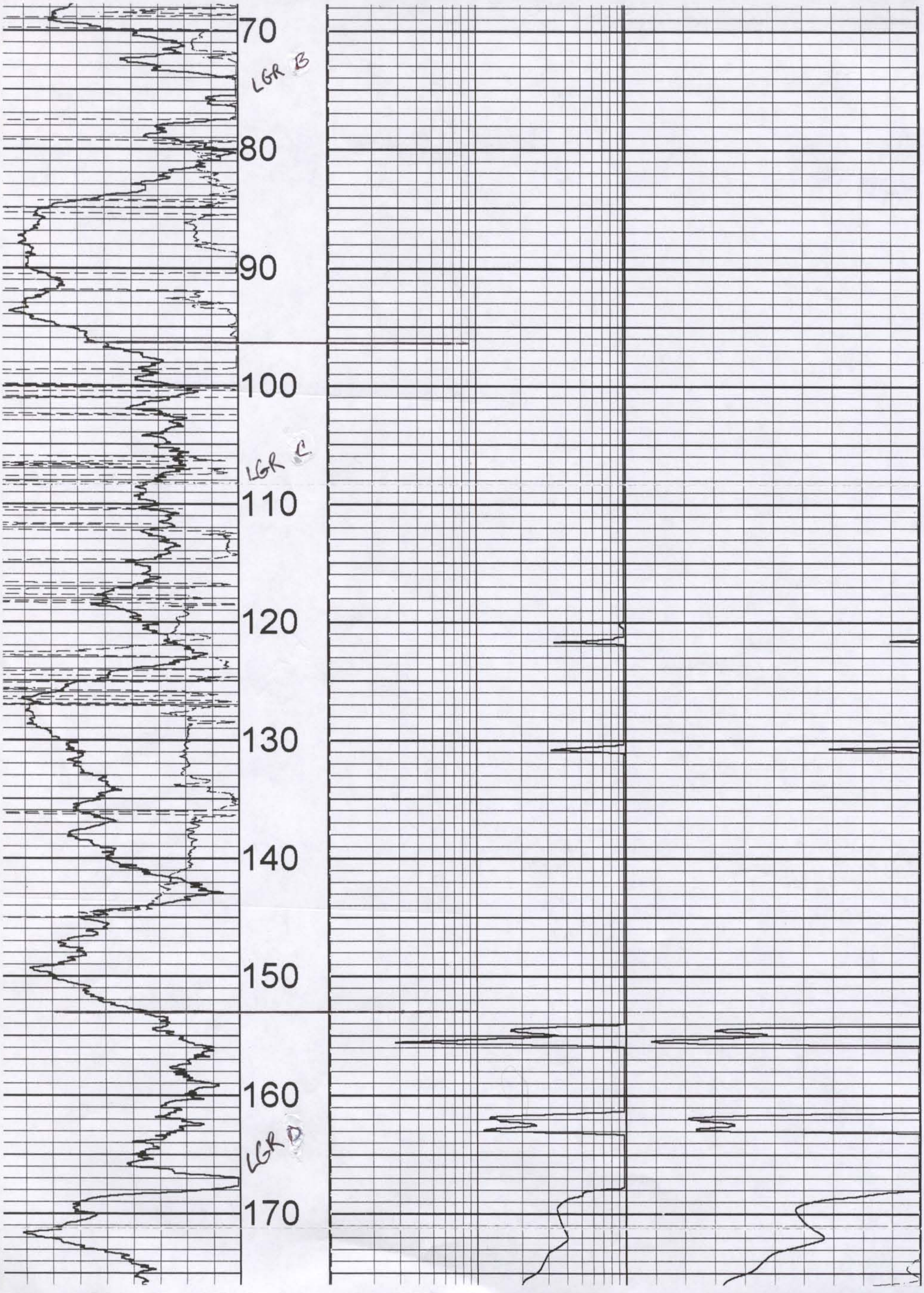
PARSONS

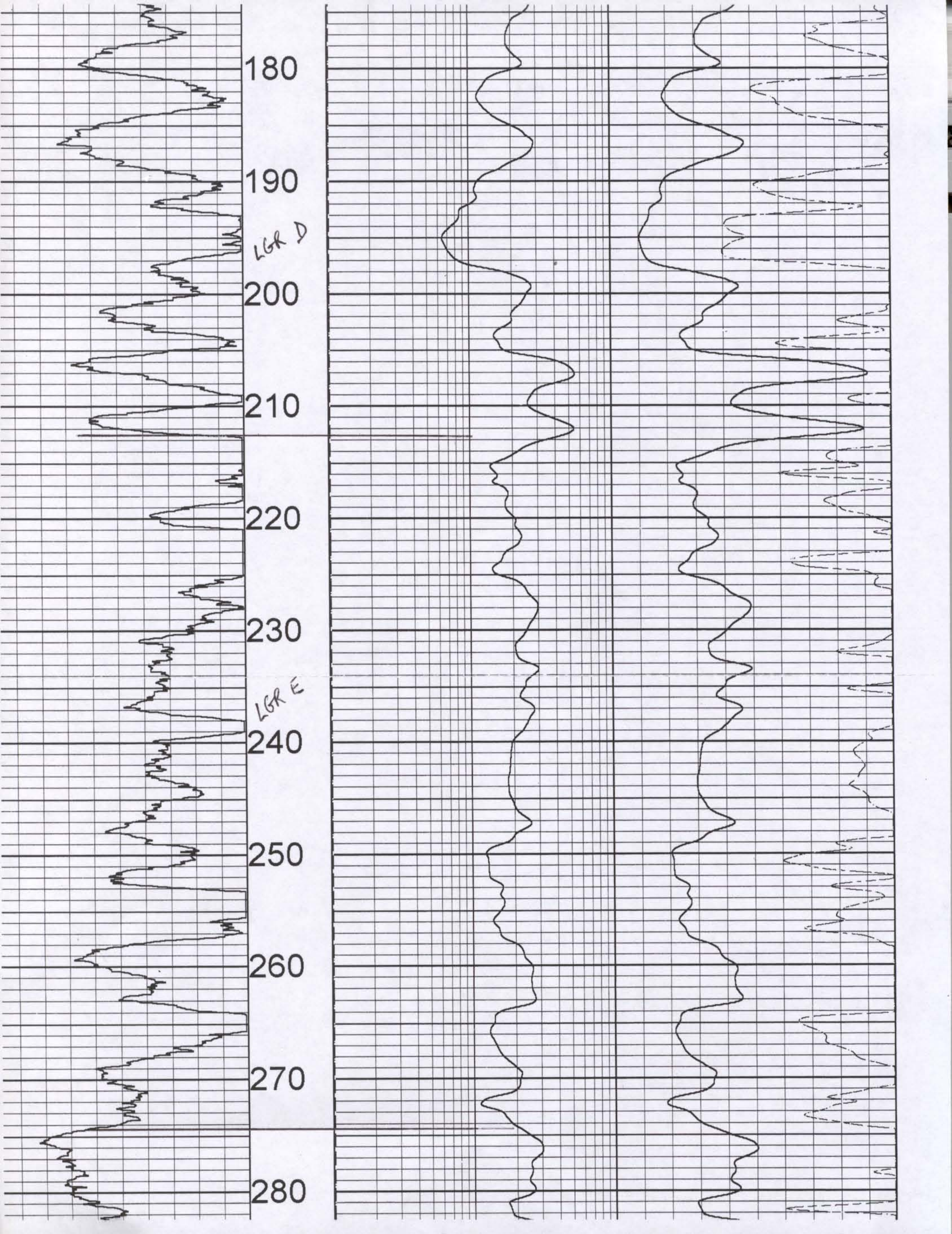
J:\744223\GIS\permit_app_well_location_map.mxd

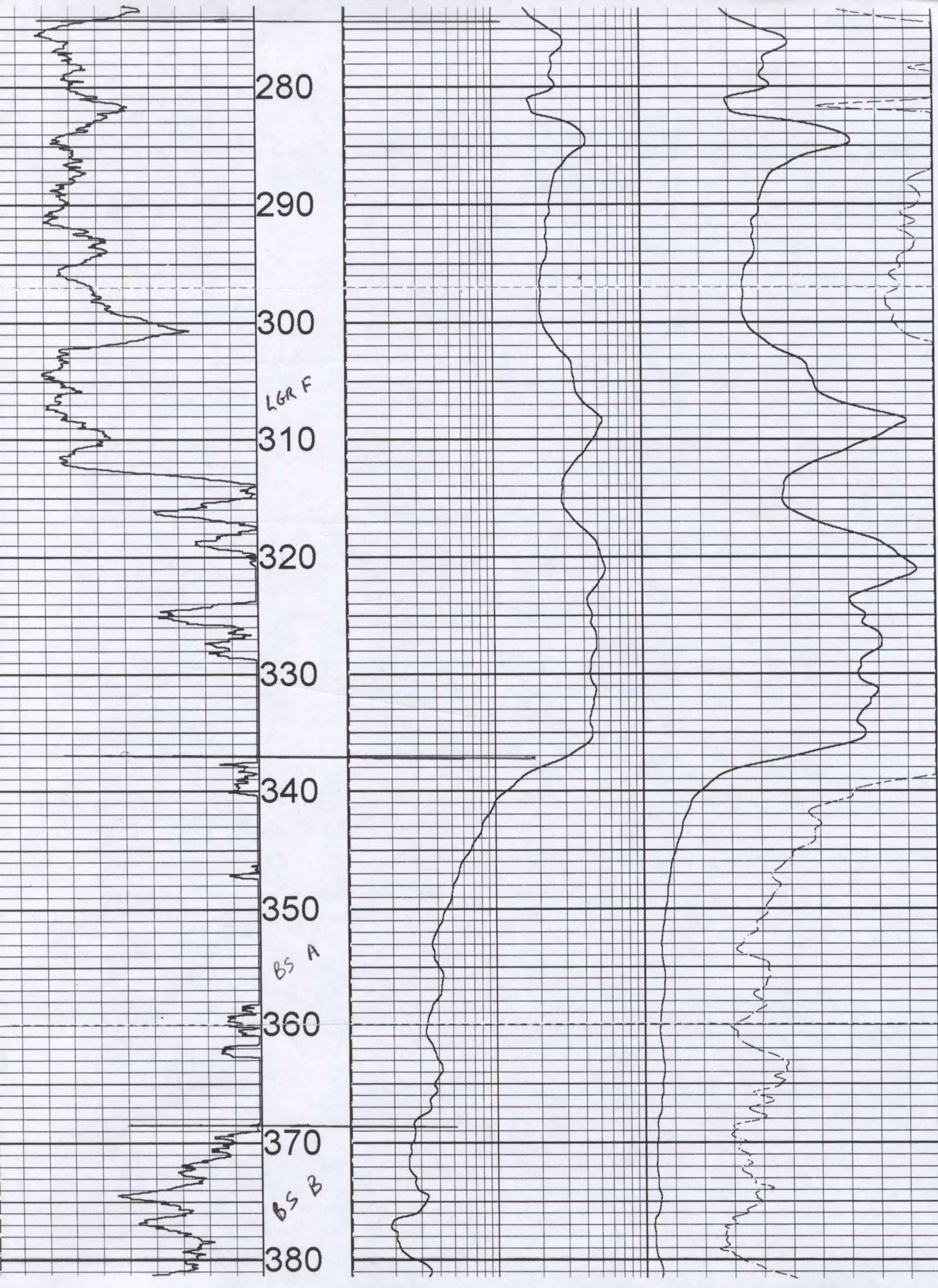
Well CS-WB05



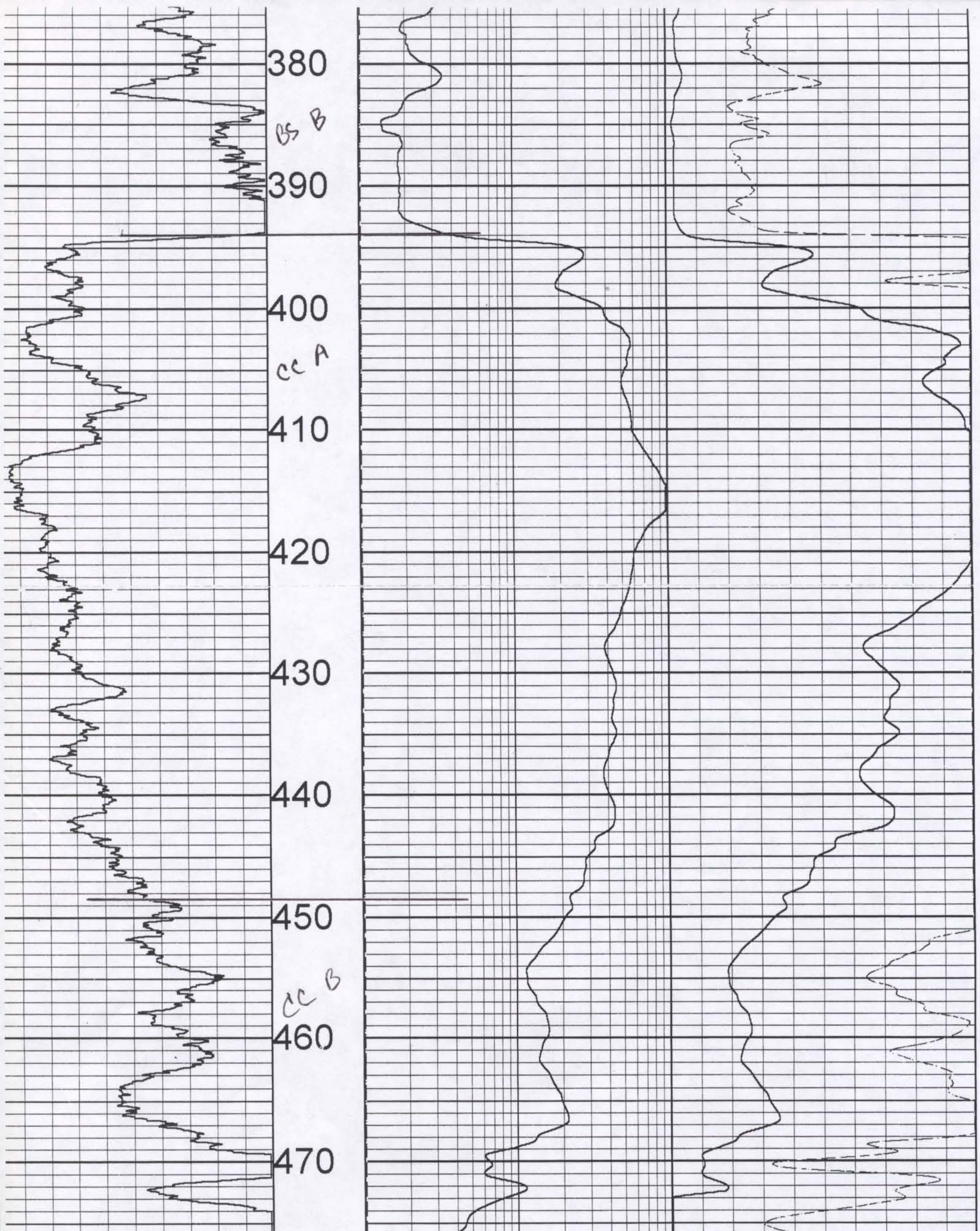
SP
20 MV 80
GAM(NAT)
0 API-GR 60
RES(64N)
10 OHM-M 1000
RES(16N)
10 OHM-M 1000
RES
0 OHM 200
LATERAL
0 OHM-M 800
0
10
20
30
40
50
60
70
80
90
Casing
LGRA
LGRB


70
LGR B
80
90
100
LGR C
110
120
130
140
150
160
LGR D
170


180
190
LGR D
200
210
220
230
LGR E
240
250
260
270
280



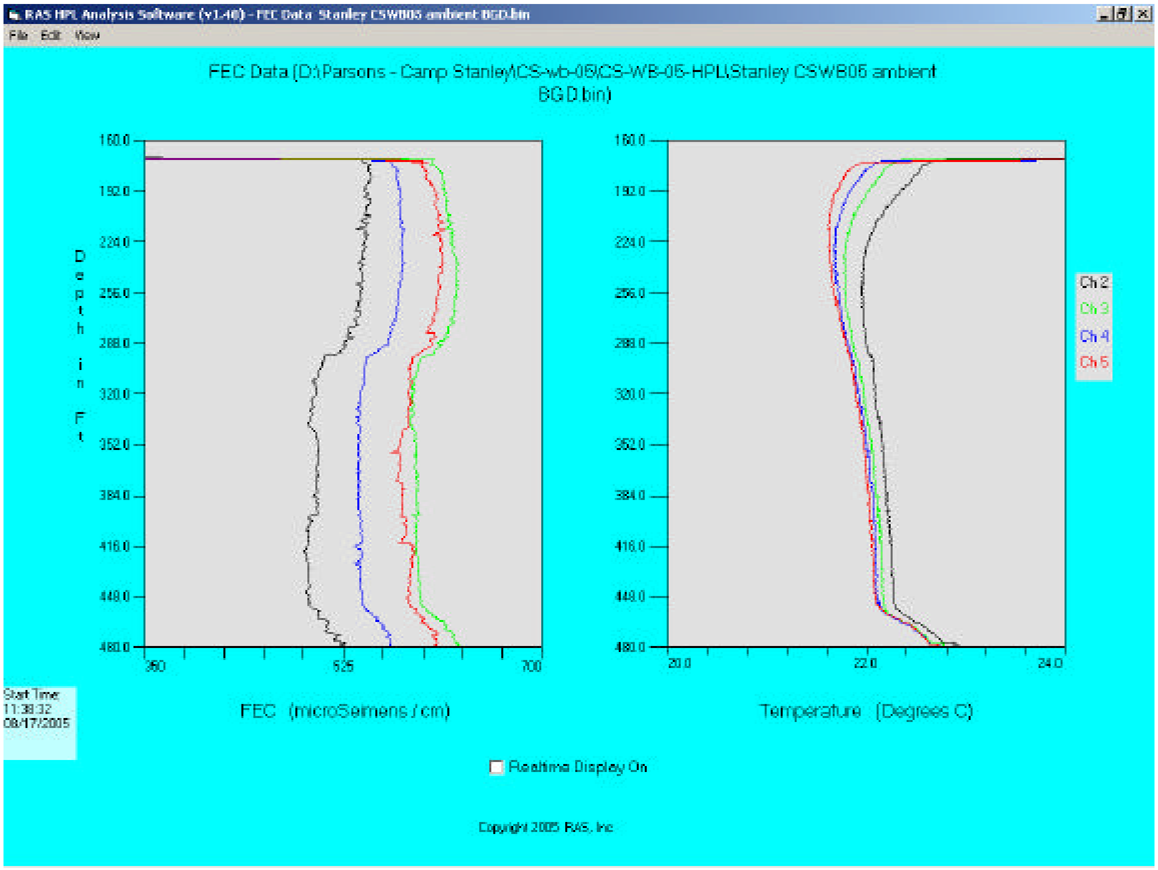
280
290
300
LGR F
310
320
330
340
350
BS A
360
370
BS B
380



