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In Situ Anaerobic Bioremediation Pilot Study at Site 57 – Building 292 TCE Contamination Area

Naval District Washington, Indian Head

Indian Head, Maryland

Engineering Field Activity Chesapeake
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0805

March 2004

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IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY REPORT

FOR

SITE 57 –
BUILDING 292 TCE CONTAMINATION AREA

NAVAL DISTRICT WASHINGTON, INDIAN HEAD
INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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EXECUTIVE SUMMARY

This report describes a pilot study conducted at the Naval District Washington, Indian Head (NDW, IH) in Indian Head, Maryland by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order (CTO) 0805, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract, Contract Number N62467-94-D-0888. The study was conducted on Site 57, Former Drum Loading Area, to examine the viability of utilizing enhanced anaerobic bioremediation as a technology for reducing chlorinated volatile organic compound concentrations (especially trichloroethene [TCE]) in Site 57 groundwater.

During the pilot study, a hydrogen release compound (HRC®) manufactured by Regenesis was injected into the subsurface to establish anaerobic conditions suitable for reducing groundwater volatile organic compound (VOC) concentrations through reductive dechlorination.

The study commenced in May 2003 with the installation of two new groundwater monitoring wells. Prior to HRC® injection, groundwater samples were collected from the two new monitoring wells and three existing monitoring wells to establish the baseline conditions against which subsequent samples would be evaluated. (Two monitoring wells were upgradient of the HRC® array, and three were downgradient.) HRC® was then injected into the subsurface via 12 injection points occupying an area measuring approximately 30 feet by 10 feet.

The injection points were installed with approximately five feet between each of three rows, and approximately 8 feet between the injection points within each row. The HRC® was injected at a rate of approximately 0.6 gallons (6.6 pounds) per vertical foot, starting at a depth of 20 ft below the ground surface (bgs) and continuing upward to 6 feet bgs. The study required approximately 1,110 pounds of HRC®. The HRC® material was heated to approximately 100^{0}F to 120^{0}F prior to injection. After HRC® injection, all holes were abandoned by backfilling each hole from the top of the HRC® to the ground surface with granular bentonite and hydrating it with potable water. Following the HRC® injection, groundwater samples were collected from the five study area monitoring wells on June 20th, July 30th, September 25th, and November 20th of 2003.

The groundwater samples were analyzed for TCE, the primary contaminant, and its daughter products dichloroethene (DCE), vinyl chloride, ethene, and ethane, in addition to 26 other parameters indicative of reductive dechlorination or the conditions necessary to maintain the process.

Over the six-month study duration, TCE concentrations in the most contaminated downgradient well decreased by 98%, from 9,100 µg/l to 110 µg/l, the lowest TCE concentration achieved. The fact that

reductive dechlorination was ongoing was also supported by the data for the TCE daughter products, and the other indicator analytes.

The pilot study has demonstrated that introducing HRC® into the Site 57 groundwater can significantly reduce high TCE concentrations. To evaluate if reductive dechlorination will proceed to completion and how low the TCE concentrations will go, it is recommended that additional samples be collected from the pilot study wells. That effort can be incorporated into other Site 57 groundwater investigations to control costs, and the resulting data is likely to allow the Site 57 feasibility study to incorporate a more precise evaluation of the HRC® technology for potential application at Site 57.

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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CLEAN	Comprehensive Long-Term Environmental Action Navy
CNI	Commander, Navy Installations
CTO	Contract Task Order
DCE	dichloroethene
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
EOD	explosive ordnance disposal
FS	Feasibility Study
°F	degrees Fahrenheit
HRC	hydrogen release compound
ID	inside diameter
IHDIV-NSWC	Indian Head Division, Naval Surface Warfare Center
k_h	horizontal hydraulic conductivity
mg/kg	milligrams per kilogram
msl	mean sea level
mV	millivolts
NAD	North American Datum
NAVSCOLEOD	Naval School Explosive Ordnance Disposal
NAVEODTECHDIV	Naval Explosive Ordnance Technology Division
NDW, IH	Naval District Washington, Indian Head
NGVD	National Geodetic Vertical Datum
NSF	National Sanitation Foundation
ORP	oxidation/reduction potential
PCE	tetrachloroethene
PVC	polyvinyl chloride
RI	Remedial Investigation
TCE	trichloroethene
TOC	total organic carbon
TtNUS	Tetra Tech NUS, Inc.
µg/kg	micrograms per kilogram
µg/L	microgram per liter
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 PURPOSE

The pilot study described in this report was conducted at the Naval District Washington, Indian Head (NDW, IH) in Indian Head, Maryland by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order (CTO) 0805 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract, Contract Number N62467-94-D-0888. The purpose of this report is to describe and present the results of the pilot study activities undertaken at Site 57, Building 292 TCE Contamination Area, to examine the viability of enhanced anaerobic bioremediation as a technology for treating chlorinated volatile organic (VOCs) compounds [especially trichloroethene (TCE)] in Site 57 groundwater.

1.2 SCOPE AND OBJECTIVE

During the pilot study, a hydrogen release compound (HRC®) was injected and evaluated for its effect on groundwater bioremediation of chlorinated VOCs. A previously prepared Remedial Investigation (RI) Report (TtNUS, 2000) determined the need for remedial activities at the site. In the draft Feasibility Study (FS) Report (TtNUS, 2002), in situ bioremediation was determined to be a potentially effective groundwater alternative. The overall objective of the pilot study was to provide site-specific information for a more detailed evaluation. In particular, the objective of the pilot study was to determine if the application of HRC® at Site 57 would result in reduced concentrations of TCE in groundwater.

1.3 NDW, IH LOCATION

The NDW, IH is located in northwestern Charles County, Maryland. As shown on Figure 1-1, the NDW, IH is approximately 25 miles southwest of Washington, D. C. The NDW, IH is a military facility consisting of the Main Area on the Cornwallis Neck Peninsula and the Annex on Stump Neck, which is located across Mattawoman Creek. The Stump Neck Annex is not contiguous with the Main Area and is operated by a tenant. As shown on Figure 1-2, the main area is bounded by the Potomac River to the northwest, west, and south, Mattawoman Creek to the south and east, and the Town of Indian Head to the northeast. The location of the Site 57 is shown on Figure 1-2.

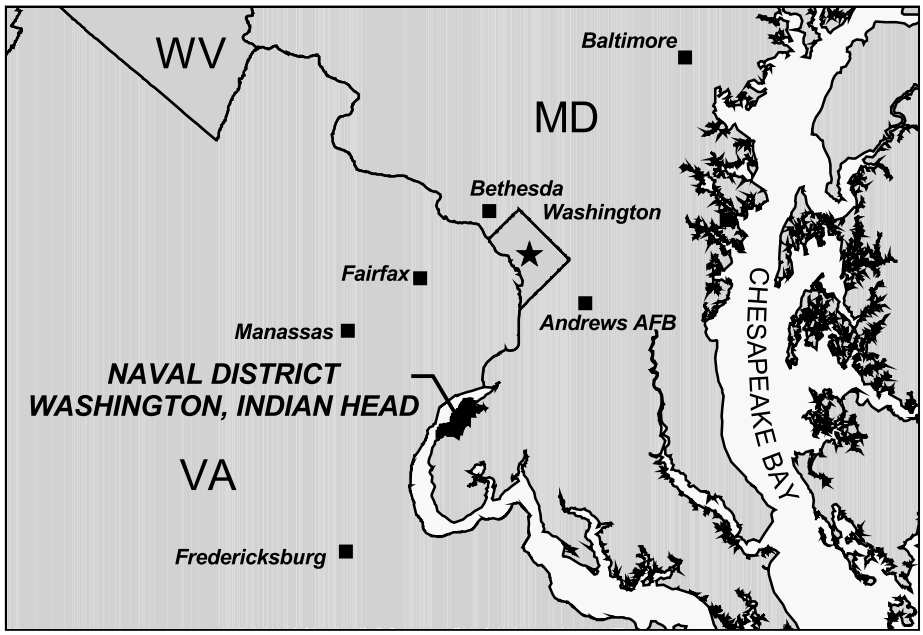
1.4 SITE BACKGROUND

Site 57, Former Drum Loading Area, encompasses the area located south of Building 292 at the Main Area of the IHDIV-NSWC (Figure 1-3). Previous operations from the mid-1960s until 1989 involved the use of TCE for vapor degreasing and general cleaning. During the 1970s and 1980s, spent TCE was transferred from a tank inside Building 292 into drums via a pipe that passed through the wall near the

southern corner of the building. The drums were reportedly stored on a grass-covered area near the southern corner of the building. It is believed that these operations have resulted in the TCE contamination detected in soil and groundwater at Site 57. The use of TCE at Building 292 stopped in 1989. Site 57 also includes Buildings 165 and 496, located approximately 150 feet southwest of Building 292, which were used to store ethyl ether. The conditions existing at Site 57 prior to the pilot study are described in more detail in Section 4.

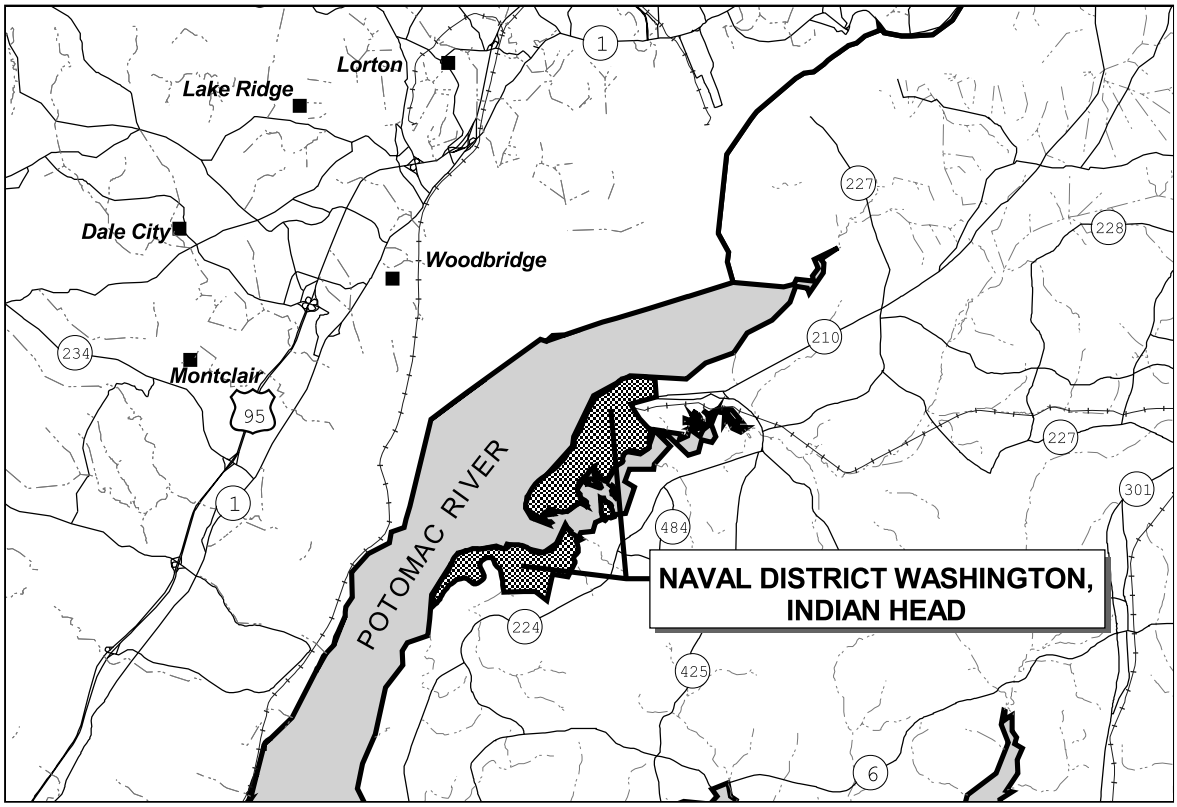
1.5 DOCUMENT ORGANIZATION

Section 1.0 is the introduction to this report and describes the purpose of the document, outlines the scope and objectives of the work, briefly describes the facility's location and mission, and summarizes the background of Site 57. Section 2.0 discusses the field activities performed during the pilot study at Site 57. Section 3.0 provides a description of enhanced bioremediation in the context of this pilot study and explains the significance of the parameters monitored during the study. Section 4.0 describes the baseline conditions existing in the pilot study area at the commencement of the pilot study, Section 5 discusses the data collected during the pilot study, and Section 6 offers conclusions and recommendations based on the results of the pilot study.



LEGEND

- City
- Highway
- Railroad
- River



DRAWN BY K. PEILA — DATE 3/18/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4020	OWNER NO. CTO 0805
CHECKED BY G. LATULIPPE — DATE 3/18/04	FACILITY LOCATION MAP NAVAL DISTRICT WASHINGTON, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY GJL — DATE 3/18/04	
COST/SCHEDULE-AREA		APPROVED BY — — DATE —	
SCALE AS NOTED		DRAWING NO. FIGURE 1-1	REV 0

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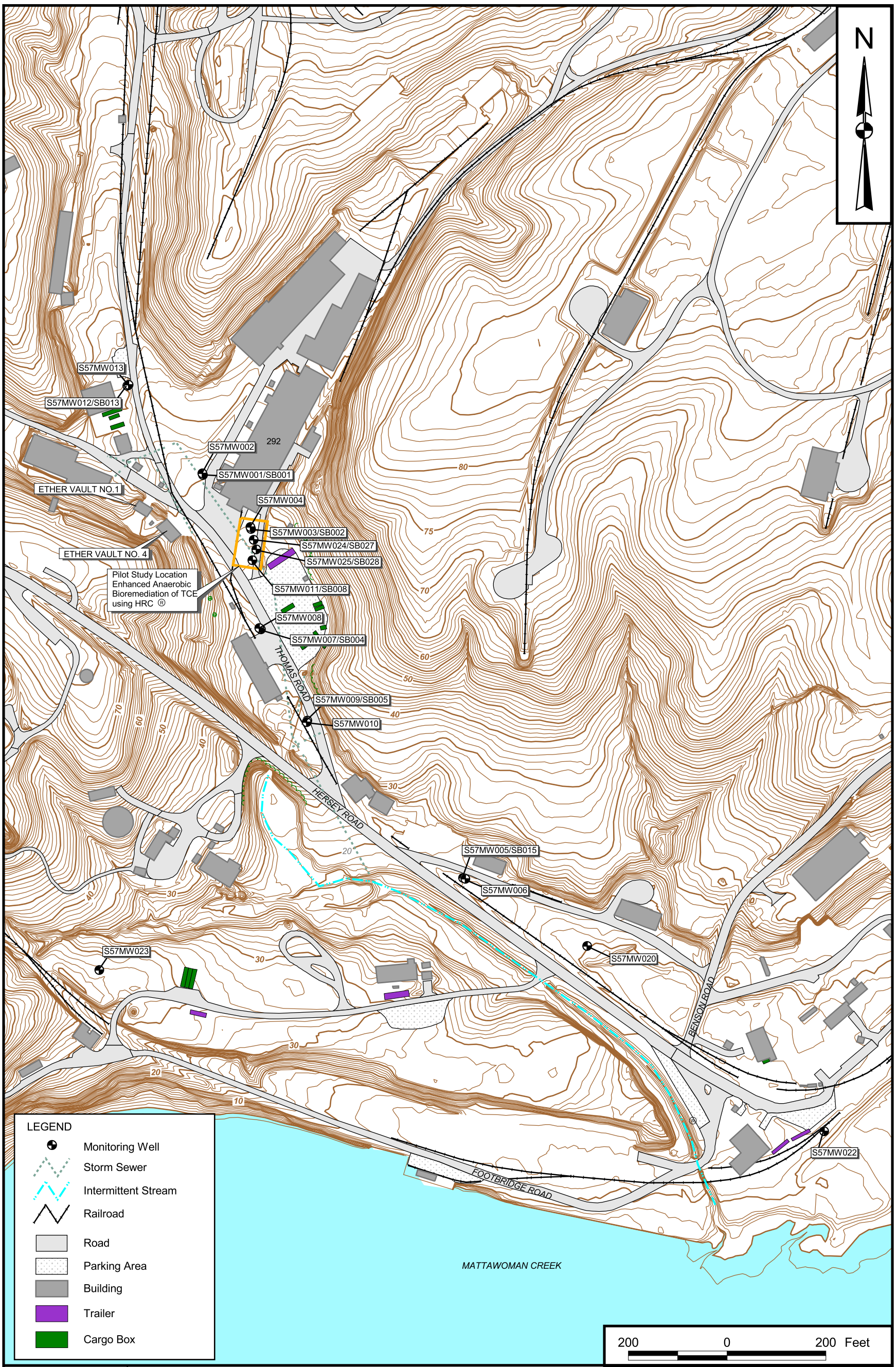
DRAWN BY K. PEILA — DATE 3/18/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4020	OWNER NUMBER CTO 0805
CHECKED BY GJL — DATE 3/18/04	SITE LOCATION MAP IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY SITE 57 - BUILDING 292 TCE CONTAMINATION AREA NAVAL DISTRICT WASHINGTON, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY GJL	DATE 3/18/04
COST/SCHEDULE-AREA		APPROVED BY —	DATE —
SCALE AS NOTED		DRAWING NO. FIGURE 1-2	REV 0

P:\GIS\INDIANHEAD_NSWC\APR\7129_SITE57.APR SITE 57_ANAEROBIC CONDITIONS 3/18/04 KMP



DRAWN BY K. PEILA — DATE 3/18/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4020	OWNER NUMBER CTO 0805
CHECKED BY G. LATULIPPE — DATE 3/18/04	SITE 57 MAP IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY SITE 57 - BUILDING 292 TCE CONTAMINATION AREA NAVAL DISTRICT WASHINGTON, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY GJL — DATE 3/18/04	
COST/SCHEDULE-AREA		APPROVED BY — — DATE —	
SCALE AS NOTED		DRAWING NO. FIGURE 1-3	REV 0

2.0 FIELD ACTIVITIES

This section describes the specific field activities conducted during the pilot study to obtain data for evaluating the viability of enhanced anaerobic bioremediation as a technology for removing chlorinated VOCs from contaminated groundwater at Site 57. In summary, two new monitoring wells were installed, and surface and subsurface soil samples were collected from the well borings. Groundwater from both new and existing wells was then sampled to provide a baseline for parameter concentrations prior to HRC® injection. HRC® was then injected using direct push technology (DPT) equipment at 12 injection points. Injection points and new wells were surveyed, and water-level measurements were taken at both new and previously existing wells. In addition, aquifer tests were conducted at the two new and three existing wells. In general, the field activities were carried out in accordance with procedures provided in the Work Plan (TtNUS, 2003).

The locations of the monitoring wells, soil borings, and HRC® injection points at the Site 57 pilot study area are shown on Figure 2-1. A summary of samples and analyses is provided on Table 2-1.

2.1 SUBSURFACE SOIL INVESTIGATION

The subsurface soil samples were collected prior to HRC® injection. Subsurface soil sampling consisted of collecting soil from four depths at each of two soil boring locations downgradient of the HRC® injection area (SB027 and SB028). Geoprobe direct push methods utilizing 4-foot macro-core sampling tools were used to collect the subsurface soil samples from the soil boring locations. Soil samples collected for volatile organics analysis were collected from the macro-core using Encore samplers. However, the third sample collected from SB028, sample ID S57SB0280304, was collected and submitted to the laboratory in a glass jar. Because abundant gravels were encountered at the sampling depth for that sample, the Encore sampler could not be used. A total of eight soil samples and one duplicate were collected from two soil borings. Soil sample log sheets, chain of custody forms, and soil boring log sheets were generated by TtNUS personnel during the soil sampling and boring installation and are provided in Appendix A.

The subsurface soil samples were subjected to analyses for chlorinated VOCs plus ethyl ether and arsenic (see Table 2-1).

2.2 MONITORING WELL INSTALLATION AND BASELINE GROUNDWATER SAMPLING

The groundwater investigation consisted of installing two new monitoring wells downgradient of the HRC® injection points, measuring water levels, and collecting groundwater samples from these new wells and from three existing monitoring wells.

Hollow stem auger drilling techniques were used to install the new wells. The wells were developed by vigorous surging and pumping to remove all fine material from around the well screen. Well construction sheets and development records for the new wells are provided in Appendix A.

The new monitoring wells were constructed of Schedule 40, flush-jointed, 2-inch inside diameter (ID) National Sanitation Foundation (NSF) polyvinyl chloride (PVC) well screen and PVC riser pipe. The well screens are 10 feet long with a slot size of 0.01 inch. After the screen and the riser pipe were in place, the annulus of the boring was backfilled with clean silica sand (Nos. 10/20 United States Standard Sieve size) filter pack from the bottom of the boring to 2 feet above the top of the well screen. A bentonite pellet seal, 1-foot thick, was installed above the filter pack and hydrated. The depths of the backfill materials were constantly measured during the monitoring well installation with a weighted stainless steel or plastic tape. The wells were completed with flush-mounted-type well protection consisting of concrete pad and a bolt-down well cover.

The initial round of groundwater sampling was completed on May 15, 2003, prior to the HRC® injection, to provide a baseline for comparison with future data. Both field and laboratory analyses were performed. All the collected groundwater samples were analyzed for chlorinated VOCs plus ethyl ether, field parameters, biological activity indicators, HRC®-based electron donors, and end-product dissolved gases. A complete set of analytical results is included in Appendix B. The groundwater sample log sheets, low flow purge data sheets, chain of custody forms, and the field analytical forms are provided in Appendix A.

2.3 HRC® INJECTION

The pilot-scale biotreatability test was conducted just south of monitoring well MW004 (see Figure 2-1). The HRC® injections were accomplished using nominal 1-inch ID DPT rods. A positive displacement pump was used to provide the required injection pressures. The injection points were installed with approximately 5 feet between each of three rows with approximately 8 feet between the points within each row. The HRC® was injected at a rate of approximately 0.6 gallon (6.6 pounds) per vertical foot, starting at a depth of 20 feet below ground surface (bgs) and continuing upward to 6 feet bgs [equivalent to 8.4 gallons (92.4 pounds) per location]. As a result, approximately 1,109 pounds of HRC® were injected into the ground. For the pilot study, the treatment area was approximately 30 feet by 10 feet and consisted of 12 HRC® DPT injection points. The HRC® material was heated to approximately

100 degrees Fahrenheit (°F) to 120°F prior to injecting into the ground, and because Site 57 is located within a restricted area of the Facility, the heating process took place (outside of the restricted area) approximately 1 mile from Site 57. The heating process took approximately 2 to 3 hours to complete. The HRC® dose per injection point was determined by the vendor prior to the field work based on the estimated aquifer characteristics, contaminant loading, and competing electron acceptors. The actual dose per foot was based on the depth to water encountered during well installation drilling as part of the pilot study. After HRC® injection, all holes were abandoned by backfilling from the top of the HRC® to the ground surface with granular bentonite and hydrating it with potable water.

2.4 GROUNDWATER SAMPLING - SUBSEQUENT ROUNDS

Four rounds of groundwater sampling were performed after the HRC® injection to collect the data needed for evaluating the effectiveness of the HRC®. The initial (baseline) sampling round took place in May, 2003; this was done prior to the HRC® installation. Subsequent groundwater sampling rounds were completed 1, 2, 4, and 6 months after injection on the dates of June 20, July 30, September 25, and November 20, 2003, respectively.

2.5 SYNOPTIC GROUNDWATER-LEVEL MEASUREMENTS

One complete round of water-level measurements was collected from the 16 existing and two newly installed monitoring wells at Site 57 and three wells located at Site 41 (adjacent to Site 57) on May 16, 2003. The synoptic groundwater-level measurements were performed to determine the groundwater flow pattern at the site. Measurements were taken with an electronic water-level indicator using the top of the well riser pipe as the reference point for determining depths to water. Groundwater-level measurements were recorded on a groundwater-level measurement form to the nearest 0.01 foot. The resulting groundwater-level data was used to generate the potentiometric contours discussed in Sections 4.0. The groundwater-level data are provided in Appendix A.

2.6 AQUIFER TESTS

Slug tests were completed at five monitoring wells to better estimate the horizontal hydraulic conductivity (k_h) of the aquifer within the pilot study area. A rising head slug test was performed at each well. The change in water level at each well was induced by withdrawing two bailers (each having a volume of 1 liter) simultaneously. The bailers were cleaned and a new piece of bailer rope was attached prior to each test. Before a slug test was initiated, the static water level in the monitoring well was measured using an electronic water-level indicator. Water levels were recorded with a pressure transducer at logarithmic intervals of time via a programmed electronic data logger as the head returned to the original static water level. The time and the rate of change required for the water level to return to the original

static level are functions of the hydraulic conductivity of the aquifer. The slug tests results were evaluated using the Hvorslev method (Hvorslev, 1951). Hydraulic conductivity data estimated from aquifer tests completed during the pilot study, along with hydraulic conductivity data from the RI (TtNUS, 2000) and FS (TtNUS, 2002), are provided in Table 2-2. The raw data for the tests conducted during the pilot study are provided in Appendix A.

2.7 SURVEYING

TtNUS personnel surveyed monitoring wells and HRC® injection locations. Planimetric features and topography were previously surveyed during the Site 57 RI (TtNUS, 2000). Existing Site 57 wells were utilized as reference points. The reference points were previously surveyed to Maryland State Plane coordinates [North American Datum (NAD) 1983], and vertical elevations were referenced to 1929 National Geodetic Vertical Datum (NGVD). Each HRC® injection location was determined by measuring the distance between it and the three reference points, SB006, MW003, and MW011. The vertical elevations were determined using an auto level and a stadia rod with two existing monitoring wells, MW003 and MW011 as reference points. Survey data are provided in Appendix A.

TABLE 2-1

SUMMARY OF SAMPLES AND ANALYTES
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 – BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

Location	Sample Designation	LABORATORY ANALYSES										FIELD TESTS						
		Sample Depth (feet bgs)	Chlorinated VOCs plus ethyl ether	Arsenic	Alkalinity ($CaCO_3$)	Dissolved Gases[1]	Iron (Total & Dissolved)	Miscellaneous Anions[2]	Manganese (Total & Dissolved)	Metabolic Acids[3]	TOC	Temperature	pH	Specific Conductivity	Oxidation / Reduction Potential	Dissolved Oxygen	Iron (Ferrous)	Hydrogen Sulfide
SUBSURFACE SOIL																		
S57SB027 /MW024	S57SB0270104	4 – 5	•	•														
S57SB027 /MW024	S57SB0270204	9 – 10	•	•														
S57SB027 /MW024	S57SB0270304	13 - 14	•	•														
S57SB027 /MW024	S57SB0270404	15 - 16	•	•														
S57SB028 /MW025	S57SB0280104	4 – 5	•	•														
S57SB028 /MW025	S57SB0280204	9 – 10	•	•														
S57SB028 /MW025	S57SB0280304	14 – 15	•	•														
S57SB028 /MW025	S57SB0280404	15 - 16	•	•														
GROUNDWATER																		
Baseline Samples																		
S57MW003	S57MW0030104	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW004	S57MW0040104	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW011	S57MW0110104	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW024	S57MW0240104	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW025	S57MW0250104	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
Month 1 Samples																		
S57MW003	S57MW0030105	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW004	S57MW0040105	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW011	S57MW0110105	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW024	S57MW0240105	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW025	S57MW0250105	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
Month 2 Samples																		
S57MW003	S57MW0030106	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW004	S57MW0040106	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW011	S57MW0110106	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW024	S57MW0240106	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW025	S57MW0250106	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
Month 4 Samples																		
S57MW003	S57MW0030107	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW004	S57MW0040107	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW011	S57MW0110107	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW024	S57MW0240107	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW025	S57MW0250107	NA	•			•	•	•	•	•	•	•	•	•	•	•	•	•
Month 6 Samples																		
S57MW003	S57MW0030108	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW004	S57MW0040108	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW011	S57MW0110108	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW024	S57MW0240108	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
S57MW025	S57MW0250108	NA	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•

1 Dissolved gases include carbon dioxide, ethane, ethene, and methane.
2 Miscellaneous anions include sulfate, sulfide, nitrate, nitrite, chloride, and phosphate.
3 Metabolic acids include lactic, pyruvic, acetic, propionic, and butyric.

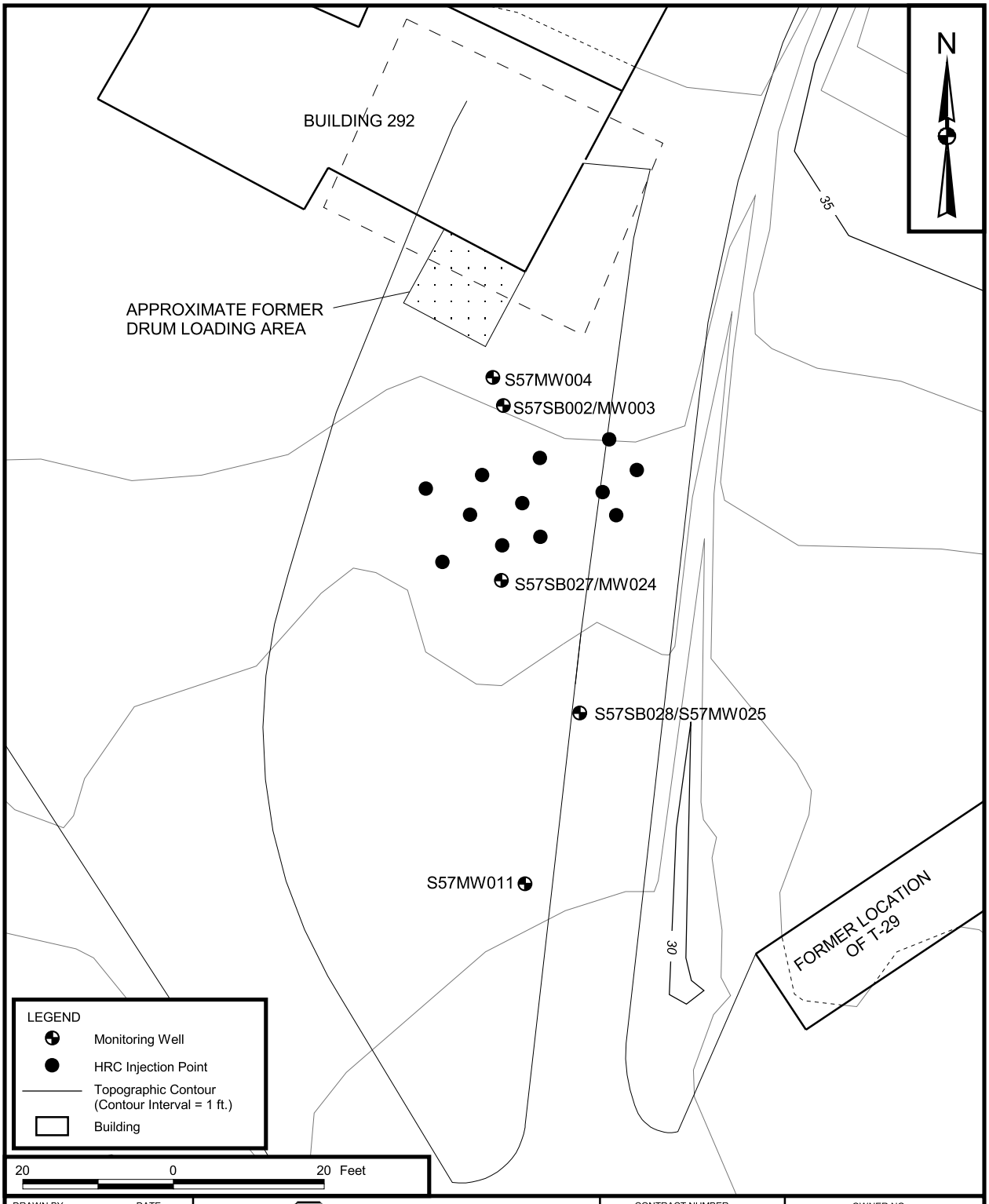
bgs = Below ground surface.
VOC = Volatile organic compounds.
TOC = Total organic carbon.
NA = Not applicable.

TABLE 2-2

HYDRAULIC CONDUCTIVITY RESULTS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

Well Identification	Remedial Investigaton Slug Test Data (1999)		Feasibility Study Field Investigation Slug Test Data (2001)		Pilot Study Slug Test Data (2003)		Well Average	
	(feet/day)	(cm/sec)	(feet/day)	(cm/sec)	(feet/day)	(cm/sec)	(feet/day)	(cm/sec)
S57MW003 (D)	ND	ND	3.18	1.1E-03	2.64	9.3E-04	2.91	1.0E-03
S57MW004	5.2	1.8E-03	15.20	5.4E-03	11.00	3.9E-03	10.47	3.7E-03
S57MW011	0.64	2.3E-04	0.50	1.7E-04	0.42	1.5E-04	0.52	1.8E-04
S57MW024	ND	ND	ND	ND	12.80	4.5E-03	12.80	4.5E-03
S57MW025	ND	ND	ND	ND	12.60	4.4E-03	12.60	4.4E-03
						Geometric Mean =	4.80	1.7E-03

D - Deep well
ND - Not determined



DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER	OWNER NO.
K. PEILA	3/18/04		4020	CTO 0805
CHECKED BY	DATE	PILOT STUDY AREA MAP IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY SITE 57 - BUILDING 292 TCE CONTAMINATION AREA NAVAL DISTRICT WASHINGTON, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY	DATE
G. LATULIPPE	3/18/04		GJL	3/18/04
COST/SCHEDULE-AREA			APPROVED BY	DATE
			—	—
SCALE			DRAWING NO.	REV
AS NOTED			FIGURE 2-1	0

P:\GIS\INDIANHEAD_NSWC\APR\SITE57_HRC.APR SITE 57_PILOT STUDY AREA 3/18/04 KMP

3.0 ANAEROBIC REDUCTIVE DECHLORINATION

This section provides a brief summary of the anerobic reductive dechlorination process for chlorinated VOCs. It also describes how the introduction of additional electron donor material can stimulate or accelerate the reductive dechlorination process.

3.1 BIODEGRADATION OF CHLORINATED VOCs

Reductive dechlorination is one of several biological degradation processes by which chlorinated VOCs are transformed to environmentally innocuous compounds such as carbon dioxide, ethene, ethane, and chloride. In the presence of a suitable electron donor (e.g., hydrogen) and favorable geochemical conditions, a hydrogen atom can replace a chlorine atom on a chlorinated ethene molecule. This rigorously studied microbial process occurs under anaerobic (oxygen-deficient) conditions. Hydrogen is typically generated when organic carbon ferments. This organic supply can come from natural organic carbon or anthropogenic carbon sources such as hydrocarbon contaminants (e.g., benzene, toluene).

It is widely recognized that, in the presence of hydrogen, TCE (C_2HCl_3), can be reduced to dichloroethene (DCE or $C_2H_2Cl_2$). While various DCE isomers (e.g., 1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE) can be produced, it is well documented that cis-1,2-DCE is the most common degradation product of TCE. DCE can then be reduced to vinyl chloride (VC or C_2H_3Cl), which, in turn, can be reduced to ethene (C_2H_4) and potentially ethane (C_2H_6), or via mineralization, to carbon dioxide (CO_2), water (H_2O), and chloride ions (Cl^-).

Although degradation of DCE and vinyl chloride can occur via anaerobic reductive dechlorination, this process is generally slow and can be limited by a number of factors. In fact, at many sites, DCE and vinyl chloride levels have been shown to persist where reductive dechlorination is inefficient or ineffective.

3.2 ENHANCED BIOREMEDIATION

As stated earlier, one of the requirements for reductive dechlorination is having a sufficient supply of electron donor. Enhanced bioremediation is a technology that enhances the natural biodegradation of contaminants by supplying a carbon substrate to the subsurface. This carbon substrate is broken down and therefore supplies hydrogen to the subsurface. One of the many carbon substrates that have been demonstrated to foster the reductive dechlorination process is HRC®. HRC® is a proprietary polylactate ester marketed by Regenesis of San Clemente, California. A food-grade product, HRC® is composed of tripolylactate and glycerol. HRC® is a viscous “honey-like” liquid that is applied to in situ contaminated groundwater using direct injection techniques. Once in contact with water, HRC® becomes hydrated and

lactic acid is released. Indigenous microorganisms, primarily bacteria, then metabolize the lactic acid and produce hydrogen. Because the higher concentration of hydrogen allows the natural dechlorination processes to occur at a faster rate, HRC® serves to enhance the rate of the transformation that would otherwise occur under natural conditions (e.g., natural attenuation). Note that the same biodegradation process occurs in the presence of HRC® as it does under natural attenuation. Regenesis' product is classified as a "slow-release" electron donor, meaning the lactic acid ferments in a slow process. Thus, a continuous, long-term supply of electron donor is available for microbial activity. Based upon numerous studies, it has been shown that HRC® can supply electron donor material for approximately 9 to up to 18 months.

3.3 BIOREMEDIATION INDICATORS

There are several lines of evidence by which the biodegradation processes can be measured. Because the biodegradation processes in natural attenuation are the same as in enhanced bioremediation, similar measures of performance can be used to demonstrate whether enhanced bioremediation is effectively reducing contamination. The first line of evidence is to demonstrate a trend of decreasing contaminant mass and/or concentration. More specifically, demonstrating a decrease of the parent compounds [e.g., tetrachloroethene (PCE), TCE, etc.] coupled with the generation or increase of daughter or breakdown products (cis-1,2-DCE, VC, ethene, etc.) is useful. It is important to note that because dechlorination occurs sequentially, dechlorination of TCE may result in a temporary increase, then decrease, of the various daughter products.

A secondary line of evidence includes the use of geochemistry data to indirectly illustrate that biodegradation is occurring. Natural attenuation (i.e., geochemical) parameters are generally used to evaluate the suitability of geochemical conditions for biodegradation and to determine if bioremediation is occurring. The complex relationship among many of these parameters is described in the following sections.

3.3.1 Natural Attenuation Parameters

Dissolved Oxygen: Dissolved oxygen (DO) acts as a primary substrate or co-substrate during the initial stages of metabolism. For chlorinated hydrocarbon degradation, anaerobic pathways are more efficient. If dissolved oxygen concentrations are greater than 0.5 to 1.0 mg/L, anaerobic bacteria cannot exist and reductive dechlorination will not occur.

Nitrate/Nitrite: After dissolved oxygen has been depleted through aerobic respiration, anaerobes will utilize nitrate (NO_3^-) as an electron acceptor to anaerobically degrade hydrocarbons (denitrification). This process reduces nitrate to nitrite (NO_2) and generates carbon dioxide.

Dissolved Manganese: After dissolved oxygen and nitrate have been depleted, anaerobic microbes will utilize manganese (Mn^{+4}) as an electron acceptor to anaerobically degrade hydrocarbons, generating manganese (Mn^{+2}) and carbon dioxide.

Ferric Iron/Ferrous Iron: After dissolved oxygen, nitrate, and manganese reduction, anaerobic microbes will utilize ferric iron (Fe^{+3}) as an electron acceptor (iron reduction), generating ferrous iron (Fe^{+2}) and carbon dioxide. Ferric iron is not typically analyzed, thus, the presence or increase in concentration of ferrous iron (Fe^{+2}) and carbon dioxide are indicators of iron reduction.

Sulfate/Sulfide: After dissolved oxygen, nitrate, manganese, and ferric iron have been utilized, anaerobic microbes will utilize sulfate (SO_4^-) as an electron acceptor, resulting in sulfide and carbon dioxide increases. Sulfate reduction, along with methanogenesis, is one of the most important reduction pathways responsible for biodegradation of chlorinated hydrocarbons. Sulfide can be present in many forms, the three primary forms being the sulfide ion (S^{-2}) or dissolved hydrogen sulfide as either H_2S or HS^-.

Phosphate: Similar in mechanism to sulfate reduction (but to a lesser degree), phosphate (PO_4^-) reduction is an anaerobic biodegradation process whereby bacteria can use phosphate as an electron acceptor. Phosphate along with nitrogen are also regarded as nutrients for biodegradation.

Dissolved Carbon Dioxide: Methanogenesis occurs after oxygen, nitrate, manganese, ferric iron, and sulfate have been utilized. It is one of the most important reduction pathways responsible for chlorinated VOC degradation. During methanogenesis, bacteria utilize carbon dioxide as an electron acceptor, generating methane as a byproduct. Carbon dioxide is produced by every terminal electron acceptor process.

Dissolved Methane: Because methane is not a chemical component of solvents, its presence at concentrations greater than background provides strong evidence of methanogenic fermentation (and carbon dioxide utilization). Background concentrations of methane are important because some natural sources of methane exist.

Dissolved Hydrogen: Hydrogen is produced as a result of fermentation of organic carbon. Hydrogen is then utilized by respiratory microbes such as nitrate reducers, iron reducers, sulfate reducers, and methane producers. Each microbe utilizes hydrogen more or less efficiently, leading to either a buildup or a decrease of hydrogen concentration. The hydrogen concentration, therefore, can provide an indication of the reduction process that is most prevalent in the subsurface at any one location.

Dissolved Ethene/Ethane: As discussed earlier ethene and possibly ethane signify the final degradation step of chlorinated ethenes. Concentrations of ethene (greater than 0.01 mg/L) and ethane (greater than 0.1 mg/L) provide strong evidence of such degradation.

Total Alkalinity: Groundwater pH decreases as a result of both aerobic and anerobic biodegradation. As carbon dioxide is produced by microbial activity, dissolution of rock minerals occur, which increases the alkalinity, expressed as calcium carbonate ($CaCO_3$). As a result, there is a positive correlation between microbial metabolism and alkalinity.

Chloride: Chloride concentrations are used to evaluate biodegradation because chloride is released into groundwater during dechlorination of chlorinated VOCs. Therefore, an increase in chloride concentration in the downgradient direction is direct evidence of dechlorination.

Oxidation/Reduction Potential: The oxidation/reduction potential (ORP) of groundwater (Eh) is a measure of the relative tendency of the groundwater solution to accept or donate electrons and the amount of energy released during electron transfer. The Eh (in millivolts; mV) can provide evidence of the type of biodegradation processes that are active in a particular plume or area within a plume. Eh should be used only as a qualitative indicator of the overall oxidation/reduction state. Figure 3-1 provides a summary of Eh measurements and the respective terminal electron acceptor processes.

3.3.2 Breakdown Products of HRC®

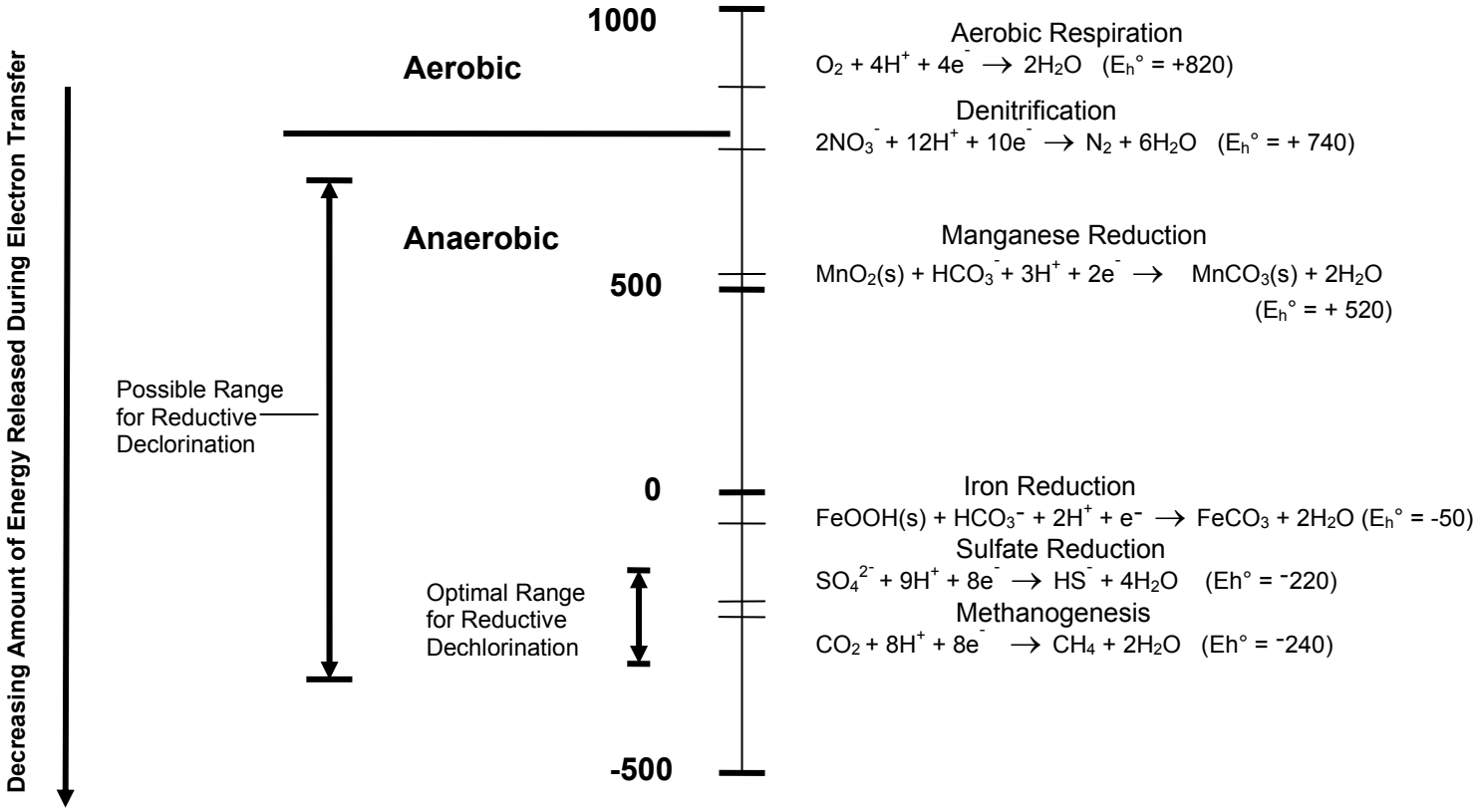
Total organic carbon (TOC) and other metabolic acids (e.g., volatile fatty acids) would be expected to increase following the breakdown of HRC® (e.g., lactic acid) in the subsurface. The generation of these acids is favorable as it represents essentially hydrogen storage molecules, and their accumulation indicates that there is significant hydrogen in the system for dechlorination (Regenesis, 2003).

HRC® [e.g., lactic acid ($C_3H_6O_3$)] can be oxidized to pyruvic acid ($C_3H_4O_3$) and hydrogen is released. Pyruvic acid may then convert to acetic acid ($C_2H_4O_2$) followed by the generation of butyric acid ($C_4H_8O_2$) and propionic acid ($C_3H_6O_2$).

FIGURE 3-1

OXYDATION/REDUCTION POTENTIAL
(Eh° in millivolts @ pH = 7 and T=25°C)

IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 – FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND



SOURCE: http://www.epa.gov/ada/download/reports/protocol.pdf

4.0 PILOT STUDY AREA BASELINE CONDITIONS

The pilot study area is shown on Figures 2-1 and 4-1. With the exception of MW024, MW025, and the HRC injection points, the general physical site features shown on the figures existed prior to commencing the pilot study. The initial pilot study activities included installing MW024 and MW025, sampling those monitoring wells in addition to MW003, MW004, and MW011, and then performing slug tests in the same wells, followed by an initial round of groundwater samples. For the purposes of this pilot study, "baseline conditions" includes consideration of MW003, MW004, MW011, MW024, and MW025, along with the results from the initial (i.e., baseline) round of groundwater samples.

4.1 MONITORING WELLS

Monitoring wells MW003, MW004, and MW011 were installed at Site 57 during the 1999 RI (TtNUS, 2000). MW024 and MW025 were installed during the initial pilot study activities in May 2003. Table 4-1 lists the physical information for the pilot study area monitoring wells. Table 4-2 displays the baseline analytical information for the study area monitoring wells.

4.1.1 Existing Monitoring Wells

Monitoring wells MW003, MW004, and MW011 were installed and sampled in January 1999 during the Site 57 RI (TtNUS, 2000). Wells MW003 and MW004 are adjacent to each other, 15 to 20 feet south of Building 292, as shown on Figure 4-1. MW003 is the deeper well, screened at 17 to 22 feet below ground surface (bgs), while MW004 is screened from 6 feet to 16 feet bgs. Well MW011 is located approximately 85 feet south of Building 292 and is screened from 9 to 19 feet bgs. More complete information regarding these wells (i.e., boring logs, well installation diagrams, etc.) is included in the Site 57 RI Report (TtNUS, 2000).

4.1.2 New Monitoring Wells

In May 2003, just prior to HRC® injection, two additional wells were installed. MW024 and MW025 were installed 5 feet and 25 feet respectively downgradient from the proposed HRC injection area (see Figure 4-1). The screened intervals for both MW024 and MW025 extend from 4 to 14 feet bgs (see Figure 4-2). More complete information regarding these wells is included in Appendix A.

4.2 GROUNDWATER CONTAMINATION

4.2.1 Historical Groundwater Contaminant Concentrations

An RI conducted in 1999 (TtNUS, 2000) and a subsequent investigation conducted in 2001 (TtNUS, 2002) determined that the highest concentrations of TCE contamination in Site 57 groundwater occurred near the southern corner of Building 292. Table 4-2 presents the analytical results from these investigations for TCE and its daughter products for the then existing wells which are included in this pilot study (MW003, MW004, and MW011). The well locations are shown on Figure 1-3 and Figure 4-1.

From Table 4-2, it can be seen that for the two sampling dates preceding the pilot study (January 1999 and August 2001), MW004 had consistently higher concentrations of TCE and its daughter products than MW003 (the deeper of the two wells). MW011 (the most downgradient well) had lower TCE concentrations than either MW003 or MW004. The TCE daughter product concentrations in MW011 were consistently less than in MW004. They were sometimes greater, sometimes less than those in MW003.

4.2.2 Baseline Groundwater Contaminant Concentrations

All of the monitoring wells involved in the pilot study were subjected to a single round of groundwater sampling immediately prior to HRC® injection in May 2003. The analyses for those baseline samples are shown on Table 2-1. For TCE and its daughter products, the analytical results for the baseline samples are shown on Table 4-2. More complete analytical results are included in Appendix B.

For the three sampling dates ending with May 2003, MW004 had concentrations of TCE and its daughter products that were consistently higher than those in MW003 (the deeper of the two wells). Scanning the Table 4-2 May 2003 analytical results in the downgradient direction (i.e., from MW003/MW004 to MW024 to MW025 to MW011), contaminant concentrations appear to peak in MW025, the second most downgradient of the three wells downgradient from the HRC® array. The concentrations of TCE and its daughter products are higher in MW025 than they are in MW024, and they are higher in both MW024 and MW025 than in MW003, MW004, or MW011.

4.3 SOIL CONTAMINATION

Although not strictly viewed as an element of the groundwater bioremediation pilot study, soil samples were collected during the installation of MW024 and MW025 because it was an opportune time to improve the current understanding of the extent of soil contamination in the pilot study area and to add data to the Site 57 analytical database. Soil samples were taken at 4 to 5 feet bgs, 9 to 10 feet bgs, 14 to 15 feet bgs, and 17 to 18 feet bgs from borings SB027/MW024 and SB028/MW025. The soil data will be

primarily of importance during completion of the Site 57 FS. The analytical results from the soil samples are included in Appendix B.

4.4 TOPOGRAPHY

Site 57 is located in the southeastern section of the main facility (see Figure 1-2), south of Building 292 (see Figure 1-3 and Figure 4-1). The pilot study area consists of relatively flat ground that slopes generally toward the south. As can be seen on Figure 1-3, Building 292 is located in a valley approximately 1,300 feet north of Mattawoman Creek at an elevation of approximately 35 feet above mean sea level (msl). The valley trends approximately southeast toward Mattawoman Creek to approximately 0 feet above msl. The valley slopes are much steeper east, north, and west of the site. A storm drain from Building 292 approximately follows the valley and discharges to Mattawoman Creek. An intermittent stream also flows through the valley (southwest of Hershey Road) before discharging to Mattawoman Creek. Portions of an abandoned railroad track are located in the valley.

4.5 HYDROGEOLOGY

The surficial aquifer in the pilot study area consists primarily of sand and gravel that has the characteristics of an unconfined system. The depths to the static water levels in the pilot study area wells ranged from 5.3 to 6.4 feet bgs. Figure 4-2 illustrates the subsurface materials in the pilot study area.

The aquitard beneath the surficial aquifer hinders the downward movement of groundwater from the surficial aquifer to deeper aquifers. However, where the fine sand, silt, and clay aquitard becomes sandier or thinner, it would be less restrictive to downward groundwater flow.

One complete round of water-level measurements was collected from the 18 Site 57 monitoring wells on May 16, 2003. The synoptic groundwater-level measurements were performed to verify the groundwater flow pattern at the site. Measurements were taken with an electronic water-level indicator (M-scope) using the top of the well riser pipe as the reference point for determining depths to water. Groundwater-level measurements were recorded on a groundwater-level measurement form to the nearest 0.01 foot. The potentiometric surface in the pilot study area is shown on Figure 4-1. Groundwater elevations for the same wells are shown in the cross section on Figure 4-2. All groundwater elevations are included in Appendix A.

Based on the potentiometric surface map, the groundwater in the surficial aquifer beneath the pilot study area is flowing toward the south. Based on the previous RI and FS field investigations in 1999 and 2001, the surficial groundwater flow from the pilot study area generally follows the Site 57 valley for approximately 1,300 feet and may discharge to the Mattawoman Creek.

Data from previous investigations supporting the Site 57 RI indicated a slight downward flow component in the northern end of Site 57 at well cluster MW012/013 (See Figure 1-3). The same data set indicated a very slight upward flow component in the southern portion of the Site 57 RI area at MW005/006 (see Figure 1-3). In the pilot study area, which is positioned generally between those two locations, the May 2003 data from well cluster MW003/004 indicate a slight upward flow component. The upper surficial groundwater may be discharging to Mattawoman Creek. The lower groundwater in the surficial aquifer is most likely discharging to Mattawoman Creek. The surficial aquifer is recharged by infiltration of precipitation through the vadose zone and by groundwater flowing from the adjacent upland areas located to the north, east, and west.

As discussed in Section 2.6, the pilot study field work included performing slug tests in the five pilot study area monitoring wells. As shown on Figure 4-2, the well screens for MW004, MW024, MW025, and MW011 were installed at similar depths. Calculations from the pilot study slug test data show a reasonably consistent 11 to 12 feet per day hydraulic conductivity in wells MW004, MW024, and MW025. The hydraulic conductivity for MW011, the most downgradient of the pilot study monitoring wells, is somewhat lower at 0.42 feet per day. The deep well, MW003 had consistent hydraulic conductivity results of 2 to 3 feet per day. Including previously collected slug test data, the pilot study area average hydraulic conductivity was 4.8 feet per day (see Table 2-2). Table 2-2 provides a summary of the slug test results.

The hydraulic gradient in the pilot study area was estimated to be 0.0455 foot per foot based on graphic interpretation of the most recent potentiometric groundwater contour map (Figure 4-1). The effective porosity is estimated to be 25 percent for sand (Fetter, 1988), based upon the types of subsurface material present at the site.

The seepage velocity for sand (V_s) is calculated using the following equation:

$$\mathbf{V_s = K \times i\ (1/n)}$$

Where:

V_s	=	estimated groundwater seepage velocity (feet/day)
K	=	horizontal hydraulic conductivity (feet/day)
i	=	hydraulic gradient (feet/feet)
n	=	effective porosity

For Site 57, the values used to calculate groundwater velocity were as follows:

K	=	4.8 feet/day
n	=	0.25 (effective porosity for sand)
i	=	0.0455

The resulting V_s is 0.87 feet per day

TABLE 4-1

MONITORING WELL PHYSICAL DATA SUMMARY
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

Monitoring Wells	Ground Elevation(1) (feet above msl)	Top of Riser Elevation(1) (feet above msl)	Screen Depth (feet bgs)	Screen Elevation(1) (feet above msl)	Depth to Ground-water (feet bfor)(2)	Ground-water Elevation(1)(2) (feet above msl)	Northing Coordinate (3)	Easting Coordinate (3)	Average Hydraulic Conductivity (feet per day)
MW003	33.83	35.82	Top: 17 Bottom: 22	Top: 16.83 Bottom: 11.83	7.33	28.49	335285.641	1263748.262	2.91
MW004	33.91	35.72	Top: 6 Bottom: 16	Top: 27.91 Bottom: 17.91	7.83	27.89	335289.358	1263746.882	10.47
MW024	32.86	32.50	Top: 4 Bottom: 14	Top: 28.86 Bottom: 18.86	5.50	27.00	335262.441	1263748.028	12.80
MW025	32.60	32.43	Top: 4 Bottom: 14	Top: 28.60 Bottom: 18.60	6.04	26.39	335244.821	1263758.446	12.60
MW011	31.61	33.49	Top: 9 Bottom: 19	Top: 22.61 Bottom: 12.61	8.30	25.19	335222.164	1263751.168	0.52

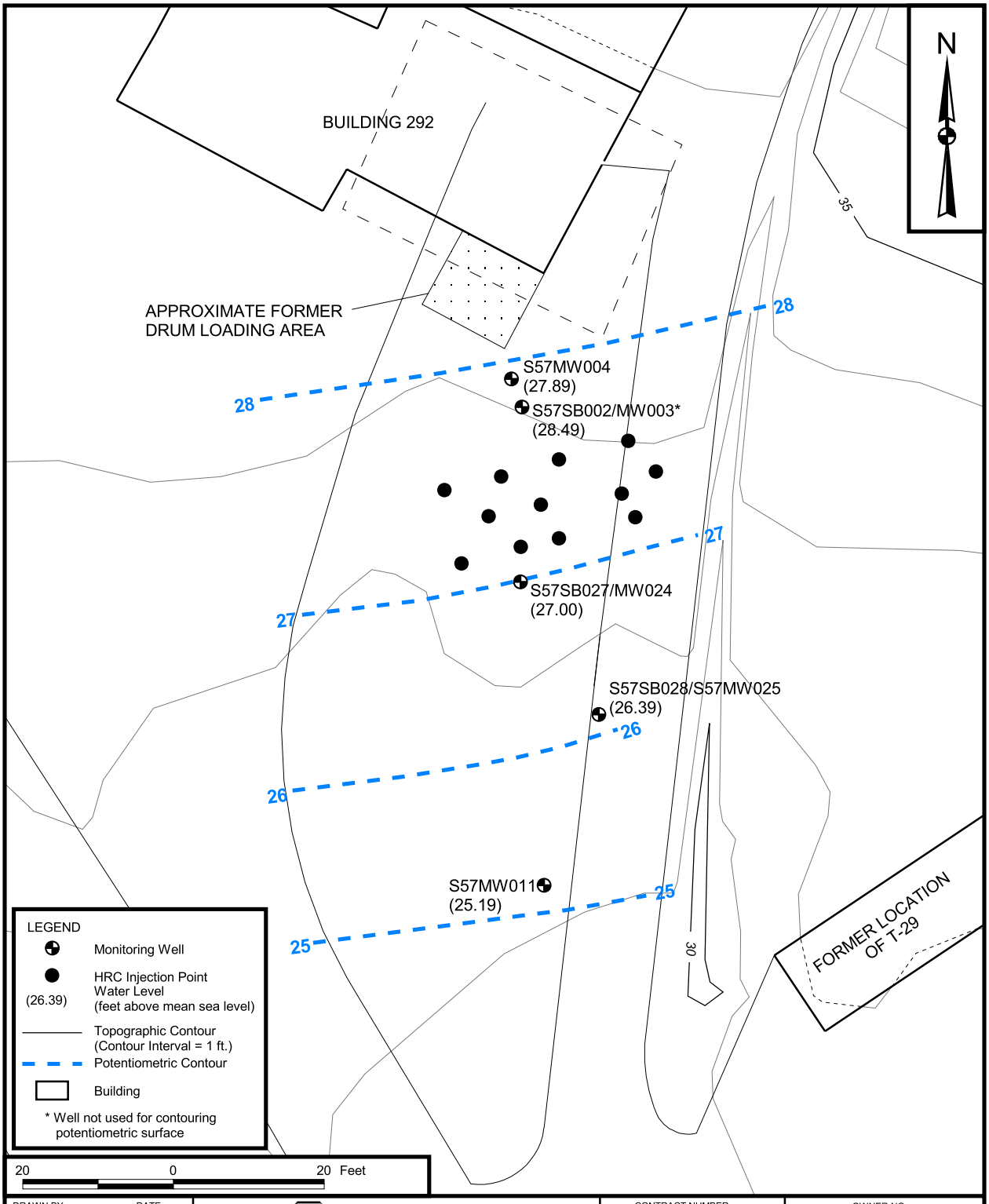
1 Elevation Datum = National Geodetic Vertical Datum (NGVD) 1929.
2 Measurement taken 5/16/03.
3 Coordinate Datum = North American Datum (NAD) 1983.
msl = Mean sea level.
bgs = Below ground surface.
btor = Below top of riser.

TABLE 4-2

BASELINE ANALYTICAL DATA FROM PILOT STUDY AREA WELLS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

Sampling Date	Monitoring Wells - Groundwater Data (μg/L)									
	MW003		MW004		MW024		MW025		MW011	
Trichloroethene (TCE)										
January-99	247	J	612	J	---		---		51	J
August-01	450		12,000		---		---		94	
May-03	570		2,900		8,600		9,100		310	
1,1-Dichloroethene (1,1-DCE)										
January-99	3		10		---		---		1	U
August-01	3	J	6		---		---		5	U
May-03	25	U	100	U	500	U	500	U	50	U
cis-1,2-Dichloroethene (cis-1,2-DCE)										
January-99	54	J	528	J	---		---		5	
August-01	47		620		---		---		30	
May-03	9	J	1,150		3,900		12,000		14	J
Vinyl Chloride										
January-99	3		48	J	---		---		1	U
August-01	5	U	26		---		---		5	U
May-03	10	U	70	U	410		2,300		20	U

J = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered to be an estimated value.
U = Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner.
--- = Not sampled.



DRAWN BY K. PEILA — DATE 3/18/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4020	OWNER NO. CTO 0805
CHECKED BY G. LATULIPPE — DATE 3/18/04	POTENTIOMETRIC SURFACE IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY SITE 57 - BUILDING 292 TCE CONTAMINATION AREA NAVAL DISTRICT WASHINGTON, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY GJL — DATE 3/18/04	
COST/SCHEDULE-AREA		APPROVED BY — — DATE —	
SCALE AS NOTED		DRAWING NO. FIGURE 4-1	REV 0

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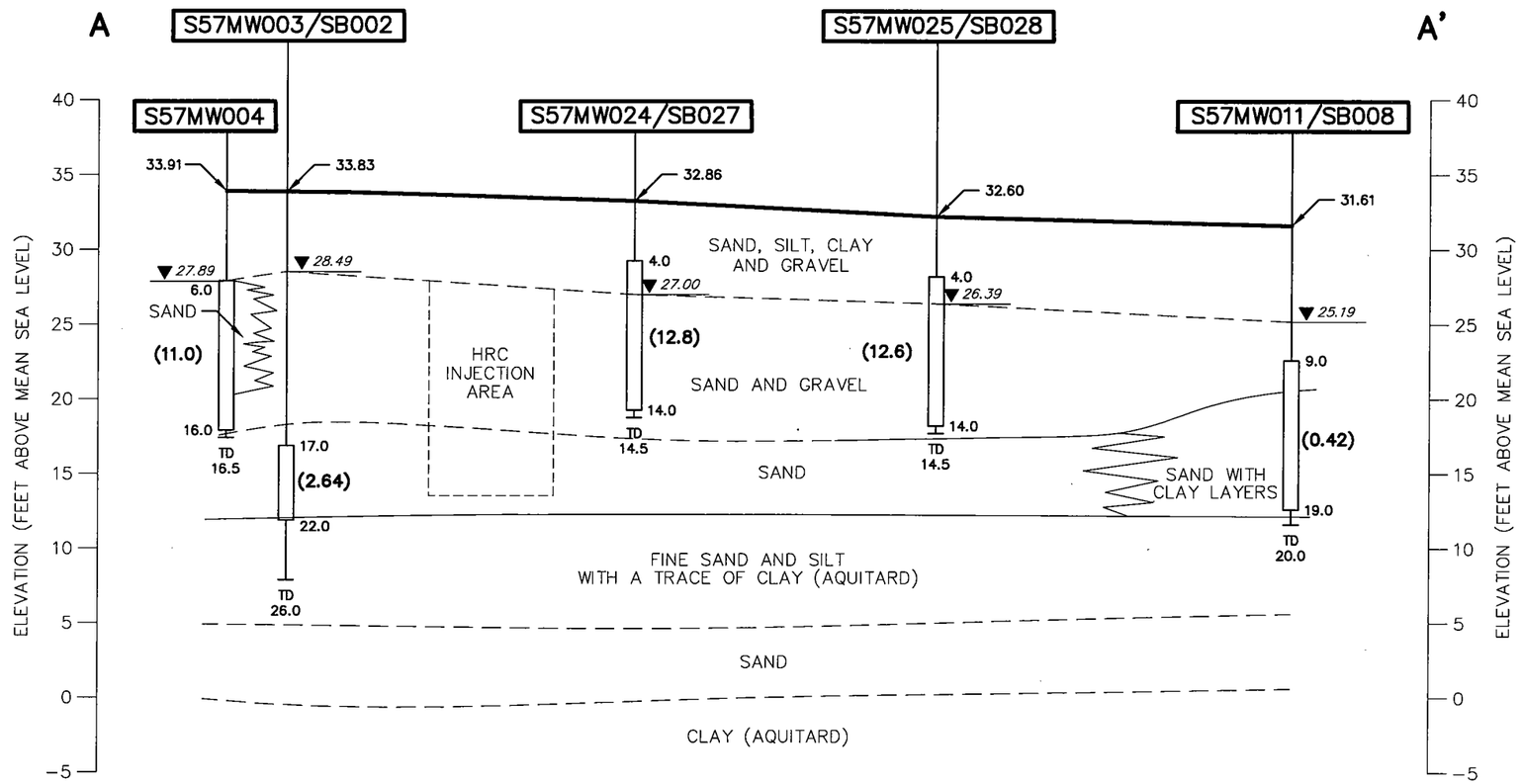

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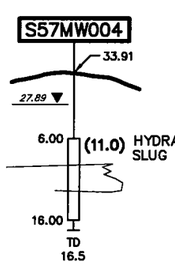
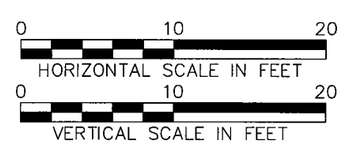


- MONITORING WELL OR BORING NUMBER
- GROUND SURFACE ELEVATION
- GROUND SURFACE
- GROUNDWATER ELEVATION
- TOP OF MONITORED INTERVAL (FT BGS)
- LITHOLOGIC CONTACT (INFERRED BETWEEN BORINGS)
- BOTTOM OF MONITORED INTERVAL (FT BGS)
- TOTAL DEPTH OF WELL OR BORING (FT BGS)
- (11.0) HYDRAULIC CONDUCTIVITY FROM SLUG TEST (2003) IN FEET PER DAY



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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CHECKED BY DATE 3/15/04
COST/SCHED-AREA
SCALE AS NOTED

Tetra Tech NUS, Inc.

GENERALIZED GEOLOGICAL CROSS SECTION
IN SITU AEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 – FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

CONTRACT NO. 4020
OWNER NO. 0550
APPROVED BY
DATE 3/15/04
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DATE
DRAWING NO. FIGURE 4-2
REV. 0

FORM CADD NO. TtNUS_BH.DGN - REV 0 - 1/20/98

5.0 DATA EVALUATION

This section discusses the implications of the data collected during the 6-month pilot study. Because the changes in the concentrations of TCE and its daughter products over time are the primary indicators that reductive dechlorination is or is not occurring, this section will initially focus on TCE and its daughter products. The discussion will then move to the supporting data, applying a weight-of-evidence approach to the data from the other monitored parameters to evaluate whether they support observations that reductive dechlorination is or is not occurring. Table 5-1 shows the analytical data for TCE and its daughter products. Table 5-2 shows the data for secondary indicators, and Table 5-3 shows other indicators of bioremediation. Appendix B contains a complete set of the analytical data from the samples collected during the pilot study.

5.1 PRIMARY INDICATORS

Figure 5-1 shows the concentrations of TCE detected in samples collected from each of the five monitoring wells prior to HRC® injection. [It should be noted that, as shown on Figure 4-2, MW003 and MW004 are essentially co-located as a well cluster but are screened at different depths (17 to 22 feet bgs for MW003 and 6 to 16 feet bgs for MW004).] Figure 5-1 illustrates that prior to the commencement of the pilot study, the TCE concentrations in the wells just downgradient of the HRC® array (MW024 at 8,600 µg/L and MW025 at 9,100 µg/L) were higher than the concentrations upgradient of the array (MW003 at 570 µg/L and MW004 at 2,900 µg/L). The TCE concentration in the most downgradient well (MW011 at 310 µg/L) was low compared to MW004, MW024, and MW025.

Figure 5-2 illustrates a dramatic reduction in TCE concentrations in MW024 and MW025 within 2 months of the HRC® installation. By November, TCE concentrations had decreased by approximately 97 percent in MW024 (8,600 µg/L to 280 µg/L) and 98 percent in MW025 (9,100 µg/L to 110 µg/L). Although the TCE concentration in the upgradient well, MW004, decreased by approximately 59 percent (2,900 µg/L to 1,200 µg/L) during the same period, MW004 continued to have TCE concentrations four to ten times greater than MW024 and MW025. TCE concentrations in MW011 were relatively low (310 µg/L) at the commencement of the pilot study and remained so (210 µg/L) through November.

Figure 5-3 shows the concentrations of TCE and its daughter products in the upgradient well, MW004, over the duration of the pilot study. During the study, TCE concentrations generally decreased, and cis-1,2-DCE concentrations remained fairly stable. Vinyl chloride concentrations have not increased in MW004 as of the November samples. The reduction in TCE concentrations alone might be viewed as evidence of degradation; however, the relatively small change in cis-1,2-DCE concentrations and the absence of increases in vinyl chloride concentrations indicate limited evidence of degradation.

Figures 5-4, 5-5, and 5-6 show the concentrations of TCE and its daughter products in MW024, MW025, and MW011 respectively, all of which are downgradient of the HRC® array. It should be noted that the scales of the Y-axes vary considerably among the three figures, so care is required when using these figures to compare concentrations among the three wells.

In MW024 (Figure 5-4), TCE concentrations decreased significantly (by 86 percent) during the first month, while cis-1,2-DCE increased (by 92 percent) over the same period, followed by lower cis-1,2-DCE concentrations over the remaining study duration. TCE remained low (decreased by 97 percent) through November, and vinyl chloride increased nominally over the study duration. The data from MW024 illustrate the classic indications that reductive dechlorination is occurring in this well.

In MW025 (Figure 5-5), the baseline concentration of cis-1,2-DCE exceeded the TCE baseline concentration; however, over the duration of the study, TCE decreases were followed by lagging increasing, then decreasing, cis-1,2-DCE concentrations. (Although Table 5-1 shows the June and July TCE concentrations as non-detected values, the data indicate that the TCE concentrations in those samples were at least as low as the 1,000 µg/L and 250 µg/L detection limits shown.) As in MW024, the vinyl chloride concentrations in MW025 increased nominally during the study. The data for MW025 support the conclusion that reductive dechlorination is occurring in MW025.

The data from MW011 also exhibit evidence of ongoing reductive dechlorination. As with the other two downgradient wells, this well shows a rapid decrease (45 percent in the first month; 32 percent over the study duration) in TCE concentrations accompanied by an increase then a decrease in cis-1,2-DCE concentrations. (The July cis-1,2-DCE concentration plotted on Figure 5-6 appears on Table 5-1 as an elevated detection limit and may be higher than the actual concentration in the groundwater.) The 1,1-DCE concentrations shown on Figure 5-6 also exhibit concentration changes that roughly parallel the changes in cis-1,2-DCE concentrations. (As for cis-1,2-DCE, high detection limits as shown on Table 5-1 and plotted on Figure 5-6 for the May, June, and July samples may be higher concentrations than actually present in the groundwater.) Although exaggerated by the vertical scale in the figure, TCE shows a sharp increase in September. Verifying the analytical data validation records as well as checking the field log book and sample collection logs for unusual conditions revealed no circumstances that might have resulted in the apparent spike in TCE concentration.

Table 5-1 data indicate the presence of ethene and ethane in wells MW024 and MW025. Their presence is indicative of the reduction of vinyl chloride and a completion of the dechlorination process. Concentrations of ethene and ethane were detected in the baseline samples prior to HRC® injection indicating that natural attenuation process was occurring prior to the treatability study. With the exception

of an increase in ethane concentrations in MW024, these concentrations have remained stable during post-injection sampling indicating that reductive dechlorination continues to be effective.

5.2 SECONDARY INDICATORS

Parameters other than VOCs can be monitored to evaluate the suitability of conditions for biodegradation and to determine if bioremediation is occurring. Section 3.0 offers a description of the parameters monitored during this pilot study and the role each plays in connection with reductive dechlorination.

5.2.1 Dissolved Oxygen

For anaerobic dechlorination to operate effectively, the anaerobic bacteria require DO concentrations of approximately 0.5 mg/L or less. Table 5-2 displays two sets of DO data, one determined using a field direct reading meter and the second determined using a Chemetrics field test kit. Both indicate distinctly lower concentrations in wells downgradient from the HRC® array (MW024, MW025, and MW011) prior to the HRC® injection (i.e., before May 2003). Following the injection, all of the DO concentrations for MW024 and MW025 are consistently less than 0.5 mg/L, and with a single exception, the data for MW011 are all less than 0.5 mg/L indicating favorable conditions for reductive dechlorination.

5.2.2 Oxidation/Reduction Potential (ORP)

As noted in Section 3 and Figure 3-1, the reduction of chlorinated VOCs is favored when the ORP is less than 50 mV and is likely when the ORP is less than -100mV. The ORP was very favorable in MW024 (at -126.5 mV) in November. In MW025, the levels were favorable (at -52.1 and -55 mV) in June and July but may be on the rise if November's 123.4 mV reading is the beginning of a trend. In MW011, ORP appears to be increasing with the September and November readings of 71.9 mV and 97.3 mV, respectively.

5.2.3 Nitrate/Nitrite

As oxygen is depleted, nitrate (NO^-_3) becomes increasingly important as an electron acceptor. Nitrate reduces to nitrite. Table 5-2 shows that nitrate was detected in the upgradient monitoring wells (MW003 and MW004) and in the May baseline samples from the downgradient wells (MW024, MW025, and MW011). Following the HRC® injection, nitrate was not detected in MW024 and was detected at decreased concentrations in MW025, indicating that nitrate reduction apparently occurred in the vicinity of these wells. With the exception of the September sample, the nitrate reduction was also apparent in MW011. Nitrite was detected in downgradient wells beginning in September and November indicating the possible reduction of nitrate to nitrite.

5.2.4 Manganese

Manganese IV is among the most common naturally occurring electron acceptors in groundwater. It becomes a more important electron acceptor as nitrate is depleted. Under anaerobic conditions, manganese IV is reduced to manganese II, which is much more soluble; thus, an increase in manganese II in the groundwater indicates that reducing conditions exist. Table 5-2 displays manganese data from samples analyzed for both total and dissolved manganese. Generally, the two data sets correspond closely. Following HRC® injection in May, the manganese concentrations in MW024 and MW025 increased significantly, indicating that reducing conditions existed in those wells.

5.2.5 Iron

Iron becomes an increasingly important electron acceptor as manganese is depleted. Similar to manganese, iron III minerals are reduced to soluble iron II under reducing conditions. Therefore, increasing iron II (ferrous iron) concentrations would be expected under reducing conditions. Several of the total and dissolved iron analytical results shown on Table 5-2 are qualified with a “B” due to laboratory blank contamination; however, the concentrations shown in the table were actually detected in the samples. Because some portion of the detected concentrations may be due to the blank contamination, it can be said that the actual concentrations in the samples are no greater than the values in the table, and they may be lower. With respect to the total and dissolved iron concentrations detected in the samples from MW024 and MW025, the concentrations are much higher in the November samples than in the May baseline samples. The ferrous iron shows a distinct pattern of increased concentrations throughout the pilot study (with the exception of the November result in MW025). These results indicate that favorable reducing conditions existed in these wells.

5.2.6 Sulfate/Sulfide

The importance of sulfate (SO_4^{-2}) as an electron acceptor increases as oxygen, nitrate, manganese, and iron are depleted. Sulfate reduces to sulfide. Table 5-2 shows sulfate, sulfide, and hydrogen sulfide concentrations. As the table indicates, the May baseline sulfate concentrations decreased by November. Although the sulfide analytical results are “masked” by analytical detection limits for several analyses, the hydrogen sulfide data shows increased concentrations in the later samples collected from the downgradient wells, especially MW024 and MW025, indicating that reducing conditions exist in those monitoring wells.

5.2.7 Phosphate

Because phosphate is a potential substrate and/or nutrient for biological degradation of organic contamination, changes in its concentration may indicate that microbial degradation is ongoing. The

phosphate data in Table 5-2 indicate only two detections each for MW024 and MW025. The data are not sufficiently conclusive to identify a trend.

5.2.8 Methane

Methanogenesis, the production of methane by single-celled microorganisms called methanogens, occurs when acetate is converted into carbon dioxide and methane. Methane can also be produced when carbon dioxide, hydrogen, and electrons combine to form methane and water. Typically, methanogenesis occurs after oxygen, nitrate, and sulfate are depleted. Because methane is a competing electron acceptor, an increase in methane concentrations indicates methanogenesis, but does not necessarily indicate dechlorination. Methane concentrations increased in MW024 and remained elevated in MW025 (from baseline conditions) over the duration of the study. These concentrations verify the occurrence of methanogenesis in the vicinity of those wells.

5.3 OTHER INDICATORS OF BIOREMEDIATION

During the pilot study, data were collected for several additional parameters that are capable of indicating whether conditions are favorable to reductive dechlorination. Data for these parameters are presented in Table 5-3.

5.3.1 Carbon Dioxide

Carbon dioxide is produced by many microbial metabolism processes including every terminal electron acceptor process (nitrate, manganese, iron, and sulfate reduction, as well as methanogenesis). The carbon dioxide concentrations in the upgradient wells MW003 and MW004 were relatively constant during the study. The data for the downgradient wells, MW024, MW025, and MW011, show some increase between May and November, with the largest increase occurring in MW024. These values indicate that microbial metabolism is occurring in the subsurface. However, the increases are not sufficiently large to suggest, by themselves, that complete dechlorination has occurred.

5.3.2 Alkalinity

An increase in alkalinity may be due to the dissolution of aquifer minerals by carbon dioxide, which is in turn due to microbial activity. The alkalinity increased significantly in MW024 and slightly in MW025 between May and November. These data indicate increased microbial activity in MW024, but is less certain regarding MW025.

5.3.3 Chloride

Although in theory an increase in chloride concentrations is direct evidence in reductive dechlorination, in practice, this parameter is not always a reliable indicator. In this case, the chloride concentrations remained relatively stable from the baseline sampling event and throughout the pilot study.

5.3.4 Breakdown Products of HRC®

Lactic acid, pyruvic acid, acetic acid, propionic acid, and butyric acid (i.e., volatile fatty acids) result from the breakdown of HRC® in groundwater and would be expected to be present during the pilot study. Table 5-3 data show that, with the exception of the September data, neither lactic nor pyruvic acids were detected in the groundwater. However, other indicators verify that they were, in fact, present. Under conditions of low hydrogen, lactic acid oxidizes to pyruvic acid with subsequent conversions from pyruvic acid to acetic acid. The presence of butyric and propionic acids are an indication that the subsurface system has an abundance of hydrogen available for dechlorination. The data in Table 5-3 indicate the presence of both propionic acid and butyric acid in downgradient wells MW024 and MW025.

Increasing concentrations of total organic carbon (TOC) are another indication that there is sufficient organic carbon in the system to ferment to hydrogen. Table 5-3 data indicate increased TOC concentrations in MW024 and MW025 following the May HRC® injection. Although the data indicate decreasing concentrations of volatile fatty acids and TOC as the pilot study progresses, a sufficient supply of carbon remains to continue to stimulate the reductive dechlorination process.

5.3.5 Other Field Parameters

Specific conductivity is a measure of the groundwater's ability to conduct electricity and is directly related to the concentration of ions in solution. Conductivity would tend to increase as the ion concentration increases. The Table 5-3 data show generally increasing specific conductivity in the downgradient wells from May through September. The decreasing specific conductivity values in November may indicate that the peak occurred with the September data.

The pH and temperature of the groundwater samples were within the desired ranges for reductive dechlorination.

5.4 ETHYL ETHER

Ethyl ether degrades aerobically; therefore HRC® would not be expected to enhance the degradation of ethyl ether. Ethyl ether is not a chlorinated VOC but an unrelated compound historically found at high levels at Site 57. Analyses for ethyl ether were included with the pilot study samples primarily for the

purpose of evaluating if the HRC® had any effect on ethyl ether concentrations. Although there were some fluctuations in ethyl ether concentrations over the 6 months of the study, a comparison of the May baseline data and the final November data indicate essentially no change in ethyl ether concentrations (see Tale 5-4).

5.5 SUMMARY

Primary indicators described in Section 5.1 show definite evidence of reductive dechlorination, especially in the downgradient monitoring wells MW024 and MW025. Over the 6-month pilot study duration, TCE concentrations decreased by as much as 98 percent (MW024), cis-1,2-DCE concentrations exhibited expected increases, then decreases, and vinyl chloride concentrations increased.

The secondary indicators described in Section 5.2 generally support the conclusion that reductive dechlorination was ongoing during the pilot study. Particularly in MW024 and MW025, oxygen was depleted, ferrous iron was generated, sulfate was reduced while sulfides were generated, and methane was generated. All of these are indicators of moderately to strongly reducing conditions favorable for reductive dechlorination.