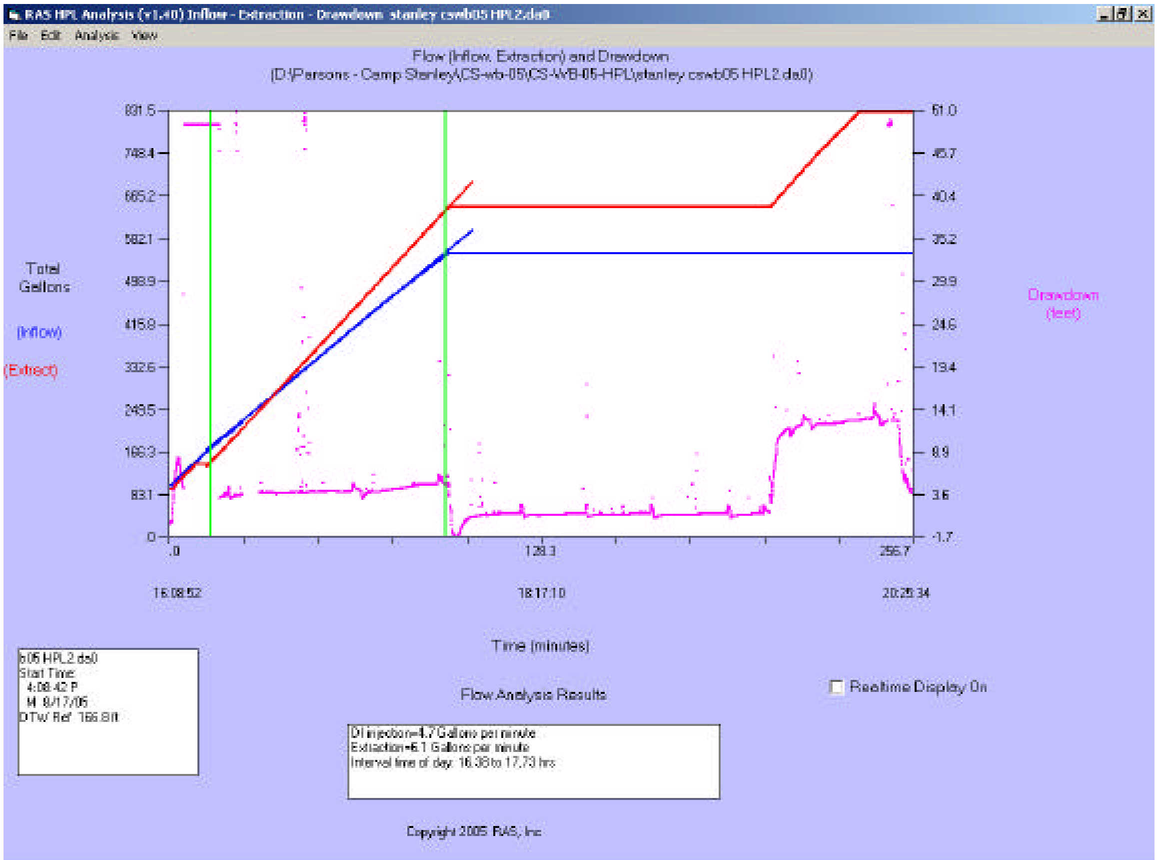
380
BS B
390
400
CC A
410
420
430
440
450
CC B
460
470
480
API-GR
60
10
OHM-M
1000
0
OHM-M
800

Camp Stanley – Preliminary Results

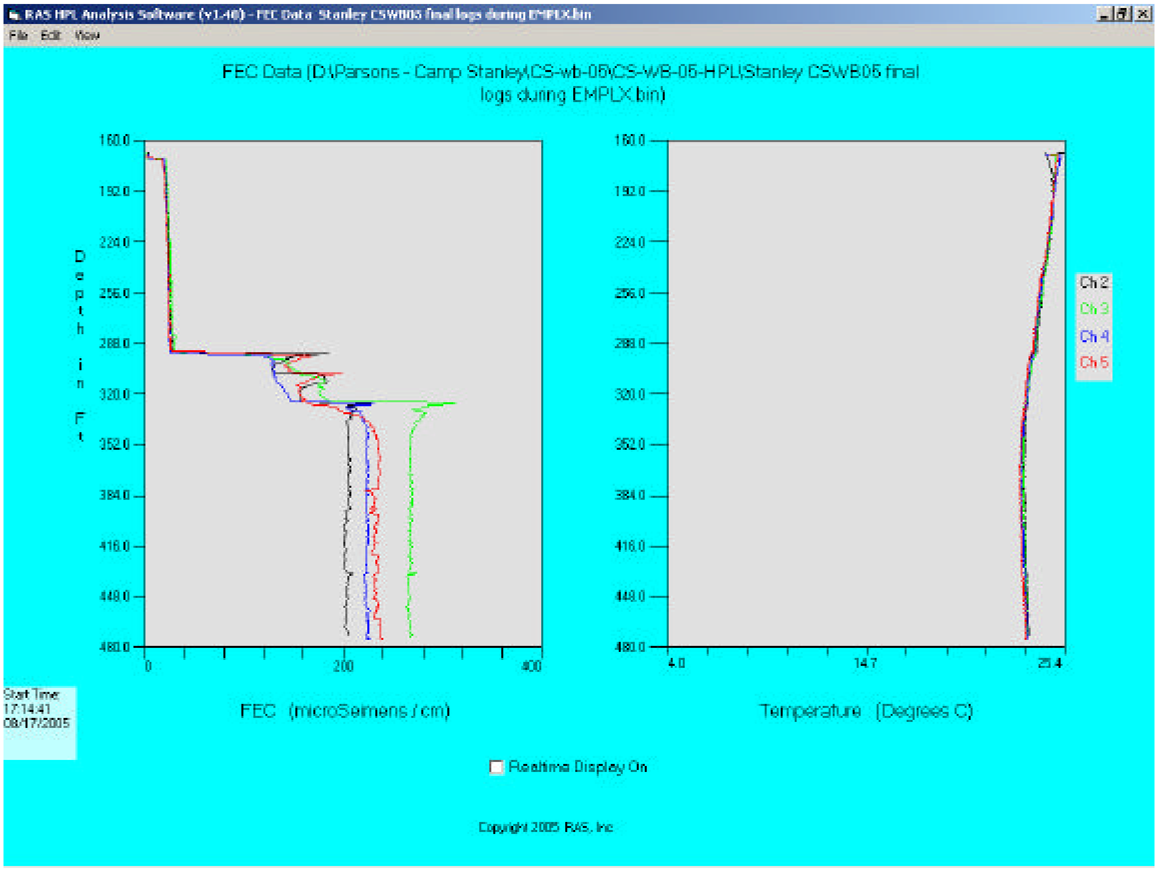
Well CS-WB-05



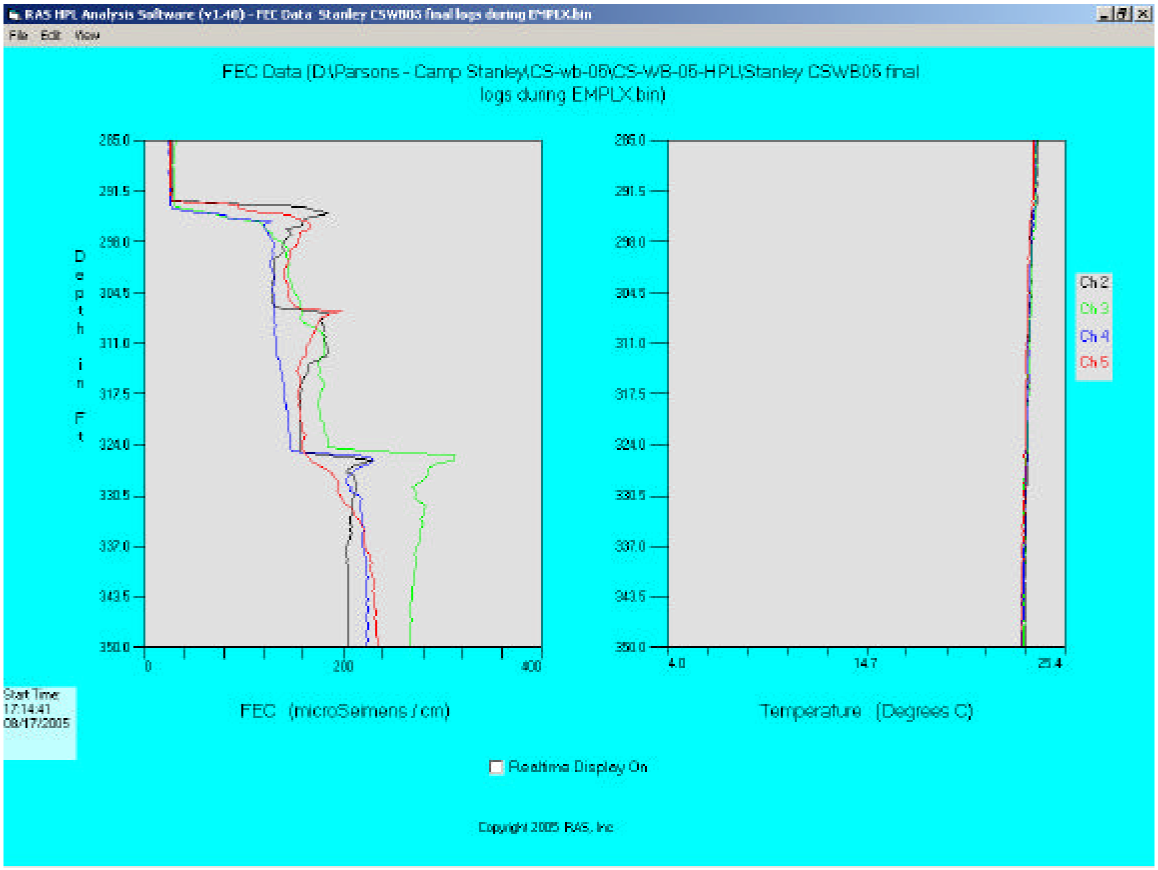
Ambient FEC and Temperature logs (pre emplx)



Pumping and drawdown data



During Emplx – quasi PDI data set, processed below.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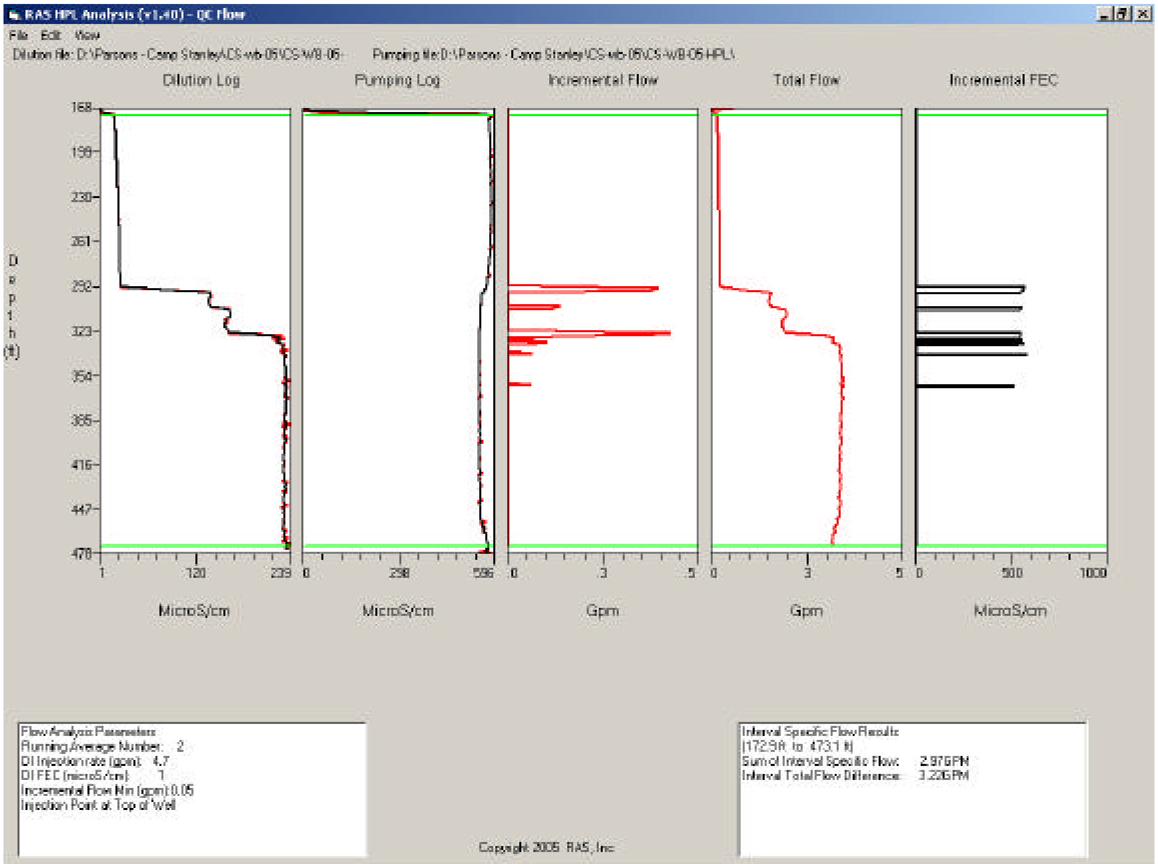
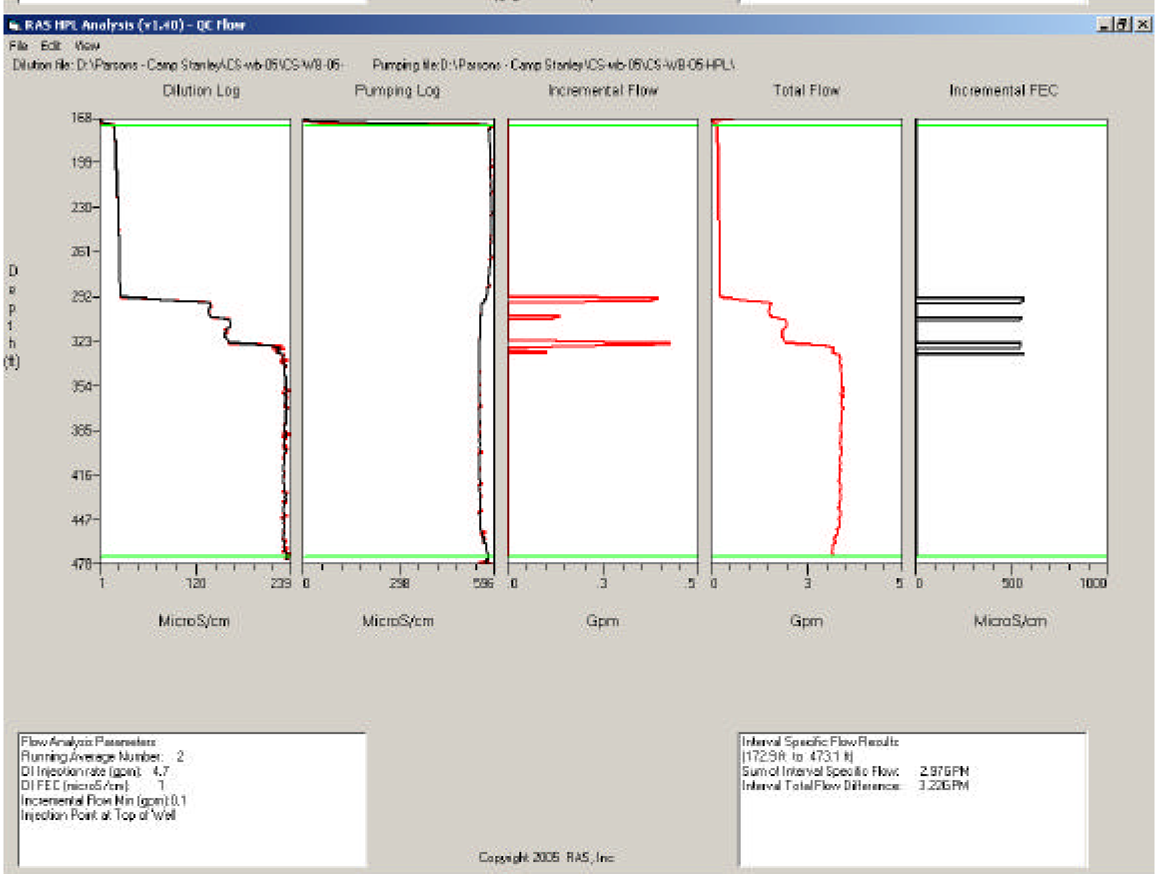
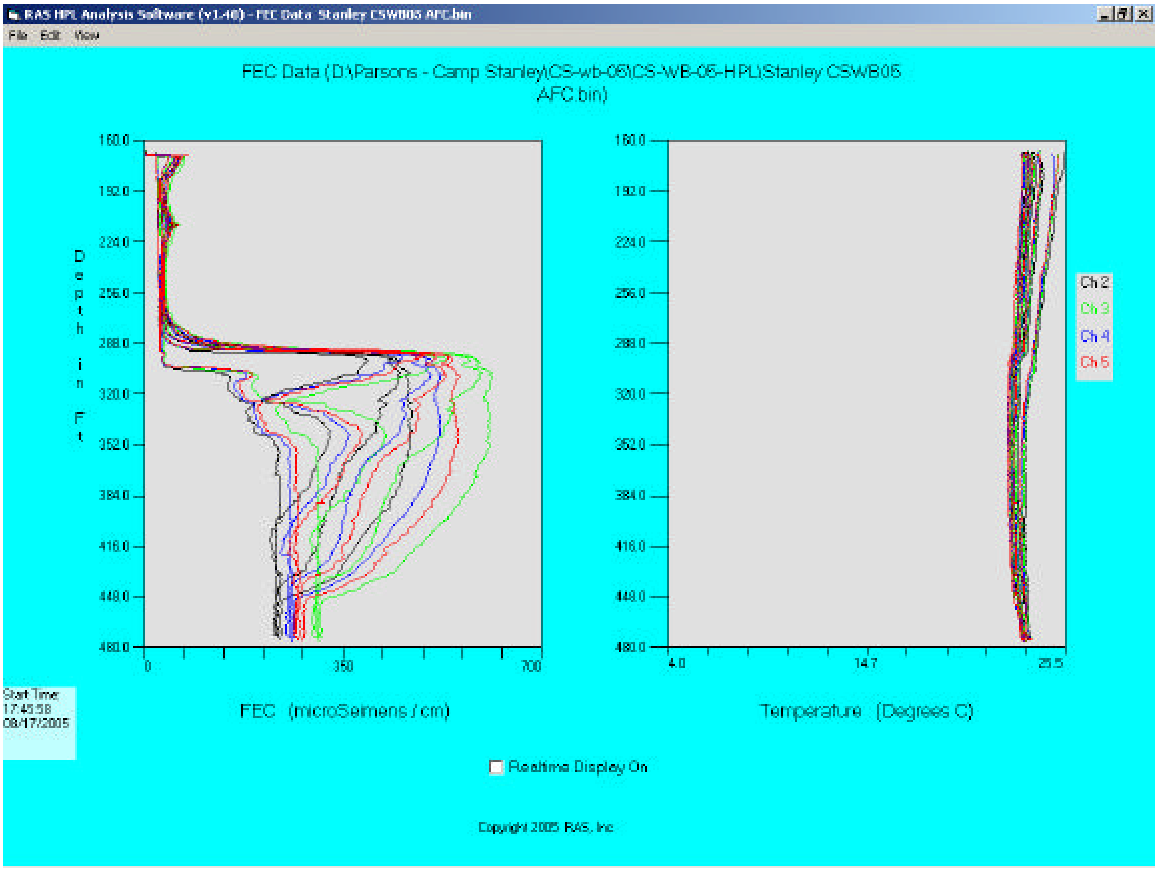
File Edit View
FEC Data (D:\Parsons - Camp Stanley\CS-wb-05\CS-WB-05-HPL\Stanley CSWB05 final logs during EMPLX.bin)
Depth in Ft
285.0
291.5
298.0
304.5
311.0
317.5
324.0
330.5
337.0
343.5
350.0
0
200
400
FEC (microSeimens / cm)
4.0
14.7
25.4
Temperature (Degrees C)
Ch 2
Ch 3
Ch 4
Ch 5
Start Time:
17:14:41
08/17/2005
Realtime Display On
Copyright 2005 RAS, Inc.