As a group, the secondary indicators discussed in Section 5.3 were not as conclusive. While carbon dioxide concentrations increased, alkalinity and chloride concentrations showed little change. The presence of volatile fatty acids and TOC indicate that conditions continue to be suitable for reductive dechlorination. It is expected that carbon present in the aquifer will continue to ferment to hydrogen, furthering the biodegradation of the remaining TCE, DCE, and vinyl chloride at the site.

TABLE 5-1

PRIMARY INDICATORS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

	Monitoring Wells - Groundwater Data (µg/L)									
Sampling Date	**MW003**		**MW004**		**MW024**		**MW025**		**MW011**	
Trichloroethene (TCE)										
January-99	247	J	612	J	---		---		51	J
August-01	450		12,000		---		---		94	
May-03	570		2,900		8,600		9,100		310	
June-03	490		2,700		1,200		1,000	U	170	J
July-03	380		1,300		60	J	250	U	54	J
September-03	170		1,600		250		130		600	
November-03	240		1,200		280		110		210	
1,1-Dichloroethene (1,1 DCE)										
January-99	3		10		---		---		1	U
August-01	3	J	6		---		---		5	U
May-03	25	U	100	U	500	U	500	U	50	U
June-03	2	J	250	U	500	U	1,000	U	250	U
July-03	3	J	100	U	500	U	250	U	250	U
September-03	5	U	3	J	2	J	70		5	U
November-03	5	U	2	J	2	J	18	J	25	U
cis-1,2-Dichloroethene (cis-1,2-DCE)										
January-99	54	J	528	J	---		---		5	
August-01	47		620		---		---		30	
May-03	9	J	1,150		3,900		12,000		14	J
June-03	8	J	980		7,500		6,550	J	30	J
July-03	9	J	760		7,300		6,600		250	U
September-03	1.5	J	920		600		49,000		81	
November-03	4	J	1,000		1,300	J	10,000		30	
Vinyl Chloride										
January-99	3		48	J	---		---		1	U
August-01	5	U	26		---		---		5	U
May-03	10	U	70	U	410		2,300		20	U
June-03	10	U	100	U	470		950		100	U
July-03	10	U	56		150	J	2,000		100	U
September-03	2	U	7		390		2,800		2	J
November-03	2	U	29		710		2,600		10	U
Ethene (µg/L)										
January-99	---		---		---		---		---	
August-01	---		---		---		---		---	
May-03	10	U	10	U	50		430		10	U
June-03	10	U	10	U	20		325		10	U
July-03	10	U	10	U	37		270		10	U
September-03	10	U	10	U	350		340		10	U
November-03	10	U	10	U	250		330		10	U
Ethane (µg/L)										
January-99	---		---		---		---		---	
August-01	---		---		---		---		---	
May-03	10	U	10	U	19		380		10	U
June-03	10	U	10	U	10	U	180		10	U
July-03	10	U	10	U	12		130		10	U
September-03	10	U	10	U	10	U	110		10	U
November-03	10	U	10	U	18		150		10	U

U = Indicates that the chemical was not detected at the numerical deteciton limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner.

J = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered to be an estimated value.

--- = Not sampled.

TABLE 5-2

SECONDARY INDICATORS
IN SITU ANAEROBIC BIOLOGICAL PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

Sampling Date	Monitoring Wells - Groundwater Data									
	MW003		MW004		MW024		MW025		MW011	
Dissolved Oxygen (mg/L) (YSI Meter or Horiba Meter)										
January-99	9.46		11.17		--		--		8.53	
August-01	3.43		3.26		--		--		3.3	
May-03	5.6		0.87		1.27		1		0.33	
June-03	0.15		0.45		0.15		0.19		0.15	
July-03	0.18		0.48		0.2		0.31		0.32	
Sep-03	0.22		0.8		0.15		0.15		0.17	
Nov-03	0.23		0.27		0.23		0.17		0.29	
Dissolved Oxygen (mg/L) (Field Test Kit)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	2		0.6		0.8		1		0.5	
June-03	0.2		0.6		0		0		0.4	
July-03	0.4		0.6		0		0		0.4	
Sep-03	0.3		0.9		0		0		0.6	
November-03	0.3		0.25		0		0		0.4	
Oxidation/Reduction Potential (mV)										
January-99	--		--		--		--		--	
August-01	258		168		--		--		135	
May-03	-4.8		-50.1		-24.1		24.7		39.6	
June-03	191.8		171.2		39.9		18.3		139.5	
July-03	38.3		10.7		-82.8		-52.1		-12.8	
Sep-03	257		173		-114.7		-55		71.9	
November-03	120		92.8		-126.5		123.9		97.3	
Nitrate (NO_3) (mg/L)										
January-99	---		---		---		---		---	
August-01	---		---		---		---		---	
May-03	1.4		0.41		0.82		0.07		0.66	
June-03	1.6		0.25		0.05	U	0.026	J	0.1	
July-03	1.4		0.6		0.10	U	0.1	U	0.17	
September-03	1.6		0.45		0.1	U	0.0168	J	0.81	
November-03	1.6	L	0.59	L	0.05	UR	0.05	J	0.37	L
Nitrite (NO_2) (mg/L)										
January-99	---		---		---		---		---	
August-01	---		---		---		---		---	
May-03	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
June-03	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
July-03	0.05	U	0.05	U	0.089	J	0.1	U	0.05	U
September-03	0.05	U	0.05	U	0.1	U	0.091	J	0.05	U
November-03	0.05	UL	0.05		0.02	J	0.02	J	0.04	J
Total Manganese (µg/L)										
Jan-99	257	J	256	J	---		---		---	
August-01	---		---		---		---		---	
May-03	121		83.3		164		596		151	
June-03	108		68.0		7,220		785		353	
July-03	101		110		13,600		864		308	
September-03	96.4		47.3		8,070		1,610		382	
November-03	97.2		74.1		5,280		1,020		271	

TABLE 5-2

SECONDARY INDICATORS
IN SITU ANAEROBIC BIOLOGICAL PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

Sampling Date	Monitoring Wells - Groundwater Data									
	MW003		MW004		MW024		MW025		MW011	
Dissolved Manganese (µg/L)										
Jan-99	250		244		---		---		---	
August-01	---		---		---		---		---	
May-03	123		67.5		173		557		158	
June-03	102		41.0		7,110		767		395	
July-03	97.2		109		13,700		840		351	
September-03	91.2		52.3		8,180		1,630		372	
November-03	93.2		75.6		5,220		1,040		276	
Total Iron (µg/L)										
Jan-99	174		215	J	---		---		---	
August-01	---		---		---		---		---	
May-03	33.8	B	95.8	B	2,420		29,900		15.2	B
June-03	23.7	B	109.0	B	38,800		63,350		482	
July-03	4.8	B	34.6	B	185,000		76,500		639	
September-03	10.0	B	8.4	B	152,000		159,000		16	B
November-03	10.9	B	33.2	B	139,000		74,000		107	B
Dissolved Iron (µg/L)										
Jan-99	454	J	154							
August-01	---		---		---		---		---	
May-03	6.06	U	6.06	U	2,340		31,100		220	
June-03	6.06	U	20.7	B	38,200		62,400		346	
July-03	4.8	U	36.0	B	180,000		74,500		468	
September-03	5.35		6.3	B	153,000		160,000		63.9	B
November-03	8	B	22	B	136,000		75,400		84.6	B
Ferrous Iron (mg/L)										
Jan-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	<0.1		<0.1		2		3		<0.1	
June-03	<0.1		<0.1		2		4		1	
July-03	<0.1		<0.1		6		6		0	
September-03	<0.1		<0.1		5		>10		<0.1	
November-03	<0.1		<0.1		6		6		<0.1	
Sulfate (SO_4) (mg/L)										
January-99	---		---		---		---		---	
August-01	---		---		---		---		---	
May-03	2		13		6.5		4.3		8.3	
June-03	1	B	17		1	B	3.4		4.9	
July-03	1		8.9		1	U	1.0	U	3	
September-03	1		9.4		2		2		11	
November-03	1.5		8.9		1.7		2.1		5.6	
Sulfide (mg/L)										
January-99	---		---		---		---		---	
August-01	---		---		---		---		---	
May-03	1	U	0.95	J	1	U	0.15	J	1	U
June-03	1	B	0.65	B	1	U	1.1		3	
July-03	0.65	B	1	U	1	U	1	U	1	B
September-03	1.0	U	3		0.95	J	1.0	U	1.0	U
November-03	0.925	J	0.7	J	0.25	J	0.25	J	0.85	J

TABLE 5-2

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Sampling Date	Monitoring Wells - Groundwater Data									
	MW003		MW004		MW024		MW025		MW011	
Hydrogen Sulfide (H_2S) (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	<0.1		<0.1		<0.1		<0.1		<0.1	
June-03	<0.1		<0.1		<0.1		1		<0.1	
July-03	<0.1		<0.1		1		1		<0.1	
September-03	<0.1		<0.1		0.60		0.7		0.1	
November-03	<0.1		<0.1		1.50		1.00		<0.1	
Phosphate (PO_4) (mg/L)										
January-99	---		---		---		---		---	
August-01	---		---		---		---		---	
May-03	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
June-03	0.05	U	0.05	U	0.07		0.05	U	0.05	U
July-03	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
September-03	0.05	U	0.05	U	0.1		0.26		0.05	U
November-03	0.050	U	0.1	U	0.50	U	0.02	J	0.05	U
Methane (CH_4) (µg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	10	U	10	U	230		6,100		16	
June-03	10	U	10	U	36		2,900		86	
July-03	10	U	12		210		2,100		10	U
September-03	10	U	10	U	2,200		2,100		100	
November-03	10	U	14		3,500		2,300		24	

B = This qualifier is addded to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

J = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered to be an estimated value.

L = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered biased low.

U = Indicates that the chemical was not detected at the numerical detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner.

UR = Indicates that the chemical may or may not be present. The nondetected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (i.e., holding times missed by a factor of two times the specified time limit, severe calibration noncompliances, and extremely low quality control recoveries).

--- = Not sampled.

TABLE 5-3

MISCELLANEOUS INDICATORS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

Monitoring Wells - Groundwater Data										
Sampling Date	**MW003**		**MW004**		**MW024**		**MW025**		**MW011**	
Carbon Dioxide (CO_2) (µg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	95,000		105,000		98,000		150,000		91,000	
June-03	98,000		110,000		210,000		175,000		120,000	
July-03	95,000		98,000		180,000		160,000		125,000	
September-03	94,000		120,000		190,000		240,000		110,000	
November-03	96,000		100,000		160,000		160,000		100,000	
Chloride (Cl^-) (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	16	K	9.7	K	16	K	32	K	19	K
June-03	17		8		15		38		22	
July-03	16		13		16		26		28	
September-03	17		11		27		140		10	
November-03	17.5		14		21		44		21	
Alkalinity ($CaCO_3$) (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	6.7	J	66		10.8	J	63		80	
June-03	6.5	J	100		110		94		40	
July-03	6.2	J	30		240		110		30	
September-03	4.6	B	67		130	L	100	L	190	
November-03	5.4	L	34	L	160	L	90	L	56	L
Lactic Acid (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	25	U	25	U	25	U	25	U	25	U
June-03	25	U	25	U	33		25	U	25	U
July-03	25	U	25	U	25	U	25	U	25	U
September-03	46		43		57		41		59	
November-03	25	U	25	U	25	U	25	U	25	U
Pyruvic Acid (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	10	U	10	U	10	U	10	U	10	U
June-03	10	U	10	U	10	U	10	U	1	U
July-03	10	U	10	U	10	U	10	U	10	U
September-03	5.9		10	U	4.4	J	1.2	J	1.9	J
November-03	10	U	10	U	10	U	10	U	10	U

TABLE 5-3

MISCELLANEOUS INDICATORS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

Monitoring Wells - Groundwater Data										
Sampling Date	**MW003**		**MW004**		**MW024**		**MW025**		**MW011**	
Acetic Acid (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	1	U	1	U	1	U	1	U	1	U
June-03	1	U	1	U	100		38		1	U
July-03	1	U	1	U	160		65		1	U
September-03	8.6	J	4.3		86		110		1	U
November-03	1	U	1	U	71		48		1	U
Propionic Acid (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	1	U	1	U	1	U	1	U	1	U
June-03	1	U	1	U	150		79		1	U
July-03	1	U	1	U	420		120		1	U
September-03	4.7	J	2.6		160		42		0.3	J
November-03	1	U	1	U	120		18		1	U
Butyric Acid (mg/L)										
January-99	--		--		--		--		--	
August-01	--		--		--		--		--	
May-03	1	U	1	U	1	U	1	U	1	U
June-03	1	U	1	U	58		48		1	U
July-03	1	U	1	U	24		68		1	U
September-03	2.3		1.1		4.7		27		0.5	J
November-03	1	U	1	U	7		8		1	U
Total Organic Carbon (mg/L)										
January-99	1	U	1	U	--		--		--	
August-01	--		--		--		--		--	
May-03	0.54	B	1	B	1	B	3.7		1.0	B
June-03	0.48	B	2	B	410		85		0.67	B
July-03	0.47	B	0.69	B	220		100		4.4	
September-03	0.40	B	0.94	B	130		110		2	B
November-03	0.40	J	0.72	J	130		53		0.7	J
Specific Conductivity (mS/cm)										
January-99	0.10		0.10		--		--		0.19	
August-01	0.06		0.14		--		--		0.10	
May-03	0.10		0.21		0.11		0.27		0.24	
June-03	0.09		0.24		0.38		0.33		0.15	
July-03	0.10		0.15		0.66		0.37		0.14	
September-03	0.10		0.23		0.67		0.98		0.48	
November-03	0.10		0.14		0.50		0.37		0.18	

TABLE 5-3

MISCELLANEOUS INDICATORS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

Monitoring Wells - Groundwater Data					
Sampling Date	**MW003**	**MW004**	**MW024**	**MW025**	**MW011**
pH					
January-99	5.3	5.5	--	--	5.9
August-01	5.3	6.5	--	--	5.8
May-03	4.9	6.0	5.2	5.6	5.6
June-03	4.5	5.9	5.0	5.3	5.4
July-03	4.0	5.1	5.9	5.1	4.4
September-03	4.7	5.9	6.2	5.6	6.4
November-03	4.9	5.6	6.2	5.8	5.9
Temperature (degrees centigrade)					
January-99	15.3	15.1	--	--	11.2
August-01	20.7	22.5	--	--	21.3
May-03	15.9	16.5	15.5	15.8	16.2
June-03	19.4	17.7	17.8	18.2	17.2
July-03	21.3	22.0	20.7	20.1	19.7
September-03	19.7	22.2	21.2	21.1	21.7
November-03	19.1	19.7	18.0	18.0	16.9

B = This qualifier is addded to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

J = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered to be an estimated value.

K = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered biased high.

L = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered biased low.

U = Indicates that the chemical was not detected at the numberial detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner.

--- = Not sampled.

TABLE 5-4

ETHYL ETHER
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

Monitoring Wells - Groundwater Data					
Sampling Date	**MW003**	**MW004**	**MW024**	**MW025**	**MW011**
Ethyl Ether (Diethyl Ether) (µg/L)					
January-99	293 J	297 J			3,950 L
August-01	440	320			1,700
May-03	180	150	270 J	93 J	1,800
June-03	200	91 J	240 J	1,000 U	3,200
July-03	600	360	560	250	5,650
September-03	75	93	220	100	890
November-03	160	120	180	120	2,000

J = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered to be an estimated value.

L = Indicates that the chemical was detected. However, the associated numerical result is not a precise representation of the amount that is actually present in the sample. The laboratory reported concentration is considered biased low.

U = Indicates that the chemical was not detected at the numberial detection limit (sample-specific quantitation limit) noted. Nondetected results from the laboratory are reported in this manner.

--- = Not sampled.

FIGURE 5-1

TCE AND DAUGHTER PRODUCTS - MAY 2003 BASELINE CONDITIONS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

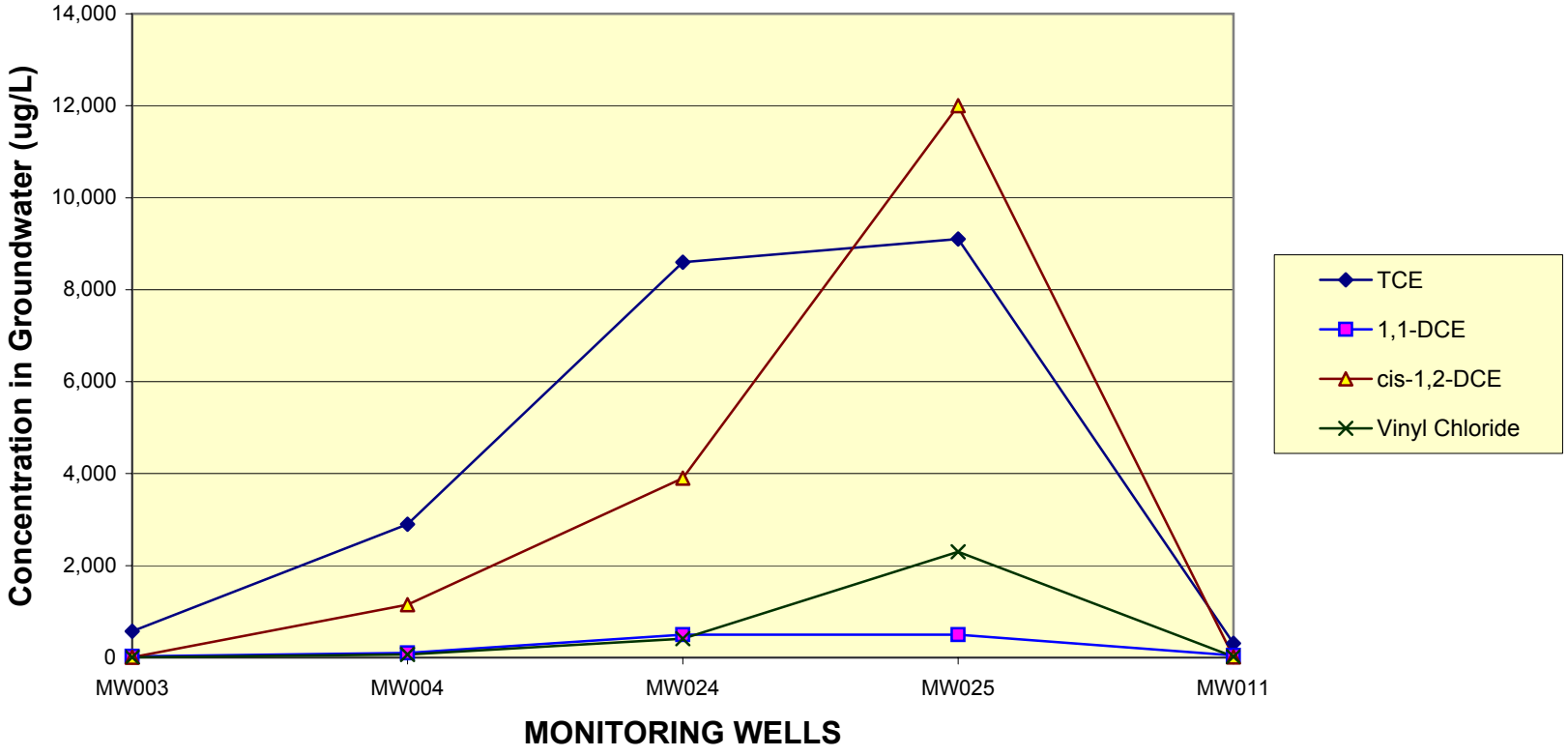


FIGURE 5-2

TCE IN ALL WELLS
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

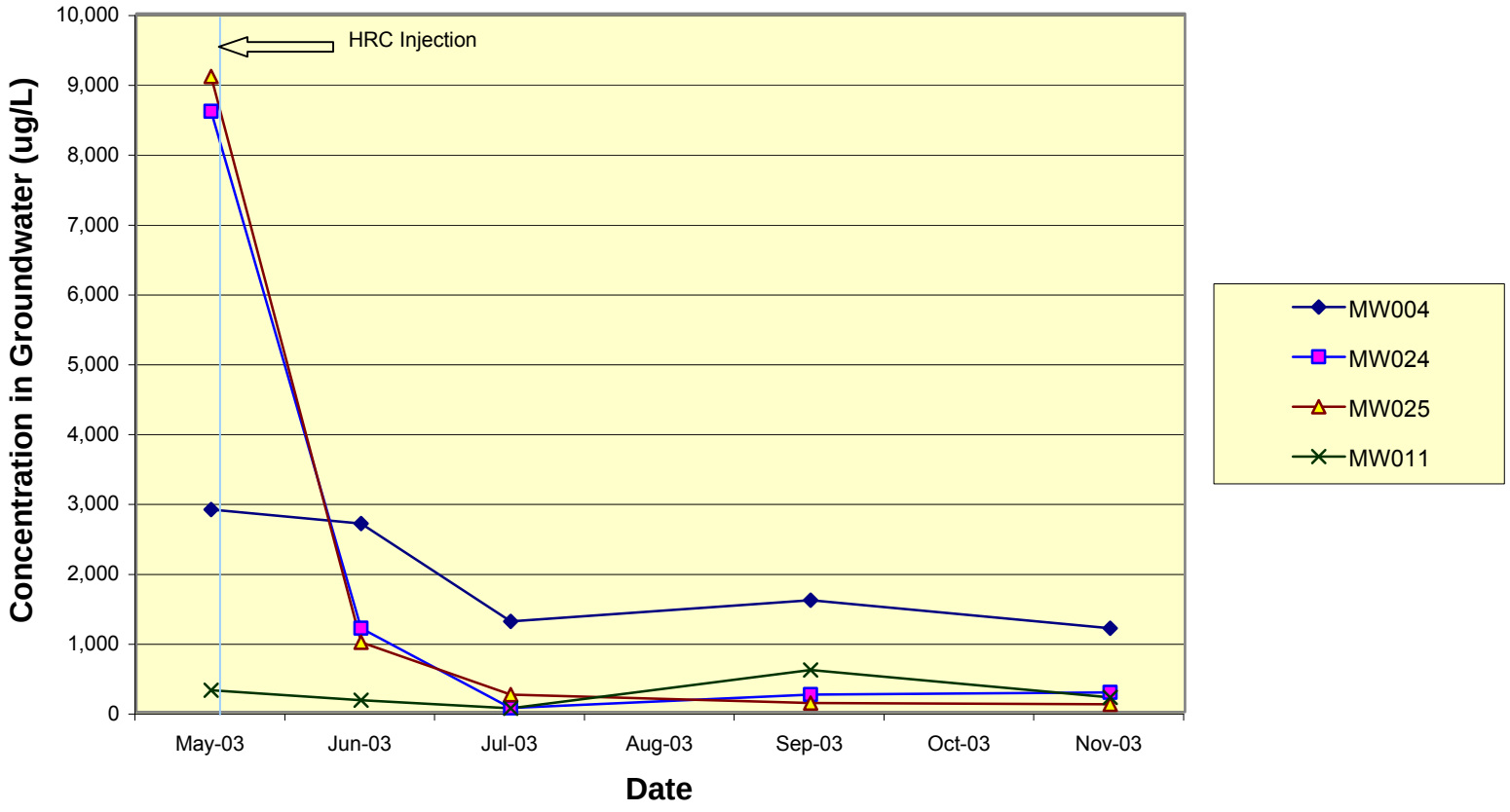


FIGURE 5-3

TCE AND DAUGHTER PRODUCTS - MW004
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

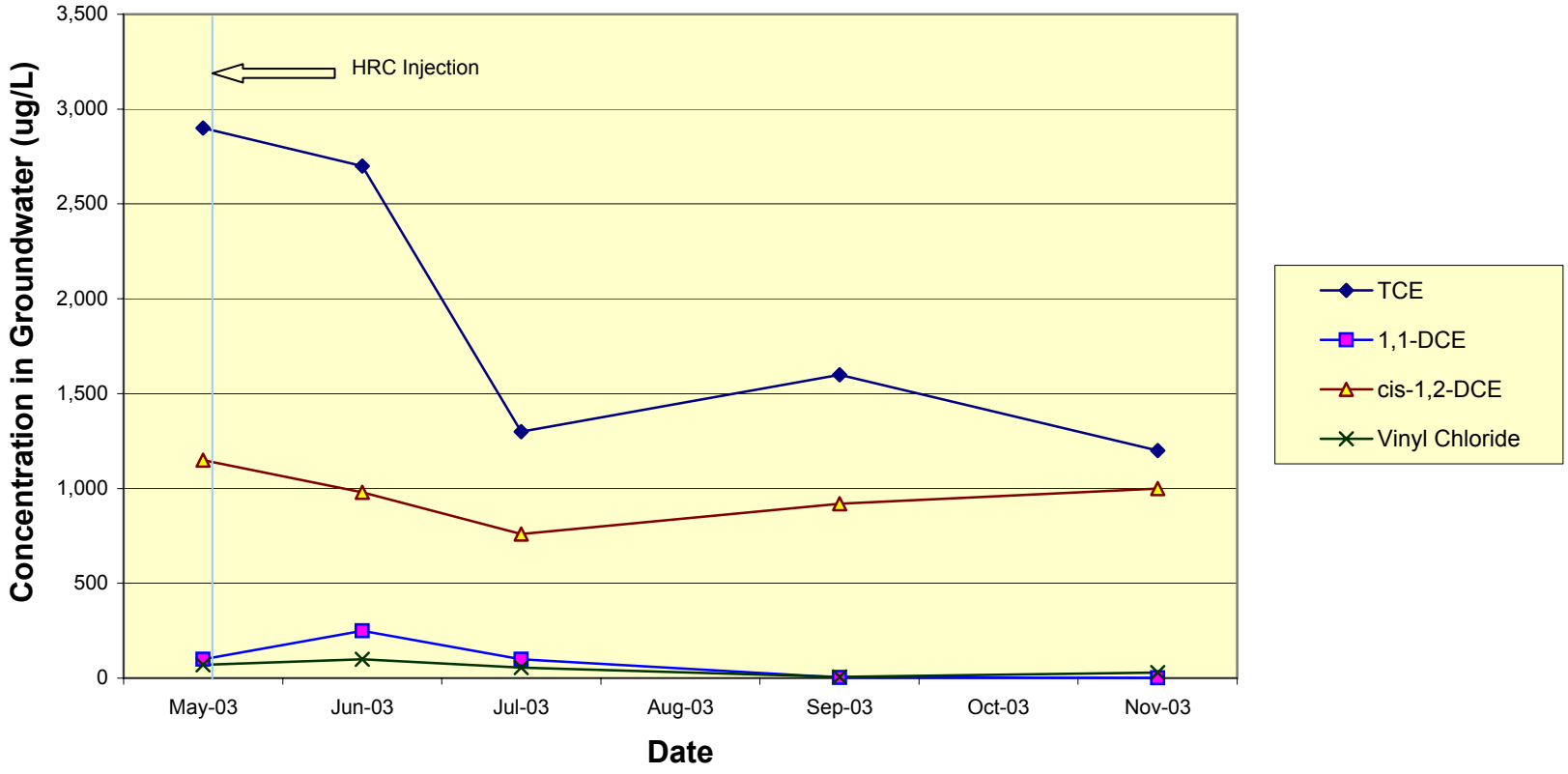


FIGURE 5-4

TCE AND DAUGHTER PRODUCTS - MW024
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

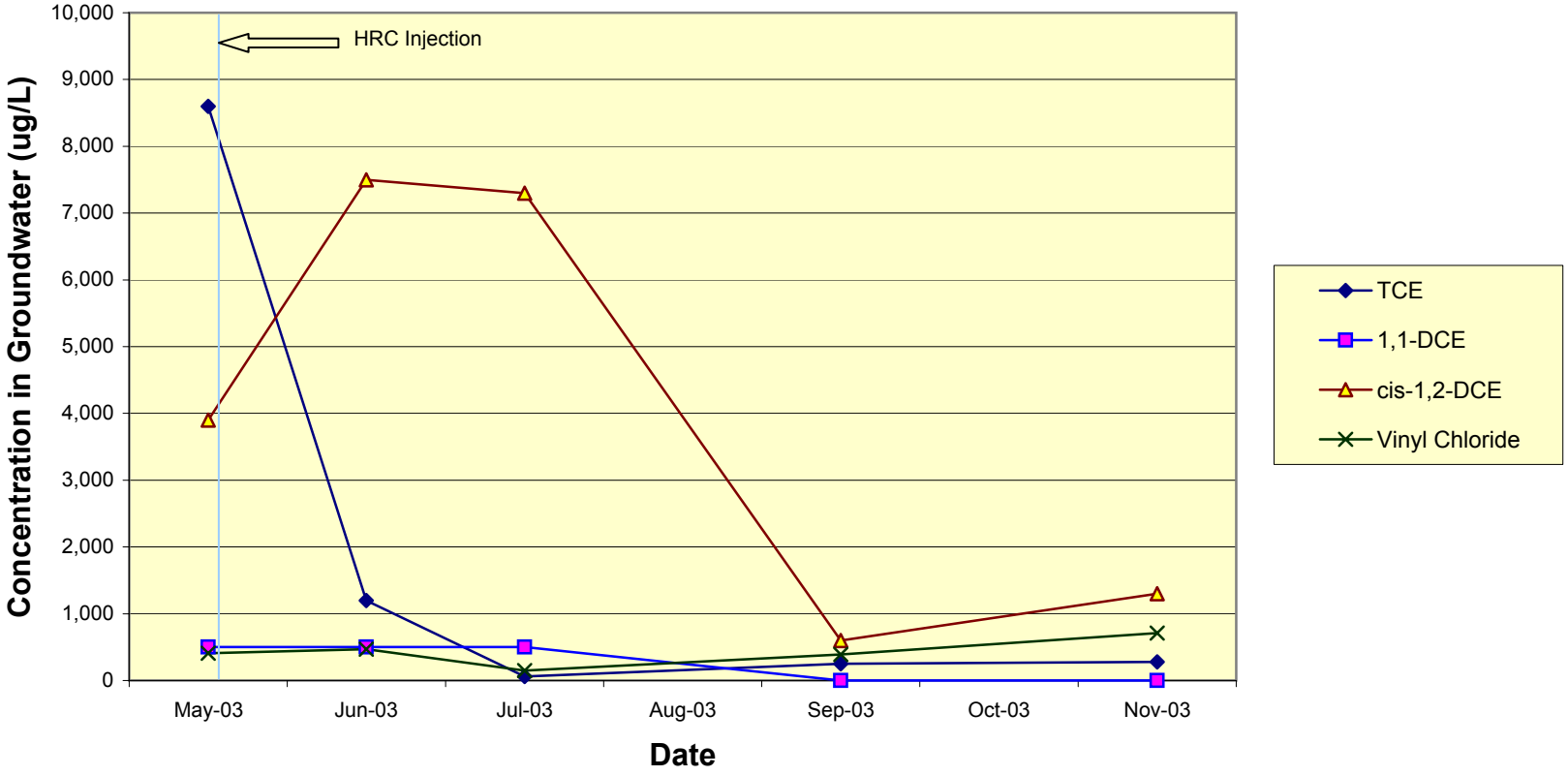


FIGURE 5-5

TCE AND DAUGHTER PRODUCTS - MW025
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND

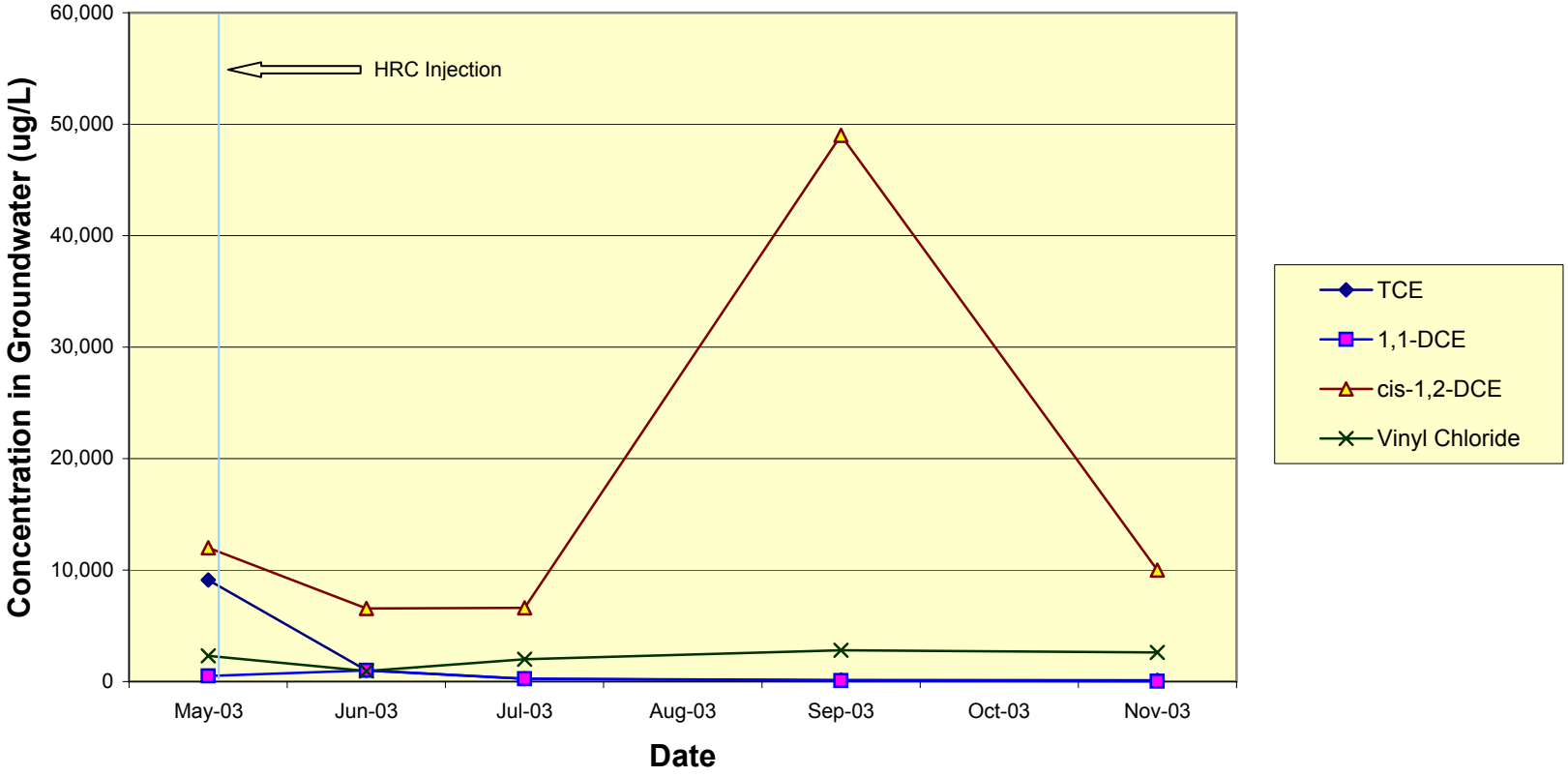
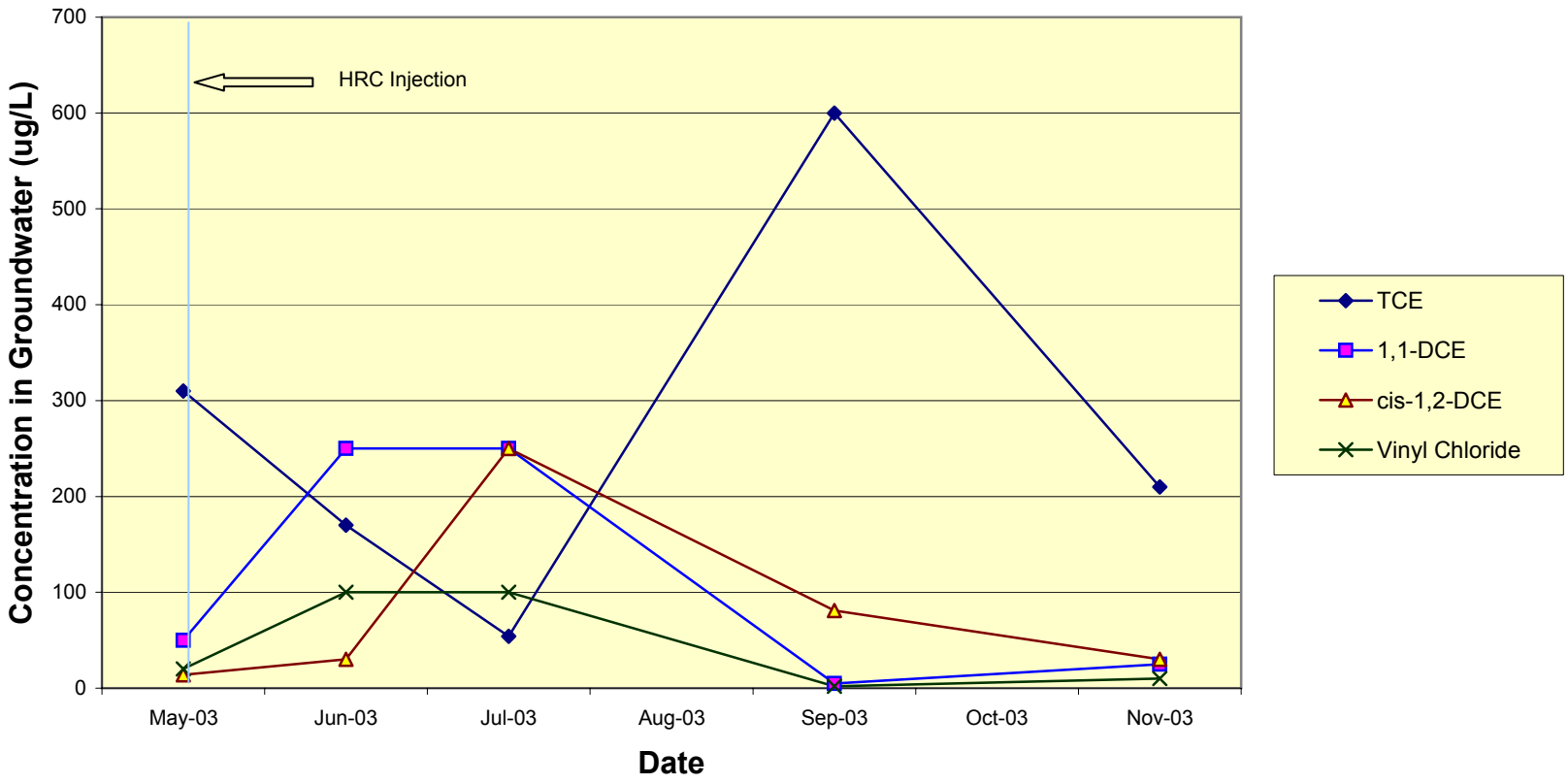


FIGURE 5-6

TCE AND DAUGHTER PRODUCTS - MW011
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - BUILDING 292 TCE CONTAMINATION AREA
NDW, IH, INDIAN HEAD, MARYLAND



6.0 RECOMMENDATIONS

The pilot study has demonstrated that HRC® is capable of fostering the conditions necessary to establish reductive dechlorination in Site 57 groundwater, and that the process will significantly reduce high TCE concentrations. Two outstanding questions remain. One is, "Will reductive dechlorination progress to the complete dechlorination of vinyl chloride?" The second is, "How low can the TCE concentrations be expected to go?"

Regenesis, the HRC® manufacturer, maintains that, under favorable conditions, the slow release of lactic acid can support microbial activity and hydrogen release for up to 18 months. That is, reductive dechlorination could continue for several months beyond the end of the pilot study, and if that is the case, the groundwater TCE concentrations may continue to decrease.

The degree to which complete reductive dechlorination can be achieved and the degree to which TCE concentrations can be reduced will be important issues as the final Site 57 FS evaluates HRC® as a potential technology for remediating TCE contamination in Site 57 groundwater.

It is recommended that one or two additional sampling rounds for the pilot study monitoring wells be considered. Planned future investigations at Site 57 will include groundwater sampling, and the cost connected with additional pilot study well sampling can be minimized if that effort is incorporated into future groundwater sampling planned for Site 57. Further, the need for each additional sampling of pilot study wells can be evaluated based on the analytical results from the previous set of analytical data.

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APPENDIX A

FIELD DATA

APPENDIX A.1

Soil Sample Log Sheets

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SS7SB0270104
Sample Location: SS7SB27
Sampled By: FCW
C.O.C. No.: K-002

Type of Sample:
[✓] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-14-03 Time: 1325 Method: DPT Monitor Reading (ppm):	4-5	YELLOW BROWN	SAND, SILT + GRAVEL

COMPOSITE SAMPLE DATA:

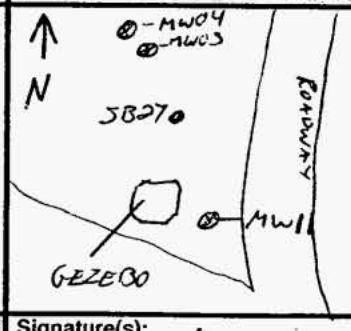
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE	✓	
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	SS7SBDUP0101

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SS75B0270204
Sample Location: SS75B27
Sampled By: FCW
C.O.C. No.: K-002

Type of Sample:
[✓] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-14-03 Time: 1335 Method: DPT Monitor Reading (ppm):	9-10 ~~13-14~~ FCW	GREY	SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE	✓	
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

MAP:

SEE SS75B0270104

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 5575B0270304
Sample Location: 5575B027
Sampled By: FCW
C.O.C. No.: K-002

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-14-03 Time: 1340 Method: DPT Monitor Reading (ppm):	13-14	GREY	MOTTLED SAND W/ SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE	✓	
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

MAP:

SEE 5575B0270104

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): FCW

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[X] Surface Soil
[X] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: S57SB0270404
Sample Location: S57S027
Sampled By: FCN
C.O.C. No.: K-002

Type of Sample:
[X] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-14-03 Time: 1345 Method: DPT Monitor Reading (ppm): –	15-16	GREY	MOTTLED SAND W/ SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE	✓	
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

MAP:

SEE S57SB0270104

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): FCN

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S57SB0280104
Sample Location: S57SB28
Sampled By: FCW
C.O.C. No.: K-002

Type of Sample:
[✓] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-14-03 Time: 1015 Method: DPT Monitor Reading (ppm): 0	4-5	YELLOW BRN	SILT + CLAY F g. SAND DAMP

COMPOSITE SAMPLE DATA:

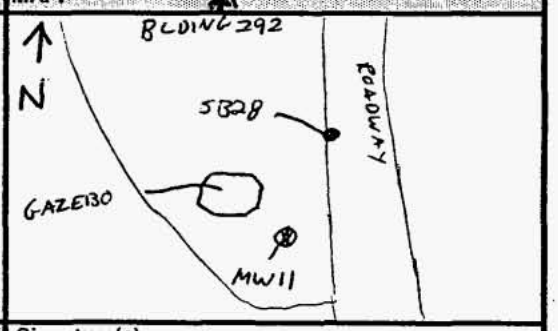
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE	✓	
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 5575B0280204
Sample Location: 5575B28
Sampled By: FCW
C.O.C. No.: K-002

Type of Sample:
[✓] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-14-03 Time: 1020 Method: DPT Monitor Reading (ppm): –	9-10	YELLOW BROWN	SILT, SAND, + GRAVEL WET

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE	✓	
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

MAP:

SEE 5575B028104

Circle if Applicable:

MS/MSD — Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: S57SB0280304
Sample Location: S57SB28
Sampled By: FCW
C.O.C. No.: K-002

Type of Sample:
[✓] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-14-03 Time: 1030 Method: DPT Monitor Reading (ppm): –	~~13-16~~ 14-15	YELLOW BROWN	GRAVEL + SAND WET

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE		
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

REQUESTED THAT THE LAB RUN TCL VOCS ON SAMPLE FROM 2 OZ JAR. LARGE GRAVEL CONTENT PREVENT US FROM COLLECTING ENCORE SAMPLES AT THIS INTERVAL.

MAP:

SEE SB57SB0280104

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: Indian Head Site 57
Project No.: 4020

[] Surface Soil
[✓] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 557SB028 0404
Sample Location: 557SB28
Sampled By: FCW
C.O.C. No.: K-002

Type of Sample:
[✓] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5-13-03 Time: 1035 Method: DPT Monitor Reading (ppm): 115	15-16	YELLOW BROWN	SAND WET

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCS	4 X 5 g ENCORE	✓	
Arsenic/Total solids	2 Oz Jar	✓	

OBSERVATIONS / NOTES:

MAP:
SEE 557SB028 0104

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):
FCW

APPENDIX A.2

Soil Boring Logs

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: IHDIV, Site 57
PROJECT NUMBER: 4020
DRILLING COMPANY: VIRONEX
DRILLING RIG: GEOPROBE 6600

BORING No.: S57SB027
DATE: 5-14-03
GEOLOGIST: FRED W/RAMSER
DRILLER: DAVE WILEY

Sample No. and Type or RQD	Depth (FL) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/FL) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1320	1						GRAVEL SURFACE						
							YEL BRN SAND	SM	MOIST				
							+ SILT + GRAVEL		WET @ 4'	210			0
	4		2.0/4.0										
S-2 1324							CLAY TR GRAVEL	GC	COLLECTED SPL. 4-5'				
									S57SB0270104				
					SOFT		CLAY + GRAVEL	GC		380		450	0
	8		2.0/4.0				GREY SAND WET	SP					
S-3 1328													
									9-10'				
									S57SB0270204	320		162	0
	12						GRAVEL + SAND						
S-4 1335					MED DENSE	GREY	MOTTLED SAND	SM	13-14'				
							W/TR SILT		S57SB0270304	435		60	0
	16								15-16' S57SB0270404				
				TD @ 16' BGS									
							INSTALL WELL						
							SCREEN 4-14						
							SAND 2-14.5						
							BENTONITE 1'-2'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: GEOPROBE 6600 1½" RODS 4/4' MACRO CORE SAMPLER 4¼ HSA ID USED TO INSTALL WELL

Drilling Area Background (ppm): 0 0

Converted to Well: Yes ✓ No _____ Well I.D. #: S57MW024

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: IHDIV, Site 57
PROJECT NUMBER: 4020
DRILLING COMPANY: VIRONEX
DRILLING RIG: GEOPROBE 6600

BORING No.: S57SB028
DATE: 5-14-03
GEOLOGIST: FRED W RAMSER
DRILLER: DAVE WILEY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 1010							ASPHALT SURFACE						
						BRN	SAND+SILT+GRA MIX	GM		0	0	0	0
							CLAY+SILT CONTENT			0	0	0	0
	4		4.0/4.0				INC. WITH DEPTH TO 4.0'			0	0	0	0
S-2 1015						YEL	SILT+CLAY+	SM	COLLECTED SBL 4-5'				
						BRN	f-g SAND		S57SB0280104				
									WET AT 6'				
	8		4/4.0										
S-3 1020						YEL	SILT + SAND,	GM	COLLECTED		0	160	0
						BRN	+GRAVEL		9-10' S57SB0280204				
							TR CLAY		WELL				
	12						GRAVEL	GP	VARIEGATED		0	110	0
S-4 1025							GRAVEL+SAND		NOT ABLE TO COLLECT ENCORE TOO MANY GRAVELS ~~13-14 14/15~~ 14'-15'				
	14								S57SB0280304	12	0	44	0
	16						SAND ORGBRN	SP	15-16' COLLECTED S57SB0280404				
							INSTALL WELL 4'-14' BGS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: GEOPROBE 6600 1 1/2" RODS w/4' MACRO CORE MOUNTED ON A FORD F-450 4 1/4 HSA ID USED TO INSTALL 2" ID PVC WELL 4-14'

Converted to Well: Yes ✓ No ___ Well I.D. #: S57MW025

APPENDIX A.3

Groundwater Sample Log Sheets

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0030104
Sample Location: S57MW03
Sampled By: FCW
C.O.C. No.: K-001/M-001
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 5-13-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 1050	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: Low Flow	CLEAR	4.85	0.103	15.9	3.1	5.6	–	-4.8

PURGE DATA:

Date: 5-13-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: Low Flow								
Monitor Reading (ppm): –								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 24.3								
Static Water Level (WL): 8.31								
One Casing Volume(gal/L): 2.6								
Start Purge (hrs): 0941								
End Purge (hrs): 1050								
Total Purge Time (min): 69								
Total Vol. Purged (gal/L): 2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Metabolic Acids		4 c	2x40 ML ~~poly~~ VIAL	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
–	

Signature(s): [signature]

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0040104
Sample Location: S57MW004
Sampled By: FCW
C.O.C. No.: K-001/M-001
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 5-13-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 1410	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: LOW FLOW	CLEAR	5.97	0.207	16.5	1.1	0.87	—	-50.1

PURGE DATA:

Date: 5-13-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 18.2								
Static Water Level (WL): 8.37								
One Casing Volume(gal/L): 1.6								
Start Purge (hrs): 1305								
End Purge (hrs): 1410								
Total Purge Time (min): 65								
Total Vol. Purged (gal/L): 2.0								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Metabolic Acids		4 c	2 X 40 ML ~~poly~~ VIAL	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	FCW S57GWDUP0101 ~~S57MW DUP~~ ~~S57FD~~

Signature(s): FCW

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0110104
Sample Location: S57MW011
Sampled By: FWRAMSER
C.O.C. No.: K-001 / M-001
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 5-13-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 1430	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: LOW FLOW	CLEAR	5.62	0.240	16.19	3.7	0.33	—	39.6

PURGE DATA:

Date: 5-13-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 20.70								
Static Water Level (WL): 8.62								
One Casing Volume (gal/L): 2gal	(7.4 l)							
Start Purge (hrs): 1315								
End Purge (hrs): 1430								
Total Purge Time (min): 75								
Total Vol. Purged (gal/L): 7.5L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL COLLECTED	MS/MSD
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Metabolic Acids		4 c	2 X 40 ML ~~poly~~ VIAL	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
VOCS	—

Signature(s): Fred W Ramser

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0240104
Sample Location: S57MW24
Sampled By: FCW
C.O.C. No.: K-003 / m-001
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. °C	Turbidity NTU	DO mg/l	Sal %	ORP mv
Date: 5-15-03 Time: 0825 Method: LOW FLOW	CLEAR	5.24	0.111	15.5	6.5	1.27	–	-24.1

PURGE DATA:

Date: 5-15-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): –								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 13.4								
Static Water Level (WL): 6.87								
One Casing Volume(gal/L): 1.0								
Start Purge (hrs): 0735								
End Purge (hrs): 0825								
Total Purge Time (min): 50								
Total Vol. Purged (gal/L): 2.5								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓ -MS/MSD
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓ 7 MS/MSD
Dissolved Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Metabolic Acids		4 c	2x40 ML ~~poly~~ VIAL	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

WELL NOT COMPLETED

Circle if Applicable:
MS/MSD Duplicate ID No.:

Signature(s):

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0250104
Sample Location: S57MW25
Sampled By: FBWR
C.O.C. No.: K-003 / M-001
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 5-15-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 0850	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: LOW FLOW	CLEAR	5.64	0.270	15.9	2.9	1.00	—	24.7

PURGE DATA:

Date: 5-15-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 15.00*								
Static Water Level (WL): 7.62								
One Casing Volume(gal/L): 9.5L								
Start Purge (hrs): 0735								
End Purge (hrs): 0850								
Total Purge Time (min): 75								
Total Vol. Purged (gal/L): 7.5L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	500 ~~250~~ ML poly	✓
Metabolic Acids		4 c	~~1L poly~~ 2 x 40ml	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

* FROM TOP OF PVC STICK UP = 1' (TEMP STICK UP WILL BE CUT TO GRADE

CASING VOL = 15.00 − 7.62 = 7.38'

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0030105
Sample Location: 957MW003
Sampled By: RW2
C.O.C. No.: ~~M-004~~
Type of Sample: K-004, M-2
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 1545	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: LOW FLOW	CREAM	4.51	0.090	19.35	3.0	0.15	—	191.8

PURGE DATA:

Date: 6-19-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 24.3								
Static Water Level (WL): 8.42								
One Casing Volume(gal/L): 9.9								
Start Purge (hrs): 1417								
End Purge (hrs): 1545								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL x3 MS/MSD	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL x2 MS/MSD	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly x 2 MS/MSD	✓
Dissolved Iron and Manganese	~~HNO3~~	4 C	250 ML poly x 2 MS/MSD	✓
Metabolic Acids		4 c	~~1L poly~~ 2 X 40ml VIAL	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL x 2 MS/MSD	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL x 2 MS/MSD	✓
Sulfide	ZnAc/NaOh		500 ML poly x 2 MS/MSD	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
✓	C

Signature(s): Fred M Rauel

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0040105
Sample Location: S57MW004
Sampled By: FWR
C.O.C. No.: K-005/M-2
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Date: 6-20-03	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Time: 0825								
Method: LOW FLOW	CLEAR	5.85	0.239	17.65	0.3	0.45	—	171.2

PURGE DATA:

Date: 6-20-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 18.2								
Static Water Level (WL): 8.54								
One Casing Volume(gal/L): 6.2L								
Start Purge (hrs): 0720								
End Purge (hrs): 0825								
Total Purge Time (min): 65								
Total Vol. Purged (gal/L): 6.5L								

FWR

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	~~HNO3~~	4 C	250 ML poly	✓
Metabolic Acids		4 c	~~1L poly~~ 2 x 40ml VIAL	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsey

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0110105
Sample Location: S57MW011
Sampled By: PLR
C.O.C. No.: K-004 / M-2
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 0830	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: SLOW FLOW	CLR	5.40	0.152	17.22	3.8	0.15	—	139.5

PURGE DATA:

Date: 6-19-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 20.70								
Static Water Level (WL): 8.66								
One Casing Volume(gal/L): 7.3L								
Start Purge (hrs): 0710								
End Purge (hrs): 0830								
Total Purge Time (min): 80								
Total Vol. Purged (gal/L): 8.0L								

PLR

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	~~HNO3~~	4 C	250 ML poly PRESERVED BY LAB	✓
Metabolic Acids		4 c	~~1 L poly~~ 2 x 40 ml VIAL	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred M Ramsey

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 857MW0240105
Sample Location: 557MW024
Sampled By: FWR
C.O.C. No.: K-005/M-2
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. °C	Turbidity NTU	DO mg/l	Sal %	ORP mv
Date: 6-20-03								
Time: 1035								
Method: LOW FLOW	CLEAR	5.00	0.379	17.79	4.9	0.15	—	39.9

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Date: 6-20-03								
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 12.55								
Static Water Level (WL): 6.17								
One Casing Volume(gal/L): 3.79				FWR				
Start Purge (hrs): 0917								
End Purge (hrs): 1035								
Total Purge Time (min): 78								
Total Vol. Purged (gal/L): 7.8L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	250 ML poly	✓
Metabolic Acids		4 c	~~1L poly~~ 2 x 40ml	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsey

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0250105
Sample Location: S57MW025
Sampled By: PMR
C.O.C. No.: K-004/M-2
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 1055	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: Low Flow	CLEAR	5.29	0.330	18.17	3.0	0.19	—	18.3

PURGE DATA:

Date: 6-19-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: Low Flow								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 13.90								
Static Water Level (WL): 6.77								
One Casing Volume(gal/L): 13.90 4.3 l								
Start Purge (hrs): 0945								
End Purge (hrs): 1050								
Total Purge Time (min): 65								
Total Vol. Purged (gal/L): 6.5 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	~~HNO3~~	4 C	250 ML poly	✓
Metabolic Acids		4 c	~~1 L poly~~ 2 x 40 ml	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

13.90
6.77
7.13

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	S57GWDU.P0105

Signature(s): [illegible]

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0030106
Sample Location: S57MW003
Sampled By: FLR
C.O.C. No.: K-006 M-3
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7-29-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 1515	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: Low Flow	CLR	3.99	0.097	21.30	1.0	0.18	—	38.3

PURGE DATA:

Date: 7-29-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: Low Flow								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 24.3								
Static Water Level (WL): 8.78								
One Casing Volume(gal/L): 9.38								
Start Purge (hrs): 1400								
End Purge (hrs): 1515								
Total Purge Time (min): 75								
Total Vol. Purged (gal/L): 8.25								

VOID FLR

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements		Collected
TCL VOCs	HCL	4 C	3x	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2x	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C		500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	2x	250 ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	2x	250 ML poly	✓
Metabolic Acids		4 c	3x	~~1 L poly~~ 2x40ml	✓
TOC	H2SO4	4 C	2x	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2x	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		2x	500 ML poly	✓

OBSERVATIONS / NOTES:

YSI 556 MPS S/N 01J0897AU

Circle if Applicable:

MS/MSD ✓ Duplicate ID No.: —

Signature(s): Fred M Ranson

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0040106
Sample Location: S57MW004
Sampled By: FUR
C.O.C. No.: K-006 M-3
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7-29-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 1315	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: LOW FLOW	CLR	5.14	0.149	22.04	0.41	0.48	—	10.7

PURGE DATA:

Date: 7-29-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 18.2								
Static Water Level (WL): 8.78								
One Casing Volume(gal): 0.62								
Start Purge (hrs): 1200								
End Purge (hrs): 1315								
Total Purge Time (min): 75								
Total Vol. Purged (gal): 8.25								

VOID FUR

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	250 ML poly	✓
Metabolic Acids		4 c	~~1L poly~~ 2x40ml	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

YSI 556 MPS S/N 01J0897AU

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [illegible]

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0110106
Sample Location: S57MW011
Sampled By: FWR
C.O.C. No.: K-006 M-3
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7-29-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 0950	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: LOW FLOW	CLR	4.40	0.138	19.74	4.7	0.32	—	-12.8

PURGE DATA:

Date: 7-29-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 20.70								
Static Water Level (WL): 8.96								
One Casing Volume(gal/L): 7.4l								
Start Purge (hrs): 0830								
End Purge (hrs): 0950								
Total Purge Time (min): 80								
Total Vol. Purged (gal/L): 8.4l								

VOID

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	250 ML poly	✓
Metabolic Acids		4 c	~~1L poly~~ 2x40ml	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

YSI 556 MPS S/N 01J0897 AU

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	S57GWDUP0106

Signature(s): Sorel M Ramos

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0240106
Sample Location: S57MW024
Sampled By: RWR
C.O.C. No.: K-007, M-3
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 7-30-03	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Time: 0850	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Method: LOW FLOW	CLR	5.89	0.660	20.65	1.5	0.20	—	-82.8

PURGE DATA:

Date: 7-30-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 12.55								
Static Water Level (WL): 6.29								
One Casing Volume(gal/L) 3.79								
Start Purge (hrs): 0855								
End Purge (hrs): 0950								
Total Purge Time (min): 55								
Total Vol. Purged (gal/L) 5.75 L								

VOID

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	250 ML poly	✓
Metabolic Acids		4 c	2x40ml ~~1L~~ poly	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred Wlamer

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDAIN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0250106
Sample Location: S57MW025
Sampled By: RJR
C.O.C. No.: K-007 M-3
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Sal	ORP
Date: 7-30-03	Visual	Standard	mS/cm	°C	NTU	mg/l	%	mv
Time: 8:30								
Method: LOW FLOW	CLR	5.06	0.365	20.10	1.0	0.31	—	-52.1

PURGE DATA:

Date: 7-30-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Sal	ORP
Method: LOW FLOW								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 13.90								
Static Water Level (WL): 6.94								
One Casing Volume(gal/L): 4.3L					VOID			
Start Purge (hrs): 0705					FLOW			
End Purge (hrs): 0800								
Total Purge Time (min): 55								
Total Vol. Purged (gal/L): 5.75L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative		Container Requirements	Collected
TCL VOCs	HCL	4 C	3 X 40 ML VIAL	✓
Dissolved methane, ethane, ethene	HCL	4 C	2 X 40 ML VIAL	✓
Anions/ Alkalinity		4 C	500 ML poly	✓
Total Iron and Manganese	HNO3	4 C	250 ML poly	✓
Dissolved Iron and Manganese	HNO3	4 C	250 ML poly	✓
Metabolic Acids		4 c	~~1L poly~~ 2x40ml	✓
TOC	H2SO4	4 C	2 X 40 ML VIAL	✓
Carbon Dioxide		4 C	2 X 40 ML VIAL	✓
Sulfide	ZnAc/NaOh		500 ML poly	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred Wlauer

TBD: To Be Determined

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0030107
Sample Location: S57MW003
Sampled By: Fred W. Ramser
C.O.C. No.: M-4, K-008
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-24-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1000	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	4.73	0.099	19.69	3	0.22	257	—

PURGE DATA:

Date: 9-24-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 24.3'								
Static Water Level (WL): 8.42			(SEE LOW FLOW PURGE DATA SHEET)					
One ~~Screen~~ WELL Volume(gal/L): ~.83								
Start Purge (hrs): 0840								
End Purge (hrs): 1000								
Total Purge Time (min): 100								
Total Vol. Purged (gal/L): 1 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4°C	2 X 40-ml vial	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4°C	2 X 40-ml vial	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

YSI METER 02A0253 AD

Circle if Applicable:

MS/MSD: —

Duplicate ID No.: S57GW DUP0107

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0040107
Sample Location: S57MW004
Sampled By: Fred W. Ramser
C.O.C. No.: M-4, K-008
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-24-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1245	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	5.86	0.228	22.17	1	0.80	173	—

PURGE DATA:

Date: 9-24-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 18.2'								
Static Water Level (WL): 5.08.50			(SEE LOW FLOW PURGE DATA SHEET)					
One ~~Screen~~ WELL Volume(gal/L): 6.2l								
Start Purge (hrs): 1135								
End Purge (hrs): 1245								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 7l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial x3	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial x3	—
Anions/Alkalinity	4°C	500-ml HDPE plastic container x3	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container x3	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container x3	✓
Metabolic Acids	4°C	2 X 40-ml vial x3	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial x3	✓
Carbon Dioxide	4°C	2 X 40-ml vial x3	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container x3	✓

OBSERVATIONS / NOTES:

YSI METER 02A0253 AD

Circle if Applicable:

MS/MSD ✓ Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0110107
Sample Location: S57MW011
Sampled By: Fred W. Ramser
C.O.C. No.: M-4 , K-008
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-24-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1525	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	6.37	0.479	21.70	2.0	0.17	71.9	—

PURGE DATA:

Date: 9-24-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 20.70'								
Static Water Level (WL): 8.70			(SEE LOW FLOW PURGE DATA SHEET)					
One ~~Screen~~ WELL Volume(gal/L): 7.4 l								
Start Purge (hrs): 1420								
End Purge (hrs): 1525								
Total Purge Time (min): 65								
Total Vol. Purged (gal/L): 6.5 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4°C	2 X 40-ml vial	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4°C	2 X 40-ml vial	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

YSI METER 02A0253AD

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0240107
Sample Location: S57MW024
Sampled By: Fred W. Ramser
C.O.C. No.: M-4, K-009
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-25-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 0855	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	6.24	0.669	21.17	2	0.15	-114.7	—

PURGE DATA:

Date: 9-25-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 12.55'								
Static Water Level (WL): 6.12			(SEE LOW FLOW PURGE DATA SHEET)					
One ~~Screen~~ WELL Volume(gal/L): 3.72								
Start Purge (hrs): 0800								
End Purge (hrs): 0855								
Total Purge Time (min): 55								
Total Vol. Purged (gal/L): 5.5 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4°C	2 X 40-ml vial	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4°C	2 X 40-ml vial	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

YSI METER 02A0253AD

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0250107
Sample Location: S57MW025
Sampled By: Fred W. Ramser
C.O.C. No.: M-4, K-009
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-25-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1100	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	5.55	0.979	21.11	1	0.15	-55.0	—

PURGE DATA:

Date: 9-25-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm): —								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 13.90'								
Static Water Level (WL): 6.99			(SEE LOW FLOW PURGE DATA SHEET)					
One ~~Screen~~ WELL Volume(gal/L): 4.3l								
Start Purge (hrs): 0955								
End Purge (hrs): 1100								
Total Purge Time (min): 65								
Total Vol. Purged (gal/L): 6.5l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4°C	2 X 40-ml vial	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4°C	2 X 40-ml vial	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

YSI METER 02A0253 AD

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0030108
Sample Location: S57MW003
Sampled By: Fred W. Ramser
C.O.C. No.: K-9
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 11-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 850	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	4.85	0.095	19.07	4.6	0.23	120	—

PURGE DATA:

Date: 11-19-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 24.3'								
Static Water Level (WL): 8.56			(SEE LOW FLOW PURGE DATA SHEET)					
One Well Volume(gal/L): 0.82 l	3.1 l							
Start Purge (hrs): 0735								
End Purge (hrs): 0850								
Total Purge Time (min): 75								
Total Vol. Purged (gal/L): 7.5 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4^0C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4^0C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4^0C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4^0C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4^0C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4^0C	2 X 40-ml vial	✓
TOC	4^0C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4^0C	2 X 40-ml vial	✓
Sulfide	4^0C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

DUPLICATE COLLECTED

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	S57GWDUP0108

Signature(s): Fred W. Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0040108
Sample Location: S57MW004
Sampled By: Fred W. Ramser
C.O.C. No.: K-9
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 11-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1150	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	clr	5.63	0.141	19.74	1.2	0.27	92.8	—

PURGE DATA:

Date: 11-19-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 18.2'								
Static Water Level (WL): 8.65			(SEE LOW FLOW PURGE DATA SHEET)					
One Well Volume(gal/L): 5.8 l								
Start Purge (hrs): 1010								
End Purge (hrs): 1150								
Total Purge Time (min): 100								
Total Vol. Purged (gal/L): 11.0 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4°C	2 X 40-ml vial	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4°C	2 X 40-ml vial	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

18.20
8.65
9.55

11.6 l = TWO VOL

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0110108
Sample Location: S57MW011
Sampled By: Fred W. Ramser
C.O.C. No.: K-9
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 11-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1515	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	5.85	0.177	16.85	2.0	0.29	97.3	—

PURGE DATA:

Date: 11-19-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 20.70'								
Static Water Level (WL): 9.18			(SEE LOW FLOW PURGE DATA SHEET)					
One Well Volume(gal/L): 6.2								
Start Purge (hrs): 1325								
End Purge (hrs): 1515								
Total Purge Time (min): 110 MIN								
Total Vol. Purged (gal/L): 12 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4°C	2 X 40-ml vial	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4°C	2 X 40-ml vial	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

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Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0240108
Sample Location: S57MW024
Sampled By: Fred W. Ramser
C.O.C. No.: K-10
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 11-20-03	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 0855	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	6.17	0.498	18.02	3.8	0.23	-126.5	—

PURGE DATA:

Date: 11-20-03	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 12.55'								
Static Water Level (WL): 6.16			(SEE LOW FLOW PURGE DATA SHEET)					
One Well Volume(gal/L): 4 l								
Start Purge (hrs): 0735								
End Purge (hrs): 0855								
Total Purge Time (min): 80								
Total Vol. Purged (gal/L): 8 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements		Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	x 3	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	x 3	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	x 3	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	x 3	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	x 3	✓
Metabolic Acids	4°C	2 X 40-ml vial		✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	x 3	✓
Carbon Dioxide	4°C	2 X 40-ml vial	x 3	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	x 3	✓

OBSERVATIONS / NOTES:

12.55
6.16
6.39

Circle if Applicable:

MS/MSD ✓ Duplicate ID No.: —

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: INDIAN HEAD SITE 57 HRC PILOT STUDY
Project No.: 4020-0507

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: S57MW0250108
Sample Location: S57MW025
Sampled By: Fred W. Ramser
C.O.C. No.: K-10
Type of Sample:
[X] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 11-20-0503	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1130	Visual	Standard	mS/cm	°C	NTU	mg/l	mv	NA
Method: Peristaltic pump	CLR	5.84	0.365	18.01	2.2	0.17	-123.9	—

PURGE DATA:

Date: 11-20-04	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: Peristaltic pump								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" / PVC								
Total Well Depth (TD): 13.90'								
Static Water Level (WL): 7.10			(SEE LOW FLOW PURGE DATA SHEET)					
One Well Volume(gal/L): ~4 l								
Start Purge (hrs): 1010								
End Purge (hrs): 1130								
Total Purge Time (min): 80								
Total Vol. Purged (gal/L): 8 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOC	4°C & HCL	3 X 40-ml vial	✓
Dissolved methane, ethane, ethene.	4°C & HCL	2 X 40-ml vial	✓
Anions/Alkalinity	4°C	500-ml HDPE plastic container	✓
Total Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Dissolved Iron and Manganese	4°C & HNO_3	250-ml HDPE plastic container	✓
Metabolic Acids	4°C	2 X 40-ml vial	✓
TOC	4°C & H_2SO_4	2 X 40-ml vial	✓
Carbon Dioxide	4°C	2 X 40-ml vial	✓
Sulfide	4°C & ZnAc/NaOH	500-ml HDPE plastic container	✓

OBSERVATIONS / NOTES:

13.90
7.10
6.80

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Fred W Ramser

APPENDIX A.4

Purge Data Sheets

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57
PROJECT NUMBER: 4020
WELL ID.: S57MW03
DATE: 5-13-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (MV)	Sal. (%)	Comments
0941	8.31									START
0947	8.64	100	5.25	0.125	89	34.0	16.1	21.3	-	
0955	8.70	120	5.06	0.112	29	17.8	15.9	7.0	-	
1005	8.71	↓	4.89	0.109	14	12.8	15.8	-0.5	-	
1012	8.74	↓	4.87	0.108	8.5	10.1	15.8	-5.6	-	
1020	8.78	↓	4.80	0.106	4.6	7.9	15.1	-6.7	-	
1027	8.80	↓	4.81	0.105	4.0	7.1	15.9	-8.6	-	
1035	8.71	110	4.86	0.104	2.8	6.6	15.9	-13.2	-	
1043	8.72	↓	4.84	0.103	2.7	6.2	15.9	-10.5	-	
1050	8.72	↓	4.85	0.103	3.1	5.6	15.9	-4.8	-	SAMPLE
1120										END

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57
PROJECT NUMBER: 4020
WELL ID.: S57MW004
DATE: 5-13-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (MV)	Sal. (%)	Comments
1305	8.37									START
1312	8.71	110	5.59	0.253	5.1	2.19	16.9	-37	-	
1320	8.90		5.75	0.240	2.7	1.64	16.4	-41.7	-	
1327	8.96		5.90	0.229	1.7	1.39	16.7	-46.7	-	
1335	9.03		5.89	0.216	1.8	1.10	16.3	-47.2	-	
1343	9.09		5.93	0.209	2	0.92	16.5	-49.7	-	
1350	9.12		5.97	0.205	1.6	0.85	16.6	-51.7	-	
1356	9.15		5.95	0.204	1.6	0.82	16.6	-51.2	-	
1403	9.15		5.97	0.207	1.4	0.80	16.5	-51.9	-	
1410	9.16		5.97	0.207	1.1	0.87	16.5	-50.1	-	SAMPLE
1500										END

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57
PROJECT NUMBER: 4020
WELL ID.: S57MW011
DATE: 5-13-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (MV)	Sal. (%)	Comments
1320	9.61	125 ml/min	4.87	0.285	85	0.54	15.96	81.1	–	Q=500ml/4min
1330	9.70	100	5.23	0.265	50	0.41	15.66	51.0	–	~125ml/min
1340	9.66	100 ml/min	5.45	0.251	32	0.37	16.34	45.0	–	LOWERED Q TO ~100ml/min
1350	9.66	100 ml/min	5.45	0.246	27	0.74	16.32	66.0	–	
1400	9.66	100 ml/min	5.49	0.235	17	0.56	16.24	65.6	–	
1410	9.66		5.57	0.238	10	0.40	16.26	41.7	–	
1420	9.66		5.62	0.247	3.9	0.35	16.18	40.6	–	
1430	9.70		5.62	0.240	3.7	0.33	16.19	39.6	–	COMPLETED PURGE

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: INDIANHEAD SITE 57
PROJECT NUMBER: 402

WELL ID.: S57MW24
DATE: 5-15-03

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (SU)	Cond. (ms/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (%)	ORP (mV)	Comments (Cumulative Vol. & Color)
0735	6.87									START
0741	7.03	200	5.49	0.111	24	1.38	15.8	–	56.2	
0750	7.11	↓	5.27	0.109	11	1.37	15.7	–	32.2	
0757	7.15	150	5.24	0.108	7.5	1.34	15.6	–	14.6	
0805	7.16		5.27	0.109	6.6	1.28	15.6	–	-1.5	
0815	7.17		5.22	0.110	6.1	1.25	15.6	–	-13.4	
0825	7.19	↓	5.24	0.111	6.5	1.27	15.5	–	-24.1	SAMPLE
0900										END

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SITE 57 PILOT STUDY
PROJECT NUMBER: 4020

WELL ID.: S57MW0250104
DATE: 5-15-03

Time (Hrs)	Water Level (Ft. below TOC)	Flow (ml/Min)	pH (SU)	Cond. (ms/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (%)	ORP (mV)	Comments (Cumulative Vol. & Color)
0745	7.88	200ml/min	5.78	0.278	9.3	2.68	15.77	—	15.1	500ml/5min
0755	7.92	100ml/min	5.67	0.280	6.5	1.20	15.75	—	19.8	↓
0805	7.97	100ml/min	5.69	0.280	4.9	1.19	15.83	—	20.4	STOPPED PUMP AT ~~805~~
0815	7.98		5.66	0.279	4.8	1.12	15.82		24.0	TO MEET DRILLERS
~~0825~~										815 – TURNED
0830	7.99		5.66	0.278	4.7	1.07	15.86		24.6	PUMP BACK ON @
0840	8.02		5.62	0.271	2.8	1.02	15.84		24.6	817 SHUTDOWN
0850	8.02		5.64	0.270	2.9	1.00	15.79		24.7	DRILLERS ARR
										AT S57
										COMPLETED
										PURGE @ 0850

SIGNATURE(S): Fred W Ramsey

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW003
DATE: 6-19-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1425	8.64	~100	3.69	0.094	9.8	1.05	20.24	224.7	SUNNY ~80's
1435	8.64	~105	4.52	0.093	5.7	0.25	19.59	188.8	.5L/4' 45"
1445	8.64	~105	4.62	0.091	4.9	0.19	19.22	183.6	= 105 mL/MIN
1455	8.64	~105	4.50	0.091	4.2	0.16	19.11	194.0	
1505	8.64	~105	4.52	0.090	3.0	0.16	19.12	192.1	
1515	8.64	~105	4.64	0.090	3.2	0.15	19.51	183.8	
1525	8.64	~105	4.54	0.090	3.0	0.16	19.53	184.2	
1535	8.64	~105	4.54	0.089	3.0	0.16	19.41	192.8	
1545	8.64	~105	4.51	0.090	3.0	0.15	19.35	191.8	COMPLETED PURGE

SIGNATURE(S): Fred Wlanier

PAGE ___ **OF** ___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW004
DATE: 6-20-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0725	8.92	~125	5.81	0.275	1.5	1.62	17.51	208.9	
0735	8.97	~100	5.93	0.273	1.1	0.58	17.66	176.6	
0745	8.97	~100	5.87	0.250	1.2	0.99	17.67	191.2	
0755	8.97	100	5.84	0.245	1.1	0.51	17.63	184.3	
0805	8.98	100	5.86	0.242	0.25	0.46	17.63	178.6	
0815	8.98	100	5.85	0.241	0.30	0.46	17.65	175.2	
0825	8.98	100	5.85	0.239	0.30	0.45	17.65	171.2	COMPLETED PURGE @ 0825

SIGNATURE(S): Fred M Ramsey

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW011
DATE: 6-19-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
720	9.62	~~[illegible]~~	5.63	0.178	42	1.03	17.35	140.2	STATIC H_2O = 8.66
730	9.54	100	5.60	0.173	38	0.28	17.50	143.6	FLOW @ 1350 @ 720
740	9.55	100	5.55	0.163	21	0.33	17.45	141.1	LOWERED TO 100
750	9.55	100	5.53	0.159	19	0.32	17.35	141.2	
800	9.55	100	5.46	0.155	9.6	0.20	17.33	146.8	
810	9.55	100	5.45	0.149	8.1	0.24	17.32	145.2	
820	9.56	100	5.37	0.148	5.0	0.15	17.32	145.4	
830	9.57	100	5.40	0.152	3.8	0.15	17.22	139.5	COMPLETED PURGE @ 0830

SIGNATURE(S): Fred M Bauer

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW024
DATE: 6-20-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0925	6.32	100	5.38	0.522	45	1.02	18.33	16.7	
0935	6.32	100	5.35	0.442	65	0.24	18.03	31.8	
0945	6.33	100	5.11	0.378	34	0.25	17.86	46.5	
0955	6.33	100	5.04	0.365	19	0.21	17.80	51.2	
1005	6.34	100	4.98	0.372	15	0.17	17.83	54.1	
1015	6.34	100	5.15	0.403	8.1	0.14	17.93	37.4	
1025	6.35	100	5.14	0.388	6.2	0.13	17.88	38.5	
1035	6.35	100	5.00	0.379	4.9	0.15	17.79	39.9	COMPLETED PURGE @ 1035

SIGNATURE(S): Fred M Kamxer

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW025
DATE: 6-19-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0950	6.98	~100	5.11	0.497	2.2	0.63	18.63	42.4	SWL=6.77
~~0955~~ 1000	7.00	~100	5.26	0.490	2.0	0.26	18.29	26.9	(1000HR)
1010	7.02	~100	5.26	0.457	3.0	0.20	18.00	22.2	
1020	7.03	~100	5.28	0.417	2.8	0.18	17.79	20.8	
1030	7.03	~100	5.29	0.386	3.0	0.19	17.88	20.3	
1040	7.04	~100	5.30	0.339	2.9	0.18	18.07*	18.8	* SUN BEGAN TO SHINE
1050	7.05	~100	5.29	0.330	3.0	0.19	18.17	18.3	COMPLETED PURGE AT 1050 HRS

SIGNATURE(S): Jared U Rowe

PAGE ___ **OF** ___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: INDIAN HEAD
PROJECT NUMBER: 4020

WELL ID.: S57MW003
DATE: 7-29-03

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (SU)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (%)	ORP (mV)	Comments (Cumulative Vol. & Color)
1405	~~9.00~~ 8.98	100	4.65	0.095	1.9	0.42	21.23	—	165.6	
1415	8.96	100	4.38	0.095	1.3	0.29	21.51	—	110.2	
1425	8.96	105	4.30	0.096	1.5	0.25	21.51	—	88.7	
1435	8.97	110	4.21	0.097	1.5	0.17	21.04	—	69.3	
1445	8.96	110	4.12	0.096	1.3	0.29	21.50	—	59.2	
1455	8.96	110	4.09	0.097	1.0	0.20	21.40	—	47.7	
1505	8.96	110	3.91	0.097	1.0	0.20	21.32	—	49.6	
1515	8.96	110	3.99	0.097	1.0	0.18	21.30	—	38.3	COMPLETED PURGE
										BEGIN TO FILL
										CONTAINERS

SIGNATURE(S): JWRanser

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: INDIAN HEAD SITE 57 HRC PILOT STUDY
PROJECT NUMBER: 4020

WELL ID.: S57MW0040106
DATE: 7-29-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (%)	ORP (mV)	Comments (Cumulative Vol. & Color)
1205	9.11	125	5.42	0.165	3.05	0.72	22.17	—	57.0	
1215	9.17	100	5.39	0.170	0.55	0.84	22.83	—	48.8	
1225	9.19	100	5.40	0.171	0.6	0.59	23.28	—	38.7	
1235	9.22	100	5.34	0.163	0.7	0.68	21.87	—	28.9	
1245	9.25	100	5.27	0.167	0.7	0.71	21.85	—	24.5	
1255	9.28	100	5.24	0.160	0.5	0.55	21.70	—	19.5	
1305	9.29	100	5.18	0.156	0.5	0.50	22.04*	—	15.6	SUNWARMING*
1315	~~10.AR~~ 9.32	100	5.14	0.149	0.41	0.48	22.04	—	10.7	

SIGNATURE(S): Fred W Rauser

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: INDIAN HEAD SITE 57 HRC PILOT STUDY
PROJECT NUMBER: 4020

WELL ID.: S57MW0110106
DATE: 7-29-03

Time (Hrs)	Water Level (Ft below TOC)	Flow (mL/Min)	pH (S.U.)	Cond. (ms/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (%)	ORP (mV)	Comments (Cumulative Vol. & Color)
0840	9.88	120	4.76	0.124	6.6	0.67	20.17	—	90.0	
0850	9.92	100	4.44	0.120	4.7	0.37	19.96	—	55.9	
0900	10.02	100	4.37	0.121	4.2	0.28	19.94	—	33.8	
0910	10.10	110	4.36	0.122	4.7	0.21	19.67	—	22.0	
0920	10.20	100	4.36	0.130	4.5	0.22	20.07*	—	12.6	*BECOMING SUNNY
0930	10.23	110	4.43	0.134	4.7	0.33	19.77*	—	0.3	*SHADED W/ COVER
0940	10.32	100	4.38	0.136	4.7	0.33	19.73	—	-6.6	
0950	10.35	100	4.40	0.138	4.7	0.32	19.74		-12.8	COMPLETED PURGE BEGIN TO FILL CONTAINER

SIGNATURE(S): Fred N Ramsey

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: IHDIV SITE 57 PILOT STUDY
PROJECT NUMBER: 4020

WELL ID.: S57MW0240106
DATE: 7-30-03

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (%)	ORP (mV)	Comments (Cumulative Vol. & Color)
0900	6.56	125	5.90	0.538	3.0	0.36	21.03	—	-69.3	
0910	6.70	100	5.88	0.543	2.2	0.30	20.88	—	-46.8	
0920	6.70	100	5.87	0.541	2.0	0.24	20.74	—	-58.9	
0930	6.70	100	5.88	0.642	1.8	0.22	20.75	—	-77.7	
0940	6.70	100	5.88	0.655	1.7	0.21	20.65	—	-80.8	
0950	6.70	100	5.89	0.660	1.5	0.20	20.65	—	-82.8	COMPLETED PURGE CONTINUED TO FILL CONT.