RAS HPL Analysis (v1.40) - QC Flow
File Edit View
Dilution file: D:\Parsons - Camp Stanley\CS-wb-05\CS-WB-05-
Pumping file:D:\Parsons - Camp Stanley\CS-wb-05\CS-WB-05-HPL\
Dilution Log
Pumping Log
Incremental Flow
Total Flow
Incremental FEC
Depth (ft)
MicroS/cm
MicroS/cm
Gpm
Gpm
MicroS/cm
Flow Analysis Parameters
Running Average Number: 2
DI Injection rate (gpm): 4.7
DI FEC (microS/cm): 1
Incremental Flow Min (gpm):0.05
Injection Point at Top of Well
Interval Specific Flow Results
(172.9 ft to 473.1 ft)
Sum of Interval Specific Flow: 2.97GPM
Interval Total Flow Difference: 3.22GPM
Copyright 2005 RAS, Inc


RAS HPL Analysis (v1.40) - QC Flow
File Edit View
Dilution file: D:\Parsons - Camp Stanley\CS-wb-05\CS-WB-05-
Pumping file:D:\Parsons - Camp Stanley\CS-wb-05\CS-WB-05-HPL\
Dilution Log
Pumping Log
Incremental Flow
Total Flow
Incremental FEC
Depth (ft)
MicroS/cm
MicroS/cm
Gpm
Gpm
MicroS/cm
Flow Analysis Parameters
Running Average Number: 2
DI Injection rate (gpm): 4.7
DI FEC (microS/cm): 1
Incremental Flow Min (gpm):0.1
Injection Point at Top of Well
Interval Specific Flow Results
(172.9 ft to 473.1 ft)
Sum of Interval Specific Flow: 2.97GPM
Interval Total Flow Difference: 3.22GPM
Copyright 2005 RAS, Inc



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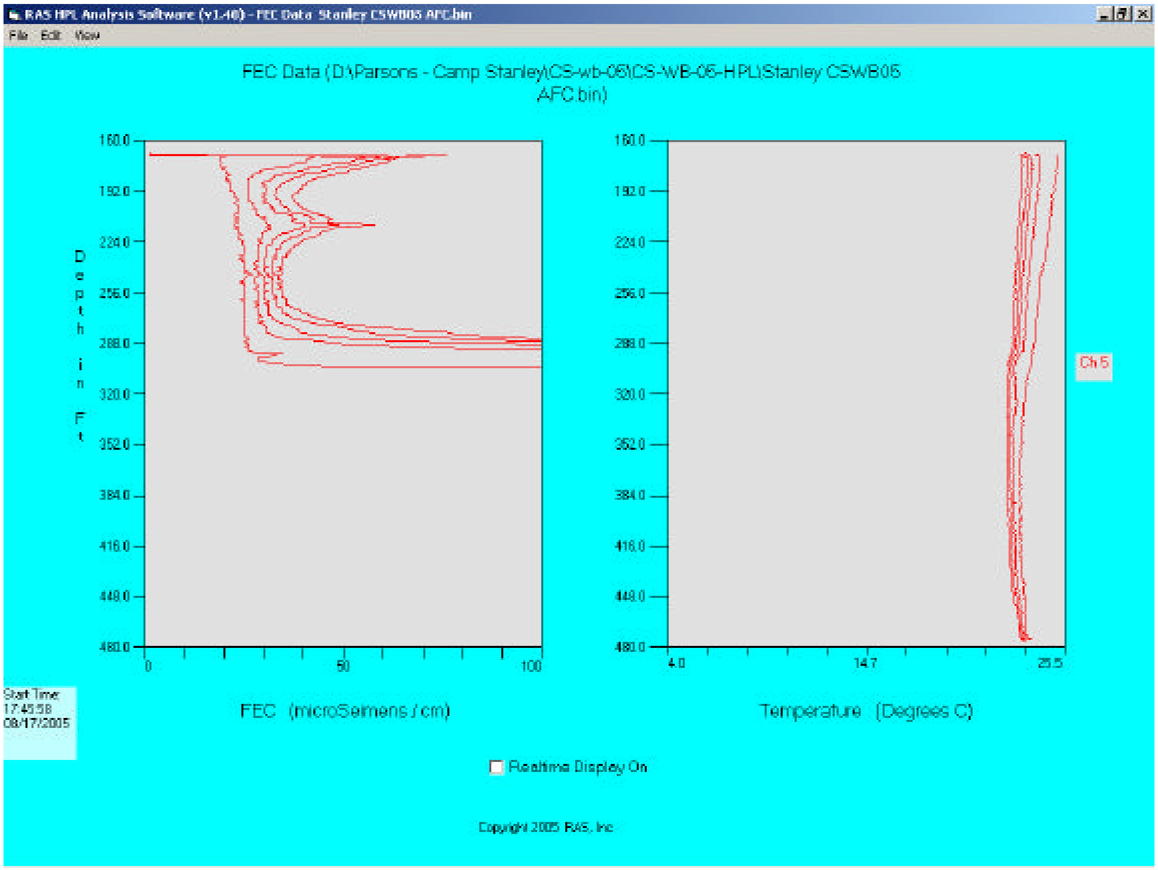
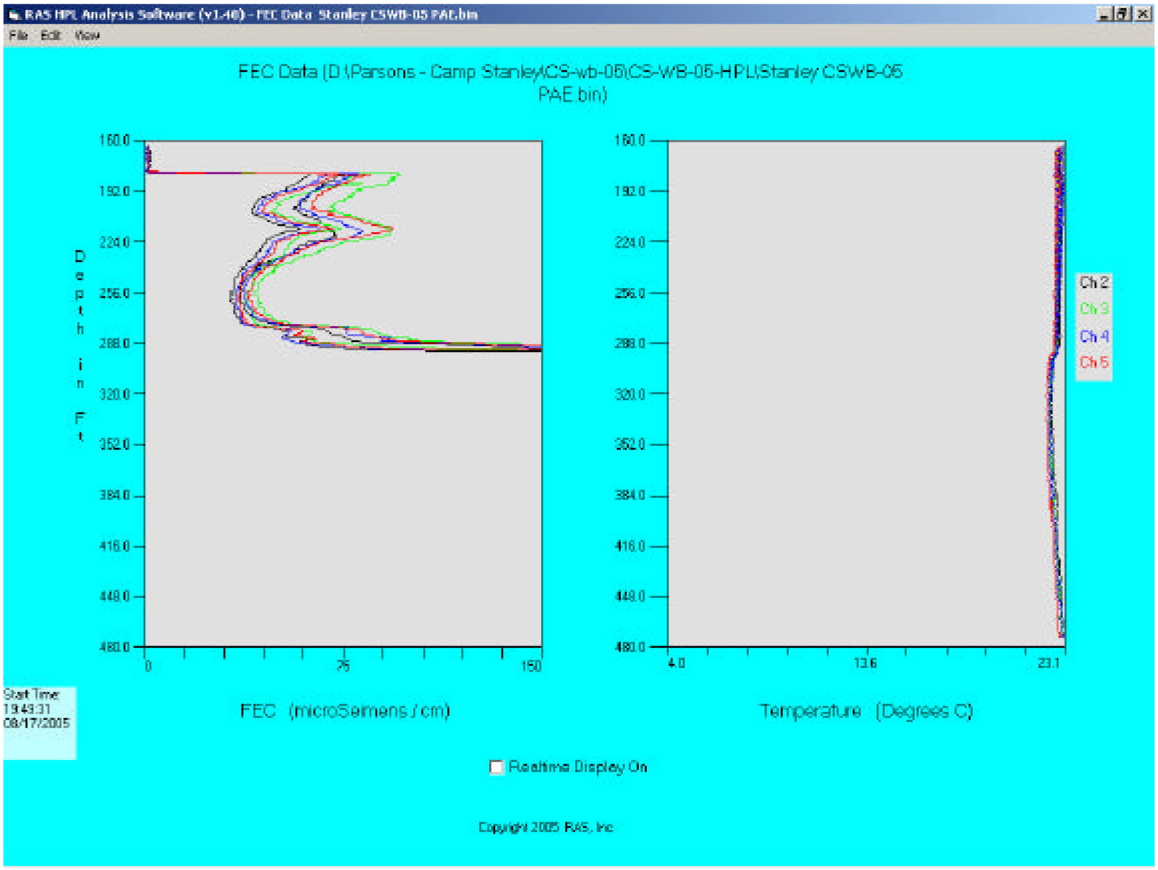
Depth in Ft
160.0
192.0
224.0
256.0
288.0
320.0
352.0
384.0
416.0
448.0
480.0
0
350
700
FEC (microSeimens / cm)
4.0
14.7
25.5
Temperature (Degrees C)
Ch 2
Ch 3
Ch 4
Ch 5
Start Time:
17:45:58
08/17/2005
Realtime Display On
Copyright 2005 RAS, Inc


RAS HPL Analysis Software (v1.40) - FEC Data Stanley CSWB05 AFC.bin
File Edit View
FEC Data (D:\Parsons - Camp Stanley\CS-wb-05\CS-WB-05-HPL\Stanley CSWB05 AFC.bin)
Depth in Ft
160.0
192.0
224.0
256.0
288.0
320.0
352.0
384.0
416.0
448.0
480.0
0
50
100
FEC (microSeimens / cm)
4.0
14.7
25.5
Temperature (Degrees C)
Ch 5
Start Time:
17:45:58
08/17/2005
Realtime Display On
Copyright 2005 RAS, Inc



SUMMARY OF INFLOW POINTS

DEPTH (ref GS)	Data or analysis type	Comments
168-173	AFC	or above in unsat zone
184-189	PAE	
205-218	AFC	
278-287	PAE	
289-297	QCFLOW	
303-309	QCFLOW	
321-333	QCFLOW	
336-340	QCFLOW	
358-362	QCFLOW	(<0.1 gpm ?)
432-450	AFC	outflow zone-more?

Rev	Date	By	Ck	Title: Hydraluic Conductivity Estimate for 198' to 218' Depth Interval in Well CS-WB05 at CSSA

Falling Head Test Results for 198' to 218' Interval at Well CS-WB05

Test Data

T_0 (min) =	54.31	min
Static Water Level =	30.83	ft
Maximum Water Level =	255.93	ft
Maximum Water Level Change =	225.1	ft

T (min)	ΔT (min)	H (ft)	ΔH (ft)	H/H_0
54.31	0	255.93	225.1	1.00
55.37	1.06	212.80	181.97	0.81
57.71	3.4	180.64	149.81	0.67
60.48	6.17	148.48	117.65	0.52
64.73	10.42	114.48	83.65	0.37
70.48	16.17	84.95	54.12	0.24
77.08	22.77	63.77	32.94	0.15
83.25	28.94	56.71	25.88	0.11
89.42	35.11	51.22	20.39	0.09

Data Analysis

Hvorslev Method (From Fetter, 1988)

$$K = \frac{r^2 \ln(L/R)}{2LT_0}$$

where:

K = hydraulic conductivity
r = radius of well casing
R = radius of well screen
L = length of well screen
T_0 = time for water level to fall to 37% of initial change

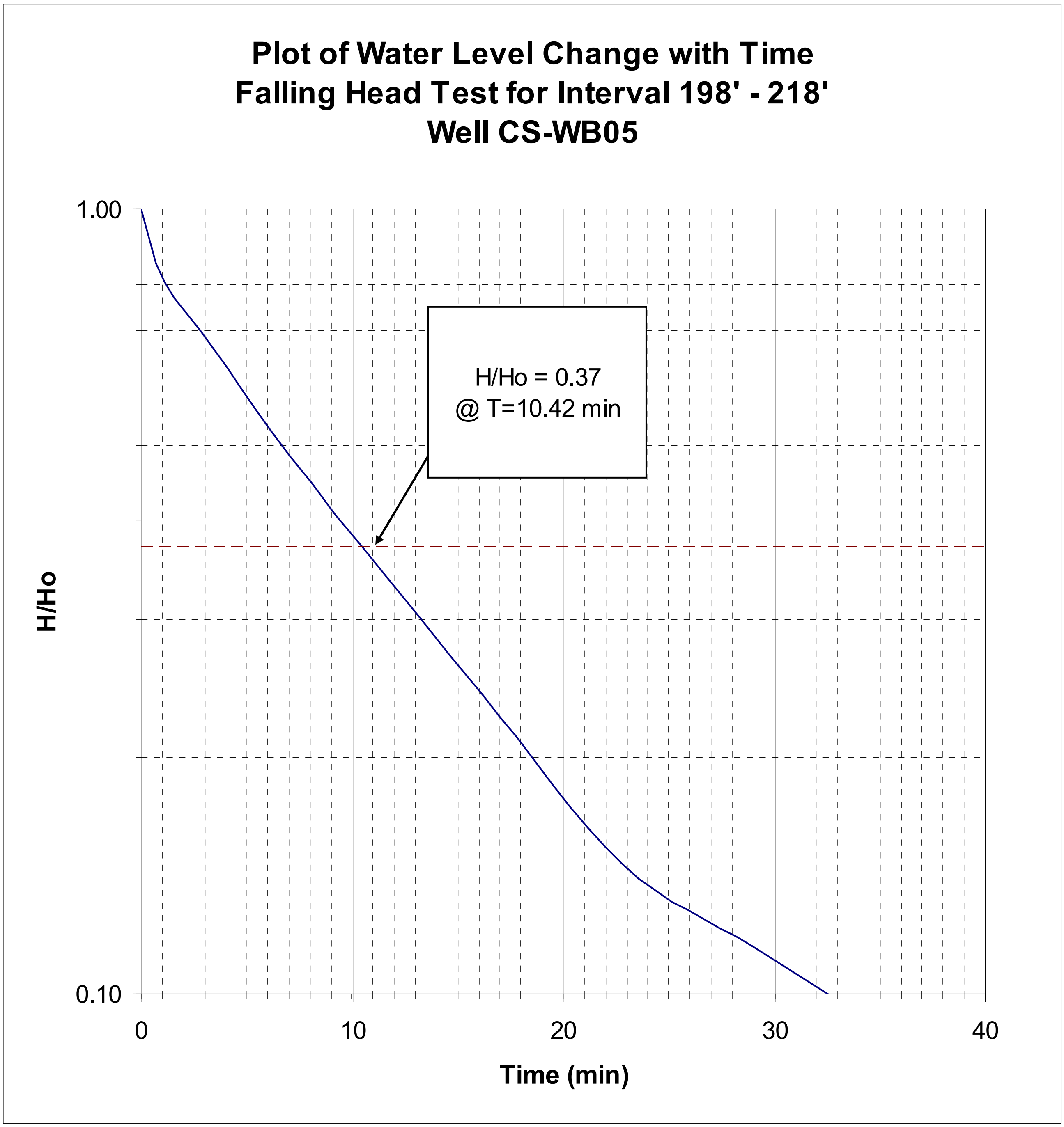
For well CS-WB05

r =	0.19	ft	ID = 4.25 in
R =	0.19	ft	ID = 4.25 in
L =	20.0	ft	Packer interval
T_0 =	10.42	min	from plot

K =	4.03E-04	ft/min
=	5.81E-01	ft/day
=	2.05E-04	cm/sec

PARSONS Calculation Sheet	Job Number	WBS Number	Page Number	Sheet of
	744223	04000		2 of 2

Rev	Date	By	Ck	Title Hydraluic Conductivity Estimate for 198' to 218' Depth Interval in Well CS-WB05 at CSSA



Rev	Date	By	Ck	Title: Hydraluic Conductivity Estimate for 268' to 288' Depth Interval in Well CS-WB05 at CSSA

Falling Head Test Results for 268' to 288' Interval at Well CS-WB05

Test Data

T_0 (min) =	115.32	min
Static Water Level =	104.81	ft
Maximum Water Level =	259.33	ft
Maximum Water Level Change =	154.52	ft

T (min)	ΔT (min)	H (ft)	ΔH (ft)	H/H_0
115.32	0	259.33	154.52	1.00
116.44	1.12	208.03	103.22	0.67
117.18	1.86	190.11	85.3	0.55
117.56	2.24	157.97	53.16	0.34
118.65	3.33	128.41	23.6	0.15
119.52	4.2	127.68	22.87	0.15
121.48	6.16	120.88	16.07	0.10
122.87	7.55	117.79	12.98	0.08
126.63	11.31	114.09	9.28	0.06

Data Analysis

Hvorslev Method (From Fetter, 1988)

$$K = \frac{r^2 \ln(L/R)}{2LT_0}$$

where:

K = hydraulic conductivity
r = radius of well casing
R = radius of well screen
L = length of well screen
T_0 = time for water level to fall to 37% of initial change

For well CS-WB05

r =	0.19	ft	ID = 4.25 in
R =	0.19	ft	ID = 4.25 in
L =	20.0	ft	Packer interval
T_0 =	2.24	min	From plot
K =	1.88E-03	ft/min	
=	2.70E+00	ft/day	
=	9.54E-04	cm/sec	

PARSONS **Calculation Sheet**	Job Number 744223	WBS Number 04000	Page Number	Sheet 2 of 2

Rev	Date	By	Ck	Title: Hydraluic Conductivity Estimate for 268' to 288' Depth Interval in Well CS-WB05 at CSSA

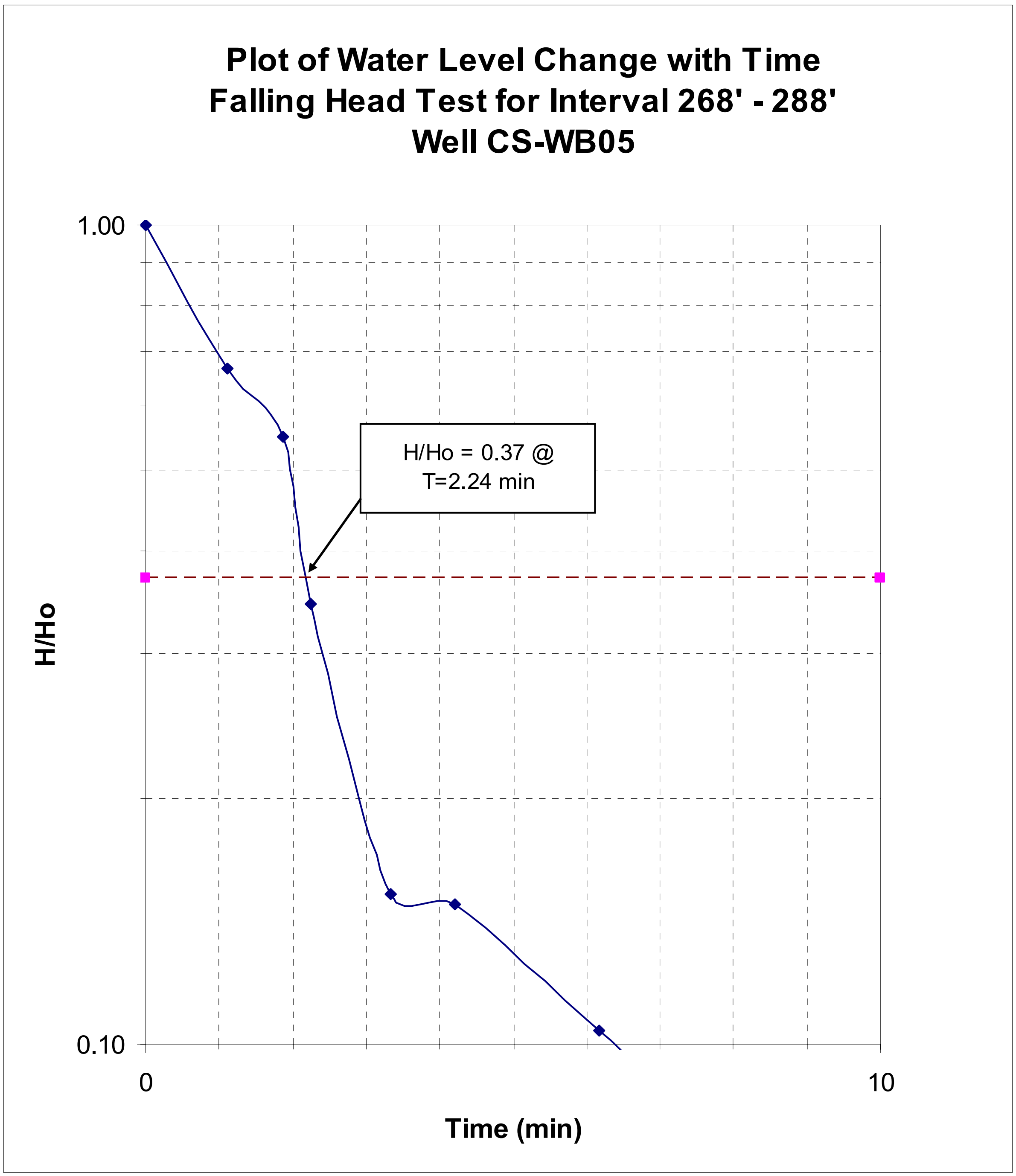


Table 1
Well CS-WB05 Discrete Interval Groundwater Sample Results
Camp Stanley Storage Activitiy, Texas