SIGNATURE(S): Fred Wanner

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: IHDIV SITE 57 HRC PILOT
PROJECT NUMBER: 4020

WELL ID.: S57MW0250106
DATE: 7-30-03

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Mins)	pH (SU)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (%)	ORP (mV)	Comments (Cumulative Vol. & Color)
0710	7.16	125	5.08	0.400	1.9	0.74	20.02	—	-9.9	
0720	7.17	100	5.13	0.393	1.5	0.37	20.19	—	-33.4	
0730	7.19	100	5.05	0.379	1.3	0.35	20.12	—	-38.5	
0740	7.20	100	5.07	0.373	1.0	0.35	20.14	—	-34.5	
0750	7.20	100	5.07	0.366	1.0	0.31	20.17	—	-44.2	
0800	7.21	100	5.06	0.365	1.0	0.31	20.10	—	-52.1	COMPLETED
										PURGE BEGIN
										TO FILL CONT.

SIGNATURE(S): [illegible]

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020 0507
WELL ID.: S57MW003
DATE: 9-24-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0850	8.59	110	4.92	0.109	3	1.79	19.68	205	
0900	8.61	110	4.91	0.106	4	0.70	19.59	213	
0910	8.63	110	4.79	0.099	4	0.36	19.60	237	
0920	8.64	110	4.75	0.099	3	0.35	19.57	247	
0930	8.65	110	4.73	0.098	3	0.27	19.58	250	
0940	8.65	110	4.73	0.098	3	0.24	19.68	255	
0950	8.65	110	4.71	0.099	3	0.23	19.69	257	
091000	8.65	110	4.73	0.099	3	0.22	19.69	257	COMPLETED PURGE @ 1000 HRS

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Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020 0507
WELL ID.: S57MW004
DATE: 9-24-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1145	8.89	100	6.04	0.277	2	2.52	22.22	174	
1155	8.99	100	6.03	0.279	2	1.40	22.31	169	
1205	9.01	100	6.01	0.270	2	1.27	22.19	169	
1215	9.02	100	5.98	0.256	1	1.13	22.22	170	
1225	9.02	100	5.94	0.234	1	0.95	22.17	170	
1235	9.03	100	5.89	0.230	1	0.83	22.15	171	
1245	9.03	100	5.86	0.228	1	0.80	22.17	173	COMPLETED PURGE @ 1245

SIGNATURE(S): Fred M Ramser

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020 0507
WELL ID.: S57MW011
DATE: 9-24-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1425	9.32	100	6.38	0.525	4.5	1.52	22.84	68.0	
1435	9.78	100	6.44	0.534	3.5	0.42	22.57	84.7	
1445	9.80	100	6.45	0.531	3.0	0.27	22.57	81.2	
1455	9.92	100	6.42	0.512	2.5	0.19	21.93	75.2	
1505	10.01	100	6.41	0.488	2.0	0.17	21.85	70.1	
1515	10.05	100	6.37	0.488	2.0	0.18	21.72	71.1	
1525	10.10	100	6.37	0.479	2.0	0.17	21.70	71.9	COMPLETED PURGE

SIGNATURE(S): Fred W Ramer

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020 0507
WELL ID.: S57MW024
DATE: 9-25-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0805	6.60	100	6.20	.466	3	0.44	21.49	-118.5	
0815	6.60	100	6.18	0.477	2	0.18	21.27	-119.4	
0825	6.60	100	6.19	0.518	2	0.18	21.17	-122.1	
0835	6.60	100	6.23	0.638	2	0.15	21.19	-120.5	
0845	6.60	100	6.24	0.665	3	0.15	21.17	-116.4	
0855	6.60	100	6.24	0.669	2	0.15	21.17	-114.7	COMPLETED PURGE

SIGNATURE(S): Fred W Ramer

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020 0507
WELL ID.: S57MW025
DATE: 09-25-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1000	7.22	100	5.30	1.418	4.5	1.27	20.86	0.0	
1010	7.32	100	5.33	1.395	4	0.21	20.96	-14.3	
1020	7.32	100	5.38	1.242	3	0.23	21.04	-27.8	
1030	7.32	100	5.46	1.117	3	0.13	21.09	-39.9	
1040	7.32	100	5.51	1.015	2	0.16	21.09	-44.2	
1050	7.35	100	5.55	0.986	1	0.15	21.10	-50.1	
1100	7.35	100	5.55	0.979	1	0.15	21.11	-55.0	COMPLETED PURGE

SIGNATURE(S): Fred Ullamer

PAGE ___ **OF** ___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW003
DATE: 11-19-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
745	8.78	100 ml/m	5.21	0.103	25.4	0.55	18.76	135.9	
755	8.80	"	5.12	0.100	16.0	0.65	18.92	129.0	
805	8.80	"	4.96	0.097	7.5	0.46	19.01	126.0	
815	8.81	"	4.90	0.097	6.2	0.25	19.00	125.2	
825	8.81	"	4.87	0.098	5.2	0.33	19.01	123.7	
835	8.81	"	4.87	0.095	4.8	0.23	19.03	123.3	
845	8.81	"	4.85	0.095	4.8	0.24	19.04	120.3	
850	8.81	"	4.85	0.095	4.6	0.23	19.07	120.0	

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Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW0040108
DATE: 11-19-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1020	8.90	110 ml/min	5.68	0.157	3.0	0.74	19.61	103.5	
1030	8.92	110	5.70	0.156	2.9	0.36	19.84	100.4	
1040	8.94	110	5.70	0.159	2.5	0.33	19.91	99.4	
1050	8.94	110	5.70	0.156	2.2	0.35	20.22*	98.0	*SOME SUN WARMING
1100	8.94	110	5.67	0.150	2.0	0.26	20.22	98.4	
1110	8.94	110	5.67	0.148	2.0	0.26	20.16+	97.6	BECOMING CLOUDY
1120	8.95	110	5.66	0.147	1.8	0.28	20.01	95.1	
1130	8.95	110	5.66	0.145	1.4	0.29	19.78	94.9	
1140	8.97	110	5.65	0.142	1.2	0.28	19.75	93.8	
1150	8.99	110	5.63	0.141	1.2	0.27	19.74	92.8	COMPLETED PURGE @ 1150

SIGNATURE(S): Fred M Ramer

PAGE ___ **OF** ___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW011
DATE: 11-19-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1335	9.80	120	5.97	0.214	13	0.80	18.99	110.6	
1345	9.83	110	5.95	0.204	11	0.27	18.73	106.0	
1355	9.84	110	5.90	0.201	7.6	0.30	18.65	102.8	
1405	9.86	110	5.83	0.189	6.5	0.33	18.60	102.2	
1415	9.88	110	5.80	0.181	5	0.20	18.57	100.7	
1425	9.94	110	5.80	0.175	5	0.20	17.95	98.2	
1435	10.05	110	5.79	0.177	4.5	0.17	17.76	98.7	
1445	10.10	110	5.75	0.169	4	0.17	17.38	99.1	
1455	10.12	110	5.76	0.172	4	0.24	16.82	98.5	
1505	10.14	110	5.80	0.178	3.5	0.26	16.79	97.6	
1515	10.18	110	5.85	0.177	2	0.29	16.85	97.3	COMPLETED PURGING @ 1515 HR

SIGNATURE(S): Fred Ulanser

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW024
DATE: 11-20-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
0745	6.43	100	6.10	0.361	14.5	0.82	17.40	-70.9	
0755	6.60	100	6.13	0.365	10.6	0.40	17.67	-94.7	
0805	6.69	100	6.17	0.371	7.8	0.52	17.84	-90.2	
0815	6.72	100	6.13	0.390	5.9	0.53	17.84	-108.6	
0825	6.72	100	6.15	0.408	5.0	0.19	17.77	-110.1	
0835	6.73	100	6.15	0.486	4.1	0.20	17.98	-122.9	
0845	6.73	100	6.19	0.493	4.0	0.21	18.00	-123.4	
0855	6.74	100	6.17	0.498	3.8	0.23	18.02	-126.5	PURGE COMPLETED @0855

SIGNATURE(S): Fred W Rauser

PAGE ___ **OF** ___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: Indian Head Site 57 HRC Pilot Study
PROJECT NUMBER: 4020

WELL ID.: S57MW025
DATE: 11-20-03

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	Comments
1020	7.33	100	5.85	0.226	12.5	3.09	16.91	-78.9	
1030	7.38	100	5.85	0.240	6.8	0.23	17.25	-112.9	
1040	7.38	100	5.85	0.261	4.6	0.29	17.54	-121.9	
1050	7.39	100	5.85	0.296	4.2	0.17	17.70	-124.9	
1100	7.39	100	5.86	0.339	4.0	0.23	17.87	-125.3	
1110	7.40	100	5.85	0.356	2.8	0.17	17.91	-124.4	
1120	7.40	100	5.84	0.361	2.5	0.18	17.95	-124.2	
1130	7.40	100	5.84	0.365	2.2	0.17	18.01	-123.9	COMPLETED PURGE AT 1130HRS

SIGNATURE(S): Fred M Ramer

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APPENDIX A.5

Field Analytical Forms

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: IHDIV Site 57 HRC Pilot Study
Project No.: 402
Sampled By: F. WUDKWYCH
Field Analyst: F. WUDKWYCH
Field Form Checked as per QA/QC Checklist (initials): FCW

Sample ID No.: S57MW0030104
Sample Location: S57MW03
Duplicate: ☐
Blank: ☑

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 5-13-03								
Time: 1050								
Method: LOW FLOW	CLEAR	4.85	~~103~~ 0.103	15.9	3.1	5.6	—	-4.8

Equipment Used: YSI 556 MPS LAMOTT TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Range Used:	Range	Method	Concentration ppm
☐	0 to 1 ppm	K-7510	
☑	1 to 12 ppm	K-7512	

Concentration: 2.0 ppm

Analysis Time: 1115

Equipment: HACH Digital Titrator OX-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Analysis ~~Time~~ RANGE: 1-12

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L
Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1116

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.0 ppm

Analysis Time: 1120

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑
Mulitplication is correct for each *Multiplier* table: ☐ NA
Final calulated concentration is within the appropriate *Range Used* block: ☑
Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: IHDIV Site 57 HRC Pilot Study

Sample ID No.: S57MW0040104

Project No.: 4020

Sample Location: S57MW004

Sampled By: F. WUDKWYCH

Duplicate: ☐

Field Analyst: F. WUDKWYCH

Blank: ☑

Field Form Checked as per QA/QC Checklist (initials): FCW

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 5-13-03								
Time: 1440								
Method: LOW FLOW	CLEAR	5.97	~~207~~ 0.207	16.5	1.1	0.87	–	-50.1

Equipment Used: YSI 556 MPS LA MOTT TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.6 ppm

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1440

Equipment: HACH Digital Titrator OX-DT

~~Analysis Time:~~ RANGE 0-1

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1452

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1450

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☑

Final calulated concentration is within the appropriate *Range Used* block: ☑

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: IHDIV Site 57 HRC Pilot Study

Project No.: 4020

Sampled By: F. WUDKWYCH

Field Analyst: F. WUDKWYCH

Field Form Checked as per QA/QC Checklist (initials): FCW

Sample ID No.: S57MW0040104

Sample Location: S57MW004

Duplicate: ☑

Blank: ☐

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 5-13-03 Time: 1450								
Method: LOW FLOW	CLEAR	5.97	~~207~~	16.5	1.1	0.87	–	-50.1

Equipment Used: YSI 556 MPS 0.207 LAMOTT TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.6 ppm

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1442

Equipment: HACH Digital Titrator OX-DT

~~Analysis Time~~ RANGE: 0-1

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1449

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: /

Concentration: 0.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1447

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☑

Final calulated concentration is within the appropriate *Range Used* block: ☑

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: IHDIV Site 57 HRC Pilot Study

Project No.: 4020

Sampled By: FWR

Field Analyst: FWR

Field Form Checked as per QA/QC Checklist (initials): FWR

Sample ID No.: S57MW0110104

Sample Location: S57MW011

Duplicate: ☐

Blank: ☑

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 5-13-03 Time: 1430 Method: LOW FLOW	CLEAR	5.62	0.240	16.19	3.7	0.33	—	39.6

Equipment Used: YSI 556 MPS LA MOTT TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.5 ppm

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	0.5
☐	1 to 12 ppm	K-7512	

Analysis Time: 1540

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: ~~0.0~~ ppm <0.2

Analysis Time: 1545

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.0 ppm

Analysis Time: 1547

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☒ NA

Final calulated concentration is within the appropriate *Range Used* block: ☑

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: IHDIV Site 57 HRC Pilot Study
Project No.: 4020
Sampled By: F. WUDKWYCH
Field Analyst: F. WUDKWYCH
Field Form Checked as per QA/QC Checklist (initials): FEW

Sample ID No.: S57MW0240104
Sample Location: S57MW24
Duplicate: ☐
Blank: ☑

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 5-15-03								
Time: 0825								
Method: LOW FLOW	CLEAR	5.24	0.111	15.5	6.5	1.27	-	-24.1

Equipment Used: YSI 556 MPS LAMOTT TURBIDITYMETER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Concentration: 0.8 ppm

Analysis Time: 0840

Equipment: HACH Digital Titrator OX-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Analysis Time: _____

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L
Program/Module: 500nm 33

Concentration: 2.0 ppm

Analysis Time: 0844

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.0 ppm

Analysis Time: 0850

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑
Mulitplication is correct for each *Multiplier* table: ☑ NA
Final calulated concentration is within the appropriate *Range Used* block: ☑
Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Project Site Name: IHDIV Site 57 HRC Pilot Study

Project No.: 4020

Sampled By: FWR

Field Analyst: FWR

Field Form Checked as per QA/QC Checklist (initials): FWR

Sample ID No.: S57MW025010Y

Sample Location: S57MW025

Duplicate: ☐

Blank: ☑

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 5-15-03								
Time: 0850								
Method: LOW FLOW	CLEAR	5.64	0.270	15.79	2.9	1.00	—	24.7

Equipment Used: YSI 556 MPS LAMOTT TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 1.0 ppm

Range Used:	Range	Method	Concentration ppm
☐	0 to 1 ppm	K-7510	1.0
☒	1 to 12 ppm	K-7512	

Analysis Time: 0919

Equipment: HACH Digital Titrator OX-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Analysis Time: _____

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 3.4 ppm

Analysis Time: 0918

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.0 ppm

Analysis Time: 0915

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☒ NA

Final calulated concentration is within the appropriate *Range Used* block: ☑

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name: IHDIV Site 57 HRC Pilot Study

Project No.: 4020

Sampled By: SLR

Field Analyst: SLR

Field Form Checked as per QA/QC Checklist (initials): SLR

Sample ID No.: S57MW00030105

Sample Location: S57MW003

Duplicate: ☐

Blank: ☐

SAMPLING DATA:

Date: 6-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1545	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	4.51	0.090	19.35	3.0	0.15	—	191.8

Equipment Used: YSI MODEL 556 S/N 02F0623AE LAMOTTE MODEL 2020 TURBIDITYMETER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	0.2
☐	1 to 12 ppm	K-7512	

Concentration: 0.2 ppm — DUP 0.2

Analysis Time: 1602 — 1607

Equipment: HACH Digital Titrator OX-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Analysis Time: _____

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Concentration: <0.2 ppm — DUP <0.2

Analysis Time: 1611 — 1620

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Notes:

Concentration: 0.0 ppm — DUP 0.0

Analysis Time: 1600 — 1630

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐ NA

Final calulated concentration is within the appropriate *Range Used* block: ☐ NA

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: IHDIV Site 57 HRC Pilot Study
Project No.: 4020
Sampled By: FWR
Field Analyst: FWR
Field Form Checked as per QA/QC Checklist (initials): FWR

Sample ID No.: S57MW0040105
Sample Location: S57MW004
Duplicate: ☐
Blank: ☐

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU) FWR	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 6-20-03 Time: 0825 Method: LOW FLOW	CLEAR	5.85	0.239	17.65	~~2.450~~ 0.30	0.45	—	171.2

Equipment Used: YSI 556 MPS S/N 02F0623 AE LAMOTTE MODEL 2020 TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	0.6
☐	1 to 12 ppm	K-7512	

Concentration: 0.6 ppm

Analysis Time: 0900

Equipment: HACH Digital Titrator OX-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Analysis Time: _____

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L
Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 0855

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.0 ppm

Analysis Time: 0852

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑
Mulitplication is correct for each *Multiplier* table: ☐ NA
Final calulated concentration is within the appropriate *Range Used* block: ☐ NA
Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name: IHDIV Site 57 HRC Pilot Study

Sample ID No.: 57MW0110105

Project No.: 4020

Sample Location: 57MW011

Sampled By: MR

Duplicate: ☐

Field Analyst: MR

Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): MR

SAMPLING DATA:

Date: 6-19-03 / Time: 0830	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Method: LOW FLOW	CLR	5.40	0.152	17.22	3.8	0.15	—	139.5

Equipment Used: YSI MODEL 556 S/N 02F0623AE

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.4 ppm

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	0.4
☐	1 to 12 ppm	K-7512	—

Analysis Time: 0914

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 0.5 ppm

Analysis Time: 0850

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 0839

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐ NA

Final calulated concentration is within the appropriate *Range Used* block: ☐ NA

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: IHDIV Site 57 HRC Pilot Study

Project No.: 4020

Sampled By: FWR

Field Analyst: FWR

Field Form Checked as per QA/QC Checklist (initials): FWR

Sample ID No.: S57MW0240105

Sample Location: S57MW024

Duplicate: ☐

Blank: ☐

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 6-20-03 Time: 1035 Method: LOW FLOW	CLEAR	5.00	0.379	17.79	4.9	0.15	—	39.9

Equipment Used: YSI 556 MPS S/N 02F0623 AE LAMOTTE MODEL 2020 TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Analysis Time: 1057

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 1.6 ppm

Analysis Time: 1110

Equipment: R-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.3 ppm

Analysis Time: 1100

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: IHDIV Site 57 HRC Pilot Study

Project No.: 4020

Sampled By: RWR

Field Analyst: RWR

Field Form Checked as per QA/QC Checklist (initials): RWR

Sample ID No.: S57MW0250105

Sample Location: S57MW025

Duplicate: ☐

Blank: ☐

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 6-19-03								
Time: 1055								
Method: LOW FLOW	CLEAR	5.29	0.330	18.17	3.0	0.19	—	18.3

Equipment Used: YSI MODEL 556 S/N 02F0623 AE LAMOTTE MODEL 2020 TURBIDITY METER

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Analysis Time: 11:17

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	0.0
☐	1 to 12 ppm	K-7512	

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 3.6 ppm

Analysis Time: 1107

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 1.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1114

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐ NA

Final calulated concentration is within the appropriate *Range Used* block: ☐ NA

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: IHDIV Site 57 HRC Pilot Study

Project No.: 4020

Sampled By: RWR

Field Analyst: RWR

Field Form Checked as per QA/QC Checklist (initials): RWR

Sample ID No.: S57MW0030106

Sample Location: S57MW003

Duplicate: ☐

Blank: ☐

SAMPLING DATA:

Date: 7-29-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1515	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	3.99	0.097	21.30	1.0	0.18	—	38.3

Equipment Used: YSI 556 MPS S/N 01J0897AU

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Concentration: 0.4 ppm

Analysis Time: 1607

Equipment: HACH Digital Titrator OX-DT

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Analysis Time: _____

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1617

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.0 ppm

Analysis Time: 1615

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name: IHDIV Site 57 HRC Pilot Study

Sample ID No.: S57MW0040106

Project No.: 4020

Sample Location: S57MW004

Sampled By: RWR

Duplicate: ☐

Field Analyst: RWR

Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): SWR

SAMPLING DATA

Date: 7-29-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1315	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	5.14	0.149	22.04	0.41	0.48	—	10.7

Equipment Used:
YSI 556 MPS S/N 01J0897AU

SAMPLE COLLECTION/ANALYSIS INFORMATION

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.6 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1340

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1347

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1345

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name: IHDIV Site 57 HRC Pilot Study

Sample ID No.: S57MW0110106

Project No.: 4020

Sample Location: S57MW011

Sampled By: RWR

Duplicate: ☐

Field Analyst: RWR

Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): RWR

SAMPLING DATA:

Date: 7-29-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 0950	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	4.40	0.138	19.74	4.7	0.32	—	-12.8

Equipment Used:

YSI 556 MPS S/N 01J0897 AU

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.4 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1045

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 0.4 ppm

Analysis Time: 1058

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1055

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name: IHDIV Site 57 HRC Pilot Study

Sample ID No.: 557MW0240106

Project No.: 4020

Sample Location: 557MW024

Sampled By: PWR

Duplicate: ☐

Field Analyst: PWR

Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): PWR

SAMPLING DATA:

Date: 7-30-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 0950	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	5.89	0.660	20.65	1.5	0.20	—	-82.8

Equipment Used: YSI 556 MPS S/N 01J0897AU

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1005

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 6.0 ppm

Analysis Time: 1010

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.5 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1015

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☐

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name: IHDIV Site 57 HRC Pilot Study

Sample ID No.: 557MW0250106

Project No.: 4020

Sample Location: 557MW025

Sampled By: RWR

Duplicate: ☐

Field Analyst: RWR

Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): RWR

SAMPLING DATA

Date: 07-30-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 0800	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	5.06	0.365	20.10	1.0	0.31	—	-52.1

Equipment Used: YSI 556 MPS S/N 01J0897 AU

SAMPLE COLLECTION/ANALYSIS INFORMATION

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 0825

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 5.8 ppm

Analysis Time: 0840

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: ~~0.0~~ 0.7 RWR ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: ~~0825~~ 0835 RWR

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☐

Correct measurement units are cited in the SAMPLING DATA block: ☐

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☐

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0030107
Project No.:	4020-0507	Sample Location:	S57MW003
Sampled By:	Fred W. Ramser	Duplicate:	☐
Field Analyst:	Fred W. Ramser	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	SWR		

SAMPLING DATA:

Date: 9-24-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1000	(Visual)	(S.U.)	(mS/cm)	(^{0}C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: Low Flow	CLR	4.73	0.099	19.69	3	0.22	—	257

Equipment Used: YSI METER 02A0253 AD

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.3 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1036

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1038

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1042

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0040107
Project No.:	4020-0507	Sample Location:	S57MW004
Sampled By:	Fred W. Ramser	Duplicate:	☐
Field Analyst:	Fred W. Ramser	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	JWR		

SAMPLING DATA:

Date: 9-24-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1245	(Visual)	(S.U.)	(mS/cm)	(^{0}C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	5.86	0.228	22.17	1	0.80	—	173

Equipment Used: YSI METER 02A0253 AD

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.9 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1340

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1342

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1345

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0110107
Project No.:	4020-0507	Sample Location:	S57MW011
Sampled By:	Fred W. Ramser	Duplicate:	☐
Field Analyst:	Fred W. Ramser	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	SWR		

SAMPLING DATA:

Date: 9-24-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1525	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	6.37	0.479	21.70	2.0	0.17	—	71.9

Equipment Used: YSI METER 02A0253AD

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.6 ppm

Range Used:	Range	Method	Concentration ppm
☑	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1542

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1545

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.1 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1548

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☑

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0240107
Project No.:	4020-0507	Sample Location:	S57MW024
Sampled By:	Fred W. Ramser	Duplicate:	☐
Field Analyst:	Fred W. Ramser	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	SWR		

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Date: 9-25-03								
Time: 0855	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	6.24	0.669	21.17	2	0.15	—	-114.7

Equipment Used:
YSI METER 02A0253AD

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 0920

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 5.0 ppm

Analysis Time: 0925

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.6 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 0922

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

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Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0250107
Project No.:	4020-0507	Sample Location:	S57MW025
Sampled By:	Fred W. Ramser	Duplicate:	☐
Field Analyst:	Fred W. Ramser	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	RWR		

SAMPLING DATA:

Date: 9-25-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1100	(Visual)	(S.U.)	(mS/cm)	(^{0}C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: LOW FLOW	CLR	5.55	0.979	21.11	1	0.15	—	-55.0

Equipment Used: YSI METER 02A0253 AD

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1118

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: > 10 ppm

Analysis Time: 1125

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 0.7 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1120

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0083 0108
Project No.:	4020-0507	Sample Location:	S57MW0083
Sampled By:	FRED W. RAMSER	Duplicate:	☐
Field Analyst:	FRED W. RAMSER	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	FWR		

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 11-19-03								
Time: 0850								
Method: PERISTALTIC	CLR	4.85	0.095	19.07	4.6	0.23	—	120

Equipment Used: 556 MPS
YSI S/N 01D0435 AA LAMOTTE TURBIDITY MODEL 2020 S/N 3665-4002

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.3 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 0945

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm (0.0)

Analysis Time: 0952

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: <0.2 ppm (0.0)

Analysis Time: 0955

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☒

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0040108
Project No.:	4020-0507	Sample Location:	S57MW004
Sampled By:	FREDW RAMSER	Duplicate:	☐
Field Analyst:	FREDW. RAMSER	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	PWR		

SAMPLING DATA:

Date: 11-19-03	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Time: 1150	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	(+/- mv)
Method: PERISTALTIC	CLR	5.63	0.141	19.74	1.2	0.27	—	92.8

Equipment Used: 556 MPS
YSI S/N 01D0435AA. LAMOTTE TURBIDITY MODEL 2020 S/N 3665-4002

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.25 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1212

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01	= mg/L
_____	x 0.02	= mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: <0.2 ppm

Analysis Time: 1215

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: <0.2 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1218

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW011-0108
Project No.:	4020-0507	Sample Location:	S57MW011
Sampled By:	RWR	Duplicate:	☐
Field Analyst:	RWR	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	RWR		

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 11-19-03								
Time: 1515								
Method: PERISTALTIC	CLR	5.85	0.177	16.85	2.0	0.29	—	97.3

Equipment Used: YSI 556 MPS S/N 01D0435AA LAMOTTE TURBIDITY METER 2020 S/N 3665-4002

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.4 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 1537

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 0.0 ppm

Analysis Time: 1540

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Exceeded 5.0 mg/L range on color chart: ☐

Concentration: 0.0 ppm

Analysis Time: 1542

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0240108
Project No.:	4020-0507	Sample Location:	S57MW024
Sampled By:	FRED W. RAMSER	Duplicate:	☐
Field Analyst:	FWR	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	FWR		

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 11-20-03								
Time: 0855								
Method: PERISTALTIC	CLEAR	6.17	0.498	18.02	3.8	0.23	—	-126.5

Equipment Used: YSI 556 MPS S/N 01D0435AA LAMOTTE TURBIDITY MODEL 2020 S/N 3665-4002

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	
☐	1 to 12 ppm	K-7512	

Analysis Time: 0927

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 6.0 ppm

Analysis Time: 0935

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S): Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 1.5 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 0938

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☑

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☑

Note: Analyte, method, and/or equipment may be deleted from form if not being performed.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name:	IHDIV Site 57 HRC Pilot Study	Sample ID No.:	S57MW0250108
Project No.:	4020-0507	Sample Location:	S57MW025
Sampled By:	FRED W RAMSER	Duplicate:	☐
Field Analyst:	FWR	Blank:	☐
Field Form Checked as per QA/QC Checklist (initials):	FWR		

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (+/- mv)
Date: 11-20-03								
Time: 1130								
Method: PERISTALTIC	CLR	5.84	0.365	18.01	2.2	0.17	—	-123.9

Equipment Used: 556 MPS LAMOTTE TURBIDITY METER 2020
YSI S/N 0100435AA. S/N 3665-4002

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: Chemetrics Test Kit

Concentration: 0.0 ppm

Range Used:	Range	Method	Concentration ppm
☒	0 to 1 ppm	K-7510	0.0
☐	1 to 12 ppm	K-7512	

Analysis Time: 1146

Equipment: HACH Digital Titrator OX-DT

Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01	= mg/L
_____	x 0.02	= mg/L

Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-850 DR-8 __ Range: 0 - 3.00 mg/L

Program/Module: 500nm 33

Concentration: 6.0 ppm

Analysis Time: 1149

Equipment: IR-18C Color Wheel Range: 0 - 10 mg/L

Notes:

Filtered: ☐

Hydrogen Sulfide (H_2S):

Range: 0 - 5 mg/L

Equipment: HS-C Other: _____

Concentration: 1.0 ppm

Exceeded 5.0 mg/L range on color chart: ☐

Analysis Time: 1200

Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑

Correct measurement units are cited in the SAMPLING DATA block: ☑

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☐

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

APPENDIX A.6

Chain of Custody Forms

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER M-001 | PAGE 1 OF 1

PROJECT NO: 4020	SITE NAME: SITE 57 IH	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412-921-8684	LABORATORY NAME AND CONTACT: MICROSEEPS
SAMPLERS (SIGNATURE): Fred Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED RAMSER 412-921-8838	ADDRESS: 220 WILLIAM PITT WAY
		CARRIER/WAYBILL NUMBER: FED EX 8243 8235 0342	CITY, STATE: PITTSBURGH PA

STANDARD TAT ☑
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: -

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: METABOLIC ACIDS								COMMENTS
5-13	1050	S57MW0030104	AQ	G	2	2								
↓	1410	S57MW0040104	↓	↓	2	2								
↓	0000	S57GWDUP0101	↓	↓	2	2								DUP of MW004
↓	1430	S57MW0110104	↓	↓	2	2								
5-15	0825	S57MW0240104	↓	↓	2	2								
↓	0850	S57MW0250104	↓	↓	2	2								

1. RELINQUISHED BY: Fred Ramser	DATE: 5-15-03	TIME: 1900	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER K-003 | PAGE 1 OF 1

PROJECT NO: 4020	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412 921-8684	LABORATORY NAME AND CONTACT: KATAHDIN A. COLBY
SAMPLERS (SIGNATURE): [signature]		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED RAMSER 412-921-8838	ADDRESS: 340 COUNTY RD. NO. 5
		CARRIER/WAYBILL NUMBER: FEDEX 8243 8235 0353	CITY, STATE: WESTBROOK ME

STANDARD TAT ☑
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOCS	DISSOLVED METHANE, ETHANE, ETHENE	ANIONS	ALKALINITY	TOTAL IRON + MANGANESE	DISSOLVED IRON + MANGANESE	TOC	CO2	SULFIDE	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G	G	P		P	P	G	G	P	
PRESERVATIVE USED						HCL	HCL	–		HNO_3	HNO_3	H_2SO_4	–	ZNAC NaOH	
5-15	0800	S57TB0030001	AQ	G	2	X									
↓	0825	S57MW0240104	↓	G	17	X	X	X	X	X	X	X	X		MS/MSD
↓	0850	S57MW0250104	↓	G	13	X	X	X	X	X	X	X	X		

1. RELINQUISHED BY [signature]	DATE 5-15-03	TIME 1900	1. RECEIVED BY FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUT. WHITE (ACCOMPANIES SAMPLE) YELLOW (FIEL COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER K-002 | PAGE 1 OF 1

PROJECT NO: 4020	SITE NAME: IH SITE 57	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412-921-8684	LABORATORY NAME AND CONTACT: KATAHDIN, MS. ANDRIA COLBY
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED W RAMSER 412-921-8838	ADDRESS: 340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER: FED EX 8243 8235 0364	CITY, STATE: WESTBROOK ME 04092

STANDARD TAT ☑
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): P G
PRESERVATIVE USED: – –

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL	VOCS	ARSENIC						COMMENTS
5-14	0800	S57TB0020001	AQ	G	2	X								FROM LAB
	1015	S57SB0280104	SOIL		5	X	X							
	1020	S57SB0280204			5	X	X							
	1030	S57SB0280304			~~5~~ 1	X	X							RUN TCL VOCS FROM GLASS JAR
	1035	S57SB0280404			5	X	X							
	1325	S57SB0270104			5	X	X							
	1335	S57SB0270204			5	X	X							
	1340	S57SB0270304			5	X	X							
	1345	S57SB0270404			10	X	X							MS/MSD
	0000	S57SB DUP0101			5	X	X							DUP SB270104
	1515	S57RB0020001	AQ		4	✓	✓*							PRESERVE BY LAB
	1520	S57FB0010001	AQ		3	✓	✓*							" " "
	1550	S57FB0020001	AQ		3	✓	✓*							PLEASE PRESERVE UPON RECIEPT AT LAB

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: Fred W Ramser	5-14-03	1900	1. RECEIVED BY: FED EX		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS: *PLEASE PRESERVE THESE SAMPLES UPON RECEIPT BY LAB

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER K-001 | PAGE 1 OF 1

PROJECT NO: 4020	SITE NAME: IH SITE 57
PROJECT MANAGER AND PHONE NUMBER	GEORGE LATULIPPE 412-921-8684
LABORATORY NAME AND CONTACT:	KATAHDIN
SAMPLERS (SIGNATURE)	Fred W Ramser
FIELD OPERATIONS LEADER AND PHONE NUMBER	FRED RAMSER 412-921-8838
ADDRESS	340 COUNTY RD NO. 5
CARRIER/WAYBILL NUMBER	FED EX 8412 2491 4197
CITY, STATE	WESTBROOK, ME

STANDARD TAT ☑
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOCs	DISSOLVED METHANE, ETHANE, ETHENE	ANIONS/ALKALINITY	TOTAL IRON + MANGANESE	DISSOLVED IRON + MANGANESE	TOC	CO2	SULFIDE	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G	G	P	P	P	G	G		
PRESERVATIVE USED						HCL	HCL	-	HNO3	HNO3	H2SO4	-	ZNAC/NaOH	
5-13	0900	S57TB0010001	AQ	G	2	X								TRIP BLANK
	1050	S57MW0030104			13	X	X	X	X	X	X	X	X	
	1410	S57MW0040104			13	X	X	X	X	X	X	X	X	
	0000	S57GWDUP0101			13	X	X	X	X	X	X	X	X	DUP OF MW004
	1430	S57MW0110104			19	X	X	X	X	X	X	X	X	MS/MSD
	1645	S57RB0010001			3	X								

1. RELINQUISHED BY Fred W Ramser	DATE 5-13-03	TIME 1900	1. RECEIVED BY FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTI WHITE (ACCOMPANIES SAMPLE) YELLOW (FIEL JPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER K-004 | PAGE ___ OF ___

PROJECT NO: 4020	SITE NAME: INDIAN HEAD	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412-921-8684	LABORATORY NAME AND CONTACT: KATAHDIN ANA. ANDREA COLBY
SAMPLERS (SIGNATURE): Fred Wramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED WRAMSER 412-921-8838	ADDRESS: 340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER: FED EX 841224914201	CITY, STATE: WEST BROOK ME 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOAS	DISS. GASES MET. ETHANE/ETHENE	ANIONS/ALK	TOT FE + MN	DISS FE + MN*	TOC	CO2	SULFIDE	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G	G	P	P	P	G	G	P	
PRESERVATIVE USED						HCL	HCL	NONE	HNO3	NONE	H2SO4	NONE	ZNAC/NaOH	
6/19	0830	S57TB0010005	AQ	FROM LAB	3	3								* PRESERVE DISS. METALS
6/18	0830	S57MW0110105	AQ	G	13	3	2	1	1	1*	2	2	1	UPON LAB
	1055	S57MW0250105	AQ	G	13	3	2	1	1	1*	2	2	1	RECEIPT.
	0000	S57GWDUP0105	AQ	G	13	3	2	1	1	1*	2	2	1	
6/19	1545	S57GWMW0030105	AQ	G	30	9	6	1	2	2*	4	4	2	RUN MS/MSD
		TEMP BLANK		FROM LAB										

1. RELINQUISHED BY: Fred Wramser	DATE: 6-19-03	TIME: 1900	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS: *PRESERVE (ADD HNO_3) DISS METALS (FE + Mn) UPON LABORATORY RECEIPT

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER K-005 | PAGE ___ OF ___

PROJECT NO: 4020	SITE NAME: INDIAN HEAD
PROJECT MANAGER AND PHONE NUMBER	GEORGE LATULIPPE 412-921-8684
LABORATORY NAME AND CONTACT:	KATAHDIN ANA. ANDRIA COLBY
SAMPLERS (SIGNATURE)	Fred W Ramser
FIELD OPERATIONS LEADER AND PHONE NUMBER	FRED W. RAMSER 412-921-8838
ADDRESS	340 COUNTY RD #5
CARRIER/WAYBILL NUMBER	FED EX ~~AIR~~ 8412 2491 4278
CITY, STATE	WEST BROOK ME 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOA	DISS. METHANE ETHANE, ETHENE	ANIONS/ALK	TOT Fe+Mn	DISS Fe+Mn*	TOC	CO2	SULFIDE	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G	G	P	P	P	G	G	P	
PRESERVATIVE USED						HCL	HCL	NONE	HNO_3	NONE	H_2SO_4	NONE	ZN AC NaOH	
6/20	0800	S57TB0020005	AQ	FROM LAB	3	3	~~2~~	~~1~~						
	0825	S57MW0040105	AQ	G	13	3	2	1	1	1*	2	2	1	* PRESERVE DISS METALS
6/20	1035	S57MW0240105	AQ	G	13	3	2	1	1	1*	2	2	1	UPON LAB
														RECEIPT

1. RELINQUISHED BY Fred W Ramser	DATE 6-20-03	TIME 1350	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS * PRESERVE DISS. METALS (Fe+Mn) PON LABORATORY RECEIPT

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER M-2 | PAGE ___ OF ___

PROJECT NO: 4020	SITE NAME: INDIAN HEAD	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412-921-8684	LABORATORY NAME AND CONTACT: Ms. BECKY HANS
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED W RAMSER 412-921-8838	ADDRESS: 220 WILLIAM PITT WAY
		CARRIER/WAYBILL NUMBER: FED EX 8412 2491 4289	CITY, STATE: PGH PA 15238

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: NONE

TYPE OF ANALYSIS: METABOLIC ACID

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	METABOLIC ACID								COMMENTS
6/19	0830	S57MW0110105	AQ	G		2								
	1055	S57MW0250105	AQ	G		2								
	0000	S57GWDUP0105	AQ	G		2								
6/19	1545	S57MW0030105	AQ	G		2								RUN MS/MSD
6/20	0825	S57MW0040105	AQ	G		2								
6/20	1035	S57MW0240105	AQ	G		2								

1. RELINQUISHED BY: Fred W Ramser	DATE 6-20-03	TIME 1330	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER K-006 | PAGE ___ OF ___

PROJECT NO: 4020 0507	SITE NAME: IHDV SITE 57	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULUPPE 412-921-8684	LABORATORY NAME AND CONTACT: KATAHDIN ANA. ANDRIA COLBY
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED W RAMSER 412-921-8838	ADDRESS: 340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER: FEDEX 8412 2491 4212	CITY, STATE: WEST BROOK ME 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: HCL 4°C; HCL 4°C; 4°C; HNO3 4°C; HNO3 4°C; H_2SO_4; 4°C; ZnA/NaOH

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOAs + ee	DISS. GASSES METH, ETHANE, ETHELNE	ANIONS + ALK	TOTAL Fe + Mn	DIS. Fe + Mn	TOC	CO2	SULFIDE	COMMENTS
7-29	0800	S57TB0010006	AQ	FROM LAB	3	✓								
	0950	S57MW0110106	AQ	G	13	3✓	2✓	1✓	1	1	2	2	1	
	0000	S57~~MW0111~~ EMK GWDUP0106	AQ	G	13	3	2	1	1	1	2	2	1	FROM S57MW0110106
	1315	S57MW0040106	AQ	G	13	3	2	1	1	1	2	2	1	
7-29	1515	S57MW0030106	AQ	G	13	9 ~~3~~*	4 ~~2~~*	1	2*	2*	2 ~~4~~	2 ~~4~~*	2*	* RUN MS/MSD

1. RELINQUISHED BY: Fred W Ramser	DATE: 7-29-03	TIME: 1900	1. RECEIVED BY: FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTI. WHITE (ACCOMPANIES SAMPLE) YELLOW (FIEL OPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER K-007 PAGE ____ OF _____

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
4020 0507	INDIV SITE 57	GEORGE LATULUPPE 412-921-8684	KATAHDIN ANA. ANDRIA COLBY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
Fred Ramser		FRED RAMSER 412-921-8838	340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX 8412 2491 4256	WEST BROOK ME 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOAs + ee (HCL 4°C)	DISS. GASSES METHANE, ETHANE, ETHENE (HCL 4°C)	ANIONS + ALK (4°C)	TOTAL Fe + Mn (HNO3)	DIS. Fe + Mn (HNO3)	TOC (H2SO4)	CO_2 (4°C)	SULFIDE (ZnAc/NaOH)	COMMENTS
7-30	0800	S57TB0020006	AQ	FROM LAB	3	3								
7-30	0800	S57MW0250106	AQ	G	13	3	2	1	1	1	2	2	1	
7-30	0950	S57MW0240106	AQ	G	13	3	2	1	1	1	2	2	1	

1. RELINQUISHED BY Fred Ramser	DATE 7/30/03	TIME 1300	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER M-3 | PAGE ___ OF ___

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
4020-0507	IHDIV SITE 57	GEORGE LATULIPPE 412-921-8684	MS BECKY HANS MICROSEEPS
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
Fred W Ramser		FRED W RAMSER 412-921-8838	220 WILLIAM PITT WAY
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX 8412 2491 4267	PGH PA 15238

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)