Packer Interval (ft bgs)	PCE	TCE	*cis*-1,2-DCE	*trans*-1,2-DCE	Toluene
268 to 288	31.3	152	286	ND	4.18
290 to 310	160	273	344	4.94	ND
320 to 340	319	427	533	ND	ND

Results presented in ug/L conentrations
ND - Analyte not detected

APPENDIX F
COMPREHENSIVE LABORATORY ANALYTICAL REPORTS

NELAP CERTIFICATE NUMBER 01955

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 10/19/2005

GCAL Report 205100631

RECEIVED
NOV 1 2005

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons

Project Camp Stanley

7979 GSRI Avenue, Baton Rouge, Louisiana 70820-7402 • Phone 225.769.4900 • Fax 225.767.5717

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS_B-3_MW01

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205100631

Matrix: (soil/water) Soil

Sample wt/vol: 5 (g/ml) mL Lab Sample ID: 20510063101

Level: (low/med) LOW Lab File ID: 2051017/A6150

% Moisture: not dec. Date Collected: 10/05/05 Time: 1131

GC Column: DB-VRX-20M ID: .18 (mm) Date Received: 10/06/05

Instrument ID: MSV6 Date Analyzed: 10/17/05 Time: 1249

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: ABD

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 302323

CONCENTRATION UNITS: mg/L Analytical Method: 1311/8260B

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.019	U	0.019	0.200
107-06-2	1,2-Dichloroethane	0.017	U	0.017	0.200
78-93-3	2-Butanone	0.022	U	0.022	0.200
71-43-2	Benzene	0.017	U	0.017	0.200
56-23-5	Carbon tetrachloride	0.014	U	0.014	0.200
108-90-7	Chlorobenzene	0.018	U	0.018	0.200
67-66-3	Chloroform	0.018	U	0.018	0.200
127-18-4	Tetrachloroethene	0.016	U	0.016	0.200
79-01-6	Trichloroethene	0.017	U	0.017	0.200
75-01-4	Vinyl chloride	0.00708	U	0.00708	0.200

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

RO-01+02

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205100631

Matrix: (soil/water) Soil

Sample wt/vol: 5 (g/ml) mL Lab Sample ID: 20510063102

Level: (low/med) LOW Lab File ID: 2051017/A6154

% Moisture: not dec. Date Collected: 10/05/05 Time: 1141

GC Column: DB-VRX-20M ID: .18 (mm) Date Received: 10/06/05

Instrument ID: MSV6 Date Analyzed: 10/17/05 Time: 1421

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: ABD

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 302323

CONCENTRATION UNITS: mg/L Analytical Method: 1311/8260B

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.019	U	0.019	0.200
107-06-2	1,2-Dichloroethane	0.017	U	0.017	0.200
78-93-3	2-Butanone	0.022	U	0.022	0.200
71-43-2	Benzene	0.017	U	0.017	0.200
56-23-5	Carbon tetrachloride	0.014	U	0.014	0.200
108-90-7	Chlorobenzene	0.018	U	0.018	0.200
67-66-3	Chloroform	0.018	U	0.018	0.200
127-18-4	Tetrachloroethene	0.016	U	0.016	0.200
79-01-6	Trichloroethene	0.017	U	0.017	0.200
75-01-4	Vinyl chloride	0.00708	U	0.00708	0.200

U.S. EPA - CLP

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205100631

SOW No.:

EPA Sample No.	*Lab Sample ID.*
CS_B-3_MW01	20510063101
RO-01+02	20510063102

Were ICP interelement corrections applied ? Yes / No YES

Were ICP background corrections applied ? Yes / No YES

If yes-were raw data generated before application of background corrections ? Yes / No NO

INORGANIC ANALYSIS DATA SHEET

Lab Name: GCAL

Sample ID: CS_B-3_MW01

Lab Code: LA024   Case No.:

Contract:

Matrix: (soil / water) Soil

SAS No.:   SDG No.: 205100631

Level: (low / med)   % Solids:

Lab Sample ID: 20510063101

Date Received: 10/06/05   Time: 1400

Date Collected: 10/05/05   Time: 1131

Analyte	Concentration	Units	C	MDL	PQL	Method	Type
Antimony	0.0080	mg/L	F	0.0026	0.060	SW-846 1311/6010B	P
Arsenic	0.0039	mg/L	U	0.0039	0.20	SW-846 1311/6010B	P
Barium	0.43	mg/L	F	0.00040	1.00	SW-846 1311/6010B	P
Beryllium	0.000070	mg/L	U	0.000070	0.0050	SW-846 1311/6010B	P
Cadmium	0.00010	mg/L	U	0.00010	0.010	SW-846 1311/6010B	P
Chromium	0.0028	mg/L	F	0.00080	0.050	SW-846 1311/6010B	P
Lead	0.0012	mg/L	U	0.0012	0.10	SW-846 1311/6010B	P
Mercury	0.00008	mg/L	U	0.00008	0.00020	SW-846 1311/7470A	AV
Nickel	0.017	mg/L	F	0.00060	0.040	SW-846 1311/6010B	P
Selenium	0.024	mg/L	F	0.0045	0.10	SW-846 1311/6010B	P
Silver	0.00080	mg/L	U	0.00080	0.050	SW-846 1311/6010B	P

INORGANIC ANALYSIS DATA SHEET

Lab Name: GCAL

Sample ID: RO-01+02

Lab Code: LA024 Case No.:

Contract:

Matrix: (soil / water) Soil

SAS No.: SDG No.: 205100631

Level: (low / med) % Solids:

Lab Sample ID: 20510063102

Date Received: 10/06/05 Time: 1400

Date Collected: 10/05/05 Time: 1141

Analyte	Concentration	Units	C	MDL	PQL	Method	Type
Antimony	0.0098	mg/L	F	0.0026	0.060	SW-846 1311/6010B	P
Arsenic	0.0039	mg/L	U	0.0039	0.20	SW-846 1311/6010B	P
Barium	0.28	mg/L	F	0.00040	1.00	SW-846 1311/6010B	P
Beryllium	0.000070	mg/L	U	0.000070	0.0050	SW-846 1311/6010B	P
Cadmium	0.00010	mg/L	U	0.00010	0.010	SW-846 1311/6010B	P
Chromium	0.0038	mg/L	F	0.00080	0.050	SW-846 1311/6010B	P
Lead	0.0012	mg/L	U	0.0012	0.10	SW-846 1311/6010B	P
Mercury	0.00008	mg/L	U	0.00008	0.00020	SW-846 1311/7470A	AV
Nickel	0.089	mg/L		0.00060	0.040	SW-846 1311/6010B	P
Selenium	0.019	mg/L	F	0.0045	0.10	SW-846 1311/6010B	P
Silver	0.00080	mg/L	U	0.00080	0.050	SW-846 1311/6010B	P

Camp Stanley Storage Activity Chain Of Custody

COC ID: 100505GCALA | Relinquish_Date: 10/5/2005 | Cooler ID: A
Project Location: Parsons TO-6 | Relinquished_By: ET | LabCode: GCAL
Job Number: 744223.07000 | Relinquish_Time: 6:00 PM | Carrier: FedEx
Creation Date: 10/5/2005 | Collection Team: ET | Airbill Carrier: 8463 3579 2820

Sampler(s): E. Tennyson

LOCID: **CS_B-3_MW01** LOGDATE: **10/5/2005** MATRIX: **SD** TBLOT:
SBD: **0** LOGTIME: **11:30** SACODE: **N** SMCODE: **CS** ABLOT:
SED: **0** FLDSAMPID **CS_B-3_MW01_100505_N1130** EBLOT:
Containers: 1
Remarks: **TAT as per contract.**

Analysis Required:

SW8260B	TCLP VOC Full List

LOCID: **CS_B-3_MW01** LOGDATE: **10/5/2005** MATRIX: **SD** TBLOT:
SBD: **0** LOGTIME: **11:31** SACODE: **N** SMCODE: **CS** ABLOT:
SED: **0** FLDSAMPID **CS_B-3_MW01_100505_N1131** EBLOT:
Containers: 1
Remarks: **TAT as per contract.**

Analysis Required: —1

SW6010B	TCLP-Silver (Ag)	SW6010B	TCLP-Arsenic (As)
SW6010B	TCLP-Barium (Ba)	SW6010B	TCLP-Beryllium (Be)
SW6010B	TCLP-Cadmium (Cd)	SW6010B	TCLP-Chromium (Cr)
SW6010B	TCLP-Mercury (Hg)	SW6010B	TCLP-Nickel (Ni)
SW6010B	TCLP-Lead (Pb)	SW6010B	TCLP-Antimony (Sb)
SW6010B	TCLP-Selenium (Se)		

LOCID: **RO-01+02** LOGDATE: **10/5/2005** MATRIX: **SD** TBLOT:
SBD: **0** LOGTIME: **11:40** SACODE: **N** SMCODE: **CS** ABLOT:
SED: **0** FLDSAMPID **RO-01+02_100505_N1140** EBLOT:
Containers: 1
Remarks: **TAT as per contract.**

Analysis Required:

SW8260B	TCLP VOC Full List

LOCID: **RO-01+02** LOGDATE: **10/5/2005** MATRIX: **SD** TBLOT:
SBD: **0** LOGTIME: **11:41** SACODE: **N** SMCODE: **CS** ABLOT:
SED: **0** FLDSAMPID **RO-01+02_100505_N1141** EBLOT:
Containers: 1
Remarks: **TAT as per contract.**

Analysis Required: —2

SW6010B	TCLP-Silver (Ag)	SW6010B	TCLP-Arsenic (As)
SW6010B	TCLP-Barium (Ba)	SW6010B	TCLP-Beryllium (Be)
SW6010B	TCLP-Cadmium (Cd)	SW6010B	TCLP-Chromium (Cr)
SW6010B	TCLP-Mercury (Hg)	SW6010B	TCLP-Nickel (Ni)
SW6010B	TCLP-Lead (Pb)	SW6010B	TCLP-Antimony (Sb)
SW6010B	TCLP-Selenium (Se)		

10° on ice

000028

Relinquished by: E. Tennyson Date 10/5/05 Time 1800 | Relinquished by: Feeley Date 10-7-05 Time 1400 | Relinquished by:____ Date____ Time____
Recieved by: FDX Date____ Time____ | Recieved by: [signature] Date 10-6-05 Time 1400 | Recieved by:____ Date____ Time____

NELAP CERTIFICATE NUMBER 01955

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 10/03/2005

GCAL Report 205091619

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons

Project Camp Stanley

RECEIVED
OCT 12 2005

000001

TCLP

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB05

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091619

Matrix: (soil/water) Soil

Sample wt/vol: 5 (g/ml) mL Lab Sample ID: 20509161901

Level: (low/med) LOW Lab File ID: 2050922P/A5198

% Moisture: not dec. Date Collected: 09/14/05 Time: 1500

GC Column: DB-VRX-20M ID: .18 (mm) Date Received: 09/16/05

Instrument ID: MSV6 Date Analyzed: 09/23/05 Time: 0223

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: ABD

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 300006

Analytical Method: 1311/8260B

CONCENTRATION UNITS: mg/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.019	U	0.019	0.200
107-06-2	1,2-Dichloroethane	0.017	U	0.017	0.200
78-93-3	2-Butanone	0.022	U	0.022	0.200
71-43-2	Benzene	0.017	U	0.017	0.200
56-23-5	Carbon tetrachloride	0.014	U	0.014	0.200
108-90-7	Chlorobenzene	0.018	U	0.018	0.200
67-66-3	Chloroform	0.018	U	0.018	0.200
127-18-4	Tetrachloroethene	0.016	U	0.016	0.200
79-01-6	Trichloroethene	0.017	U	0.017	0.200
75-01-4	Vinyl chloride	0.00708	U	0.00708	0.200

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091619

Matrix: (soil/water) Soil

Sample wt/vol: 5 (g/ml) mL Lab Sample ID: 20509161902

Level: (low/med) LOW Lab File ID: 2050922P/A5199

% Moisture: not dec. Date Collected: 09/14/05 Time: 1515

GC Column: DB-VRX-20M ID: .18 (mm) Date Received: 09/16/05

Instrument ID: MSV6 Date Analyzed: 09/23/05 Time: 0247

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: ABD

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 300006

Analytical Method: 1311/8260B

CONCENTRATION UNITS: mg/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.019	U	0.019	0.200
107-06-2	1,2-Dichloroethane	0.017	U	0.017	0.200
78-93-3	2-Butanone	0.022	U	0.022	0.200
71-43-2	Benzene	0.017	U	0.017	0.200
56-23-5	Carbon tetrachloride	0.014	U	0.014	0.200
108-90-7	Chlorobenzene	0.018	U	0.018	0.200
67-66-3	Chloroform	0.018	U	0.018	0.200
127-18-4	Tetrachloroethene	0.016	U	0.016	0.200
79-01-6	Trichloroethene	0.017	U	0.017	0.200
75-01-4	Vinyl chloride	0.00708	U	0.00708	0.200

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB06

Lab Name: GCAL   Contract:

Lab Code: LA024   Case No.:   SAS No.:   SDG No.: 205091619

Matrix: (soil/water) Soil

Sample wt/vol: 5 (g/ml) mL   Lab Sample ID: 20509161903

Level: (low/med) LOW   Lab File ID: 2050922P/A5200

% Moisture: not dec.   Date Collected: 09/14/05   Time: 1545

GC Column: DB-VRX-20M   ID: .18 (mm)   Date Received: 09/16/05

Instrument ID: MSV6   Date Analyzed: 09/23/05   Time: 0310

Soil Extract Volume: (µL)   Dilution Factor: 40   Analyst: ABD

Soil Aliquot Volume: (µL)   Prep Batch: Analytical Batch: 300006

Analytical Method: 1311/8260B

CONCENTRATION UNITS: mg/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.019	U	0.019	0.200
107-06-2	1,2-Dichloroethane	0.017	U	0.017	0.200
78-93-3	2-Butanone	0.022	U	0.022	0.200
71-43-2	Benzene	0.017	U	0.017	0.200
56-23-5	Carbon tetrachloride	0.014	U	0.014	0.200
108-90-7	Chlorobenzene	0.018	U	0.018	0.200
67-66-3	Chloroform	0.018	U	0.018	0.200
127-18-4	Tetrachloroethene	0.016	U	0.016	0.200
79-01-6	Trichloroethene	0.017	U	0.017	0.200
75-01-4	Vinyl chloride	0.00708	U	0.00708	0.200

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091619

Matrix: (soil/water) Soil

Sample wt/vol: 5 (g/ml) mL

Lab Sample ID: 20509161904

Level: (low/med) LOW

Lab File ID: 2050922P/A5201

% Moisture: not dec.

Date Collected: 09/14/05 Time: 1615

GC Column: DB-VRX-20M ID: .18 (mm)

Date Received: 09/16/05

Instrument ID: MSV6

Date Analyzed: 09/23/05 Time: 0333

Soil Extract Volume: (µL)

Dilution Factor: 40 Analyst: ABD

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 300006

Analytical Method: 1311/8260B

CONCENTRATION UNITS: mg/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.019	U	0.019	0.200
107-06-2	1,2-Dichloroethane	0.017	U	0.017	0.200
78-93-3	2-Butanone	0.022	U	0.022	0.200
71-43-2	Benzene	0.017	U	0.017	0.200
56-23-5	Carbon tetrachloride	0.014	U	0.014	0.200
108-90-7	Chlorobenzene	0.018	U	0.018	0.200
67-66-3	Chloroform	0.018	U	0.018	0.200
127-18-4	Tetrachloroethene	0.016	U	0.016	0.200
79-01-6	Trichloroethene	0.017	U	0.017	0.200
75-01-4	Vinyl chloride	0.00708	U	0.00708	0.200

INORGANIC ANALYSIS DATA SHEET

Lab Name: GCAL

Sample ID: CS-WB05

Lab Code: LA024 Case No.:

Contract:

Matrix: (soil / water) Soil

SAS No.: SDG No.: 205091619

Level: (low / med) % Solids:

Lab Sample ID: 20509161901

Date Received: 09/16/05 Time: 1710

Date Collected: 09/14/05 Time: 1500

Analyte	Concentration	Units	C	MDL	PQL	Method	Type
Antimony	0.0037	mg/L	U	0.0037	0.060	SW-846 1311/6010B	P
Arsenic	0.0025	mg/L	U	0.0025	0.20	SW-846 1311/6010B	P
Barium	0.21	mg/L	F	0.00030	1.00	SW-846 1311/6010B	P
Beryllium	0.00010	mg/L	U	0.00010	0.0050	SW-846 1311/6010B	P
Cadmium	0.00010	mg/L	U	0.00010	0.010	SW-846 1311/6010B	P
Chromium	0.0015	mg/L	F	0.00050	0.050	SW-846 1311/6010B	P
Lead	0.0015	mg/L	U	0.0015	0.10	SW-846 1311/6010B	P
Mercury	0.00021	mg/L		0.00008	0.00020	SW-846 1311/7470A	AV
Nickel	0.026	mg/L	F	0.00050	0.040	SW-846 1311/6010B	P
Selenium	0.0088	mg/L	F	0.0031	0.10	SW-846 1311/6010B	P
Silver	0.00060	mg/L	U	0.00060	0.050	SW-846 1311/6010B	P

INORGANIC ANALYSIS DATA SHEET

Lab Name: GCAL

Sample ID: CS-WB07

Lab Code: LA024 Case No.:

Contract:

Matrix: (soil / water) Soil

SAS No.: SDG No.: 205091619

Level: (low / med) % Solids:

Lab Sample ID: 20509161902

Date Received: 09/16/05 Time: 1710

Date Collected: 09/14/05 Time: 1515

Analyte	*Concentration*	*Units*	*C*	*MDL*	*PQL*	*Method*	*Type*
Antimony	0.0037	mg/L	U	0.0037	0.060	SW-846 1311/6010B	P
Arsenic	0.0025	mg/L	U	0.0025	0.20	SW-846 1311/6010B	P
Barium	0.16	mg/L	F	0.00030	1.00	SW-846 1311/6010B	P
Beryllium	0.00010	mg/L	U	0.00010	0.0050	SW-846 1311/6010B	P
Cadmium	0.00010	mg/L	U	0.00010	0.010	SW-846 1311/6010B	P
Chromium	0.0025	mg/L	F	0.00050	0.050	SW-846 1311/6010B	P
Lead	0.0015	mg/L	U	0.0015	0.10	SW-846 1311/6010B	P
Mercury	0.00016	mg/L	F	0.00008	0.00020	SW-846 1311/7470A	AV
Nickel	0.043	mg/L		0.00050	0.040	SW-846 1311/6010B	P
Selenium	0.015	mg/L	F	0.0031	0.10	SW-846 1311/6010B	P
Silver	0.00060	mg/L	U	0.00060	0.050	SW-846 1311/6010B	P

INORGANIC ANALYSIS DATA SHEET

Lab Name: GCAL

Sample ID: CS-WB06

Lab Code: LA024 Case No.:

Contract:

Matrix: (soil / water) Soil

SAS No.: SDG No.: 205091619

Level: (low / med) % Solids:

Lab Sample ID: 20509161903

Date Received: 09/16/05 Time: 1710

Date Collected: 09/14/05 Time: 1545

Analyte	Concentration	Units	C	MDL	PQL	Method	Type
Antimony	0.0041	mg/L	F	0.0037	0.060	SW-846 1311/6010B	P
Arsenic	0.0025	mg/L	U	0.0025	0.20	SW-846 1311/6010B	P
Barium	0.22	mg/L	F	0.00030	1.00	SW-846 1311/6010B	P
Beryllium	0.00010	mg/L	U	0.00010	0.0050	SW-846 1311/6010B	P
Cadmium	0.00010	mg/L	U	0.00010	0.010	SW-846 1311/6010B	P
Chromium	0.0029	mg/L	F	0.00050	0.050	SW-846 1311/6010B	P
Lead	0.0015	mg/L	U	0.0015	0.10	SW-846 1311/6010B	P
Mercury	0.00023	mg/L		0.00008	0.00020	SW-846 1311/7470A	AV
Nickel	0.049	mg/L		0.00050	0.040	SW-846 1311/6010B	P
Selenium	0.014	mg/L	F	0.0031	0.10	SW-846 1311/6010B	P
Silver	0.00060	mg/L	U	0.00060	0.050	SW-846 1311/6010B	P

INORGANIC ANALYSIS DATA SHEET

Lab Name: GCAL

Sample ID: CS-WB08

Lab Code: LA024 Case No.:

Contract:

Matrix: (soil / water) Soil

SAS No.: SDG No.: 205091619

Level: (low / med) % Solids:

Lab Sample ID: 20509161904

Date Received: 09/16/05 Time: 1710

Date Collected: 09/14/05 Time: 1615

Analyte	***Concentration***	***Units***	***C***	***MDL***	***PQL***	***Method***	***Type***
Antimony	0.0044	mg/L	F	0.0037	0.060	SW-846 1311/6010B	P
Arsenic	0.0025	mg/L	U	0.0025	0.20	SW-846 1311/6010B	P
Barium	0.12	mg/L	F	0.00030	1.00	SW-846 1311/6010B	P
Beryllium	0.00010	mg/L	U	0.00010	0.0050	SW-846 1311/6010B	P
Cadmium	0.00010	mg/L	U	0.00010	0.010	SW-846 1311/6010B	P
Chromium	0.0013	mg/L	F	0.00050	0.050	SW-846 1311/6010B	P
Lead	0.0015	mg/L	U	0.0015	0.10	SW-846 1311/6010B	P
Mercury	0.00008	mg/L	U	0.00008	0.00020	SW-846 1311/7470A	AV
Nickel	0.027	mg/L	F	0.00050	0.040	SW-846 1311/6010B	P
Selenium	0.0031	mg/L	U	0.0031	0.10	SW-846 1311/6010B	P
Silver	0.00060	mg/L	U	0.00060	0.050	SW-846 1311/6010B	P

Parsons/ 7315/ CCS 091019/ 4-2-C

Camp Stanley Storage Activity Chain Of Custody

COC ID:	091505GCALA	Relinquish_Date:	9/15/2005	Cooler ID:	A
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL
Job Number:	744223.07000	Relinquish_Time:	7:00 PM	Carrier:	FedEx
Creation Date:	9/15/2005	Collection Team:	ET	Airbill Carrier:	850454594840

Sampler(s): E. Tennyson

LOCID: **CS-WB05** LOGDATE: 9/14/2005 MATRIX: SD TBLOT: n/a
SBD: 0 LOGTIME: 15:00 SACODE: N SMCODE: CS ABLOT:
SED: 0 FLDSAMPID CS-WB05_091405_N1500 EBLOT: Containers: 1
Remarks: See contract for parameter list. Standard TAT.

Analysis Required:

SW8260B	TCLP VOC

LOCID: **CS-WB05** LOGDATE: 9/14/2005 MATRIX: SD TBLOT: n/a
SBD: 0 LOGTIME: 15:00 SACODE: N SMCODE: CS ABLOT:
SED: 0 FLDSAMPID CS-WB05_091405_N1500 EBLOT: Containers: 1
Remarks: See contract for parameter list. Standard TAT.

Analysis Required:

SW6010B	TCLP-Silver (Ag)	SW6010B	TCLP-Arsenic (As)
SW6010B	TCLP-Barium (Ba)	SW6010B	TCLP-Beryllium (Be)
SW6010B	TCLP-Cadmium (Cd)	SW6010B	TCLP-Chromium (Cr)
SW6010B	TCLP-Nickel (Ni)	SW6010B	TCLP-Lead (Pb)
SW6010B	TCLP-Antimony (Sb)	SW6010B	TCLP-Selenium (Se)
SW7470A	TCLP-Mercury (Hg)		

LOCID: **CS-WB07** LOGDATE: 9/14/2005 MATRIX: SD TBLOT: n/a
SBD: 0 LOGTIME: 15:15 SACODE: N SMCODE: CS ABLOT:
SED: 0 FLDSAMPID CS-WB07_091405_N1515 EBLOT: Containers: 1
Remarks: See contract for parameter list. Standard TAT.

Analysis Required:

SW6010B	TCLP-Silver (Ag)	SW6010B	TCLP-Arsenic (As)
SW6010B	TCLP-Barium (Ba)	SW6010B	TCLP-Beryllium (Be)
SW6010B	TCLP-Cadmium (Cd)	SW6010B	TCLP-Chromium (Cr)
SW6010B	TCLP-Nickel (Ni)	SW6010B	TCLP-Lead (Pb)
SW6010B	TCLP-Antimony (Sb)	SW6010B	TCLP-Selenium (Se)
SW7470A	TCLP-Mercury (Hg)		

LOCID: **CS-WB07** LOGDATE: 9/14/2005 MATRIX: SD TBLOT: n/a
SBD: 0 LOGTIME: 15:15 SACODE: N SMCODE: CS ABLOT:
SED: 0 FLDSAMPID CS-WB07_091405_N1515 EBLOT: Containers: 1
Remarks: See contract for parameter list. Standard TAT.

Analysis Required:

SW8260B	TCLP VOC

LOCID: **CS-WB06** LOGDATE: 9/14/2005 MATRIX: SD TBLOT: n/a
SBD: 0 LOGTIME: 15:45 SACODE: N SMCODE: CS ABLOT:
SED: 0 FLDSAMPID CS-WB06_091405_N1545 EBLOT: Containers: 1
Remarks: See contract for parameter list. Standard TAT.

Analysis Required:

SW6010B	TCLP-Silver (Ag)	SW6010B	TCLP-Arsenic (As)
SW6010B	TCLP-Barium (Ba)	SW6010B	TCLP-Beryllium (Be)
SW6010B	TCLP-Cadmium (Cd)	SW6010B	TCLP-Chromium (Cr)
SW6010B	TCLP-Nickel (Ni)	SW6010B	TCLP-Lead (Pb)
SW6010B	TCLP-Antimony (Sb)	SW6010B	TCLP-Selenium (Se)
SW7470A	TCLP-Mercury (Hg)		

LOCID: **CS-WB06** LOGDATE: 9/14/2005 MATRIX: SD TBLOT: n/a
SBD: 0 LOGTIME: 15:45 SACODE: N SMCODE: CS ABLOT:
SED: 0 FLDSAMPID CS-WB06_091405_N1545 EBLOT: Containers: 1
Remarks: See contract for parameter list. Standard TAT.

Analysis Required:

SW8260B	TCLP VOC

LOCID: **CS-WB08** LOGDATE: 9/14/2005 MATRIX: SD TBLOT: n/a
SBD: 0 LOGTIME: 16:15 SACODE: N SMCODE: CS ABLOT:
SED: 0 FLDSAMPID CS-WB08_091405_N1615 EBLOT: Containers: 1
Remarks: See contract for parameter list. Standard TAT.

Analysis Required:

SW6010B	TCLP-Silver (Ag)	SW6010B	TCLP-Arsenic (As)
SW6010B	TCLP-Barium (Ba)	SW6010B	TCLP-Beryllium (Be)
SW6010B	TCLP-Cadmium (Cd)	SW6010B	TCLP-Chromium (Cr)
SW6010B	TCLP-Nickel (Ni)	SW6010B	TCLP-Lead (Pb)
SW6010B	TCLP-Antimony (Sb)	SW6010B	TCLP-Selenium (Se)
SW7470A	TCLP-Mercury (Hg)		

Relinquished by: E. Tennyson Date 9/15/05 Time 1900 | Relinquished by: FedEx Date 9/16/05 Time 1710 | Relinquished by:______ Date____ Time____
Recieved by: FDX Date____ Time____ | Recieved by: [signature] Date 9/16/05 Time 1710 | Recieved by:______ Date____ Time____

Camp Stanley Storage Activity Chain Of Custody

COC ID:	091505GCALA	Relinquish_Date:	9/15/2005	Cooler ID:	A
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL
Job Number:	744223.07000	Relinquish_Time:	7:00 PM	Carrier:	FedEx
Creation Date:	9/15/2005	Collection Team:	ET	Airbill Carrier:	850454594840

Sampler(s): E. Tennyson [signature]

LOCID: **CS-WB08** LOGDATE: **9/14/2005** MATRIX: **SD** TBLOT: **n/a**

SBD: **0** LOGTIME: **16:15** SACODE: **N** SMCODE: **CS** ABLOT:

SED: **0** FLDSAMPID **CS-WB08_091405_N1615** EBLOT:

Containers: 1

Analysis Required:

SW8260B TCLP VOC [redacted]

Remarks: **See contract for parameter list. Standard TAT.**

-4

Relinquished by: E. Tennyson	Date 9/15/05	Time 1900	
Recieved by: FDX	Date	Time	
Relinquished by: Fedex	Date 9-16-05	Time 1710	
Recieved by: MR	Date 9-16-05	Time 1710	
Relinquished by:	Date	Time	3C
Recieved by:	Date	Time	

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 09/27/2005

GCAL Report 205091333

RECEIVED
OCT 5 2005

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons

Project Camp Stanley

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07 (10-30)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091333

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL Lab Sample ID: 20509133301

Level: (low/med) Lab File ID: 2050915/S0769

% Moisture: not dec. Date Collected: 09/06/05 Time: 1500

GC Column: RTX-1 ID: .32 (mm) Date Received: 09/13/05

Instrument ID: MSSV2 Date Analyzed: 09/15/05 Time: 1814

Soil Extract Volume: (µL) Dilution Factor: 50 Analyst: RFS

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 299453

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.500	U	0.500	25.0
75-34-3	1,1-Dichloroethane	0.500	U	0.500	25.0
75-35-4	1,1-Dichloroethene	0.500	U	0.500	25.0
107-06-2	1,2-Dichloroethane	0.500	U	0.500	25.0
71-43-2	Benzene	0.500	U	0.500	25.0
67-66-3	Chloroform	0.500	U	0.500	25.0
75-09-2	Methylene chloride	0.500	U	0.500	25.0
127-18-4	Tetrachloroethene	83.3		0.500	25.0
79-01-6	Trichloroethene	4160		0.500	25.0
75-01-4	Vinyl chloride	0.500	U	0.500	25.0
156-59-2	cis-1,2-Dichloroethene	1340		0.500	25.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07 (30-50)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091333

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL Lab Sample ID: 20509133302

Level: (low/med) Lab File ID: 2050915/S0771

% Moisture: not dec. Date Collected: 09/06/05 Time: 1548

GC Column: RTX-1 ID: .32 (mm) Date Received: 09/13/05

Instrument ID: MSSV2 Date Analyzed: 09/15/05 Time: 1944

Soil Extract Volume: (µL) Dilution Factor: 50 Analyst: RFS

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 299453

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.500	U	0.500	25.0
75-34-3	1,1-Dichloroethane	0.500	U	0.500	25.0
75-35-4	1,1-Dichloroethene	0.500	U	0.500	25.0
107-06-2	1,2-Dichloroethane	0.500	U	0.500	25.0
71-43-2	Benzene	0.500	U	0.500	25.0
67-66-3	Chloroform	0.500	U	0.500	25.0
75-09-2	Methylene chloride	0.500	U	0.500	25.0
127-18-4	Tetrachloroethene	25.7		0.500	25.0
79-01-6	Trichloroethene	937		0.500	25.0
75-01-4	Vinyl chloride	0.500	U	0.500	25.0
156-59-2	cis-1,2-Dichloroethene	229		0.500	25.0

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VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07 (110-130)

Lab Name: GCAL   Contract:

Lab Code: LA024   Case No.:   SAS No.:   SDG No.: 205091333

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL   Lab Sample ID: 20509133303

Level: (low/med)   Lab File ID: 2050915/S0778

% Moisture: not dec.   Date Collected: 09/07/05   Time: 1020

GC Column: RTX-1   ID: .32 (mm)   Date Received: 09/13/05

Instrument ID: MSSV2   Date Analyzed: 09/16/05   Time: 1006

Soil Extract Volume: (µL)   Dilution Factor: 5   Analyst: RFS

Soil Aliquot Volume: (µL)   Prep Batch: Analytical Batch: 299453

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.050	U	0.050	2.50
75-34-3	1,1-Dichloroethane	0.050	U	0.050	2.50
75-35-4	1,1-Dichloroethene	0.050	U	0.050	2.50
107-06-2	1,2-Dichloroethane	0.050	U	0.050	2.50
71-43-2	Benzene	0.050	U	0.050	2.50
67-66-3	Chloroform	0.050	U	0.050	2.50
75-09-2	Methylene chloride	0.050	U	0.050	2.50
127-18-4	Tetrachloroethene	21.5		0.050	2.50
79-01-6	Trichloroethene	94.3		0.050	2.50
75-01-4	Vinyl chloride	0.050	U	0.050	2.50
156-59-2	cis-1,2-Dichloroethene	25.5		0.050	2.50

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB06 (10-30)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091333

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL Lab Sample ID: 20509133304

Level: (low/med) Lab File ID: 2050915/S0775

% Moisture: not dec. Date Collected: 09/08/05 Time: 0950

GC Column: RTX-1 ID: .32 (mm) Date Received: 09/13/05

Instrument ID: MSSV2 Date Analyzed: 09/15/05 Time: 2242

Soil Extract Volume: (µL) Dilution Factor: 50 Analyst: RFS

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 299453

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.500	U	0.500	25.0
75-34-3	1,1-Dichloroethane	0.500	U	0.500	25.0
75-35-4	1,1-Dichloroethene	0.500	U	0.500	25.0
107-06-2	1,2-Dichloroethane	0.500	U	0.500	25.0
71-43-2	Benzene	0.500	U	0.500	25.0
67-66-3	Chloroform	0.500	U	0.500	25.0
75-09-2	Methylene chloride	0.500	U	0.500	25.0
127-18-4	Tetrachloroethene	1270		0.500	25.0
79-01-6	Trichloroethene	711		0.500	25.0
75-01-4	Vinyl chloride	0.500	U	0.500	25.0
156-59-2	cis-1,2-Dichloroethene	856		0.500	25.0

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VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB06 (50-70)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091333

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL

Lab Sample ID: 20509133305

Level: (low/med)

Lab File ID: 2050915/S0779

% Moisture: not dec.

Date Collected: 09/08/05 Time: 1125

GC Column: RTX-1 ID: .32 (mm)

Date Received: 09/13/05

Instrument ID: MSSV2

Date Analyzed: 09/16/05 Time: 1052

Soil Extract Volume: (µL)

Dilution Factor: 50 Analyst: RFS

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 299453

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.500	U	0.500	25.0
75-34-3	1,1-Dichloroethane	0.500	U	0.500	25.0
75-35-4	1,1-Dichloroethene	0.500	U	0.500	25.0
107-06-2	1,2-Dichloroethane	0.500	U	0.500	25.0
71-43-2	Benzene	0.500	U	0.500	25.0
67-66-3	Chloroform	0.500	U	0.500	25.0
75-09-2	Methylene chloride	0.500	U	0.500	25.0
127-18-4	Tetrachloroethene	1570		0.500	25.0
79-01-6	Trichloroethene	1270		0.500	25.0
75-01-4	Vinyl chloride	0.500	U	0.500	25.0
156-59-2	cis-1,2-Dichloroethene	931		0.500	25.0

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VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB06 (130-150)

Lab Name: GCAL　　Contract:

Lab Code: LA024　　Case No.:　　SAS No.:　　SDG No.: 205091333

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL　　Lab Sample ID: 20509133306

Level: (low/med)　　Lab File ID: 2050915/S0780

% Moisture: not dec.　　Date Collected: 09/08/05　　Time: 1412

GC Column: RTX-1　　ID: .32 (mm)　　Date Received: 09/13/05

Instrument ID: MSSV2　　Date Analyzed: 09/16/05　　Time: 1141

Soil Extract Volume: (µL)　　Dilution Factor: 50　　Analyst: RFS

Soil Aliquot Volume: (µL)　　Prep Batch:　　Analytical Batch: 299453

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.500	U	0.500	25.0
75-34-3	1,1-Dichloroethane	0.500	U	0.500	25.0
75-35-4	1,1-Dichloroethene	0.500	U	0.500	25.0
107-06-2	1,2-Dichloroethane	0.500	U	0.500	25.0
71-43-2	Benzene	0.500	U	0.500	25.0
67-66-3	Chloroform	0.500	U	0.500	25.0
75-09-2	Methylene chloride	0.500	U	0.500	25.0
127-18-4	Tetrachloroethene	540		0.500	25.0
79-01-6	Trichloroethene	490		0.500	25.0
75-01-4	Vinyl chloride	0.500	U	0.500	25.0
156-59-2	cis-1,2-Dichloroethene	520		0.500	25.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07 (70-90)

Lab Name: GCAL   Contract:

Lab Code: LA024   Case No.:   SAS No.:   SDG No.: 205091333

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL   Lab Sample ID: 20509133307

Level: (low/med)   Lab File ID: 2050915/S0782

% Moisture: not dec.   Date Collected: 09/07/05   Time: 0852

GC Column: RTX-1   ID: .32 (mm)   Date Received: 09/13/05

Instrument ID: MSSV2   Date Analyzed: 09/16/05   Time: 1329

Soil Extract Volume: (µL)   Dilution Factor: 5   Analyst: RFS

Soil Aliquot Volume: (µL)   Prep Batch: Analytical Batch: 299453

CONCENTRATION UNITS: ppbv   Analytical Method: TO-15

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.050	U	0.050	2.50
75-34-3	1,1-Dichloroethane	0.050	U	0.050	2.50
75-35-4	1,1-Dichloroethene	0.050	U	0.050	2.50
107-06-2	1,2-Dichloroethane	0.050	U	0.050	2.50
71-43-2	Benzene	0.050	U	0.050	2.50
67-66-3	Chloroform	0.050	U	0.050	2.50
75-09-2	Methylene chloride	0.050	U	0.050	2.50
127-18-4	Tetrachloroethene	4.57		0.050	2.50
79-01-6	Trichloroethene	106		0.050	2.50
75-01-4	Vinyl chloride	0.050	U	0.050	2.50
156-59-2	cis-1,2-Dichloroethene	27.1		0.050	2.50

Parsons /4515/2050915 33/9-22-05

Camp Stanley Storage Activity Chain Of Custody

COC ID:	**090905GCALB**	Relinquish_Date:	**9/9/2005**	Cooler ID:	**B**	Sampler(s):	E. Tennyson
Project Location:	**Parsons TO-06**	Relinquished_By:	**ET**	LabCode:	**GCAL**		
Job Number:	**743322.07000**	Relinquish_Time:	**5:30 PM**	Carrier:	**FedEx**		
Creation Date:	**9/9/2005**	Collection Team:	**ET**	Airbill Carrier:	**850454594830**		

LOCID: **CS-WB07** LOGDATE: **9/6/2005** MATRIX: **GS** TBLOT: Analysis Required:
SBD: **10** LOGTIME: **15:00** SACODE: **N** SMCODE: **SA** ABLOT: TO 15 TO 15
SED: **30** FLDSAMPID **CS-WB07_090705_N1500** EBLOT: Containers: 1
Remarks: **field PID = 6.1 ppm;TAT as per contract.** -1

LOCID: **CS-WB07** LOGDATE: **9/6/2005** MATRIX: **GS** TBLOT: Analysis Required:
SBD: **30** LOGTIME: **15:48** SACODE: **N** SMCODE: **SA** ABLOT: TO 15 TO 15
SED: **50** FLDSAMPID **CS-WB07_090705_N1548** EBLOT: Containers: 1
Remarks: **field PID = 0.2 ppm;TAT as per contract.** -2

LOCID: **CS-WB07** LOGDATE: **9/7/2005** MATRIX: **GS** TBLOT: Analysis Required:
SBD: **110** LOGTIME: **10:20** SACODE: **N** SMCODE: **SA** ABLOT: TO 15 TO 15
SED: **130** FLDSAMPID **CS-WB07_090705_N1020** EBLOT: Containers: 1
Remarks: **field PID = 0; TAT as per contract.** -3