PRESERVATIVE USED

TYPE OF ANALYSIS: METABOLIC ACID

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	METABOLIC ACID								COMMENTS
7-29	0950	S57MW0110106	AQ	G	2	✓								
↓	0000	S57GWDUP0106	AQ	G	2	✓								
↓	1315	S57MW0040106	AQ	G	2	✓								
7-29	1515	S57MW0030106	AQ	G	~~8~~ 6*	✓								RUN MS/MSD
7-30	0800	S57MW0250106	AQ	G	2	✓								
7-30	0950	S57MW0240106	AQ	G	2	✓								

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
Fred W Ramser	7/30/03	1300	FED EX		
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTI WHITE (ACCOMPANIES SAMPLE) YELLOW (FIEL OPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER K-009 | PAGE ___ OF ___

PROJECT NO: 4020	SITE NAME: IH DIV	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412 921 8684	LABORATORY NAME AND CONTACT: KATAHDIN ANA. ANDRIA COLBY
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED W RAMSER 412 921 8838	ADDRESS: 340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER: 8412 2491 4223	CITY, STATE: WEST BROOK ME 04092

STANDARD TAT [X]
RUSH TAT [ ]
[ ] 24 hr. [ ] 48 hr. [ ] 72 hr. [ ] 7 day [ ] 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOA + ee ***	DISS. GASES METHANE, ETHANE, ETHENE	AMONS + ALK	TOTAL Fe + Mn	DISS. Fe + Mn	TOC	CO2	SULFIDE	COMMENTS
		CONTAINER TYPE PLASTIC (P) or GLASS (G)				G	G	P	P	G	G	P		
		PRESERVATIVE USED												
9/25	0800	S57TB0020007	AQ	FROM LAB	2	2								
9/25	0855	S57MW0240107	AQ	G	13	2	2	1	1	1	2	2	1	
9/25	1100	S57MW0250107	AQ	G	13	3	2	1	1	1	2	2	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: Fred W Ramser	9-25-03	1900	1. RECEIVED BY: FED EX		
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS: *** RUN ANALYSIS FOR TCL VOAs + ee @ TWO DILUTION LEVELS AS PER A. COLBY

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER M-4 | PAGE ___ OF ___

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
4020-0507	IH DIV SITE 57	GEORGE LATULIPPE 412-921-8684	BECKY HANS, MICROSEEPS
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED W. RAMSER 412-921-8838	ADDRESS: 220 WILLIAM PITT WAY
Fred W Ramser		CARRIER/WAYBILL NUMBER: FED EX 8412 2491 4245	CITY, STATE: PGH, PA 15238

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: 4°

TYPE OF ANALYSIS: METABOLIC ACIDS

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS									COMMENTS
9/24	1000	S57MW0030107	AQ	G	2	2								
↓	1245	S57MW0040107	↓	G	6	6								RUN MS/MSD
↓	0000	S57GWDUP0107	↓	G	2	2								COLLECTED @ S57MW003
9/24	1525	S57MW0110107	AQ	G	2	2								
9/25	0855	S57MW0240107	AQ	G	2	2								
9/25	1100	S57MW0250107	AQ	G	2	2								

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: Fred W Ramser	9-25-03	1900	1. RECEIVED BY: FED EX		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTI WHITE (ACCOMPANIES SAMPLE) YELLOW (FIEL OPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER ~~1~~ FVR K-0081 PAGE ___ OF ___

PROJECT NO: 4020 ~~0525~~	SITE NAME: IHDIV	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412-921-8684	LABORATORY NAME AND CONTACT: KATAHDIN ANA. ANDRIA COLBY
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED W RAMSER 412 921 8838	ADDRESS: 340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER: 8412 2491 1419	CITY, STATE: WEST BROOK ME 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOA + ee ***	DISS. GASES METH/ETHANE/ETHENE	ANIONS + ALK	TOTAL Fe + Mn	DISS. Fe + Mn	TOC	CO_2	SULFIDE	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G	G	P	P	P	G	G	P	
PRESERVATIVE USED														
9/24	0800	S57TB0010007	AQ	FROM LAB	2	2								FROM LAB
9/24	1000	S57MW0030107	AQ	G	13	3	2	1	1	1	2	2	1	
9/24	0000	S57GWDUP0107	AQ	G	13	3	2	1	1	1	2	2	1	COLLECTED @ S57MW0030107
9/24	1245	S57MW0040107	AQ	G	39	9	6	3	3	3	6	6	3	RUN MS/MSD
9/24	1525	S57MW0110107	AQ	G	13	3	2	1	1	1	2	2	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: Fred W Ramser	9-24-03	1830	1. RECEIVED BY: FED EX		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS *** RUN ANALYSIS FOR TCL VOA'S + ee @ TWO DILUTION LEVELS AS PER A. COLBY

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER K-9 | PAGE ___ OF ___

PROJECT NO: 4020	SITE NAME: JUDIAN HEAD	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPIS 412-921-	LABORATORY NAME AND CONTACT: KATAHDIN ANALYTICAL ANDRIA COLBY
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FREDW RAMSER 412-921-8838	ADDRESS: 340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER: FED EX 8243 8235 0331	CITY, STATE: WESTBROOK, ME 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOC + ee	DISS. METH, ETHANE + ETHENE	ANIONS/ALK.	TOTAL IRON + MANGANESE	DISSOLVED FE + MN	TOC	CO2	SULFIDE	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G	G	PE	PE	PE	G	G	PE	
PRESERVATIVE USED						HCL	HCL	NONE	HNO3	HNO3	H2SO4	NONE	ZNAC NaOH	
11-19	0850	S57MW0030108	AQ	G	13	3	2	1	1	1	2	2	1	
11-19	0000	S57GWDUP0108	AQ	G	13	3	2	1	1	1	2	2	1	COLLECTED @ S57MW003
11-19	0800	S57GWTB0108	AQ	FROM LAB	3	3								
11-19	1150	S57MW0040108	AQ	G	13	3	2	1	1	1	2	2	1	
11-19	1515	S57MW0110108	AQ	G	13	3	2	1	1	1	2	2	1	

TEMP BLANK INCLUDED

1. RELINQUISHED BY: Fred W Ramser	DATE: 11-19-03	TIME: 1830	1. RECEIVED BY: FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS *** PLEASE RUN ANALYSIS AT TWO LEVELS OF DILUTIONS AS PER ANDRIA COLBY

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER K-10 | PAGE ___ OF ___

PROJECT NO: 4020	SITE NAME: INDIAN HEAD	PROJECT MANAGER AND PHONE NUMBER: GEORGE LATULIPPE 412-921-7090	LABORATORY NAME AND CONTACT: KATAHDIN ANALYTICAL ANDRIA COLBY
SAMPLERS (SIGNATURE): Fred W Ramser		FIELD OPERATIONS LEADER AND PHONE NUMBER: FRED W RAMSER 412 921-8838	ADDRESS: 340 COUNTY RD #5
		CARRIER/WAYBILL NUMBER: FED EX 8243 8235 0250	CITY, STATE: WESTBROOK, ME 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOC + ee	DISS. METHANE + ETHENE	ANIONS/ALK	TOTAL FE + MN	DISS. FE + MN	TOC	CO_2	SULFIDE	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G	G	P	P	P	G	G	P	
PRESERVATIVE USED						HCL	HCL	NONE	HNO_3	HNO_3	H_2SO_4	NONE	ZNAC NaOH	
11-20	0800	S57GWTB0208	AQ	FROM LAB	3	3								
11-20	0855	S57MW0240108	AQ	G	39.	9	6	3	3	3	6	6	3	RUN MS/MSD
11-20	1130	S57MW0250108	AQ	G	13	3	2	1	1	1	2	2	1	

1. RELINQUISHED BY: Fred W Ramser	DATE 11-20-03	TIME 1430	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS: *** PLEASE RUN ANALYSIS @ TWO DILUTION LEVELS. AS PER ANDRIA COLBY

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER | PAGE ___ OF ___

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
9020	INDIAN HEAD	GEORGE LATULIPPE 412-921-7090	MICROSEEPS BECKY HANS
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
Fred W Ramser		FRED W RAMSER 412-921-8838	220 WILLIAM PITT WAY
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX 8243 8235 0261	PITTSBURGH PA 15238

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2003	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: METABOLIC ACIDS							COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)						G							
PRESERVATIVE USED						NONE							
11-19	0850	S57MW0030108	AQ	G	2	2							
11-19	0000	S57GWDUP0108	AQ	G	1	1							COLLECTED @ S57MW003
11-19	1150	S57MW0040108	AQ	G	2	2							
11-19	1515	S57MW0110108	AQ	G	2	2							
11-20	0855	S57MW0240108	AQ	G	2	2							RUN MS/MSD
11-20	1130	S57MW0250108	AQ	G	2	2							

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
Fred W Ramser	11-20-03	1430			
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

APPENDIX A.7

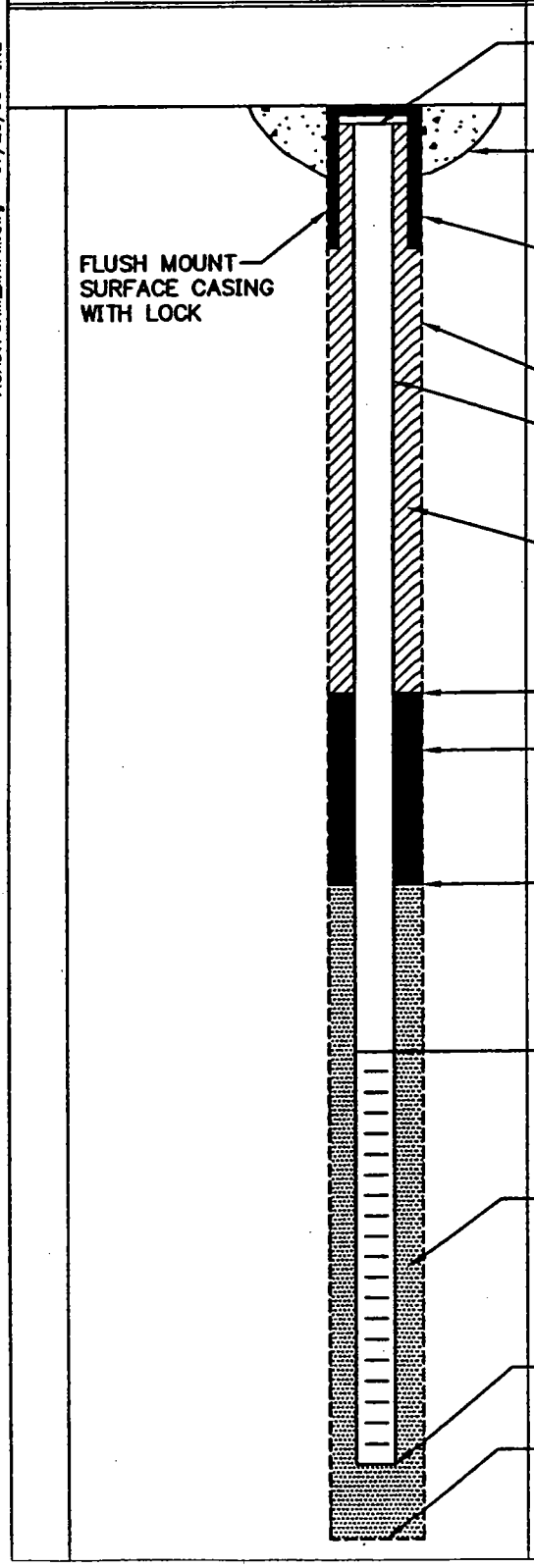
Well Construction Diagrams

WELL NO.: S57MW024

Tetra Tech NUS, Inc.

OVERBURDEN MONITORING WELL SHEET FLUSH - MOUNT

PROJECT SITE 57 PILOT STUDY	LOCATION INDIAN HEAD	DRILLER DAVID WILEY
PROJECT NO. 4020	BORING S57SB027	DRILLING METHOD HSA
DATE BEGUN 5-14-03	DATE COMPLETED 5-14-03	
FIELD GEOLOGIST FRED W RAMSER		DEVELOPMENT METHOD SURGE, BAILER PUMP
GROUND ELEVATION 32.86	DATUM NGVD	



ELEVATION TOP OF RISER: 32.50

TYPE OF SURFACE SEAL: CONCRETE

TYPE OF PROTECTIVE CASING: STEEL BOLT DOWN

I.D. OF PROTECTIVE CASING: 8"

DIAMETER OF HOLE: ~8"

TYPE OF RISER PIPE: SCH. 40 PVC

RISER PIPE I.D.: 2-INCH

TYPE OF BACKFILL/SEAL: BENTONITE 3/8" CHIPS

ELEVATION/DEPTH TOP OF SEAL: 31.86/1.0

TYPE OF SEAL: BENTONITE 3/8" CHIPS

ELEVATION/DEPTH TOP OF SAND: 30.86/2.0

ELEVATION/DEPTH TOP OF SCREEN: 28.86/4.0

TYPE OF SCREEN: PVC SCHEDULE 40

SLOT SIZE x LENGTH: .010" x 10'

TYPE OF SAND PACK: SILICA SAND 10/20

DIAMETER OF HOLE IN BEDROCK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: 18.86/14.0

ELEVATION / DEPTH BOTTOM OF SAND: 18.36/14.5

ELEVATION/DEPTH BOTTOM OF HOLE: 18.36/14.5

BACKFILL MATERIAL BELOW SAND: NONE

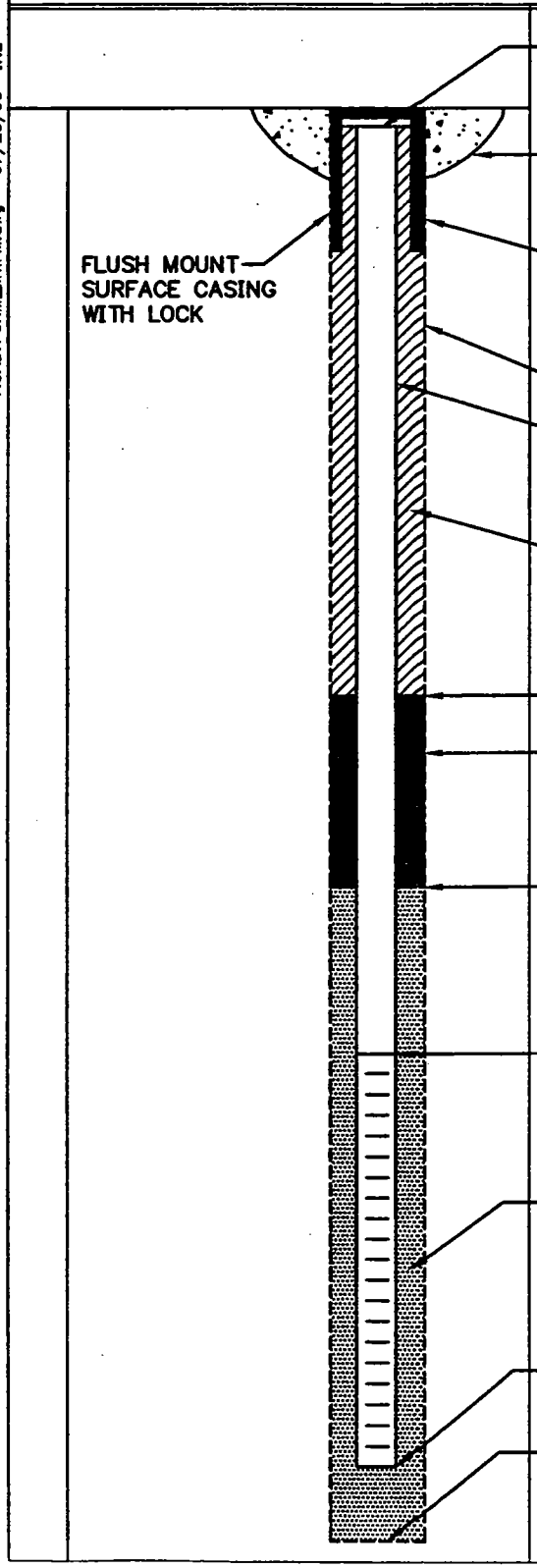
ACAD:FORM_MWFM.dwg 07/28/99 INL

WELL NO.: S57MW025

Tetra Tech NUS, Inc.

OVERBURDEN MONITORING WELL SHEET FLUSH - MOUNT

PROJECT SITE 57 PILOT STUDY	LOCATION INDIAN HEAD	DRILLER DAVID WILEY
PROJECT NO. 4020	BORING S57SB028	DRILLING METHOD HSA
DATE BEGUN 5-14-03	DATE COMPLETED 5-14-03	
FIELD GEOLOGIST FRED W RAMSER		DEVELOPMENT METHOD SURGE, BAILER PUMP
GROUND ELEVATION 32.60	DATUM NGVD 29	



ELEVATION TOP OF RISER: 32.43

TYPE OF SURFACE SEAL: CONCRETE

TYPE OF PROTECTIVE CASING: STEEL BOLT DOWN

I.D. OF PROTECTIVE CASING: 8"

DIAMETER OF HOLE: ~8"

TYPE OF RISER PIPE: SCH. 40 PVC

RISER PIPE I.D.: 2-INCH

TYPE OF BACKFILL/SEAL: BENTONITE 3/8" CHIPS

ELEVATION/DEPTH TOP OF SEAL: 31.6 / 1.0

TYPE OF SEAL: BENTONITE 3/8" CHIPS

ELEVATION/DEPTH TOP OF SAND: 30.6 / 2.0

ELEVATION/DEPTH TOP OF SCREEN: 28.6 / 4.0

TYPE OF SCREEN: PVC SCH. 40

SLOT SIZE x LENGTH: .010" x 10'

TYPE OF SAND PACK: SILICA SAND 10/20

DIAMETER OF HOLE IN BEDROCK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: 18.6 / 14.0

ELEVATION / DEPTH BOTTOM OF SAND: 18.1 / 14.5

ELEVATION/DEPTH BOTTOM OF HOLE: 18.1 / 14.5

BACKFILL MATERIAL BELOW SAND: NONE

ACAD:FORM_MWFM.dwg 07/28/99 INL

APPENDIX A.8

Well Development Data

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: S57MW025
Site: SITE 57 INDIAN HEAD
Date Installed: 5-14-03
Date Developed: 5-14-03
Dev. Method: SURGED, BAILER, PUMP
Pump Type: 12VDC

Depth to Bottom (ft.): 14'
Static Water Level Before (ft.): 6.52
Static Water Level After (ft.): 6.05
Screen Length (ft.): 10
Specific Capacity: NA
Casing ID (in.): 2"

Responsible Personnel: FREDW. RAMSEY/FRANK W.
Drilling Co.: VIRONEX
Project Name: SITE 57 HRC PILOT STUDY
Project Number: 4020

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units uS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1650	0.4	—	— *	17.9	5.80	250	999	BROWN * PUMP IN
1700	—	35	—	17.8	5.60	221	999	THE WAY, CAN NOT
1710	—	38	—	17.6	5.60	226	999	MEASURE DEPTH TO
1720	—	40	—	17.3	5.63	213	190	H_2O WHILE PUMPING
1730	—	42	—	17.1	5.43	214	120	Q ~ 1.5gpm - 1.0gpm
1740	—	47	—	17.1	5.49	213	36	
1745	0.0	55GALS	—	17.1	5.70	210	32	

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: S57MW024
Site: SITE 57 INDIAN HEAD
Date Installed: 5-14-03
Date Developed: 5-14-03
Dev. Method: SURGED, BAILER, PUMP
Pump Type: 12VDC

Depth to Bottom (ft.): 14'
Static Water Level Before (ft.): 6.95
Static Water Level After (ft.): 6.87
Screen Length (ft.): 10
Specific Capacity: NA
Casing ID (in.): 2"

Responsible Personnel: FRED W. RAMSEY/FRANK W.
Drilling Co.: VIRONEX
Project Name: SITE 57 HRC PILOT STUDY
Project Number: 4020

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units uS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1810	—			18.0	5.91	133	650	
1830	—	20		18.26	5.14	132	380	
1845								PUMP SILTED UP, FLUSHED
1900	—	25		16.61	5.32	148	650	OUT.
1905	—	30		16.28	5.31	144	350	
1910	—	35		16.10	5.23	142	220	
1920	—	43		16.00	5.26	143	150	
1925	—	47		15.90	5.21	139	130	
1930	—	55		15.90	5.22	140	100	

APPENDIX A.9

Slug Test Data

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 1 OF

CLIENT: INDIAN HEAD NSWC	JOB NUMBER: 4020-0507
SUBJECT: SLUG TEST WELL S57MW003	
BASED ON: HVORSLEV	DRAWING NUMBER:
BY: FRED R. / CHECKED BY: FCW	APPROVED BY: / DATE:

1) EQ: $$K = \frac{r^2 \ln(L/R)}{2 L T_o}$$

Where
r = riser radius (ft)
R = screen radius (ft)
L = Input length (ft)
T_o = Time for 37% head change (min)
K = Hydraulic Cond. (ft/min)

NOTE: Formation material "K" is similar to sand pack ∴ $R = r$. FORMATION MATERIALS CONSIST OF SAND, GRAVEL AND SILTS.

2)
r = 1 inch
R = 1 inch
L = 5 ft
T_o = 1.55 min

CONV:
$r = 1\text{in} \times \frac{1\text{ft}}{12\text{in}} = 8.33 \times 10^{-2}$ ✓
$R = 8.33 \times 10^{-2}$ ✓

SUB:
$$K = \frac{(8.33 \times 10^{-2})^2 \ln\left(5/8.33\times10^{-2}\right)}{2(5)(1.55)}$$ ✓

$$= \frac{2.84 \times 10^{-2}}{15.5}$$ ✓

$$= 1.83 \times 10^{-3} \text{ ft/min}$$ ✓

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 2 OF

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY	CHECKED BY	APPROVED BY	DATE

3) CONV:

$$1.83 \times 10^{-3}\ ft/min \times \frac{60\ min}{1\ hr} \times \frac{24\ hr}{1\ day}$$

$$= \underline{2.6\ ft/day}$$ ✓

$$1.83 \times 10^{-3}\ \frac{ft}{min} \times \frac{12\ in}{ft} \times \frac{2.54\ cm}{1\ in} \times \frac{1\ min}{60\ sec}$$

$$= \underline{9.3 \times 10^{-4}\ cm/sec}$$ ✓

$$1.83 \times 10^{-3}\ \frac{ft}{min} \times \frac{1\ min}{60\ sec}$$

$$= \underline{3.1 \times 10^{-5}\ ft/sec}$$ ✓

TETRA-TECH NUS

HYDRAULIC CONDUCTIVITY TEST DATA EVALUATION SHEET
Hvorslev Method

Project Name:	Indian Head Site 57 HRC Pilot Study	**Well/Boring No.:**	S57MW003
Project No.:	4020-0507	**Aquifer Type:**	unconfined
Test Type:	Rising Head	**Test Date:**	25-Sep-03

Done By: FWR
Checked By: FCW

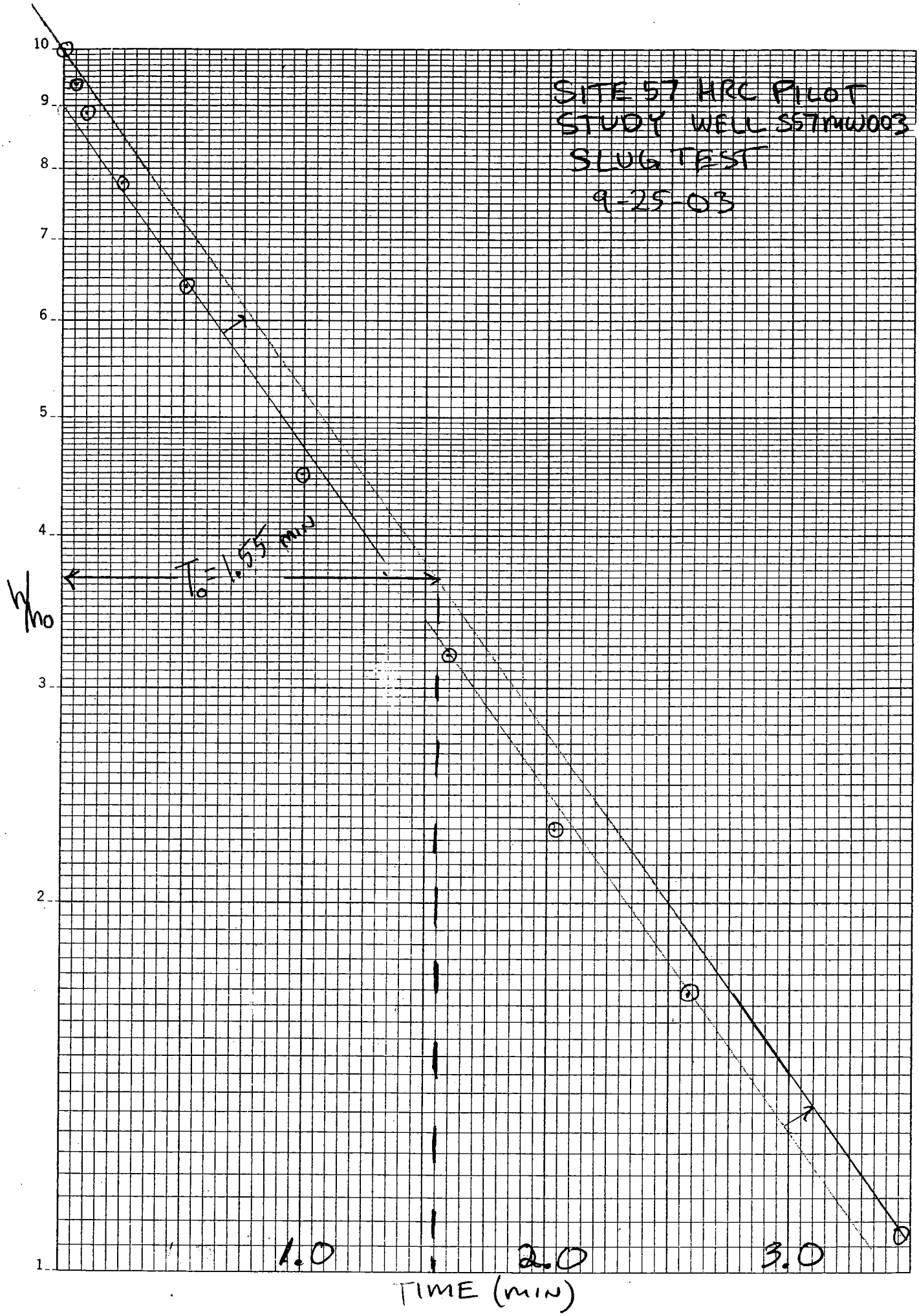
Radius of Well Casing (in.) :	1 = r
Effective Radius of Well Screen (in.) :	1 = R
Length of Well Screen (ft.) :	5 = L
Time for 37% head change (min.) :	1.55 = To ✓

Hydraulic Conductivity (K) :

1.83E-03	ft./min.	✓
3.06E-05	ft./sec.	✓
2.64E+00	ft./day	✓
9.32E-04	cm./sec.	✓

Equation:

$$K = \frac{r^2 \times Ln(L/R)}{2 \times L \times To}$$


SITE 57 HRC PILOT
STUDY WELL S57MW003
SLUG TEST
9-25-03
$T_0 = 1.55$ min
h/h_0
10
9
8
7
6
5
4
3
2
1
1.0
2.0
3.0
TIME (min)
46 4650
K+E SEMI-LOGARITHMIC 1 CYCLE X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

Tetra Tech NUS, Inc.

PROJECT NAME: INDIANHEAD SITE 57 HRC PILOT STUDY WELL/BORING NO.: S57MW03

PROJECT NO.: 4020-0507 GEOLOGIST: FRED W RAMSER

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 5' / 18.99'-23.99' TEST NO.: 1

STATIC WATER LEVEL (Depth/Elevation): 8.55 DATE: 9-25-03

TEST TYPE (Rising/Falling/Constant Head): RISING CHECKED:

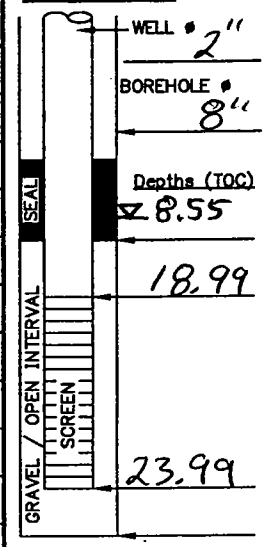
METHOD OF INDUCING WATER LEVEL CHANGE: 2 x 1 l BAILERS PAGE ..... OF .....

REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): STATIC WATER SURFACE = 0.00

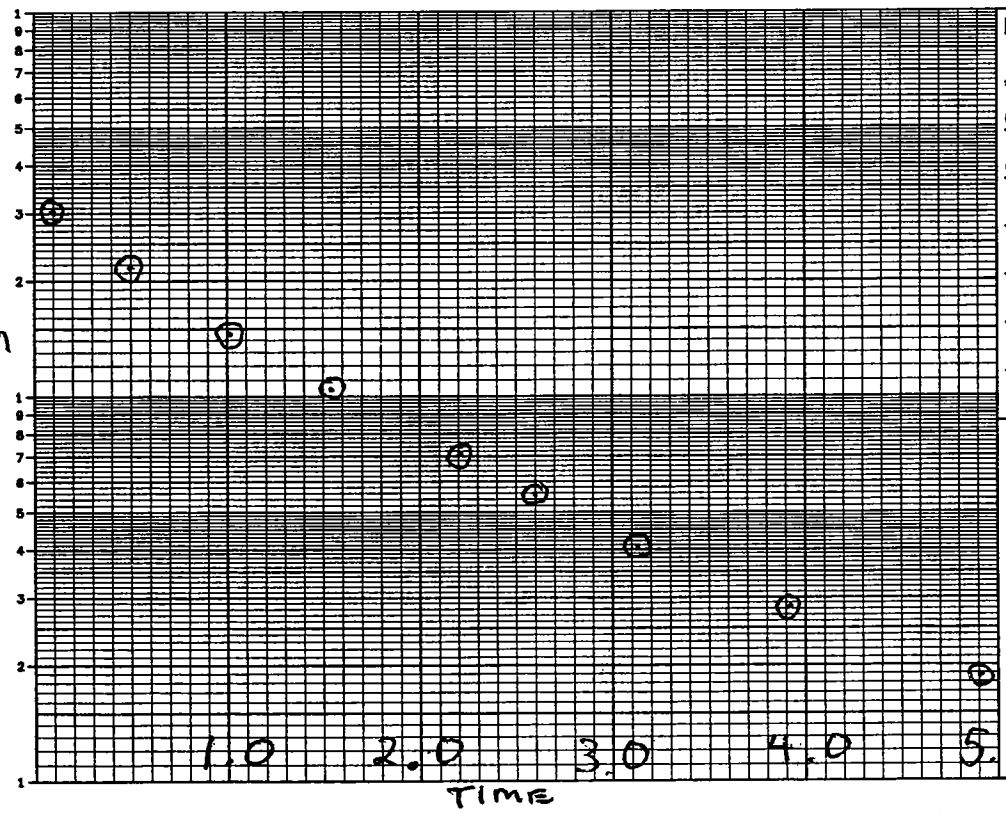
ACAD:FORM_HYDCONTST.dwg 07/06/99 INL

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0.000		0.000	4.97		0.188
0.05		3.247	5.92		0.138
0.10		3.048			
0.25		2.646			
0.50		2.16			
1.04		1.457			
1.56		1.038			
1.75		0.918			
2.21		0.700			
2.63		0.550			
3.13		0.423			
3.94		0.285			

WELL SCHEMATIC



▽ Indicate SWL Depth on Drawing



REMARKS:
INSERTED SLUG (2 x 1 l bailer) @ 1312 HRS
@ 1322 HRS SWL @ 8.55 TPVC
11.725 ft ABOVE X-DUCER
START TEST @ 1309330

CALCS, SKETCH MAPS, ETC.:
STOPPED TEST w/ 11.691 FT ABOVE X-DUCER @ 1400 HR

In-Situ Inc. MiniTroll Pro

Report generated: 9/29/2003 14:39:43
Report from file: H:\Indian Head\slugtests\hrcpilotstudy\SN06213 2003-09-25 132616 S57MW003.bin
DataMgr Version 3.68

Serial number: 6213
Firmware Version 3.06
Unit name: GM-01B

Test name: S57MW003

Test defined on: 9/19/2003 13:09:36
Test started on: 9/25/2003 13:26:16
Test stopped on: 9/25/2003 13:56:08
Test extracted on: N/A

Data gathered using Logarithmic testing
Maximum time between data points Minutes.
Number of data samples: 120

TOTAL DATA SAMPLES 120

Channel number [1]
Measurement type: Temperature
Channel name: OnBoard Temp

Channel number [2]
Measurement type: Pressure
Channel name: water level
Sensor Range: 30 PSI.
Specific gravity: 1
Mode: TOC
User-defined reference: 0 Feet H2O
Referenced on: test start
Pressure head at reference: 11.723 Feet H2O

Date	Time	ET (min)	Chan[1] Celsius	Chan[2] Feet H2O	Adjusted ET. (min)	h/ho	ho = 3.247
9/25/2003	13:26	0	19.06	0			
9/25/2003	13:26	0.005	19.07	2.612			
9/25/2003	13:26	0.01	19.08	9.538			
9/25/2003	13:26	0.015	19.07	3.889			
9/25/2003	13:26	0.02	19.08	3.444			
9/25/2003	13:26	0.025	19.08	3.483			
9/25/2003	13:26	0.03	19.08	3.424			
9/25/2003	13:26	0.035	19.08	3.38			
9/25/2003	13:26	0.04	19.08	3.332			
9/25/2003	13:26	0.045	19.08	3.308			
9/25/2003	13:26	0.05	19.08	3.247	0	1	—
9/25/2003	13:26	0.055	19.08	3.219	0.005	0.991377	
9/25/2003	13:26	0.06	19.08	3.199	0.01	0.985217	
9/25/2003	13:26	0.065	19.08	3.177	0.015	0.978442	
9/25/2003	13:26	0.07	19.1	3.157	0.02	0.972282	
9/25/2003	13:26	0.075	19.08	3.139	0.025	0.966739	
9/25/2003	13:26	0.08	19.08	3.119	0.03	0.960579	
9/25/2003	13:26	0.0848	19.1	3.102	0.0348	0.955343	
9/25/2003	13:26	0.09	19.1	3.084	0.04	0.9498	
9/25/2003	13:26	0.095	19.1	3.066	0.045	0.944256	
9/25/2003	13:26	0.1	19.1	3.048	0.05	0.938713	—
9/25/2003	13:26	0.1058	19.1	3.026	0.0558	0.931937	

9/25/2003 13:26	0.112	19.1	3.006	0.062	0.925778
9/25/2003 13:26	0.1185	19.1	2.984	0.0685	0.919002
9/25/2003 13:26	0.1255	19.1	2.962	0.0755	0.912227
9/25/2003 13:26	0.1328	19.1	2.939	0.0828	0.905143
9/25/2003 13:26	0.1407	19.1	2.917	0.0907	0.898368
9/25/2003 13:26	0.149	19.1	2.891	0.099	0.89036
9/25/2003 13:26	0.1578	19.1	2.867	0.1078	0.882969
9/25/2003 13:26	0.167	19.08	2.847	0.117	0.876809
9/25/2003 13:26	0.177	19.08	2.821	0.127	0.868802
9/25/2003 13:26	0.1875	19.08	2.797	0.1375	0.861411
9/25/2003 13:26	0.1985	19.08	2.767	0.1485	0.852171
9/25/2003 13:26	0.2102	19.08	2.739	0.1602	0.843548
9/25/2003 13:26	0.2227	19.08	2.71	0.1727	0.834617
9/25/2003 13:26	0.2358	19.07	2.677	0.1858	0.824453
9/25/2003 13:26	0.2498	19.08	2.646	0.1998	0.814906
9/25/2003 13:26	0.2647	19.07	2.612	0.2147	0.804435
9/25/2003 13:26	0.2803	19.07	2.576	0.2303	0.793348
9/25/2003 13:26	0.297	19.08	2.542	0.247	0.782877
9/25/2003 13:26	0.3147	19.07	2.504	0.2647	0.771173
9/25/2003 13:26	0.3333	19.07	2.465	0.2833	0.759162
9/25/2003 13:26	0.3532	19.07	2.425	0.3032	0.746843
9/25/2003 13:26	0.3742	19.07	2.385	0.3242	0.734524
9/25/2003 13:26	0.3963	19.07	2.341	0.3463	0.720973
9/25/2003 13:26	0.4198	19.07	2.298	0.3698	0.70773
9/25/2003 13:26	0.4447	19.07	2.254	0.3947	0.694179
9/25/2003 13:26	0.4697	19.07	2.21	0.4197	0.680628
9/25/2003 13:26	0.4963	19.06	2.164	0.4463	0.666461
9/25/2003 13:26	0.5247	19.06	2.116	0.4747	0.651678
9/25/2003 13:26	0.5547	19.06	2.069	0.5047	0.637204
9/25/2003 13:26	0.5863	19.06	2.021	0.5363	0.622421
9/25/2003 13:26	0.6213	19.06	1.967	0.5713	0.60579
9/25/2003 13:26	0.6578	19.06	1.915	0.6078	0.589775
9/25/2003 13:26	0.6963	19.06	1.862	0.6463	0.573452
9/25/2003 13:27	0.738	19.04	1.804	0.688	0.55559
9/25/2003 13:27	0.7813	19.04	1.75	0.7313	0.538959
9/25/2003 13:27	0.828	19.04	1.692	0.778	0.521096
9/25/2003 13:27	0.8763	19.04	1.635	0.8263	0.503542
9/25/2003 13:27	0.928	19.04	1.577	0.878	0.485679
9/25/2003 13:27	0.983	19.04	1.517	0.933	0.4672
9/25/2003 13:27	1.0413	19.03	1.457	0.9913	0.448722
9/25/2003 13:27	1.103	19.03	1.4	1.053	0.431167
9/25/2003 13:27	1.168	19.03	1.338	1.118	0.412073
9/25/2003 13:27	1.238	19.03	1.278	1.188	0.393594
9/25/2003 13:27	1.3113	19.03	1.219	1.2613	0.375423
9/25/2003 13:27	1.3897	19.03	1.157	1.3397	0.356329
9/25/2003 13:27	1.473	19.03	1.095	1.423	0.337234
9/25/2003 13:27	1.5613	19.03	1.038	1.5113	0.31968
9/25/2003 13:27	1.6547	19.03	0.978	1.6047	0.301201
9/25/2003 13:28	1.753	19.03	0.918	1.703	0.282723
9/25/2003 13:28	1.858	19.03	0.863	1.808	0.265784
9/25/2003 13:28	1.968	19.03	0.807	1.918	0.248537
9/25/2003 13:28	2.0847	19.03	0.753	2.0347	0.231906
9/25/2003 13:28	2.2097	19.03	0.7	2.1597	0.215584
9/25/2003 13:28	2.3412	19.03	0.648	2.2912	0.199569
9/25/2003 13:28	2.4813	19.03	0.6	2.4313	0.184786
9/25/2003 13:28	2.6297	19.03	0.55	2.5797	0.169387
9/25/2003 13:29	2.7863	19.03	0.507	2.7363	0.156144
9/25/2003 13:29	2.953	19.02	0.465	2.903	0.143209
9/25/2003 13:29	3.1297	19.02	0.423	3.0797	0.130274
9/25/2003 13:29	3.3163	19.01	0.385	3.2663	0.118571
9/25/2003 13:29	3.5147	19.01	0.349	3.4647	0.107484
9/25/2003 13:30	3.7247	19.01	0.317	3.6747	0.097629
9/25/2003 13:30	3.9463	18.99	0.285	3.8963	0.087773
9/25/2003 13:30	4.1813	18.99	0.259	4.1313	0.079766
9/25/2003 13:30	4.4295	18.99	0.231	4.3795	0.071143

9/25/2003 13:30	4.693	18.99	0.209	4.643	0.064367
9/25/2003 13:31	4.973	18.99	0.188	4.923	0.0579
9/25/2003 13:31	5.2697	18.99	0.17	5.2197	0.052356
9/25/2003 13:31	5.583	18.99	0.152	5.533	0.046812
9/25/2003 13:32	5.9147	18.98	0.138	5.8647	0.042501
9/25/2003 13:32	6.2663	18.97	0.123	6.2163	0.037881
9/25/2003 13:32	6.6397	18.97	0.112	6.5897	0.034493
9/25/2003 13:33	7.0347	18.97	0.102	6.9847	0.031414
9/25/2003 13:33	7.453	18.97	0.094	7.403	0.02895
9/25/2003 13:34	7.8963	18.96	0.087	7.8463	0.026794
9/25/2003 13:34	8.3663	18.96	0.079	8.3163	0.02433
9/25/2003 13:35	8.8647	18.94	0.073	8.8147	0.022482
9/25/2003 13:35	9.3913	18.96	0.068	9.3413	0.020942
9/25/2003 13:36	9.9497	18.94	0.063	9.8997	0.019403
9/25/2003 13:36	10.5413	18.96	0.06	10.4913	0.018479
9/25/2003 13:37	11.168	18.96	0.056	11.118	0.017247
9/25/2003 13:38	11.8313	18.96	0.056	11.7813	0.017247
9/25/2003 13:38	12.5347	18.97	0.052	12.4847	0.016015
9/25/2003 13:39	13.2797	18.97	0.05	13.2297	0.015399
9/25/2003 13:40	14.0697	18.97	0.05	14.0197	0.015399
9/25/2003 13:41	14.9063	18.97	0.046	14.8563	0.014167
9/25/2003 13:42	15.7913	18.98	0.046	15.7413	0.014167
9/25/2003 13:43	16.7297	18.98	0.044	16.6797	0.013551
9/25/2003 13:44	17.723	18.98	0.044	17.673	0.013551
9/25/2003 13:45	18.7763	18.99	0.044	18.7263	0.013551
9/25/2003 13:46	19.8913	19.01	0.043	19.8413	0.013243
9/25/2003 13:47	21.073	19.03	0.041	21.023	0.012627
9/25/2003 13:48	22.3247	19.02	0.041	22.2747	0.012627
9/25/2003 13:49	23.6497	18.99	0.04	23.5997	0.012319
9/25/2003 13:51	25.0547	18.99	0.04	25.0047	0.012319
9/25/2003 13:52	26.543	18.98	0.04	26.493	0.012319
9/25/2003 13:54	28.118	18.96	0.04	28.068	0.012319
9/25/2003 13:56	29.7863	18.96	0.04	29.7363	0.012319

TETRA-TECH NUS

HYDRAULIC CONDUCTIVITY TEST DATA EVALUATION SHEET
Hvorslev Method

Project Name:	Indian Head Site 57 HRC Pilot Study	**Well/Boring No.:**	S57MW004
Project No.:	4020-0507	**Aquifer Type:**	unconfined
Test Type:	Rising Head	**Test Date:**	25-Sep-03

Done By: FREDDY RAMSER
Checked By: FCW

Radius of Well Casing (in.) :	1	= r
Effective Radius of Well Screen (in.) :	1	= R
Length of Well Screen (ft.) :	9.37	= L
Time for 37% head change (min.) :	0.23	= To

Hydraulic Conductivity (K) :

7.61E-03	ft./min.
1.27E-04	ft./sec.
1.10E+01	ft./day
3.87E-03	cm./sec.