Room

Relinquished by: E. Tennyson	Date 9/9/05	Time 1730	Relinquished by: GCAL Courier	Date 9-13-05	Time 1455	Relinquished by:	Date Time
Recieved by: FDX	Date	Time	Recieved by: [signature]	Date 9-13-05	Time 1455	Recieved by:	Date Time

Camp Stanley Storage Activity Chain Of Custody

COC ID:	090905GCALA	Relinquish_Date:	9/9/2005	Cooler ID:	A	Sampler(s):	Er Tennyson, Eric W. Tennyson
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL		
Job Number:	744223.07000	Relinquish_Time:	5:30 PM	Carrier:	FedEx		
Creation Date:	9/9/2005	Collection Team:	ET	Airbill Carrier:	850454594830		

LOCID: **CS-WB06** LOGDATE: **9/8/2005** MATRIX: **GS** TBLOT: Analysis Required:
SBD: **10** LOGTIME: **9:50** SACODE: **N** SMCODE: **SA** ABLOT: TO 15 TO 15
SED: **30** FLDSAMPID **CS-WB06_090805_N0950** EBLOT: Containers: 1
Remarks: **field PID =0 ppm;TAT as per contract.** -4

LOCID: **CS-WB06** LOGDATE: **9/8/2005** MATRIX: **GS** TBLOT: Analysis Required:
SBD: **50** LOGTIME: **11:25** SACODE: **N** SMCODE: **SA** ABLOT: TO 15 TO 15
SED: **70** FLDSAMPID **CS-WB06_090805_N1125** EBLOT: Containers: 1
Remarks: **field PID = 0.2 ppm;TAT as per contract.** -5

LOCID: **CS-WB06** LOGDATE: **9/8/2005** MATRIX: **GS** TBLOT: Analysis Required:
SBD: **130** LOGTIME: **14:12** SACODE: **N** SMCODE: **SA** ABLOT: TO 15 TO 15
SED: **150** FLDSAMPID **CS-WB06_090805_N1412** EBLOT: Containers: 1
Remarks: **field PID = 0.0 ppm;TAT as per contract.** -6

Relinquished by: Er Tennyson Date 9/9/05 Time 1730 Relinquished by: FedEx Date 9-13-05 Time 1455 Relinquished by:____ Date____ Time____
Recieved by: FedEx Date____ Time____ Recieved by: [signature] Date 9-13-05 Time 1455 Recieved by:____ Date____ Time____

Parsons/ 9515/ CGS 0915557 9-22-05

Camp Stanley Storage Activity Chain Of Custody

3°

COC ID:	090905GCALC	Relinquish_Date:	9/9/2005	Cooler ID:	C	Sampler(s):	E. Tennyson / Eric Tennyson
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL		
Job Number:	743322.07000	Relinquish_Time:	5:30 PM	Carrier:	FedEx		
Creation Date:	9/9/2005	Collection Team:	ET	Airbill Carrier:	850454594830		

LOCID: **CS-WB07** LOGDATE: **9/7/2005** MATRIX: **GS** TBLOT:

SBD: **70** LOGTIME: **8:52** SACODE: **N** SMCODE: **SA** ABLOT:

SED: **90** FLDSAMPID **CS-WB07_090705_N0852** EBLOT: Containers: 1

Analysis Required: TO 15 TO 15

Remarks: **field PID = 0;TAT as per contract.**

Relinquished by: E. Tennyson	Date 9/9/05	Time 1730	Relinquished by:	Date	Time	Relinquished by:	Date	Time
Recieved by: FDX	Date	Time	Recieved by: [signature]	Date 9-13-05	Time 1455	Recieved by:	Date	Time

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 09/19/2005

GCAL Report 205091012

RECEIVED
OCT 3 2005

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons

Project Camp Stanley

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

TB-1

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL

Level: (low/med) LOW

% Moisture: not dec.

GC Column: DB-624-30M ID: .53 (mm)

Instrument ID: MSV0

Soil Extract Volume: (µL)

Soil Aliquot Volume: (µL)

Lab Sample ID: 20509101201

Lab File ID: 2050917/U5631

Date Collected: 09/07/05 Time: 1200

Date Received: 09/10/05

Date Analyzed: 09/17/05 Time: 2018

Dilution Factor: 1 Analyst: JCK

Prep Batch: Analytical Batch: 299601

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	***COMPOUND***	***RESULT***	***Q***	***MDL***	***RL***
75-35-4	1,1-Dichloroethene	0.064	U	0.064	1.20
75-27-4	Bromodichloromethane	0.042	U	0.042	0.800
75-25-2	Bromoform	0.080	U	0.080	1.20
67-66-3	Chloroform	0.034	U	0.034	0.300
124-48-1	Dibromochloromethane	0.036	U	0.036	0.500
75-71-8	Dichlorodifluoromethane	0.060	U	0.060	1.00
75-09-2	Methylene chloride	0.070	U	0.070	2.00
91-20-3	Naphthalene	0.00900	U	0.00900	1.00
127-18-4	Tetrachloroethene	0.034	U	0.034	1.40
108-88-3	Toluene	0.034	U	0.034	1.10
79-01-6	Trichloroethene	0.036	U	0.036	1.00
75-01-4	Vinyl chloride	0.134	U	0.134	1.10
156-59-2	cis-1,2-Dichloroethene	0.034	U	0.034	1.20
156-60-5	trans-1,2-Dichloroethene	0.075	U	0.075	0.600

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07 (200-220)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL

Lab Sample ID: 20509101202

Level: (low/med) LOW

Lab File ID: 2050917/U5632

% Moisture: not dec.

Date Collected: 09/07/05 Time: 1355

GC Column: DB-624-30M ID: .53 (mm)

Date Received: 09/10/05

Instrument ID: MSV0

Date Analyzed: 09/17/05 Time: 2040

Soil Extract Volume: (µL)

Dilution Factor: 4 Analyst: JCK

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 299601

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.256	U	0.256	4.80
75-27-4	Bromodichloromethane	0.168	U	0.168	3.20
75-25-2	Bromoform	0.320	U	0.320	4.80
67-66-3	Chloroform	0.136	U	0.136	1.20
124-48-1	Dibromochloromethane	0.144	U	0.144	2.00
75-71-8	Dichlorodifluoromethane	0.240	U	0.240	4.00
75-09-2	Methylene chloride	0.280	U	0.280	8.00
91-20-3	Naphthalene	0.036	U	0.036	4.00
127-18-4	Tetrachloroethene	34.7		0.136	5.60
108-88-3	Toluene	0.136	U	0.136	4.40
79-01-6	Trichloroethene	47.9		0.144	4.00
75-01-4	Vinyl chloride	0.536	U	0.536	4.40
156-59-2	cis-1,2-Dichloroethene	56.1		0.136	4.80
156-60-5	trans-1,2-Dichloroethene	0.300	U	0.300	2.40

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07 (265-285)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL

Lab Sample ID: 20509101203

Level: (low/med) LOW

Lab File ID: 2050917/U5633

% Moisture: not dec.

Date Collected: 09/07/05 Time: 1455

GC Column: DB-624-30M ID: .53 (mm)

Date Received: 09/10/05

Instrument ID: MSV0

Date Analyzed: 09/17/05 Time: 2103

Soil Extract Volume: (µL)

Dilution Factor: 25 Analyst: JCK

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 299601

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	1.60	U	1.60	30.0
75-27-4	Bromodichloromethane	1.05	U	1.05	20.0
75-25-2	Bromoform	2.00	U	2.00	30.0
67-66-3	Chloroform	0.850	U	0.850	7.50
124-48-1	Dibromochloromethane	0.900	U	0.900	12.5
75-71-8	Dichlorodifluoromethane	1.50	U	1.50	25.0
75-09-2	Methylene chloride	1.75	U	1.75	50.0
91-20-3	Naphthalene	0.225	U	0.225	25.0
127-18-4	Tetrachloroethene	293		0.850	35.0
108-88-3	Toluene	0.850	U	0.850	27.5
79-01-6	Trichloroethene	322		0.900	25.0
75-01-4	Vinyl chloride	3.35	U	3.35	27.5
156-59-2	cis-1,2-Dichloroethene	361		0.850	30.0
156-60-5	trans-1,2-Dichloroethene	1.88	U	1.88	15.0

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
CS-WB07 (285-305)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL Lab Sample ID: 20509101204

Level: (low/med) LOW Lab File ID: 2050917/U5634

% Moisture: not dec. Date Collected: 09/07/05 Time: 1543

GC Column: DB-624-30M ID: .53 (mm) Date Received: 09/10/05

Instrument ID: MSV0 Date Analyzed: 09/17/05 Time: 2126

Soil Extract Volume: (µL) Dilution Factor: 25 Analyst: JCK

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 299601

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	1.60	U	1.60	30.0
75-27-4	Bromodichloromethane	1.05	U	1.05	20.0
75-25-2	Bromoform	2.00	U	2.00	30.0
67-66-3	Chloroform	0.850	U	0.850	7.50
124-48-1	Dibromochloromethane	0.900	U	0.900	12.5
75-71-8	Dichlorodifluoromethane	1.50	U	1.50	25.0
75-09-2	Methylene chloride	1.75	U	1.75	50.0
91-20-3	Naphthalene	0.225	U	0.225	25.0
127-18-4	Tetrachloroethene	254		0.850	35.0
108-88-3	Toluene	0.850	U	0.850	27.5
79-01-6	Trichloroethene	306		0.900	25.0
75-01-4	Vinyl chloride	3.35	U	3.35	27.5
156-59-2	cis-1,2-Dichloroethene	322		0.850	30.0
156-60-5	trans-1,2-Dichloroethene	1.88	U	1.88	15.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB07 (310-330)

Lab Name: GCAL   Contract:

Lab Code: LA024   Case No.:   SAS No.:   SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL   Lab Sample ID: 20509101205

Level: (low/med) LOW   Lab File ID: 2050917/U5635

% Moisture: not dec.   Date Collected: 09/07/05   Time: 1636

GC Column: DB-624-30M   ID: .53 (mm)   Date Received: 09/10/05

Instrument ID: MSV0   Date Analyzed: 09/17/05   Time: 2150

Soil Extract Volume: (μL)   Dilution Factor: 25   Analyst: RJO

Soil Aliquot Volume: (μL)   Prep Batch: Analytical Batch: 299601

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	1.60	U	1.60	30.0
75-27-4	Bromodichloromethane	1.05	U	1.05	20.0
75-25-2	Bromoform	2.00	U	2.00	30.0
67-66-3	Chloroform	0.850	U	0.850	7.50
124-48-1	Dibromochloromethane	0.900	U	0.900	12.5
75-71-8	Dichlorodifluoromethane	1.50	U	1.50	25.0
75-09-2	Methylene chloride	1.75	U	1.75	50.0
91-20-3	Naphthalene	0.225	U	0.225	25.0
127-18-4	Tetrachloroethene	221		0.850	35.0
108-88-3	Toluene	0.850	U	0.850	27.5
79-01-6	Trichloroethene	277		0.900	25.0
75-01-4	Vinyl chloride	3.35	U	3.35	27.5
156-59-2	cis-1,2-Dichloroethene	403		0.850	30.0
156-60-5	trans-1,2-Dichloroethene	1.88	U	1.88	15.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB06 (260-280)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL Lab Sample ID: 20509101206

Level: (low/med) LOW Lab File ID: 2050917/U5636

% Moisture: not dec. Date Collected: 09/08/05 Time: 1555

GC Column: DB-624-30M ID: .53 (mm) Date Received: 09/10/05

Instrument ID: MSV0 Date Analyzed: 09/17/05 Time: 2216

Soil Extract Volume: (µL) Dilution Factor: 20 Analyst: RJO

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 299601

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	1.28	U	1.28	24.0
75-27-4	Bromodichloromethane	0.840	U	0.840	16.0
75-25-2	Bromoform	1.60	U	1.60	24.0
67-66-3	Chloroform	0.680	U	0.680	6.00
124-48-1	Dibromochloromethane	0.720	U	0.720	10.0
75-71-8	Dichlorodifluoromethane	1.20	U	1.20	20.0
75-09-2	Methylene chloride	1.40	U	1.40	40.0
91-20-3	Naphthalene	0.180	U	0.180	20.0
127-18-4	Tetrachloroethene	151		0.680	28.0
108-88-3	Toluene	0.680	U	0.680	22.0
79-01-6	Trichloroethene	159		0.720	20.0
75-01-4	Vinyl chloride	2.68	U	2.68	22.0
156-59-2	cis-1,2-Dichloroethene	287		0.680	24.0
156-60-5	trans-1,2-Dichloroethene	1.50	U	1.50	12.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB06 (284-304)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL Lab Sample ID: 20509101207

Level: (low/med) LOW Lab File ID: 2050917/U5637

% Moisture: not dec. Date Collected: 09/08/05 Time: 1642

GC Column: DB-624-30M ID: .53 (mm) Date Received: 09/10/05

Instrument ID: MSV0 Date Analyzed: 09/17/05 Time: 2239

Soil Extract Volume: (μL) Dilution Factor: 40 Analyst: RSP

Soil Aliquot Volume: (μL) Prep Batch: Analytical Batch: 299601

CONCENTRATION UNITS: ug/L Analytical Method: SW-846 8260

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	2.56	U	2.56	48.0
75-27-4	Bromodichloromethane	1.68	U	1.68	32.0
75-25-2	Bromoform	3.20	U	3.20	48.0
67-66-3	Chloroform	1.36	U	1.36	12.0
124-48-1	Dibromochloromethane	1.44	U	1.44	20.0
75-71-8	Dichlorodifluoromethane	2.40	U	2.40	40.0
75-09-2	Methylene chloride	2.80	U	2.80	80.0
91-20-3	Naphthalene	0.360	U	0.360	40.0
127-18-4	Tetrachloroethene	297		1.36	56.0
108-88-3	Toluene	1.36	U	1.36	44.0
79-01-6	Trichloroethene	268		1.44	40.0
75-01-4	Vinyl chloride	5.36	U	5.36	44.0
156-59-2	cis-1,2-Dichloroethene	413		1.36	48.0
156-60-5	trans-1,2-Dichloroethene	3.00	U	3.00	24.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB06 (308-328)

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205091012

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL Lab Sample ID: 20509101208

Level: (low/med) LOW Lab File ID: 2050917/U5638

% Moisture: not dec. Date Collected: 09/08/05 Time: 1725

GC Column: DB-624-30M ID: .53 (mm) Date Received: 09/10/05

Instrument ID: MSV0 Date Analyzed: 09/17/05 Time: 2302

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: RSP

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 299601

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	2.56	U	2.56	48.0
75-27-4	Bromodichloromethane	1.68	U	1.68	32.0
75-25-2	Bromoform	3.20	U	3.20	48.0
67-66-3	Chloroform	1.36	U	1.36	12.0
124-48-1	Dibromochloromethane	1.44	U	1.44	20.0
75-71-8	Dichlorodifluoromethane	2.40	U	2.40	40.0
75-09-2	Methylene chloride	2.80	U	2.80	80.0
91-20-3	Naphthalene	0.360	U	0.360	40.0
127-18-4	Tetrachloroethene	337		1.36	56.0
108-88-3	Toluene	1.36	U	1.36	44.0
79-01-6	Trichloroethene	268		1.44	40.0
75-01-4	Vinyl chloride	5.36	U	5.36	44.0
156-59-2	cis-1,2-Dichloroethene	435		1.36	48.0
156-60-5	trans-1,2-Dichloroethene	3.00	U	3.00	24.0

Camp Stanley Storage Activity Chain Of Custody

COC ID:	090805GCALA	Relinquish_Date:	9/8/2005	Cooler ID:	A	Sampler(s):	E. Tennyson
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL		
Job Number:	744223.07000	Relinquish_Time:	7:00 PM	Carrier:	FedEx		
Creation Date:	9/8/2005	Collection Team:	ET	Airbill Carrier:	850454606470		

LOCID: **TB-1** LOGDATE: **9/7/2005** MATRIX: **WQ** TBLOT: Analysis Required:
SBD: **0** LOGTIME: **12:00** SACODE: **TB** SMCODE: **NA** ABLOT: SW8260B VOC Short List
SED: **0** FLDSAMPID **TB-1_090705_TB1200** EBLOT: Containers: 3
Remarks: -1

LOCID: **CS-WB07** LOGDATE: **9/7/2005** MATRIX: **WG** TBLOT: **07090501** Analysis Required:
SBD: **200** LOGTIME: **13:55** SACODE: **N** SMCODE: **SP** ABLOT: SW8260B VOC Short List
SED: **220** FLDSAMPID **CS-WB07_090705_N1355** EBLOT: Containers: 3
Remarks: **TAT as per contract.** -2

LOCID: **CS-WB07** LOGDATE: **9/7/2005** MATRIX: **WG** TBLOT: **07090501** Analysis Required:
SBD: **265** LOGTIME: **14:55** SACODE: **N** SMCODE: **SP** ABLOT: SW8260B VOC Short List
SED: **285** FLDSAMPID **CS-WB07_090705_N1455** EBLOT: Containers: 3
Remarks: **TAT as per contract.** -3

LOCID: **CS-WB07** LOGDATE: **9/7/2005** MATRIX: **WG** TBLOT: **07090501** Analysis Required:
SBD: **285** LOGTIME: **15:43** SACODE: **N** SMCODE: **SP** ABLOT: SW8260B VOC Short List
SED: **305** FLDSAMPID **CS-WB07_090705_N1543** EBLOT: Containers: 3
Remarks: **TAT as per contract.** -4

LOCID: **CS-WB07** LOGDATE: **9/7/2005** MATRIX: **WG** TBLOT: **07090501** Analysis Required:
SBD: **310** LOGTIME: **16:36** SACODE: **N** SMCODE: **SP** ABLOT: SW8260B VOC Short List
SED: **330** FLDSAMPID **CS-WB07_090705_N1636** EBLOT: Containers: 3
Remarks: **TAT as per contract.** -5

LOCID: **CS-WB06** LOGDATE: **9/8/2005** MATRIX: **WG** TBLOT: **07090501** Analysis Required:
SBD: **260** LOGTIME: **15:55** SACODE: **N** SMCODE: **SP** ABLOT: SW8260B VOC Short List
SED: **280** FLDSAMPID **CS-WB06_090805_N1555** EBLOT: Containers: 3
Remarks: **TAT as per contract.** -6

LOCID: **CS-WB06** LOGDATE: **9/8/2005** MATRIX: **WG** TBLOT: **07090501** Analysis Required:
SBD: **284** LOGTIME: **16:42** SACODE: **N** SMCODE: **SP** ABLOT: SW8260B VOC Short List
SED: **304** FLDSAMPID **CS-WB06_090805_N1642** EBLOT: Containers: 3
Remarks: **TAT as per contract.** -7

LOCID: **CS-WB06** LOGDATE: **9/8/2005** MATRIX: **WG** TBLOT: **07090501** Analysis Required:
SBD: **308** LOGTIME: **17:25** SACODE: **N** SMCODE: **SP** ABLOT: SW8260B VOC Short List
SED: **328** FLDSAMPID **CS-WB06_090805_N1725** EBLOT: Containers: 3
Remarks: **TAT as per contract.** -8

Relinquished by: E. Tennyson Date 9/8/05 Time 1900		Relinquished by: FedEx	Date 9-10-05 Time 1400	Relinquished by:	Date Time
Recieved by: FedEx Date Time		Recieved by: [signature]	Date 9-10-05 Time 1400	Recieved by:	Date Time

000027

NELAP CERTIFICATE NUMBER 01955

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 09/08/2005

GCAL Report 205090133

RECEIVED
SEP 27 2005

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons

Project Camp Stanley

7979 GSRI Avenue, Baton Rouge, Louisiana 70820-7402 • Phone 225.769.4900 • Fax 225.767.5717
7979 GSRI Avenue, Baton Rouge, Louisiana 70820-7402 • Phone 225.769.4900 • Fax 225.767.5717

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

TB-1

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205090133

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL Lab Sample ID: 20509013301

Level: (low/med) LOW Lab File ID: 2050907/U5212

% Moisture: not dec. Date Collected: 08/26/05 Time: 1130

GC Column: DB-624-30M ID: .53 (mm) Date Received: 09/01/05

Instrument ID: MSV0 Date Analyzed: 09/07/05 Time: 1648

Soil Extract Volume: (µL) Dilution Factor: 1 Analyst: JCK

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 298677

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.064	U	0.064	1.20
75-27-4	Bromodichloromethane	0.042	U	0.042	0.800
75-25-2	Bromoform	0.080	U	0.080	1.20
67-66-3	Chloroform	0.034	U	0.034	0.300
124-48-1	Dibromochloromethane	0.036	U	0.036	0.500
75-71-8	Dichlorodifluoromethane	0.060	U	0.060	1.00
75-09-2	Methylene chloride	0.070	U	0.070	2.00
91-20-3	Naphthalene	0.00900	U	0.00900	1.00
127-18-4	Tetrachloroethene	0.034	U	0.034	1.40
108-88-3	Toluene	0.034	U	0.034	1.10
79-01-6	Trichloroethene	0.036	U	0.036	1.00
75-01-4	Vinyl chloride	0.134	U	0.134	1.10
156-59-2	cis-1,2-Dichloroethene	0.034	U	0.034	1.20
156-60-5	trans-1,2-Dichloroethene	0.075	U	0.075	0.600

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB05 416-436

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205090133

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL

Lab Sample ID: 20509013302

Level: (low/med) LOW

Lab File ID: 2050907/U5217

% Moisture: not dec.