Equation:

$$K = \frac{r^2 \times Ln(L/R)}{2 \times L \times To}$$

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

Tetra Tech NUS, Inc.

PROJECT NAME: INDIANHEAD SITE 57 HRC PILOT STUDY WELL/BORING NO.: S57MW04

PROJECT NO.: 4020-0507 GEOLOGIST: FRED W. RAMSER

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10', 7.97'-17.97' TEST NO.: 1

STATIC WATER LEVEL (Depth/Elevation): 8.60 DATE: 9-25-03

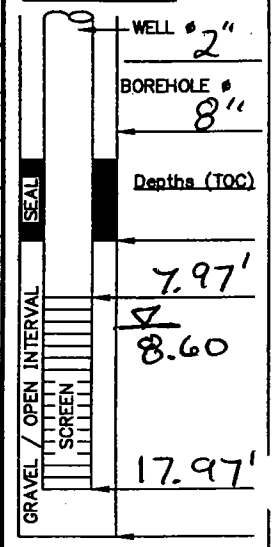
TEST TYPE (Rising/Falling/Constant Head): RISING CHECKED:

METHOD OF INDUCING WATER LEVEL CHANGE: 2x 1L BAILERS PAGE ..... OF .....

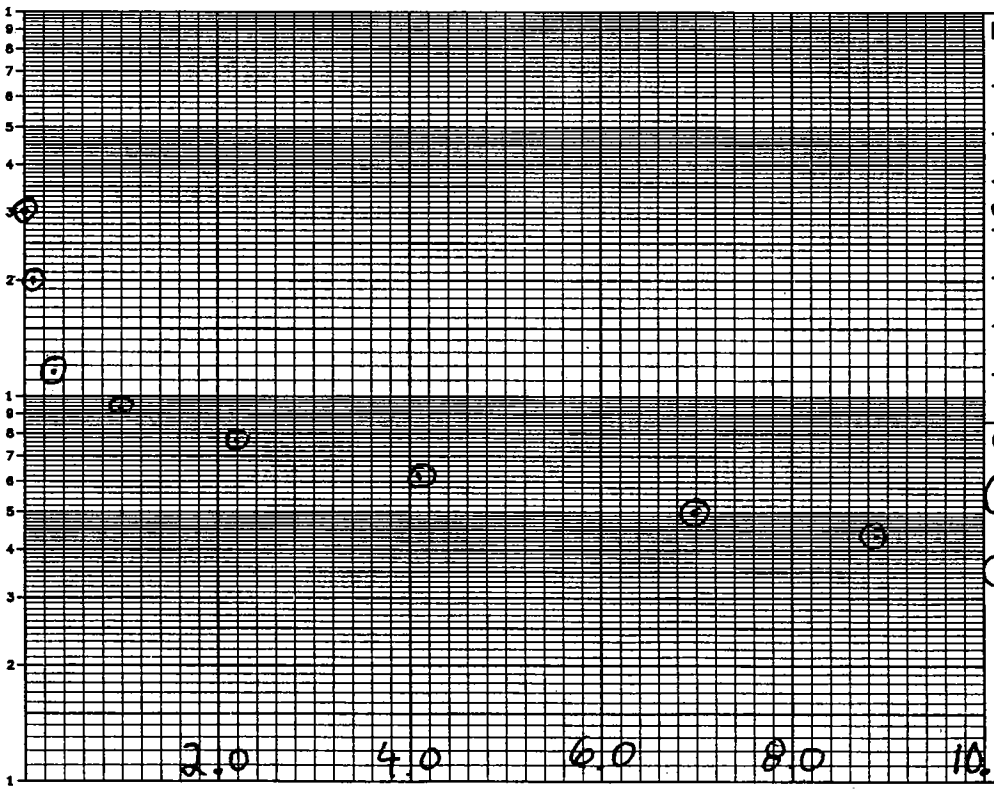
REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): STATIC WATER SURFACE = 0.00

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0.00		0.00	5.27	0.568	
0.05		3.04	7.03	0.504	
0.075		2.57	8.86	0.437	
0.100		2.15	10.54	0.383	
0.149		1.50	12.53	0.328	
0.250		1.16	15.79	0.257	
0.496		1.02	19.89	0.166	
1.04		0.909			
1.75		0.823			
2.21		0.779			
3.13		0.709			
4.18		0.64			

WELL SCHEMATIC



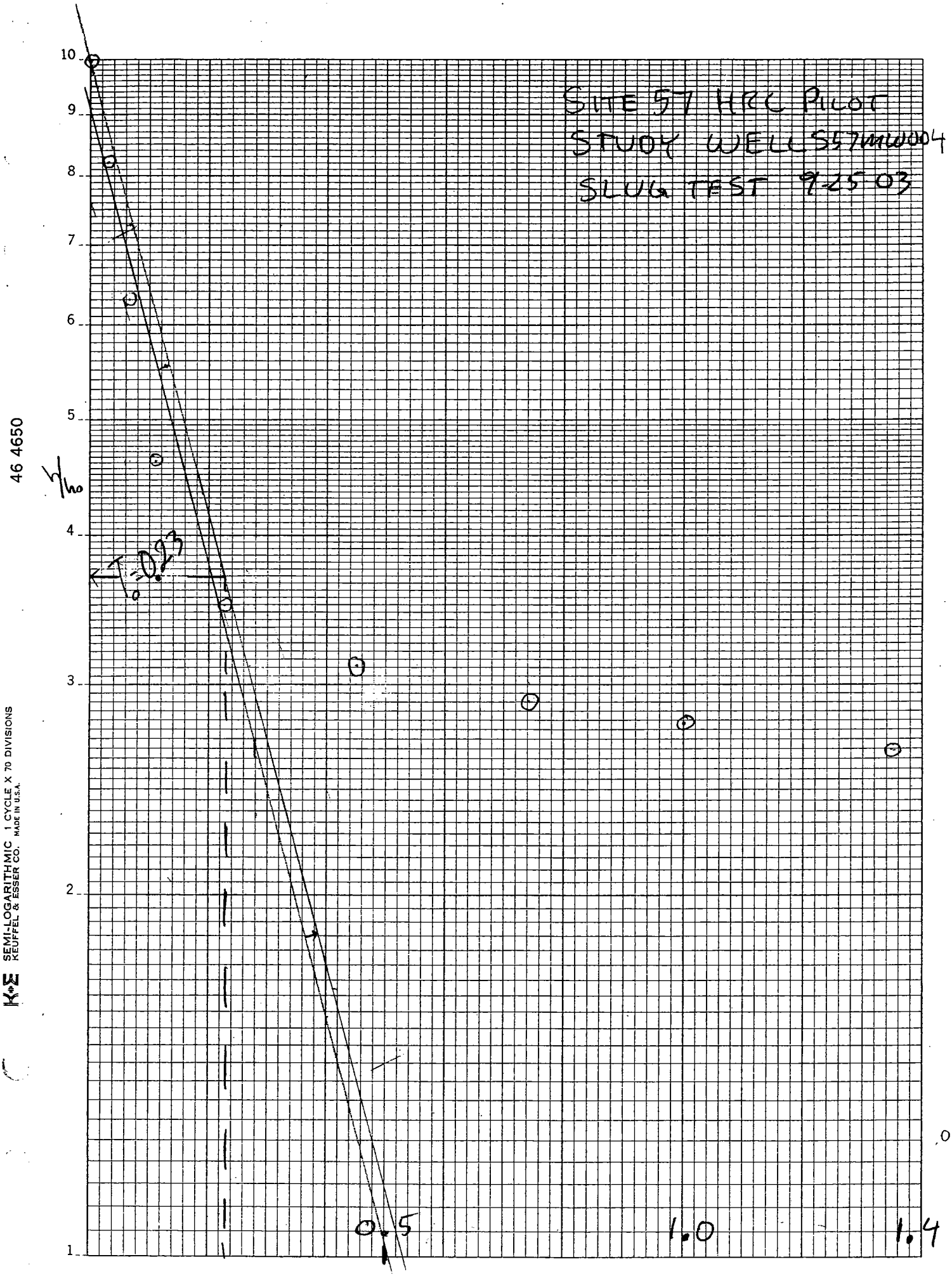
▽ Indicate SWL Depth on Drawing



REMARKS:
INSERTED SLUG @ 1412 HRS
MEASURED WATER LEVEL OF 8.60 @ 1430 HRS
9.184' H_2O ABOVE X-DUCER BEFORE TEST
STARTED TEST @ 1435 HRS

CALCS, SKETCH MAPS, ETC.:
@ 1500 HRS: 9.102' H_2O ABOVE X-DUCER
@ 1510 HRS: 9.142' H_2O ABOVE X-DUCER
STOPPED TEST @ 1513

ACAD:FORM_HYDCONTST.dwg 07/06/99 INL


SITE 57 HRC PILOT
STUDY WELL S57MW0004
SLUG TEST 9-25-03
10
9
8
7
6
5
4
3
2
1
h/h0
T0 = 0.23
0.5
1.0
1.4
46 4650
K+E SEMI-LOGARITHMIC 1 CYCLE X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

.033

In-Situ Inc. MiniTroll Pro

Report generated: 9/29/2003 14:44:38
Report from file: H:\Indian Head\slugtests\hrcpilotstudy\SN06213 2003-09-25 143244 S57MW004.bin
DataMgr Version 3.68

Serial number: 6213
Firmware Version 3.06
Unit name: GM-01B

Test name: S57MW004

Test defined on: 9/19/2003 13:16:45
Test started on: 9/25/2003 14:32:44
Test stopped on: 9/25/2003 15:08:21
Test extracted on: N/A

Data gathered using Logarithmic testing
Maximum time between data points: Minutes.
Number of data samples: 123

TOTAL DATA SAMPLES 123

Channel number [1]
Measurement type: Temperature
Channel name: OnBoard Temp

Channel number [2]
Measurement type: Pressure
Channel name: water level
Sensor Range: 30 PSI.
Specific gravity: 1
Mode: TOC
User-defined reference: 0 Feet H2O
Referenced on: test start
Pressure head at reference: 9.181 Feet H2O

Date	Time	ET (min)	Chan[1] Celsius	Chan[2] Feet H2O	Adjusted ET. (min)	h/ho	ho = 3.255
9/25/2003	14:32	0	20.05	0			
9/25/2003	14:32	0.005	20.06	-0.01			
9/25/2003	14:32	0.01	20.08	-0.011			
9/25/2003	14:32	0.015	20.08	-0.015			
9/25/2003	14:32	0.02	20.08	4.238			
9/25/2003	14:32	0.025	20.08	6.515			
9/25/2003	14:32	0.03	20.08	3.464			
9/25/2003	14:32	0.035	20.08	3.221			
9/25/2003	14:32	0.04	20.08	3.255	0	1.000	
9/25/2003	14:32	0.045	20.08	3.142	0.005	0.965	
9/25/2003	14:32	0.05	20.08	3.038	0.01	0.933	
9/25/2003	14:32	0.055	20.08	2.941	0.015	0.904	
9/25/2003	14:32	0.06	20.08	2.855	0.02	0.877	
9/25/2003	14:32	0.065	20.08	2.756	0.025	0.847	
9/25/2003	14:32	0.07	20.08	2.668	0.03	0.820	
9/25/2003	14:32	0.075	20.09	2.573	0.035	0.790	
9/25/2003	14:32	0.08	20.09	2.485	0.04	0.763	
9/25/2003	14:32	0.0848	20.08	2.402	0.0448	0.738	
9/25/2003	14:32	0.09	20.09	2.314	0.05	0.711	
9/25/2003	14:32	0.095	20.08	2.233	0.055	0.686	
9/25/2003	14:32	0.1	20.09	2.147	0.06	0.660	
9/25/2003	14:32	0.1058	20.09	2.056	0.0658	0.632	

9/25/2003 14:32	0.112	20.09	1.96	0.072	0.602
9/25/2003 14:32	0.1185	20.09	1.865	0.0785	0.573
9/25/2003 14:32	0.1255	20.09	1.767	0.0855	0.543
9/25/2003 14:32	0.1328	20.09	1.672	0.0928	0.514
9/25/2003 14:32	0.1407	20.09	1.584	0.1007	0.487
9/25/2003 14:32	0.149	20.09	1.503	0.109	0.462
9/25/2003 14:32	0.1578	20.09	1.431	0.1178	0.440
9/25/2003 14:32	0.167	20.08	1.379	0.127	0.424
9/25/2003 14:32	0.177	20.08	1.331	0.137	0.409
9/25/2003 14:32	0.1875	20.08	1.29	0.1475	0.396
9/25/2003 14:32	0.1985	20.08	1.256	0.1585	0.386
9/25/2003 14:32	0.2102	20.08	1.23	0.1702	0.378
9/25/2003 14:32	0.2227	20.08	1.204	0.1827	0.370
9/25/2003 14:32	0.2358	20.08	1.182	0.1958	0.363
9/25/2003 14:32	0.2498	20.08	1.164	0.2098	0.358
9/25/2003 14:33	0.2647	20.08	1.144	0.2247	0.351
9/25/2003 14:33	0.2803	20.08	1.13	0.2403	0.347
9/25/2003 14:33	0.297	20.08	1.115	0.257	0.343
9/25/2003 14:33	0.3147	20.08	1.103	0.2747	0.339
9/25/2003 14:33	0.3333	20.08	1.089	0.2933	0.335
9/25/2003 14:33	0.3532	20.08	1.077	0.3132	0.331
9/25/2003 14:33	0.3742	20.08	1.067	0.3342	0.328
9/25/2003 14:33	0.3963	20.06	1.057	0.3563	0.325
9/25/2003 14:33	0.4198	20.08	1.045	0.3798	0.321
9/25/2003 14:33	0.4447	20.06	1.035	0.4047	0.318
9/25/2003 14:33	0.4697	20.06	1.025	0.4297	0.315
9/25/2003 14:33	0.4963	20.08	1.017	0.4563	0.312
9/25/2003 14:33	0.5247	20.06	1.009	0.4847	0.310
9/25/2003 14:33	0.5547	20.06	1.001	0.5147	0.308
9/25/2003 14:33	0.5863	20.06	0.991	0.5463	0.304
9/25/2003 14:33	0.6213	20.06	0.983	0.5813	0.302
9/25/2003 14:33	0.6578	20.06	0.975	0.6178	0.300
9/25/2003 14:33	0.6963	20.06	0.967	0.6563	0.297
9/25/2003 14:33	0.738	20.06	0.959	0.698	0.295
9/25/2003 14:33	0.7813	20.06	0.949	0.7413	0.292
9/25/2003 14:33	0.828	20.06	0.941	0.788	0.289
9/25/2003 14:33	0.8763	20.06	0.935	0.8363	0.287
9/25/2003 14:33	0.928	20.05	0.925	0.888	0.284
9/25/2003 14:33	0.983	20.05	0.915	0.943	0.281
9/25/2003 14:33	1.0413	20.05	0.909	1.0013	0.279
9/25/2003 14:33	1.103	20.05	0.897	1.063	0.276
9/25/2003 14:33	1.168	20.05	0.891	1.128	0.274
9/25/2003 14:33	1.238	20.05	0.881	1.198	0.271
9/25/2003 14:34	1.3113	20.04	0.871	1.2713	0.268
9/25/2003 14:34	1.3897	20.04	0.861	1.3497	0.265
9/25/2003 14:34	1.473	20.04	0.851	1.433	0.261
9/25/2003 14:34	1.5613	20.04	0.843	1.5213	0.259
9/25/2003 14:34	1.6547	20.04	0.833	1.6147	0.256
9/25/2003 14:34	1.753	20.04	0.823	1.713	0.253
9/25/2003 14:34	1.858	20.03	0.813	1.818	0.250
9/25/2003 14:34	1.968	20.03	0.801	1.928	0.246
9/25/2003 14:34	2.0847	20.03	0.791	2.0447	0.243
9/25/2003 14:34	2.2097	20.03	0.779	2.1697	0.239
9/25/2003 14:35	2.3412	20.03	0.769	2.3012	0.236
9/25/2003 14:35	2.4813	20.03	0.757	2.4413	0.233
9/25/2003 14:35	2.6297	20.01	0.745	2.5897	0.229
9/25/2003 14:35	2.7863	20.01	0.733	2.7463	0.225
9/25/2003 14:35	2.953	20.01	0.721	2.913	0.222
9/25/2003 14:35	3.1297	20.01	0.709	3.0897	0.218
9/25/2003 14:36	3.3163	20.01	0.695	3.2763	0.214
9/25/2003 14:36	3.5147	20.01	0.683	3.4747	0.210
9/25/2003 14:36	3.7247	20	0.669	3.6847	0.206
9/25/2003 14:36	3.9463	20	0.653	3.9063	0.201
9/25/2003 14:36	4.1813	20	0.641	4.1413	0.197
9/25/2003 14:37	4.4295	20	0.628	4.3895	0.193

9/25/2003 14:37	4.693	20	0.612	4.653	0.188
9/25/2003 14:37	4.973	20	0.58	4.933	0.178
9/25/2003 14:38	5.2697	20.01	0.568	5.2297	0.175
9/25/2003 14:38	5.583	20	0.568	5.543	0.175
9/25/2003 14:38	5.9147	20	0.554	5.8747	0.170
9/25/2003 14:39	6.2663	20.01	0.538	6.2263	0.165
9/25/2003 14:39	6.6397	20.01	0.522	6.5997	0.160
9/25/2003 14:39	7.0347	20.01	0.504	6.9947	0.155
9/25/2003 14:40	7.453	20.01	0.489	7.413	0.150
9/25/2003 14:40	7.8963	20	0.472	7.8563	0.145
9/25/2003 14:41	8.3663	20	0.454	8.3263	0.139
9/25/2003 14:41	8.8647	20.01	0.437	8.8247	0.134
9/25/2003 14:42	9.3913	20.01	0.419	9.3513	0.129
9/25/2003 14:42	9.9497	20.03	0.399	9.9097	0.123
9/25/2003 14:43	10.5413	20.03	0.383	10.5013	0.118
9/25/2003 14:43	11.168	20.04	0.364	11.128	0.112
9/25/2003 14:44	11.8313	20.04	0.346	11.7913	0.106
9/25/2003 14:45	12.5347	20.05	0.328	12.4947	0.101
9/25/2003 14:46	13.2797	20.05	0.312	13.2397	0.096
9/25/2003 14:46	14.0697	20.05	0.292	14.0297	0.090
9/25/2003 14:47	14.9063	20.06	0.275	14.8663	0.084
9/25/2003 14:48	15.7913	20.08	0.257	15.7513	0.079
9/25/2003 14:49	16.7297	20.08	0.239	16.6897	0.073
9/25/2003 14:50	17.723	20.08	0.217	17.683	0.067
9/25/2003 14:51	18.7763	20.08	0.193	18.7363	0.059
9/25/2003 14:52	19.8913	20.08	0.166	19.8513	0.051
9/25/2003 14:53	21.073	20.08	0.142	21.033	0.044
9/25/2003 14:55	22.3247	20.08	0.118	22.2847	0.036
9/25/2003 14:56	23.6497	20.08	0.1	23.6097	0.031
9/25/2003 14:57	25.0547	20.09	0.084	25.0147	0.026
9/25/2003 14:59	26.543	20.1	0.073	26.503	0.022
9/25/2003 15:00	28.118	20.09	0.062	28.078	0.019
9/25/2003 15:02	29.7863	20.08	0.056	29.7463	0.017
9/25/2003 15:04	31.5547	20.08	0.05	31.5147	0.015
9/25/2003 15:06	33.428	20.08	0.046	33.388	0.014
9/25/2003 15:08	35.4112	20.06	0.044	35.3712	0.014

TETRA-TECH NUS

HYDRAULIC CONDUCTIVITY TEST DATA EVALUATION SHEET
Hvorslev Method

Project Name:	Indian Head Site 57 HRC Pilot Study	**Well/Boring No.:**	S57MW011
Project No.:	4020-0507	**Aquifer Type:**	unconfined
Test Type:	Rising Head	**Test Date:**	25-Sep-03

Done By: FRED W RAMSEN
Checked By: FCW

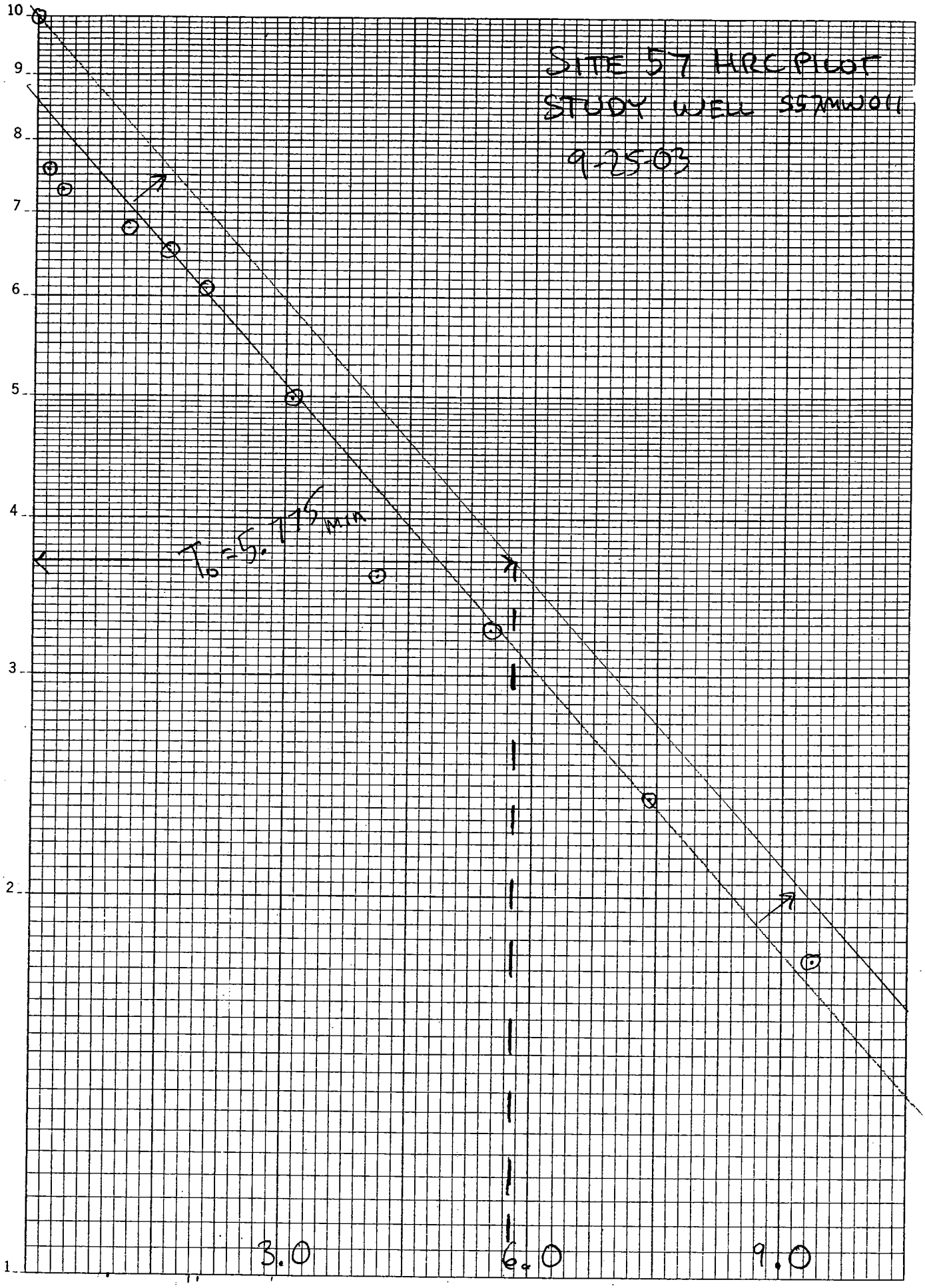
Radius of Well Casing (in.) :	1 = r
Effective Radius of Well Screen (in.) :	1 = R
Length of Well Screen (ft.) :	10 = L
Time for 37% head change (min.) :	5.78 = To ✓

Hydraulic Conductivity (K) :

2.88E-04	ft./min.	✓
4.80E-06	ft./sec.	✓
4.15E-01	ft./day	✓
1.46E-04	cm./sec.	✓

Equation:

$$K = \frac{r^2 \times Ln(L/R)}{2 \times L \times To}$$



46 4650
K+E SEMI-LOGARITHMIC 1 CYCLE X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

Tetra Tech NUS, Inc.

PROJECT NAME: INDIAN HEAD SITE 57 HRC PILOT STUDY WELL/BORING NO.: S57MW11

PROJECT NO.: 4020-0507 GEOLOGIST: FRED W. RAMSER

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10', 10.61-20.61 TEST NO.: 1

STATIC WATER LEVEL (Depth/Elevation): 8.85 TPVC DATE: 9-25-03

TEST TYPE (Rising/Falling/Constant Head): RISING CHECKED:

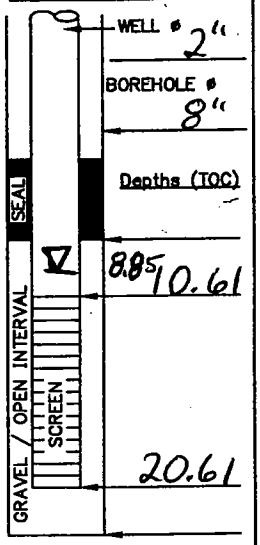
METHOD OF INDUCING WATER LEVEL CHANGE: 2 & 1 ℓ BAILERS ~6' LONG PAGE ..... OF .....

REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): STATIC WL = 0.00 REF.

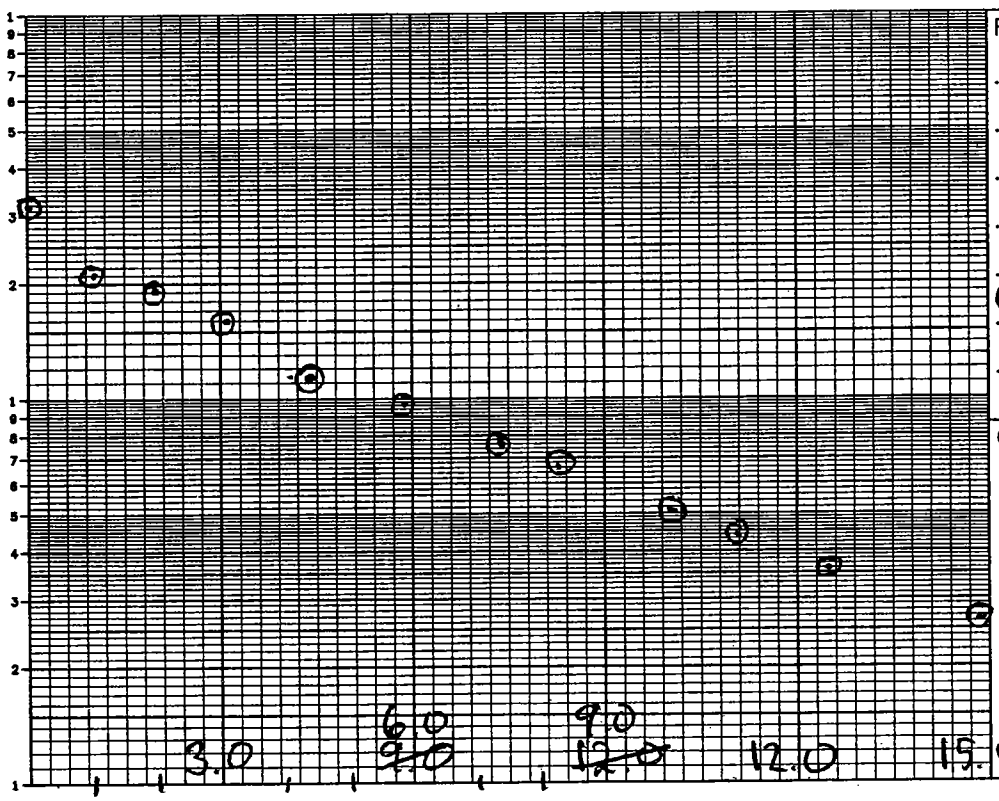
ACAD:FORM_HYDCONTST.dwg 07/06/99 INL

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0.00		0.00	12.54		0.364
0.05		3.22	14.91		0.260
0.16		2.50	16.73		0.205
1.04		2.21	18.78		0.155
2.09		1.96	21.07		0.113
3.13		1.61			
4.43		1.16			
5.95		0.993			
7.45		0.774			
8.37		0.668			
9.95		0.527			
11.17		0.441			

WELL SCHEMATIC



▽ Indicate SWL Depth on Drawing



REMARKS:
INSERTED SLUG @ 1530
AT 1604: 11.688' H2O ABOVE X-DUCER BEFORE TEST. STARTED TEST @ 1610
STOPPED TEST @ 1647

CALCS, SKETCH MAPS, ETC.:

In-Situ Inc. MiniTroll Pro

Report generated: 9/29/2003 14:46:36
Report from file: H:\Indian Head\slugtests\hrcpilotstudy\SN06213 2003-09-25 160527 S57MW011.bin
DataMgr Version 3.68

Serial number: 6213
Firmware Version 3.06
Unit name: GM-01B

Test name: S57MW011

Test defined on: 9/19/2003 13:17:37
Test started on: 9/25/2003 16:05:27
Test stopped on: 9/25/2003 16:42:08
Test extracted on: N/A

Data gathered using Logarithmic testing
Maximum time between data points: Minutes.
Number of data samples: 123

TOTAL DATA SAMPLES 123

Channel number [1]
Measurement type: Temperature
Channel name: OnBoard Temp

Channel number [2]
Measurement type: Pressure
Channel name: water level
Sensor Range: 30 PSI.
Specific gravity: 1
Mode: TOC
User-defined reference: 0 Feet H2O
Referenced on: test start
Pressure head at reference: 11.68 Feet H2O

Date	Time	ET (min)	Chan[1] Celsius	Chan[2] Feet H2O	Adjusted ET. (min)	h/ho	ho = 3.219
9/25/2003	16:05	0	19.03	0			
9/25/2003	16:05	0.005	19.04	-0.014			
9/25/2003	16:05	0.01	19.06	-0.015			
9/25/2003	16:05	0.015	19.06	-0.019			
9/25/2003	16:05	0.02	19.06	10.378			
9/25/2003	16:05	0.025	19.06	7.636			
9/25/2003	16:05	0.03	19.06	3.969			
9/25/2003	16:05	0.035	19.06	3.463			
9/25/2003	16:05	0.04	19.06	3.314			
9/25/2003	16:05	0.045	19.06	3.276			
9/25/2003	16:05	0.05	19.06	3.219	0	1.000	—
9/25/2003	16:05	0.055	19.06	3.163	0.005	0.983	
9/25/2003	16:05	0.06	19.06	3.103	0.01	0.964	
9/25/2003	16:05	0.065	19.06	3.058	0.015	0.950	
9/25/2003	16:05	0.07	19.07	3.01	0.02	0.935	
9/25/2003	16:05	0.075	19.07	2.964	0.025	0.921	

9/25/2003 16:05	0.08	19.07	2.923	0.03	0.908
9/25/2003 16:05	0.0848	19.07	2.881	0.0348	0.895
9/25/2003 16:05	0.09	19.07	2.839	0.04	0.882
9/25/2003 16:05	0.095	19.07	2.801	0.045	0.870
9/25/2003 16:05	0.1	19.07	2.765	0.05	0.859
9/25/2003 16:05	0.1058	19.07	2.726	0.0558	0.847
9/25/2003 16:05	0.112	19.07	2.688	0.062	0.835
9/25/2003 16:05	0.1185	19.07	2.65	0.0685	0.823
9/25/2003 16:05	0.1255	19.07	2.614	0.0755	0.812
9/25/2003 16:05	0.1328	19.07	2.581	0.0828	0.802
9/25/2003 16:05	0.1407	19.07	2.551	0.0907	0.792
9/25/2003 16:05	0.149	19.07	2.525	0.099	0.784
9/25/2003 16:05	0.1578	19.07	2.501	0.1078	0.777
9/25/2003 16:05	0.167	19.06	2.485	0.117	0.772
9/25/2003 16:05	0.177	19.06	2.469	0.127	0.767
9/25/2003 16:05	0.1875	19.06	2.453	0.1375	0.762
9/25/2003 16:05	0.1985	19.06	2.439	0.1485	0.758
9/25/2003 16:05	0.2102	19.06	2.425	0.1602	0.753
9/25/2003 16:05	0.2227	19.06	2.415	0.1727	0.750
9/25/2003 16:05	0.2358	19.06	2.405	0.1858	0.747
9/25/2003 16:05	0.2498	19.06	2.395	0.1998	0.744
9/25/2003 16:05	0.2647	19.06	2.387	0.2147	0.742
9/25/2003 16:05	0.2803	19.06	2.377	0.2303	0.738
9/25/2003 16:05	0.297	19.06	2.371	0.247	0.737
9/25/2003 16:05	0.3147	19.06	2.365	0.2647	0.735
9/25/2003 16:05	0.3333	19.06	2.357	0.2833	0.732
9/25/2003 16:05	0.3532	19.06	2.35	0.3032	0.730
9/25/2003 16:05	0.3742	19.06	2.344	0.3242	0.728
9/25/2003 16:05	0.3963	19.06	2.338	0.3463	0.726
9/25/2003 16:05	0.4198	19.06	2.332	0.3698	0.724
9/25/2003 16:05	0.4447	19.06	2.326	0.3947	0.723
9/25/2003 16:05	0.4697	19.06	2.318	0.4197	0.720
9/25/2003 16:05	0.4963	19.06	2.312	0.4463	0.718
9/25/2003 16:05	0.5247	19.06	2.306	0.4747	0.716
9/25/2003 16:06	0.5547	19.06	2.298	0.5047	0.714
9/25/2003 16:06	0.5863	19.06	2.292	0.5363	0.712
9/25/2003 16:06	0.6213	19.06	2.286	0.5713	0.710
9/25/2003 16:06	0.6578	19.06	2.278	0.6078	0.708
9/25/2003 16:06	0.6963	19.04	2.272	0.6463	0.706
9/25/2003 16:06	0.738	19.04	2.264	0.688	0.703
9/25/2003 16:06	0.7813	19.06	2.254	0.7313	0.700
9/25/2003 16:06	0.828	19.04	2.246	0.778	0.698
9/25/2003 16:06	0.8763	19.04	2.238	0.8263	0.695
9/25/2003 16:06	0.928	19.04	2.228	0.878	0.692
9/25/2003 16:06	0.983	19.04	2.22	0.933	0.690
9/25/2003 16:06	1.0413	19.04	2.208	0.9913	0.686
9/25/2003 16:06	1.103	19.04	2.2	1.053	0.683
9/25/2003 16:06	1.168	19.04	2.188	1.118	0.680
9/25/2003 16:06	1.238	19.04	2.178	1.188	0.677
9/25/2003 16:06	1.3113	19.04	2.166	1.2613	0.673
9/25/2003 16:06	1.3897	19.04	2.152	1.3397	0.669
9/25/2003 16:06	1.473	19.04	2.138	1.423	0.664
9/25/2003 16:07	1.5613	19.04	2.12	1.5113	0.659
9/25/2003 16:07	1.6547	19.03	2.102	1.6047	0.653
9/25/2003 16:07	1.753	19.03	2.082	1.703	0.647
9/25/2003 16:07	1.858	19.03	2.051	1.808	0.637
9/25/2003 16:07	1.968	19.03	2.007	1.918	0.623
9/25/2003 16:07	2.0847	19.03	1.959	2.0347	0.609
9/25/2003 16:07	2.2097	19.03	1.911	2.1597	0.594

9/25/2003 16:07	2.3412	19.03	1.866	2.2912	0.580
9/25/2003 16:07	2.4813	19.03	1.816	2.4313	0.564
9/25/2003 16:08	2.6297	19.03	1.766	2.5797	0.549
9/25/2003 16:08	2.7863	19.03	1.714	2.7363	0.532
9/25/2003 16:08	2.953	19.02	1.66	2.903	0.516
9/25/2003 16:08	3.1297	19.02	1.607	3.0797	0.499
9/25/2003 16:08	3.3163	19.04	1.184	3.2663	0.368
9/25/2003 16:08	3.5147	19.06	1.17	3.4647	0.363
9/25/2003 16:09	3.7247	19.07	1.164	3.6747	0.362
9/25/2003 16:09	3.9463	19.07	1.162	3.8963	0.361
9/25/2003 16:09	4.1813	19.07	1.158	4.1313	0.360
9/25/2003 16:09	4.4295	19.08	1.157	4.3795	0.359
9/25/2003 16:10	4.693	19.08	1.155	4.643	0.359
9/25/2003 16:10	4.973	19.06	1.16	4.923	0.360
9/25/2003 16:10	5.2697	19.06	1.106	5.2197	0.344
9/25/2003 16:11	5.583	19.07	1.051	5.533	0.326
9/25/2003 16:11	5.9147	19.07	0.993	5.8647	0.308
9/25/2003 16:11	6.2663	19.07	0.938	6.2163	0.291
9/25/2003 16:12	6.6397	19.06	0.882	6.5897	0.274
9/25/2003 16:12	7.0347	19.06	0.828	6.9847	0.257
9/25/2003 16:12	7.453	19.04	0.774	7.403	0.240
9/25/2003 16:13	7.8963	19.04	0.72	7.8463	0.224
9/25/2003 16:13	8.3663	19.03	0.668	8.3163	0.208
9/25/2003 16:14	8.8647	19.03	0.621	8.8147	0.193
9/25/2003 16:14	9.3913	19.03	0.573	9.3413	0.178
9/25/2003 16:15	9.9497	19.02	0.527	9.8997	0.164
9/25/2003 16:15	10.5413	19.02	0.483	10.4913	0.150
9/25/2003 16:16	11.168	19.02	0.441	11.118	0.137
9/25/2003 16:17	11.8313	19.02	0.401	11.7813	0.125
9/25/2003 16:17	12.5347	19.02	0.364	12.4847	0.113
9/25/2003 16:18	13.2797	19.02	0.326	13.2297	0.101
9/25/2003 16:19	14.0697	19.02	0.292	14.0197	0.091
9/25/2003 16:20	14.9063	19.02	0.26	14.8563	0.081
9/25/2003 16:21	15.7913	19.01	0.232	15.7413	0.072
9/25/2003 16:22	16.7297	19.02	0.205	16.6797	0.064
9/25/2003 16:23	17.723	19.02	0.181	17.673	0.056
9/25/2003 16:24	18.7763	19.02	0.155	18.7263	0.048
9/25/2003 16:25	19.8913	19.01	0.133	19.8413	0.041
9/25/2003 16:26	21.073	19.02	0.113	21.023	0.035
9/25/2003 16:27	22.3247	19.01	0.097	22.2747	0.030
9/25/2003 16:29	23.6497	19.01	0.081	23.5997	0.025
9/25/2003 16:30	25.0547	19.01	0.065	25.0047	0.020
9/25/2003 16:31	26.543	19.01	0.053	26.493	0.016
9/25/2003 16:33	28.118	19.03	0.04	28.068	0.012
9/25/2003 16:35	29.7863	19.03	0.03	29.7363	0.009
9/25/2003 16:37	31.5547	19.01	0.023	31.5047	0.007
9/25/2003 16:38	33.428	19.01	0.019	33.378	0.006
9/25/2003 16:40	35.4112	19.01	0.017	35.3612	0.005

TETRA-TECH NUS

HYDRAULIC CONDUCTIVITY TEST DATA EVALUATION SHEET
Hvorslev Method

Project Name:	Indian Head Site 57 HRC Pilot Study	**Well/Boring No.:**	S57MW024
Project No.:	4020-0507	**Aquifer Type:**	unconfined
Test Type:	Rising Head	**Test Date:**	25-Sep-03

Done By: ERFOWRAMSR
Checked By: FCW

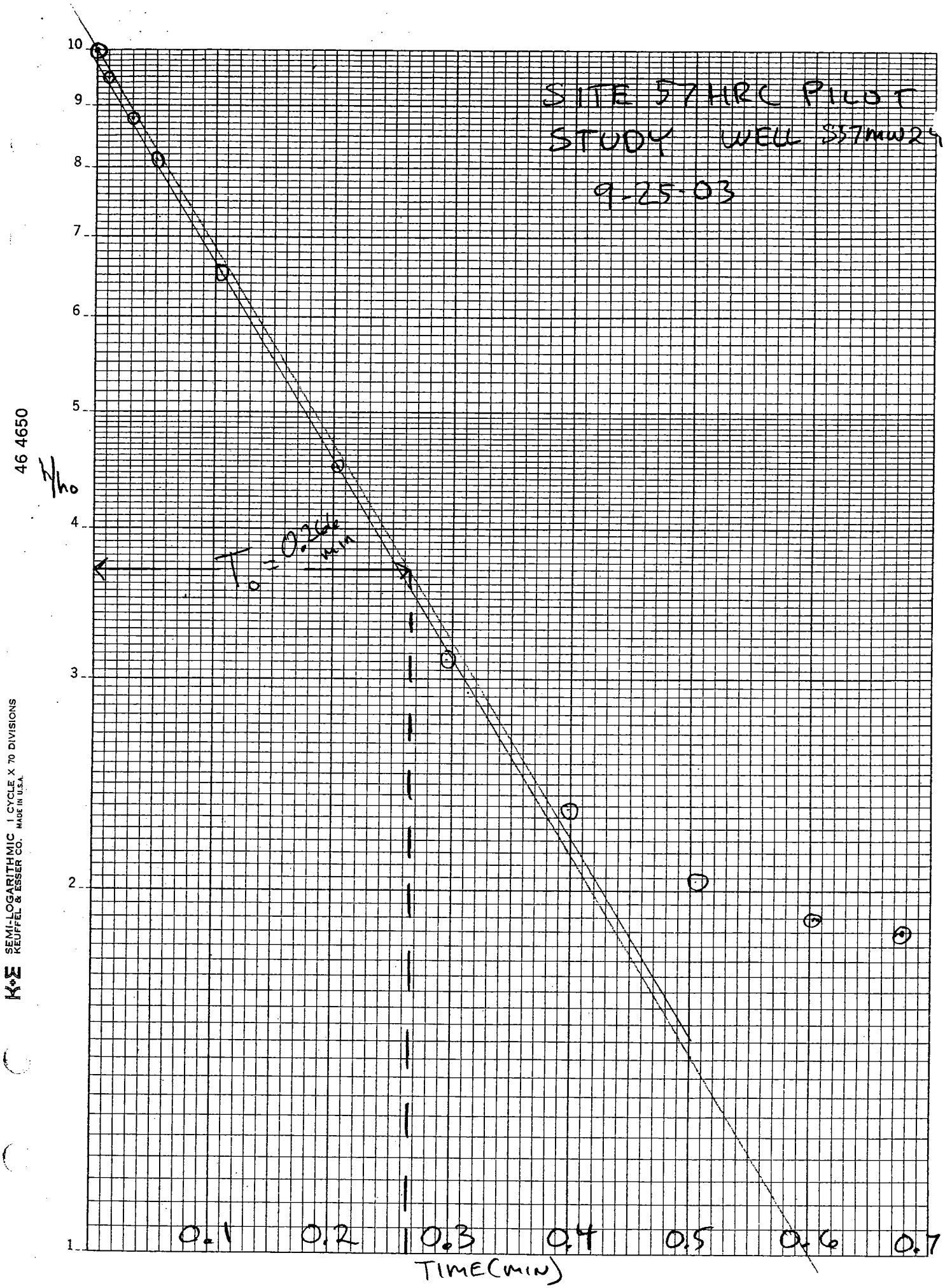
Radius of Well Casing (in.) :	1 = r
Effective Radius of Well Screen (in.) :	1 = R
Length of Well Screen (ft.) :	6.35 = L ✓
Time for 37% head change (min.) :	0.27 = To ✓

Hydraulic Conductivity (K) :

8.91E-03	ft./min.	✓
1.48E-04	ft./sec.	✓
1.28E+01	ft./day	✓
4.53E-03	cm./sec.	✓

Equation:

$$K = \frac{r^2 \times Ln(L/R)}{2 \times L \times To}$$


SITE 57 HRC PILOT
STUDY WELL S57MW24
9-25-03
h/ho
10
9
8
7
6
5
4
3
2
1
$T_o = 0.366$ min
0.1
0.2
0.3
0.4
0.5
0.6
0.7
TIME (MIN)
46 4650
K+E SEMI-LOGARITHMIC 1 CYCLE X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

Tetra Tech NUS, Inc.