Date Collected: 08/26/05 Time: 1145

GC Column: DB-624-30M ID: .53 (mm)

Date Received: 09/01/05

Instrument ID: MSV0

Date Analyzed: 09/07/05 Time: 1852

Soil Extract Volume: (µL)

Dilution Factor: 20 Analyst: JCK

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 298677

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	1.28	U	1.28	24.0
75-27-4	Bromodichloromethane	0.840	U	0.840	16.0
75-25-2	Bromoform	1.60	U	1.60	24.0
67-66-3	Chloroform	0.680	U	0.680	6.00
124-48-1	Dibromochloromethane	0.720	U	0.720	10.0
75-71-8	Dichlorodifluoromethane	1.20	U	1.20	20.0
75-09-2	Methylene chloride	1.40	U	1.40	40.0
91-20-3	Naphthalene	0.180	U	0.180	20.0
127-18-4	Tetrachloroethene	392		0.680	28.0
108-88-3	Toluene	0.680	U	0.680	22.0
79-01-6	Trichloroethene	375		0.720	20.0
75-01-4	Vinyl chloride	2.68	U	2.68	22.0
156-59-2	cis-1,2-Dichloroethene	465		0.680	24.0
156-60-5	trans-1,2-Dichloroethene	16.4		1.50	12.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08 331.5-351.5

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205090133

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL Lab Sample ID: 20509013303

Level: (low/med) LOW Lab File ID: 2050907/U5216

% Moisture: not dec. Date Collected: 08/26/05 Time: 1555

GC Column: DB-624-30M ID: .53 (mm) Date Received: 09/01/05

Instrument ID: MSV0 Date Analyzed: 09/07/05 Time: 1829

Soil Extract Volume: (µL) Dilution Factor: 10 Analyst: JCK

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 298677

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.640	U	0.640	12.0
75-27-4	Bromodichloromethane	0.420	U	0.420	8.00
75-25-2	Bromoform	0.800	U	0.800	12.0
67-66-3	Chloroform	0.340	U	0.340	3.00
124-48-1	Dibromochloromethane	0.360	U	0.360	5.00
75-71-8	Dichlorodifluoromethane	0.600	U	0.600	10.0
75-09-2	Methylene chloride	0.700	U	0.700	20.0
91-20-3	Naphthalene	0.090	U	0.090	10.0
127-18-4	Tetrachloroethene	53.7		0.340	14.0
108-88-3	Toluene	0.340	U	0.340	11.0
79-01-6	Trichloroethene	54.2		0.360	10.0
75-01-4	Vinyl chloride	1.34	U	1.34	11.0
156-59-2	cis-1,2-Dichloroethene	115		0.340	12.0
156-60-5	trans-1,2-Dichloroethene	4.62	F	0.750	6.00

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08 305-325

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205090133

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL

Lab Sample ID: 20509013304

Level: (low/med) LOW

Lab File ID: 2050907/U5218

% Moisture: not dec.

Date Collected: 08/26/05 Time: 1650

GC Column: DB-624-30M ID: .53 (mm)

Date Received: 09/01/05

Instrument ID: MSV0

Date Analyzed: 09/07/05 Time: 1914

Soil Extract Volume: (µL)

Dilution Factor: 10 Analyst: JCK

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 298677

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.640	U	0.640	12.0
75-27-4	Bromodichloromethane	0.420	U	0.420	8.00
75-25-2	Bromoform	0.800	U	0.800	12.0
67-66-3	Chloroform	0.340	U	0.340	3.00
124-48-1	Dibromochloromethane	0.360	U	0.360	5.00
75-71-8	Dichlorodifluoromethane	0.600	U	0.600	10.0
75-09-2	Methylene chloride	0.700	U	0.700	20.0
91-20-3	Naphthalene	0.090	U	0.090	10.0
127-18-4	Tetrachloroethene	50.9		0.340	14.0
108-88-3	Toluene	0.340	U	0.340	11.0
79-01-6	Trichloroethene	57.3		0.360	10.0
75-01-4	Vinyl chloride	1.34	U	1.34	11.0
156-59-2	cis-1,2-Dichloroethene	98.8		0.340	12.0
156-60-5	trans-1,2-Dichloroethene	0.750	U	0.750	6.00

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08 280-300

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205090133

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL

Lab Sample ID: 20509013305

Level: (low/med) LOW

Lab File ID: 2050907/U5219

% Moisture: not dec.

Date Collected: 08/26/05 Time: 1740

GC Column: DB-624-30M ID: .53 (mm)

Date Received: 09/01/05

Instrument ID: MSV0

Date Analyzed: 09/07/05 Time: 1937

Soil Extract Volume: (µL)

Dilution Factor: 10 Analyst: JCK

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 298677

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.640	U	0.640	12.0
75-27-4	Bromodichloromethane	0.420	U	0.420	8.00
75-25-2	Bromoform	0.800	U	0.800	12.0
67-66-3	Chloroform	0.340	U	0.340	3.00
124-48-1	Dibromochloromethane	0.360	U	0.360	5.00
75-71-8	Dichlorodifluoromethane	0.600	U	0.600	10.0
75-09-2	Methylene chloride	0.700	U	0.700	20.0
91-20-3	Naphthalene	0.090	U	0.090	10.0
127-18-4	Tetrachloroethene	38.6		0.340	14.0
108-88-3	Toluene	0.340	U	0.340	11.0
79-01-6	Trichloroethene	41.8		0.360	10.0
75-01-4	Vinyl chloride	1.34	U	1.34	11.0
156-59-2	cis-1,2-Dichloroethene	108		0.340	12.0
156-60-5	trans-1,2-Dichloroethene	0.750	U	0.750	6.00

Parsons Infrastructure/ 4515 / 2050901 55/ 9-8-05

Camp Stanley Storage Activity Chain Of Custody

COC ID:	083105GCALA	Relinquish_Date:	8/30/2005	Cooler ID:	A	Sampler(s):	E. Tennyson
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL		
Job Number:	744223.07000	Relinquish_Time:	5:00 PM	Carrier:	FedEx		
Creation Date:	8/31/2005	Collection Team:	SE, ET	Airbill Carrier:	847979276476		

LOCID: **TB-1** LOGDATE: **8/26/2005** MATRIX: **WQ** TBLOT:
SBD: **0** LOGTIME: **11:30** SACODE: **TB** SMCODE: **NA** ABLOT:
SED: **0** FLDSAMPID **TB-1_082605_TB1130** EBLOT:
Containers: 3
Analysis Required: SW8260B VOC Short List
Remarks: **TAT as per contract.**
-1

LOCID: **CS-WB05** LOGDATE: **8/26/2005** MATRIX: **WG** TBLOT: **26080501**
SBD: **416** LOGTIME: **11:45** SACODE: **N** SMCODE: **SP** ABLOT:
SED: **436** FLDSAMPID **CS-WB05_082605_N1145** EBLOT:
Containers: 3
Analysis Required: SW8260B VOC Short List
Remarks: **TAT as per contract.**
-2

LOCID: **CS-WB08** LOGDATE: **8/26/2005** MATRIX: **WG** TBLOT: **26080501**
SBD: **331.5** LOGTIME: **15:55** SACODE: **N** SMCODE: **SP** ABLOT:
SED: **351.5** FLDSAMPID **CS-WB08_082605_N1555** EBLOT:
Containers: 3
Analysis Required: SW8260B VOC Short List
Remarks: **TAT as per contract.**
-3

LOCID: **CS-WB08** LOGDATE: **8/26/2005** MATRIX: **WG** TBLOT: **26080501**
SBD: **305** LOGTIME: **16:50** SACODE: **N** SMCODE: **SP** ABLOT:
SED: **325** FLDSAMPID **CS-WB08_082605_N1650** EBLOT:
Containers: 3
Analysis Required: SW8260B VOC Short List
Remarks: **TAT as per contract.**
-4

LOCID: **CS-WB08** LOGDATE: **8/26/2005** MATRIX: **WG** TBLOT: **26080501**
SBD: **280** LOGTIME: **17:40** SACODE: **N** SMCODE: **SP** ABLOT:
SED: **300** FLDSAMPID **CS-WB08_082605_N1740** EBLOT:
Containers: 3
Analysis Required: SW8260B VOC Short List
Remarks: **TAT as per contract.**
-5

Please be aware of collection dates and holding times.

Please include SBD + SED on sample I.D. for results reports.

3°

Relinquished by: E. Tennyson Date 8/31/05 Time 1700 | Relinquished by: FedEx Date ____ Time ____ | Relinquished by: [signature] GCAL Date 9/1/05 Time 1300
Recieved by: FDX Date ____ Time ____ | Recieved by: Jessica Monroe Date 9/1/05 Time 1030 | Recieved by: Ron Stanley GCAL Date 9/1/05 Time 13:00
Relinquished by: Ron Stanley Date 9/1/05 Time ... [signature] GCAL

NELAP CERTIFICATE NUMBER 01955

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 09/14/2005

GCAL Report 205083012

RECEIVED
SEP 27 2005

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons

Project Camp Stanley

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB05 156-176

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205083012

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL Lab Sample ID: 20508301201

Level: (low/med) Lab File ID: 2050906/S0716

% Moisture: not dec. Date Collected: 08/25/05 Time: 1120

GC Column: RTX-1 ID: .32 (mm) Date Received: 08/30/05

Instrument ID: MSSV2 Date Analyzed: 09/06/05 Time: 1458

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: RFS

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 298660

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.732	F	0.400	20.0
75-34-3	1,1-Dichloroethane	0.400	U	0.400	20.0
75-35-4	1,1-Dichloroethene	1.23	F	0.400	20.0
107-06-2	1,2-Dichloroethane	0.400	U	0.400	20.0
71-43-2	Benzene	6.21	F	0.400	20.0
67-66-3	Chloroform	0.870	F	0.400	20.0
75-09-2	Methylene chloride	6.00	F	0.400	20.0
127-18-4	Tetrachloroethene	328		0.400	20.0
79-01-6	Trichloroethene	157		0.400	20.0
75-01-4	Vinyl chloride	1.22	F	0.400	20.0
156-59-2	cis-1,2-Dichloroethene	47.7		0.400	20.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB05 116-136

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205083012

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL Lab Sample ID: 20508301202

Level: (low/med) Lab File ID: 2050906/S0719

% Moisture: not dec. Date Collected: 08/25/05 Time: 1340

GC Column: RTX-1 ID: .32 (mm) Date Received: 08/30/05

Instrument ID: MSSV2 Date Analyzed: 09/06/05 Time: 1724

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: RFS

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 298660

CONCENTRATION UNITS: ppbv Analytical Method: TO-15

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.400	U	0.400	20.0
75-34-3	1,1-Dichloroethane	0.400	U	0.400	20.0
75-35-4	1,1-Dichloroethene	0.400	U	0.400	20.0
107-06-2	1,2-Dichloroethane	0.400	U	0.400	20.0
71-43-2	Benzene	0.400	U	0.400	20.0
67-66-3	Chloroform	0.400	U	0.400	20.0
75-09-2	Methylene chloride	0.400	U	0.400	20.0
127-18-4	Tetrachloroethene	479		0.400	20.0
79-01-6	Trichloroethene	439		0.400	20.0
75-01-4	Vinyl chloride	0.400	U	0.400	20.0
156-59-2	cis-1,2-Dichloroethene	368		0.400	20.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB05 71-91

Lab Name: GCAL   Contract:

Lab Code: LA024   Case No.:   SAS No.:   SDG No.: 205083012

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL   Lab Sample ID: 20508301203

Level: (low/med)   Lab File ID: 2050906/S0722

% Moisture: not dec.   Date Collected: 08/25/05   Time: 1525

GC Column: RTX-1   ID: .32 (mm)   Date Received: 08/30/05

Instrument ID: MSSV2   Date Analyzed: 09/06/05   Time: 1938

Soil Extract Volume: (µL)   Dilution Factor: 40   Analyst: RFS

Soil Aliquot Volume: (µL)   Prep Batch: Analytical Batch: 298660

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.400	U	0.400	20.0
75-34-3	1,1-Dichloroethane	0.400	U	0.400	20.0
75-35-4	1,1-Dichloroethene	0.400	U	0.400	20.0
107-06-2	1,2-Dichloroethane	0.400	U	0.400	20.0
71-43-2	Benzene	0.400	U	0.400	20.0
67-66-3	Chloroform	0.400	U	0.400	20.0
75-09-2	Methylene chloride	0.400	U	0.400	20.0
127-18-4	Tetrachloroethene	204		0.400	20.0
79-01-6	Trichloroethene	167		0.400	20.0
75-01-4	Vinyl chloride	0.400	U	0.400	20.0
156-59-2	cis-1,2-Dichloroethene	110		0.400	20.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB05 30-50

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205083012

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL Lab Sample ID: 20508301204

Level: (low/med) Lab File ID: 2050906/S0725

% Moisture: not dec. Date Collected: 08/25/05 Time: 1650

GC Column: RTX-1 ID: .32 (mm) Date Received: 08/30/05

Instrument ID: MSSV2 Date Analyzed: 09/06/05 Time: 2151

Soil Extract Volume: (µL) Dilution Factor: 40 Analyst: RFS

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 298660

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	0.400	U	0.400	20.0
75-34-3	1,1-Dichloroethane	0.400	U	0.400	20.0
75-35-4	1,1-Dichloroethene	0.400	U	0.400	20.0
107-06-2	1,2-Dichloroethane	0.400	U	0.400	20.0
71-43-2	Benzene	0.400	U	0.400	20.0
67-66-3	Chloroform	0.400	U	0.400	20.0
75-09-2	Methylene chloride	0.400	U	0.400	20.0
127-18-4	Tetrachloroethene	120		0.400	20.0
79-01-6	Trichloroethene	77.1		0.400	20.0
75-01-4	Vinyl chloride	0.400	U	0.400	20.0
156-59-2	cis-1,2-Dichloroethene	17.8	F	0.400	20.0

Parsons Infrastructure / 7515 / 2050835019 / 9-8-05

Camp Stanley Storage Activity Chain Of Custody

Roe Lep

COC ID:	082605GCALA	Relinquish_Date:	8/26/2005	Cooler ID:	A	Sampler(s): E. Tennyson / Sam Elliott
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL	
Job Number:	74332.07000	Relinquish_Time:	6:00 PM	Carrier:	FedEx	
Creation Date:	8/26/2005	Collection Team:	SE, ET	Airbill Carrier:	8527 9522 2671	

LOCID: **CS-WB05** LOGDATE: **8/25/2005** MATRIX: **GS** TBLOT: **n/a** Analysis Required: TO 15 TO 15 — 1
SBD: **156** LOGTIME: **11:20** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **176** FLDSAMPID **CS-WB05_082505_N1120** EBLOT: Containers: 1
Remarks: **Field PID = 4.6ppm; TAT as per contract.**

LOCID: **CS-WB05** LOGDATE: **8/25/2005** MATRIX: **GS** TBLOT: **n/a** Analysis Required: TO 15 TO 15 — 2
SBD: **116** LOGTIME: **13:40** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **136** FLDSAMPID **CS-WB05_082505_N1340** EBLOT: Containers: 1
Remarks: **Field PID = 0.8ppm; TAT as per contract.**

LOCID: **CS-WB05** LOGDATE: **8/25/2005** MATRIX: **GS** TBLOT: **n/a** Analysis Required: TO 15 TO 15 — 3
SBD: **71** LOGTIME: **15:25** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **91** FLDSAMPID **CS-WB05_082505_N1525** EBLOT: Containers: 1
Remarks: **Field PID = 0.5ppm; TAT as per contract.**

LOCID: **CS-WB05** LOGDATE: **8/25/2005** MATRIX: **GS** TBLOT: **n/a** Analysis Required: TO 15 TO 15 — 4
SBD: **30** LOGTIME: **16:50** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **50** FLDSAMPID **CS-WB05_082505_N1650** EBLOT: Containers: 1
Remarks: **Field PID = 0ppm; TAT as per contract.**

000023
~~000107~~ RBM 9/23/05

Relinquished by: E. Tennyson Date 8/26/05 Time 1800	Relinquished by: ____ Date ____ Time ____	Relinquished by: D Pulliam Date 8-27-05 Time 0940
Recieved by: FedEx Date ____ Time ____	Recieved by: D Pulliam Date 8-27-05 Time 0845	Recieved by: Coole Date 8-29-05 Time 845

Rel · coole 8-30-05 745

NELAP CERTIFICATE NUMBER 01955

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 09/14/2005

GCAL Report 205083023

RECEIVED
SEP 27 2005

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons

Project Camp Stanley

7979 GSRI Avenue, Baton Rouge, Louisiana 70820-7402 • Phone 225.769.4900 • Fax 225.767.5717

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08 156-176

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205083023

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL

Lab Sample ID: 20508302301

Level: (low/med)

Lab File ID: 2050907/S0737

% Moisture: not dec.

Date Collected: 08/24/05 Time: 1050

GC Column: RTX-1 ID: .32 (mm)

Date Received: 08/30/05

Instrument ID: MSSV2

Date Analyzed: 09/07/05 Time: 1307

Soil Extract Volume: (µL)

Dilution Factor: 100 Analyst: RFS

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 298674

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	1.00	U	1.00	50.0
75-34-3	1,1-Dichloroethane	1.00	U	1.00	50.0
75-35-4	1,1-Dichloroethene	135		1.00	50.0
107-06-2	1,2-Dichloroethane	1.00	U	1.00	50.0
71-43-2	Benzene	1.00	U	1.00	50.0
67-66-3	Chloroform	1.00	U	1.00	50.0
75-09-2	Methylene chloride	1.00	U	1.00	50.0
127-18-4	Tetrachloroethene	5010		1.00	50.0
79-01-6	Trichloroethene	3970		1.00	50.0
75-01-4	Vinyl chloride	234		1.00	50.0
156-59-2	cis-1,2-Dichloroethene	753		1.00	50.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08 138-158

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205083023

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL

Lab Sample ID: 20508302302

Level: (low/med)

Lab File ID: 2050907/S0739

% Moisture: not dec.

Date Collected: 08/24/05 Time: 1150

GC Column: RTX-1 ID: .32 (mm)

Date Received: 08/30/05

Instrument ID: MSSV2

Date Analyzed: 09/07/05 Time: 1444

Soil Extract Volume: (µL)

Dilution Factor: 100 Analyst: RFS

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 298674

CONCENTRATION UNITS: *ppbv*

Analytical Method: TO-15

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	1.00	U	1.00	50.0
75-34-3	1,1-Dichloroethane	1.00	U	1.00	50.0
75-35-4	1,1-Dichloroethene	45.7	F	1.00	50.0
107-06-2	1,2-Dichloroethane	1.00	U	1.00	50.0
71-43-2	Benzene	1.00	U	1.00	50.0
67-66-3	Chloroform	1.00	U	1.00	50.0
75-09-2	Methylene chloride	1.00	U	1.00	50.0
127-18-4	Tetrachloroethene	4270		1.00	50.0
79-01-6	Trichloroethene	2730		1.00	50.0
75-01-4	Vinyl chloride	69.3		1.00	50.0
156-59-2	cis-1,2-Dichloroethene	506		1.00	50.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08 89-109

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205083023

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL

Lab Sample ID: 20508302303

Level: (low/med)

Lab File ID: 2050907/S0741

% Moisture: not dec.

Date Collected: 08/24/05 Time: 1330

GC Column: RTX-1 ID: .32 (mm)

Date Received: 08/30/05

Instrument ID: MSSV2

Date Analyzed: 09/07/05 Time: 1622

Soil Extract Volume: (µL)

Dilution Factor: 100 Analyst: RFS

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 298674

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	1.00	U	1.00	50.0
75-34-3	1,1-Dichloroethane	1.00	U	1.00	50.0
75-35-4	1,1-Dichloroethene	1.00	U	1.00	50.0
107-06-2	1,2-Dichloroethane	1.00	U	1.00	50.0
71-43-2	Benzene	1.00	U	1.00	50.0
67-66-3	Chloroform	1.00	U	1.00	50.0
75-09-2	Methylene chloride	1.00	U	1.00	50.0
127-18-4	Tetrachloroethene	3310		1.00	50.0
79-01-6	Trichloroethene	2220		1.00	50.0
75-01-4	Vinyl chloride	73.6		1.00	50.0
156-59-2	cis-1,2-Dichloroethene	431		1.00	50.0

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08 10-30

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205083023

Matrix: (soil/water) Air

Sample wt/vol: 400 (g/ml) mL Lab Sample ID: 20508302304

Level: (low/med) Lab File ID: 2050907/S0743

% Moisture: not dec. Date Collected: 08/24/05 Time: 1710

GC Column: RTX-1 ID: .32 (mm) Date Received: 08/30/05

Instrument ID: MSSV2 Date Analyzed: 09/07/05 Time: 1755

Soil Extract Volume: (µL) Dilution Factor: 100 Analyst: RFS

Soil Aliquot Volume: (µL) Prep Batch: Analytical Batch: 298674

Analytical Method: TO-15

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
71-55-6	1,1,1-Trichloroethane	1.00	U	1.00	50.0
75-34-3	1,1-Dichloroethane	1.00	U	1.00	50.0
75-35-4	1,1-Dichloroethene	320		1.00	50.0
107-06-2	1,2-Dichloroethane	1.00	U	1.00	50.0
71-43-2	Benzene	1.00	U	1.00	50.0
67-66-3	Chloroform	1.00	U	1.00	50.0
75-09-2	Methylene chloride	1.00	U	1.00	50.0
127-18-4	Tetrachloroethene	12200		1.00	50.0
79-01-6	Trichloroethene	9520		1.00	50.0
75-01-4	Vinyl chloride	509		1.00	50.0
156-59-2	cis-1,2-Dichloroethene	2790		1.00	50.0

Camp Stanley Storage Activity Chain Of Custody

COC ID:	082505GCALA	Relinquish_Date:	8/25/2005	Cooler ID:	A
Project Location:	Parsons TO-06	Relinquished_By:	ET	LabCode:	GCAL
Job Number:	744223.07000	Relinquish_Time:	6:00 PM	Carrier:	FedEx
Creation Date:	8/25/2005	Collection Team:	ET	Airbill Carrier:	8463 3579 2810

Sampler(s): E. Tennyson

LOCID: **CS-WB08** LOGDATE: **8/24/2005** MATRIX: **GS** TBLOT:
SBD: **156** LOGTIME: **10:50** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **176** FLDSAMPID **CS-WB08_082405_N1050** EBLOT: Containers: 1
Analysis Required: TO 15 TO 15
Remarks: **Field PID = 3.7 ppm; TAT as per contract.** -1

LOCID: **CS-WB08** LOGDATE: **8/24/2005** MATRIX: **GS** TBLOT:
SBD: **138** LOGTIME: **11:50** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **158** FLDSAMPID **CS-WB08_082405_N1150** EBLOT: Containers: 1
Analysis Required: TO 15 TO 15
Remarks: **Field PID = 4.6 ppm; TAT as per contract.** -2

LOCID: **CS-WB08** LOGDATE: **8/24/2005** MATRIX: **GS** TBLOT:
SBD: **89** LOGTIME: **13:30** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **109** FLDSAMPID **CS-WB08_082405_N1330** EBLOT: Containers: 1
Analysis Required: TO 15 TO 15
Remarks: **Field PID = 4.2 ppm; TAT as per contract.** -3

LOCID: **CS-WB08** LOGDATE: **8/24/2005** MATRIX: **GS** TBLOT:
SBD: **10** LOGTIME: **17:10** SACODE: **N** SMCODE: **SA** ABLOT:
SED: **30** FLDSAMPID **CS-WB08_082405_N1710** EBLOT: Containers: 1
Analysis Required: TO 15 TO 15
Remarks: **Field PID = 19.5 ppm; TAT as per contract.** -4

000022
~~000106~~
RBM 9/23/05

Relinquished by: E. Tennyson	Date 8/25/05	Time 1800	Relinquished by: FedEx	Date 8-30-05	Time 1206	Relinquished by:	Date	Time
Recieved by: FDX	Date	Time	Recieved by: [signature]	Date 8-30-05	Time 1206	Recieved by:	Date	Time

NELAP CERTIFICATE NUMBER 01955

Level IV

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date

GCAL Report 205082414

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons Infrastructure & Technology Group

Project Camp Stanley

GCAL ID	Client ID	Matrix	Collect Date/Time	Receive Date/Time
20508241401	TB-1_082005_TB0800	Water	08/20/2005 08:00	08/24/2005 09:20

8260B, Volatiles

Prep Date	Prep Batch	Prep Method	Dilution	Analyzed	By	Analytical Batch
			1	08/24/2005 12:26	JCK	298066

CAS#	Parameter	Result	RDL	MDL	Units
75-35-4	1,1-Dichloroethene	0.229U	1.20	0.229	ug/L
75-27-4	Bromodichloromethane	0.219U	0.800	0.219	ug/L
75-25-2	Bromoform	0.216U	1.20	0.216	ug/L
67-66-3	Chloroform	0.194U	0.300	0.194	ug/L
124-48-1	Dibromochloromethane	0.081U	0.500	0.081	ug/L
75-71-8	Dichlorodifluoromethane	0.156U	1.00	0.156	ug/L
75-09-2	Methylene chloride	0.445U	2.00	0.445	ug/L
91-20-3	Naphthalene	0.304U	1.00	0.304	ug/L
127-18-4	Tetrachloroethene	0.227U	1.40	0.227	ug/L
108-88-3	Toluene	0.213U	1.10	0.213	ug/L
79-01-6	Trichloroethene	0.270U	1.00	0.270	ug/L
75-01-4	Vinyl chloride	0.089U	1.10	0.089	ug/L
156-59-2	cis-1,2-Dichloroethene	0.163U	1.20	0.163	ug/L
156-60-5	trans-1,2-Dichloroethene	0.139U	0.600	0.139	ug/L

CAS#	Surrogate	Conc. Spiked	Conc. Rec	Units	% Recovery	Rec Limits
460-00-4	4-Bromofluorobenzene	50	48.1	ug/L	96	76 - 119
1868-53-7	Dibromofluoromethane	50	42.4	ug/L	85	85 - 115
2037-26-5	Toluene d8	50	47.8	ug/L	96	81 - 120
17060-07-0	1,2-Dichloroethane-d4	50	41.1	ug/L	82	72 - 119

GCAL ID	Client ID	Matrix	Collect Date/Time	Receive Date/Time
20508241402	CS-WB05_082005_N1320	Water	08/20/2005 13:20	08/24/2005 09:20

8260B, Volatiles

Prep Date	Prep Batch	Prep Method	Dilution	Analyzed	By	Analytical Batch
			2	08/24/2005 13:23	JCK	298066

CAS#	Parameter	Result	RDL	MDL	Units
75-35-4	1,1-Dichloroethene	0.458U	2.40	0.458	ug/L
75-27-4	Bromodichloromethane	0.438U	1.60	0.438	ug/L
75-25-2	Bromoform	0.432U	2.40	0.432	ug/L
67-66-3	Chloroform	0.388U	0.600	0.388	ug/L
124-48-1	Dibromochloromethane	0.162U	1.00	0.162	ug/L
75-71-8	Dichlorodifluoromethane	0.312U	2.00	0.312	ug/L
75-09-2	Methylene chloride	0.890U	4.00	0.890	ug/L
91-20-3	Naphthalene	0.608U	2.00	0.608	ug/L
127-18-4	**Tetrachloroethene**	**31.3**	**2.80**	**0.454**	**ug/L**
108-88-3	**Toluene**	**4.18**	**2.20**	**0.426**	**ug/L**
79-01-6	**Trichloroethene**	**152**	**2.00**	**0.540**	**ug/L**
75-01-4	Vinyl chloride	0.178U	2.20	0.178	ug/L
156-59-2	**cis-1,2-Dichloroethene**	**286**	**2.40**	**0.326**	**ug/L**
156-60-5	trans-1,2-Dichloroethene	0.278U	1.20	0.278	ug/L

CAS#	Surrogate	Conc. Spiked	Conc. Rec	Units	% Recovery	Rec Limits
460-00-4	4-Bromofluorobenzene	100	98.1	ug/L	98	76 - 119
1868-53-7	Dibromofluoromethane	100	84	ug/L	**84***	85 - 115
2037-26-5	Toluene d8	100	96.2	ug/L	96	81 - 120
17060-07-0	1,2-Dichloroethane-d4	100	79.6	ug/L	80	72 - 119

GCAL ID	Client ID	Matrix	Collect Date/Time	Receive Date/Time
20508241403	CS-WB05_082005_N1530	Water	08/20/2005 15:30	08/24/2005 09:20

8260B, Volatiles

Prep Date	Prep Batch	Prep Method	Dilution	Analyzed	By	Analytical Batch
			2	08/24/2005 16:06	JCK	298066

CAS#	Parameter	Result	RDL	MDL	Units
75-35-4	1,1-Dichloroethene	0.458U	2.40	0.458	ug/L
75-27-4	Bromodichloromethane	0.438U	1.60	0.438	ug/L
75-25-2	Bromoform	0.432U	2.40	0.432	ug/L
67-66-3	Chloroform	0.388U	0.600	0.388	ug/L
124-48-1	Dibromochloromethane	0.162U	1.00	0.162	ug/L
75-71-8	Dichlorodifluoromethane	0.312U	2.00	0.312	ug/L
75-09-2	Methylene chloride	0.890U	4.00	0.890	ug/L
91-20-3	Naphthalene	0.608U	2.00	0.608	ug/L
127-18-4	**Tetrachloroethene**	**160**	**2.80**	**0.454**	**ug/L**
108-88-3	Toluene	0.426U	2.20	0.426	ug/L
79-01-6	**Trichloroethene**	**273**	**2.00**	**0.540**	**ug/L**
75-01-4	Vinyl chloride	0.178U	2.20	0.178	ug/L
156-59-2	**cis-1,2-Dichloroethene**	**344**	**2.40**	**0.326**	**ug/L**
156-60-5	**trans-1,2-Dichloroethene**	**4.94**	**1.20**	**0.278**	**ug/L**

CAS#	Surrogate	Conc. Spiked	Conc. Rec	Units	% Recovery	Rec Limits
460-00-4	4-Bromofluorobenzene	100	101	ug/L	101	76 - 119
1868-53-7	Dibromofluoromethane	100	106	ug/L	106	85 - 115
2037-26-5	Toluene d8	100	98.3	ug/L	98	81 - 120
17060-07-0	1,2-Dichloroethane-d4	100	97.4	ug/L	97	72 - 119

GCAL ID	Client ID	Matrix	Collect Date/Time	Receive Date/Time
20508241404	CS-WB05_082005_N1720	Water	08/20/2005 17:20	08/24/2005 09:20

8260B, Volatiles

Prep Date	Prep Batch	Prep Method	Dilution	Analyzed	By	Analytical Batch
			4	08/24/2005 16:28	JCK	298066

CAS#	Parameter	Result	RDL	MDL	Units
75-35-4	1,1-Dichloroethene	0.916U	4.80	0.916	ug/L
75-27-4	Bromodichloromethane	0.876U	3.20	0.876	ug/L
75-25-2	Bromoform	0.864U	4.80	0.864	ug/L
67-66-3	Chloroform	0.776U	1.20	0.776	ug/L
124-48-1	Dibromochloromethane	0.324U	2.00	0.324	ug/L
75-71-8	Dichlorodifluoromethane	0.624U	4.00	0.624	ug/L
75-09-2	Methylene chloride	1.78U	8.00	1.78	ug/L
91-20-3	Naphthalene	1.22U	4.00	1.22	ug/L
127-18-4	**Tetrachloroethene**	**319**	**5.60**	**0.908**	**ug/L**
108-88-3	Toluene	0.852U	4.40	0.852	ug/L
79-01-6	**Trichloroethene**	**427**	**4.00**	**1.08**	**ug/L**
75-01-4	Vinyl chloride	0.356U	4.40	0.356	ug/L
156-59-2	**cis-1,2-Dichloroethene**	**533**	**4.80**	**0.652**	**ug/L**
156-60-5	trans-1,2-Dichloroethene	0.556U	2.40	0.556	ug/L

CAS#	Surrogate	Conc. Spiked	Conc. Rec	Units	% Recovery	Rec Limits
460-00-4	4-Bromofluorobenzene	200	204	ug/L	102	76 - 119
1868-53-7	Dibromofluoromethane	200	219	ug/L	110	85 - 115
2037-26-5	Toluene d8	200	201	ug/L	101	81 - 120
17060-07-0	1,2-Dichloroethane-d4	200	195	ug/L	98	72 - 119

Parsons/4515/2050824 14/ Due 8-29-05

Camp Stanley Storage Activity Chain Of Custody

COC ID: 082305GCALA	Relinquish_Date: 8/23/2005	Cooler ID:	A	Sampler(s): E. Tennyson		
Project Location: Parsons TO-06	Relinquished_By: ET	LabCode:	GCAL			
Job Number: 744223.07000	Relinquish_Time: 6:30 PM	Carrier:	FedEx			
Creation Date: 8/23/2005	Collection Team: ET	Airbill Carrier:	8463 3579 2794			

LOCID: **TB-1** LOGDATE: 8/20/2005 MATRIX: WQ TBLOT: Analysis Required:
SBD: 0 LOGTIME: 8:00 SACODE: TB SMCODE: NA ABLOT: SW8260B VOC Short List
SED: 0 FLDSAMPID TB-1_082005_TB0800 EBLOT: Containers: 3
Remarks: TAT as per contract. 8/24-01

LOCID: **CS-WB05** LOGDATE: 8/20/2005 MATRIX: WG TBLOT: 20080501 Analysis Required:
SBD: 268 LOGTIME: 13:20 SACODE: N SMCODE: BP ABLOT: SW8260B VOC Short List
SED: 288 FLDSAMPID CS-WB05_082005_N1320 EBLOT: Containers: 3
Remarks: TAT as per contract. 02

LOCID: **CS-WB05** LOGDATE: 8/20/2005 MATRIX: WG TBLOT: 20080501 Analysis Required:
SBD: 290 LOGTIME: 15:30 SACODE: N SMCODE: BP ABLOT: SW8260B VOC Short List
SED: 310 FLDSAMPID CS-WB05_082005_N1530 EBLOT: Containers: 3
Remarks: TAT as per contract. 03

LOCID: **CS-WB05** LOGDATE: 8/20/2005 MATRIX: WG TBLOT: 20080501 Analysis Required:
SSD: 320 LOGTIME: 17:20 SACODE: N SMCODE: BP ABLOT: SW8260B VOC Short List
SED: 340 FLDSAMPID CS-WB05_082005_N1720 EBLOT: Containers: 3
Remarks: TAT as per contract. 04

3°C

Relinquished by: E. Tennyson Date 8/23/05 Time 1830 Relinquished by: Date Time Relinquished by: Date Time
Recieved by: FDX Date Time Recieved by: [signature] Date 8/24 Time 0920 Recieved by: Date Time

Page 1 of 1

FedEx # 8463 3579 2794

NELAP CERTIFICATE NUMBER 01955

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

Report Date 08/24/2005

GCAL Report 205081917

RECEIVED
SEP 7 2005

Deliver To	Parsons 800 Centre Park Drive Suite 200 Austin, TX 78754 512-719-6082
Attn	Tammy Chang

Customer Parsons Infrastructure & Technology Group

Project Camp Stanley

8/16/05

7979 GSRI Avenue, Baton Rouge, Louisiana 70820-7402 • Phone 225.769.4900 • Fax 225.767.5717

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

CS-WB08_081605_N0910

Lab Name: GCAL Contract:

Lab Code: LA024 Case No.: SAS No.: SDG No.: 205081917

Matrix: (soil/water) Water

Sample wt/vol: 25 (g/ml) mL

Lab Sample ID: 20508191701

Level: (low/med) LOW

Lab File ID: 2050823P/U4786

% Moisture: not dec.

Date Collected: 08/16/05 Time: 0910

GC Column: DB-624-30M ID: .53 (mm)

Date Received: 08/19/05

Instrument ID: MSV0

Date Analyzed: 08/23/05 Time: 2018

Soil Extract Volume: (µL)

Dilution Factor: 10 Analyst: RSP

Soil Aliquot Volume: (µL)

Prep Batch: Analytical Batch: 297997

Analytical Method: SW-846 8260

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	RESULT	Q	MDL	RL
75-35-4	1,1-Dichloroethene	0.640	U	0.640	12.0
75-27-4	Bromodichloromethane	0.420	U	0.420	8.00
75-25-2	Bromoform	0.800	U	0.800	12.0
67-66-3	Chloroform	0.340	U	0.340	3.00
124-48-1	Dibromochloromethane	0.360	U	0.360	5.00
75-71-8	Dichlorodifluoromethane	0.600	U	0.600	10.0
75-09-2	Methylene chloride	0.700	U	0.700	20.0
91-20-3	Naphthalene	0.090	U	0.090	10.0
127-18-4	Tetrachloroethene	55.3		0.340	14.0
108-88-3	Toluene	0.340	U	0.340	11.0
79-01-6	Trichloroethene	62.7		0.360	10.0
75-01-4	Vinyl chloride	1.34	U	1.34	11.0
156-59-2	cis-1,2-Dichloroethene	115		0.340	12.0
156-60-5	trans-1,2-Dichloroethene	2.15	F	0.750	6.00

Parsons Infrastructure/...-26-05

Camp Stanley Storage Activity Chain Of Custody

3

COC ID:	081805GCALA	Relinquish_Date:	8/18/2005	Cooler ID:	A	Sampler(s):	E. Tennyson
Project Location:	Parsons TO6	Relinquished_By:	ET	LabCode:	GCAL		
Job Number:	744223.07000	Relinquish_Time:	7:30 PM	Carrier:	FedEx		
Creation Date:	8/18/2005	Collection Team:	ET	Airbill Carrier:	8463 3548 8841		

LOCID: **CS-WB08** LOGDATE: **8/16/2005** MATRIX: **WG** TBLOT: **n/a**

SBD: **0** LOGTIME: **9:10** SACODE: **N** SMCODE: **SP** ABLOT:

SED: **0** FLDSAMPID **CS-WB08_081605_N0910** EBLOT: Containers: 3

Analysis Required:

SW8260B	VOC Short List

-1

Remarks: **2-week TAT for preliminary results.**

000110

Relinquished by: E. Tennyson Date 8/18/05 Time 1930 Relinquished by: FedEx Date 8-19-05 Time 905 Relinquished by:________ Date______ Time______

Recieved by: FDX Date______ Time______ Recieved by: [signature] Date 8-19-05 Time 905 Recieved by:________ Date______ Time______