PROJECT NAME: INDIANHEADSITE57 HRC PILOT STUDY WELL/BORING NO.: S57MW024

PROJECT NO.: 4020-0507 GEOLOGIST: FRED W. RAMSER

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10' / 2.55'-12.55' TEST NO.:

STATIC WATER LEVEL (Depth/Elevation): 6.20 DATE: 9-25-03

TEST TYPE (Rising/Falling/Constant Head): RISING CHECKED:

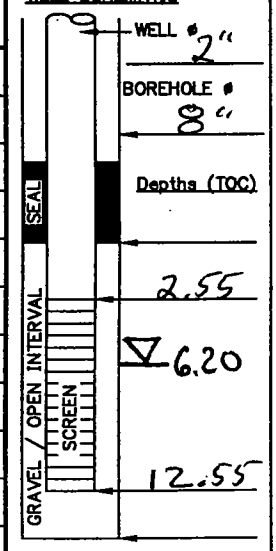
METHOD OF INDUCING WATER LEVEL CHANGE: 2 x 1 l BAILERS (LESS ~0.8') PAGE ..... OF .....

REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): STATIC H_2O LVL = 0.00

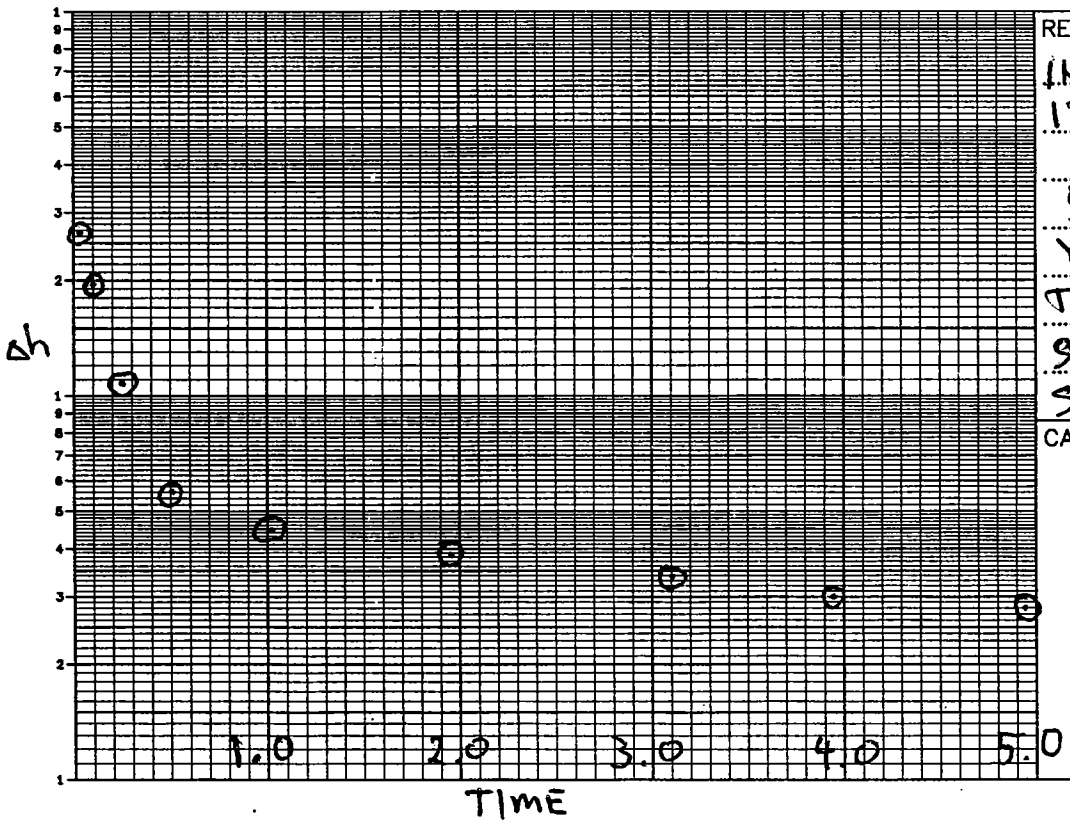
ACAD: FORM_HYDCONTST.dwg 07/06/99 INL

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0.02		2.69	3.13		0.34
0.06		2.26	3.95		0.30
0.10		1.95	4.95		0.281
0.15		1.62	7.04		0.226
0.20		1.34	10.5		0.154
0.25		1.09			
0.32		0.84			
0.40		0.66			
0.50		0.56			
0.70		0.50			
1.04		0.45			
1.97		0.39			

WELL SCHEMATIC



▽ Indicate SWL Depth on Drawing



REMARKS:

INSERTED SLUG @ 1705

5.81' H_2O ABOVE X-DUCER BEFORE TEST STARTED

STARTED @ 1735

STOPPED TEST @ 1800 HR

CALCS, SKETCH MAPS, ETC.:

In-Situ Inc. MiniTroll Pro

Report generated: 9/29/2003 14:47:55
Report from file: H:\Indian Head\slugtests\hrcpilotstudy\SN06213 2003-09-25 173025 S57MW024.bin
DataMgr Version 3.68

Serial number: 6213
Firmware Version 3.06
Unit name: GM-01B

Test name: S57MW024

Test defined on: 9/19/2003 13:18:30
Test started on: 9/25/2003 17:30:25
Test stopped on: 9/25/2003 17:55:49
Test extracted on: N/A

Data gathered using Logarithmic testing
Maximum time between data points Minutes.
Number of data samples: 117

TOTAL DATA SAMPLES 117

Channel number [1]
Measurement type: Temperature
Channel name: OnBoard Temp

Channel number [2]
Measurement type: Pressure
Channel name: water level
Sensor Range: 30 PSI.
Specific gravity: 1
Mode: TOC
User-defined reference: 0 Feet H2O
Referenced on: test start
Pressure head at reference: 5.807 Feet H2O

Date	Time	ET (min)	Chan[1] Celsius	Chan[2] Feet H2O	Adjusted ET. (min)	h/ho	ho = 2.687
9/25/2003	17:30	0	21.17	0			
9/25/2003	17:30	0.005	21.18	4.882			
9/25/2003	17:30	0.01	21.18	5.31			
9/25/2003	17:30	0.015	21.2	2.816			
9/25/2003	17:30	0.02	21.2	2.687	0	1.000	
9/25/2003	17:30	0.025	21.2	2.593	0.005	0.965	
9/25/2003	17:30	0.03	21.2	2.546	0.01	0.948	
9/25/2003	17:30	0.035	21.2	2.492	0.015	0.927	
9/25/2003	17:30	0.04	21.21	2.43	0.02	0.904	
9/25/2003	17:30	0.045	21.21	2.389	0.025	0.889	
9/25/2003	17:30	0.05	21.21	2.347	0.03	0.873	
9/25/2003	17:30	0.055	21.21	2.305	0.035	0.858	
9/25/2003	17:30	0.06	21.21	2.261	0.04	0.841	
9/25/2003	17:30	0.065	21.21	2.219	0.045	0.826	
9/25/2003	17:30	0.07	21.21	2.18	0.05	0.811	
9/25/2003	17:30	0.075	21.21	2.138	0.055	0.796	
9/25/2003	17:30	0.08	21.21	2.098	0.06	0.781	

9/25/2003 17:30	0.0848	21.21	2.06	0.0648	0.767
9/25/2003 17:30	0.09	21.21	2.02	0.07	0.752
9/25/2003 17:30	0.095	21.21	1.981	0.075	0.737
9/25/2003 17:30	0.1	21.21	1.945	0.08	0.724
9/25/2003 17:30	0.1058	21.21	1.903	0.0858	0.708
9/25/2003 17:30	0.112	21.21	1.859	0.092	0.692
9/25/2003 17:30	0.1185	21.21	1.814	0.0985	0.675
9/25/2003 17:30	0.1255	21.21	1.766	0.1055	0.657
9/25/2003 17:30	0.1328	21.21	1.718	0.1128	0.639
9/25/2003 17:30	0.1407	21.21	1.666	0.1207	0.620
9/25/2003 17:30	0.149	21.21	1.615	0.129	0.601
9/25/2003 17:30	0.1578	21.22	1.561	0.1378	0.581
9/25/2003 17:30	0.167	21.21	1.507	0.147	0.561
9/25/2003 17:30	0.177	21.21	1.451	0.157	0.540
9/25/2003 17:30	0.1875	21.21	1.394	0.1675	0.519
9/25/2003 17:30	0.1985	21.21	1.336	0.1785	0.497
9/25/2003 17:30	0.2102	21.21	1.274	0.1902	0.474
9/25/2003 17:30	0.2227	21.21	1.213	0.2027	0.451
9/25/2003 17:30	0.2358	21.2	1.151	0.2158	0.428
9/25/2003 17:30	0.2498	21.2	1.085	0.2298	0.404
9/25/2003 17:30	0.2647	21.21	1.024	0.2447	0.381
9/25/2003 17:30	0.2803	21.2	0.96	0.2603	0.357
9/25/2003 17:30	0.297	21.2	0.898	0.277	0.334
9/25/2003 17:30	0.3147	21.2	0.84	0.2947	0.313
9/25/2003 17:30	0.3333	21.2	0.788	0.3133	0.293
9/25/2003 17:30	0.3532	21.2	0.741	0.3332	0.276
9/25/2003 17:30	0.3742	21.2	0.699	0.3542	0.260
9/25/2003 17:30	0.3963	21.2	0.661	0.3763	0.246
9/25/2003 17:30	0.4198	21.2	0.629	0.3998	0.234
9/25/2003 17:30	0.4447	21.2	0.603	0.4247	0.224
9/25/2003 17:30	0.4697	21.2	0.58	0.4497	0.216
9/25/2003 17:30	0.4963	21.2	0.564	0.4763	0.210
9/25/2003 17:30	0.5247	21.2	0.548	0.5047	0.204
9/25/2003 17:30	0.5547	21.2	0.534	0.5347	0.199
9/25/2003 17:31	0.5863	21.18	0.524	0.5663	0.195
9/25/2003 17:31	0.6213	21.18	0.514	0.6013	0.191
9/25/2003 17:31	0.6578	21.18	0.504	0.6378	0.188
9/25/2003 17:31	0.6963	21.18	0.498	0.6763	0.185
9/25/2003 17:31	0.738	21.18	0.488	0.718	0.182
9/25/2003 17:31	0.7813	21.18	0.482	0.7613	0.179
9/25/2003 17:31	0.828	21.18	0.474	0.808	0.176
9/25/2003 17:31	0.8763	21.18	0.468	0.8563	0.174
9/25/2003 17:31	0.928	21.18	0.462	0.908	0.172
9/25/2003 17:31	0.983	21.18	0.456	0.963	0.170
9/25/2003 17:31	1.0413	21.18	0.45	1.0213	0.167
9/25/2003 17:31	1.103	21.18	0.444	1.083	0.165
9/25/2003 17:31	1.168	21.2	0.438	1.148	0.163
9/25/2003 17:31	1.238	21.2	0.432	1.218	0.161
9/25/2003 17:31	1.3113	21.2	0.426	1.2913	0.159
9/25/2003 17:31	1.3897	21.2	0.422	1.3697	0.157
9/25/2003 17:31	1.473	21.2	0.416	1.453	0.155
9/25/2003 17:31	1.5613	21.21	0.411	1.5413	0.153
9/25/2003 17:32	1.6547	21.21	0.405	1.6347	0.151
9/25/2003 17:32	1.753	21.22	0.399	1.733	0.148
9/25/2003 17:32	1.858	21.22	0.395	1.838	0.147
9/25/2003 17:32	1.968	21.24	0.389	1.948	0.145
9/25/2003 17:32	2.0847	21.24	0.383	2.0647	0.143
9/25/2003 17:32	2.2097	21.24	0.377	2.1897	0.140
9/25/2003 17:32	2.3412	21.24	0.371	2.3212	0.138
9/25/2003 17:32	2.4813	21.24	0.367	2.4613	0.137

9/25/2003 17:33	2.6297	21.25	0.362	2.6097	0.135
9/25/2003 17:33	2.7863	21.25	0.356	2.7663	0.132
9/25/2003 17:33	2.953	21.25	0.35	2.933	0.130
9/25/2003 17:33	3.1297	21.26	0.342	3.1097	0.127
9/25/2003 17:33	3.3163	21.27	0.336	3.2963	0.125
9/25/2003 17:33	3.5147	21.27	0.328	3.4947	0.122
9/25/2003 17:34	3.7247	21.29	0.323	3.7047	0.120
9/25/2003 17:34	3.9463	21.3	0.301	3.9263	0.112
9/25/2003 17:34	4.1813	21.31	0.293	4.1613	0.109
9/25/2003 17:34	4.4295	21.3	0.299	4.4095	0.111
9/25/2003 17:35	4.693	21.3	0.291	4.673	0.108
9/25/2003 17:35	4.973	21.31	0.281	4.953	0.105
9/25/2003 17:35	5.2697	21.32	0.274	5.2497	0.102
9/25/2003 17:36	5.583	21.32	0.266	5.563	0.099
9/25/2003 17:36	5.9147	21.32	0.254	5.8947	0.095
9/25/2003 17:36	6.2663	21.32	0.246	6.2463	0.092
9/25/2003 17:37	6.6397	21.32	0.234	6.6197	0.087
9/25/2003 17:37	7.0347	21.34	0.226	7.0147	0.084
9/25/2003 17:37	7.453	21.34	0.214	7.433	0.080
9/25/2003 17:38	7.8963	21.35	0.205	7.8763	0.076
9/25/2003 17:38	8.3663	21.35	0.193	8.3463	0.072
9/25/2003 17:39	8.8647	21.38	0.183	8.8447	0.068
9/25/2003 17:39	9.3913	21.39	0.174	9.3713	0.065
9/25/2003 17:40	9.9497	21.4	0.164	9.9297	0.061
9/25/2003 17:40	10.5413	21.41	0.154	10.5213	0.057
9/25/2003 17:41	11.168	21.43	0.145	11.148	0.054
9/25/2003 17:42	11.8313	21.44	0.135	11.8113	0.050
9/25/2003 17:42	12.5347	21.45	0.127	12.5147	0.047
9/25/2003 17:43	13.2797	21.44	0.119	13.2597	0.044
9/25/2003 17:44	14.0697	21.44	0.109	14.0497	0.041
9/25/2003 17:45	14.9063	21.45	0.099	14.8863	0.037
9/25/2003 17:46	15.7913	21.46	0.098	15.7713	0.036
9/25/2003 17:47	16.7297	21.46	0.09	16.7097	0.033
9/25/2003 17:48	17.723	21.46	0.084	17.703	0.031
9/25/2003 17:49	18.7763	21.45	0.079	18.7563	0.029
9/25/2003 17:50	19.8913	21.44	0.071	19.8713	0.026
9/25/2003 17:51	21.073	21.43	0.069	21.053	0.026
9/25/2003 17:52	22.3247	21.4	0.062	22.3047	0.023
9/25/2003 17:54	23.6497	21.39	0.058	23.6297	0.022
9/25/2003 17:55	25.0547	21.38	0.054	25.0347	0.020

TETRA-TECH NUS

HYDRAULIC CONDUCTIVITY TEST DATA EVALUATION SHEET
Hvorslev Method

Project Name:	Indian Head Site 57 HRC Pilot Study	**Well/Boring No.:**	S57MW025
Project No.:	4020-0507	**Aquifer Type:**	unconfined
Test Type:	Rising Head	**Test Date:**	26-Sep-03

Done By: FRED W. RAMSER
Checked By: FCW

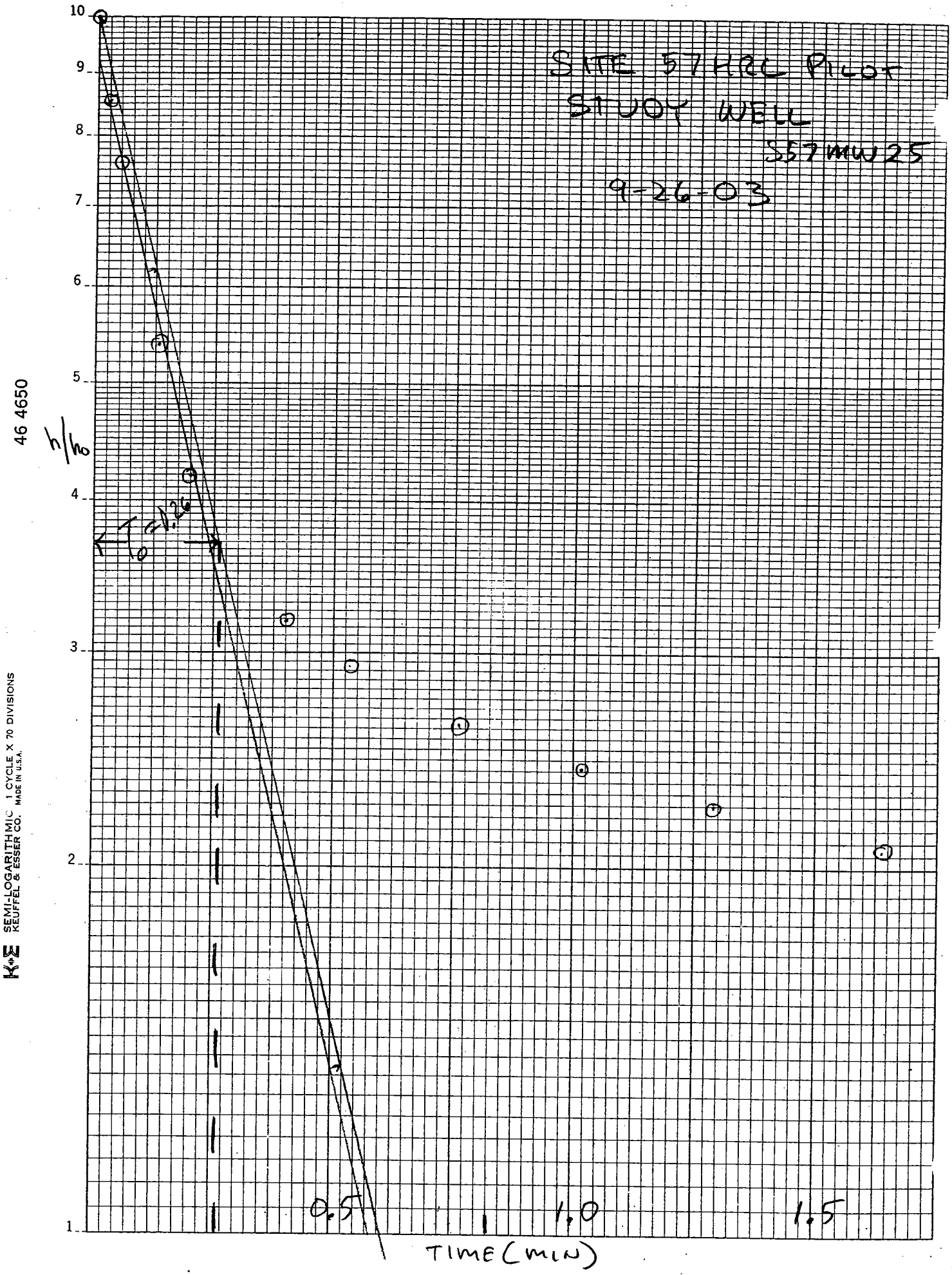
Radius of Well Casing (in.) :	1 = r
Effective Radius of Well Screen (in.) :	1 = R
Length of Well Screen (ft.) :	6.72 = L ✓
Time for 37% head change (min.) :	0.26 = To ✓

Hydraulic Conductivity (K) :

8.72E-03	ft./min.	✓
1.45E-04	ft./sec.	✓
1.26E+01	ft./day	✓
4.43E-03	cm./sec.	✓

Equation:

$$K = \frac{r^2 \times Ln(L/R)}{2 \times L \times To}$$


SITE 57 HRC PILOT
STUDY WELL
S57MW25
9-26-03
h/h0
10
9
8
7
6
5
4
3
2
1
0.5
1.0
1.5
TIME (MIN)
46 4650
K+E SEMI-LOGARITHMIC 1 CYCLE X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

Tetra Tech NUS, Inc.

PROJECT NAME: INDIANHEAD SITE 57 HRC PILOT STUDY WELL/BORING NO.: S57MW025

PROJECT NO.: 4020-0507 GEOLOGIST: FRED W. RAMSER

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10', 3.9 - 13.9 TEST NO.: 1

STATIC WATER LEVEL (Depth/Elevation): 7.18 DATE: 9-26-03

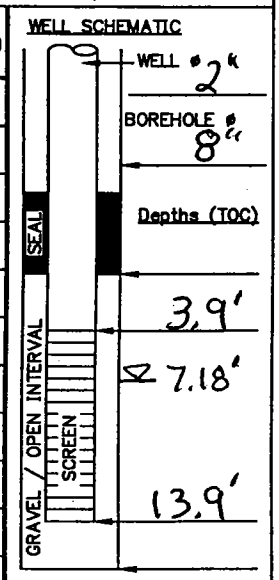
TEST TYPE (Rising/Falling/Constant Head): RISING HEAD CHECKED:

METHOD OF INDUCING WATER LEVEL CHANGE: 2 x 1 l BAILERS PAGE ..... OF .....

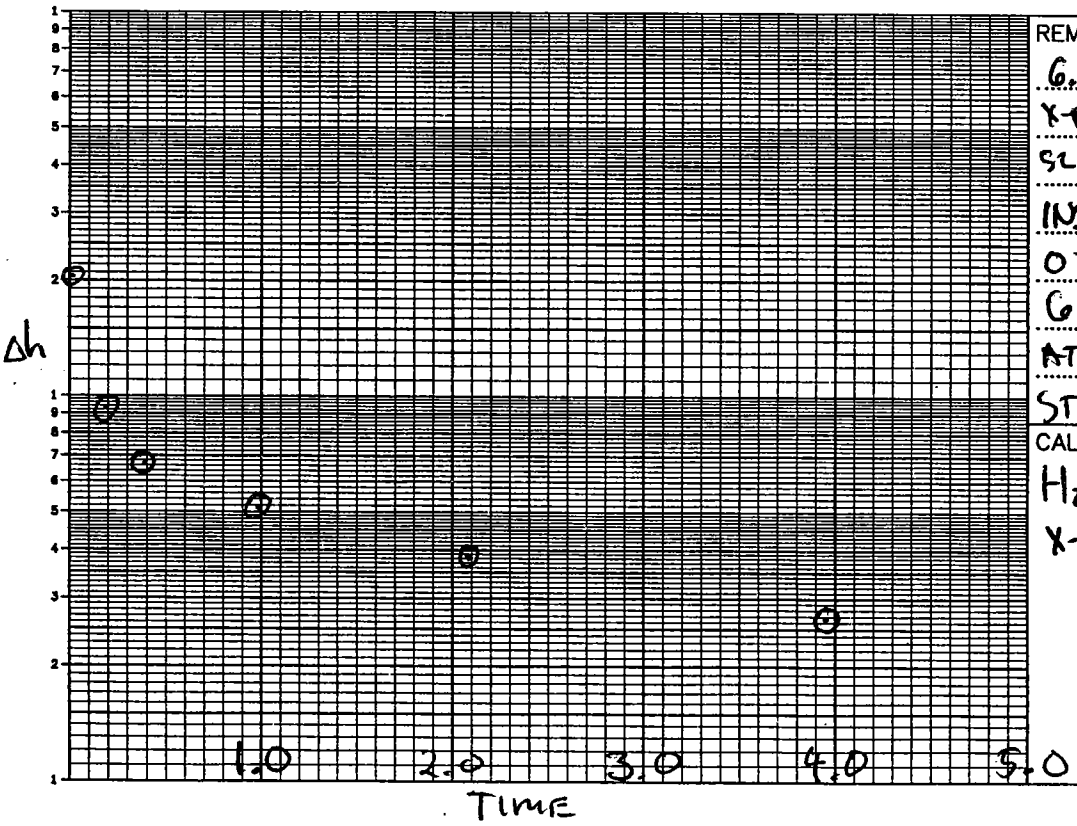
REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): STATIC H_2O LEVEL = 0.00

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0.0		0.00			
0.02		2.04			
0.05		1.70			
0.075		1.52			
0.10		1.36			
0.149		1.099			
0.1985		0.92			
0.3963		0.663			
0.98		0.505			
2.09		0.386			
3.95		0.268			
4.97		0.223			

WELL SCHEMATIC



▽ Indicate SWL Depth on Drawing



REMARKS:
6.020' H_2O ABOVE X-DUCER BEFORE INSERTING SLUG (STATIC H_2O)
INSERTED SLUG @ 0745 "SNUG FIT"
6.06' H_2O ABOVE X-D AT START. 0820 HRS
STOPPED TEST @ 843

CALCS, SKETCH MAPS, ETC.:
H_2O 6.037' ABOVE X-D.

ACAD:FORM_HYDCONTST.dwg 07/06/99 INL

In-Situ Inc. MiniTroll Pro

Report generated: 9/29/2003 14:49:53
Report from file: H:\Indian Head\slugtests\hrcpilotstudy\SN06213 2003-09-26 081549 S57MW025.bin
DataMgr Version 3.68

Serial number: 6213
Firmware Version 3.06
Unit name: GM-01B

Test name: S57MW025

Test defined on: 9/19/2003 13:20:29
Test started on: 9/26/2003 8:15:49
Test stopped on: 9/26/2003 8:38:53
Test extracted on: N/A

Data gathered using Logarithmic testing
Maximum time between data points: Minutes.
Number of data samples: 115

TOTAL DATA SAMPLES 115

Channel number [1]
Measurement type: Temperature
Channel name: OnBoard Temp

Channel number [2]
Measurement type: Pressure
Channel name: water level
Sensor Range: 30 PSI.
Specific gravity: 1
Mode: TOC
User-defined reference: 0 Feet H2O
Referenced on: test start
Pressure head at reference: 6.057 Feet H2O

Date	Time	ET (min)	Chan[1] Celsius	Chan[2] Feet H2O	Adjusted ET. (min)	h/ho (ho = 2.04)
9/26/2003	8:15	0	20.33	0		
9/26/2003	8:15	0.005	20.34	2.002		
9/26/2003	8:15	0.01	20.34	8.575		
9/26/2003	8:15	0.015	20.34	2.141		
9/26/2003	8:15	0.02	20.36	2.04	0	1.000
9/26/2003	8:15	0.025	20.36	1.955	0.005	0.958
9/26/2003	8:15	0.03	20.36	1.891	0.01	0.927
9/26/2003	8:15	0.035	20.36	1.829	0.015	0.897
9/26/2003	8:15	0.04	20.36	1.785	0.02	0.875
9/26/2003	8:15	0.045	20.36	1.74	0.025	0.853
9/26/2003	8:15	0.05	20.36	1.702	0.03	0.834
9/26/2003	8:15	0.055	20.36	1.664	0.035	0.816
9/26/2003	8:15	0.06	20.36	1.626	0.04	0.797
9/26/2003	8:15	0.065	20.36	1.59	0.045	0.779
9/26/2003	8:15	0.07	20.36	1.555	0.05	0.762
9/26/2003	8:15	0.075	20.36	1.521	0.055	0.746
9/26/2003	8:15	0.08	20.36	1.487	0.06	0.729

9/26/2003 8:15	0.0848	20.36	1.455	0.0648	0.713
9/26/2003 8:15	0.09	20.36	1.421	0.07	0.697
9/26/2003 8:15	0.095	20.36	1.389	0.075	0.681
9/26/2003 8:15	0.1	20.36	1.36	0.08	0.667
9/26/2003 8:15	0.1058	20.37	1.324	0.0858	0.649
9/26/2003 8:15	0.112	20.37	1.288	0.092	0.631
9/26/2003 8:15	0.1185	20.37	1.252	0.0985	0.614
9/26/2003 8:15	0.1255	20.37	1.215	0.1055	0.596
9/26/2003 8:15	0.1328	20.37	1.177	0.1128	0.577
9/26/2003 8:15	0.1407	20.37	1.137	0.1207	0.557
9/26/2003 8:15	0.149	20.37	1.099	0.129	0.539
9/26/2003 8:15	0.1578	20.37	1.061	0.1378	0.520
9/26/2003 8:15	0.167	20.36	1.025	0.147	0.502
9/26/2003 8:16	0.177	20.36	0.989	0.157	0.485
9/26/2003 8:16	0.1875	20.36	0.954	0.1675	0.468
9/26/2003 8:16	0.1985	20.36	0.92	0.1785	0.451
9/26/2003 8:16	0.2102	20.36	0.886	0.1902	0.434
9/26/2003 8:16	0.2227	20.36	0.856	0.2027	0.420
9/26/2003 8:16	0.2358	20.36	0.826	0.2158	0.405
9/26/2003 8:16	0.2498	20.36	0.8	0.2298	0.392
9/26/2003 8:16	0.2647	20.36	0.777	0.2447	0.381
9/26/2003 8:16	0.2803	20.36	0.757	0.2603	0.371
9/26/2003 8:16	0.297	20.36	0.737	0.277	0.361
9/26/2003 8:16	0.3147	20.36	0.719	0.2947	0.352
9/26/2003 8:16	0.3333	20.36	0.705	0.3133	0.346
9/26/2003 8:16	0.3532	20.36	0.689	0.3332	0.338
9/26/2003 8:16	0.3742	20.34	0.675	0.3542	0.331
9/26/2003 8:16	0.3963	20.34	0.663	0.3763	0.325
9/26/2003 8:16	0.4198	20.36	0.649	0.3998	0.318
9/26/2003 8:16	0.4447	20.36	0.637	0.4247	0.312
9/26/2003 8:16	0.4697	20.34	0.627	0.4497	0.307
9/26/2003 8:16	0.4963	20.34	0.615	0.4763	0.301
9/26/2003 8:16	0.5247	20.34	0.605	0.5047	0.297
9/26/2003 8:16	0.5547	20.34	0.595	0.5347	0.292
9/26/2003 8:16	0.5863	20.34	0.585	0.5663	0.287
9/26/2003 8:16	0.6213	20.34	0.575	0.6013	0.282
9/26/2003 8:16	0.6578	20.34	0.565	0.6378	0.277
9/26/2003 8:16	0.6963	20.34	0.557	0.6763	0.273
9/26/2003 8:16	0.738	20.34	0.547	0.718	0.268
9/26/2003 8:16	0.7813	20.34	0.539	0.7613	0.264
9/26/2003 8:16	0.828	20.34	0.532	0.808	0.261
9/26/2003 8:16	0.8763	20.34	0.522	0.8563	0.256
9/26/2003 8:16	0.928	20.33	0.513	0.908	0.251
9/26/2003 8:16	0.983	20.33	0.505	0.963	0.248
9/26/2003 8:16	1.0413	20.33	0.495	1.0213	0.243
9/26/2003 8:16	1.103	20.33	0.487	1.083	0.239
9/26/2003 8:16	1.168	20.33	0.478	1.148	0.234
9/26/2003 8:17	1.238	20.33	0.47	1.218	0.230
9/26/2003 8:17	1.3113	20.33	0.46	1.2913	0.225
9/26/2003 8:17	1.3897	20.33	0.452	1.3697	0.222
9/26/2003 8:17	1.473	20.33	0.442	1.453	0.217
9/26/2003 8:17	1.5613	20.32	0.431	1.5413	0.211
9/26/2003 8:17	1.6547	20.32	0.424	1.6347	0.208
9/26/2003 8:17	1.753	20.32	0.414	1.733	0.203
9/26/2003 8:17	1.858	20.32	0.406	1.838	0.199
9/26/2003 8:17	1.968	20.32	0.394	1.948	0.193
9/26/2003 8:17	2.0847	20.32	0.386	2.0647	0.189
9/26/2003 8:18	2.2097	20.32	0.376	2.1897	0.184
9/26/2003 8:18	2.3412	20.32	0.366	2.3212	0.179
9/26/2003 8:18	2.4813	20.31	0.356	2.4613	0.175

9/26/2003 8:18	2.6297	20.32	0.344	2.6097	0.169
9/26/2003 8:18	2.7863	20.32	0.336	2.7663	0.165
9/26/2003 8:18	2.953	20.32	0.324	2.933	0.159
9/26/2003 8:18	3.1297	20.32	0.312	3.1097	0.153
9/26/2003 8:19	3.3163	20.32	0.302	3.2963	0.148
9/26/2003 8:19	3.5147	20.32	0.29	3.4947	0.142
9/26/2003 8:19	3.7247	20.32	0.28	3.7047	0.137
9/26/2003 8:19	3.9463	20.32	0.268	3.9263	0.131
9/26/2003 8:20	4.1813	20.32	0.237	4.1613	0.116
9/26/2003 8:20	4.4295	20.34	0.227	4.4095	0.111
9/26/2003 8:20	4.693	20.33	0.233	4.673	0.114
9/26/2003 8:20	4.973	20.33	0.223	4.953	0.109
9/26/2003 8:21	5.2697	20.33	0.211	5.2497	0.103
9/26/2003 8:21	5.583	20.34	0.199	5.563	0.098
9/26/2003 8:21	5.9147	20.34	0.189	5.8947	0.093
9/26/2003 8:22	6.2663	20.34	0.179	6.2463	0.088
9/26/2003 8:22	6.6397	20.34	0.169	6.6197	0.083
9/26/2003 8:22	7.0347	20.33	0.159	7.0147	0.078
9/26/2003 8:23	7.453	20.32	0.149	7.433	0.073
9/26/2003 8:23	7.8963	20.31	0.141	7.8763	0.069
9/26/2003 8:24	8.3663	20.31	0.131	8.3463	0.064
9/26/2003 8:24	8.8647	20.31	0.121	8.8447	0.059
9/26/2003 8:25	9.3913	20.31	0.115	9.3713	0.056
9/26/2003 8:25	9.9497	20.32	0.105	9.9297	0.051
9/26/2003 8:26	10.5413	20.33	0.097	10.5213	0.048
9/26/2003 8:26	11.168	20.34	0.09	11.148	0.044
9/26/2003 8:27	11.8313	20.34	0.082	11.8113	0.040
9/26/2003 8:28	12.5347	20.34	0.076	12.5147	0.037
9/26/2003 8:29	13.2797	20.34	0.07	13.2597	0.034
9/26/2003 8:29	14.0697	20.36	0.062	14.0497	0.030
9/26/2003 8:30	14.9063	20.36	0.056	14.8863	0.027
9/26/2003 8:31	15.7913	20.37	0.053	15.7713	0.026
9/26/2003 8:32	16.7297	20.37	0.047	16.7097	0.023
9/26/2003 8:33	17.723	20.37	0.039	17.703	0.019
9/26/2003 8:34	18.7763	20.38	0.037	18.7563	0.018
9/26/2003 8:35	19.8913	20.39	0.033	19.8713	0.016
9/26/2003 8:36	21.073	20.38	0.029	21.053	0.014
9/26/2003 8:38	22.3247	20.37	0.027	22.3047	0.013

APPENDIX A.10

Groundwater Level Data

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: SITE 57 HRC PILOT STUDY **Project No.:** 4020
Location: INDIANHEAD **Personnel:** FREDW. RAMSER
Weather Conditions: RAINY **Measuring Device:** M-SCOPE
Tidally Influenced: Yes ___ No ___ **Remarks:**

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Groundwater Elevation (feet)*	Comments
S57MW22	5-16-03	1050	10.09	15.98	7.70	2.39	
S57MW20		1052	13.31	16.92	6.60	6.71	
S57MW05		1055	18.54	20.36	4.83	13.71	
S57MW06		1056	18.57	14.00	5.04	13.53	
S57MW09		1059	25.75	20.85	8.02	17.73	
S57MW10		1058	25.82	16.48	8.07	17.75	
S57MW07		1100	30.58	28.41	8.28	22.30	
S57MW08		1102	30.26	17.17	5.83	24.43	
S57MW01		1110	37.09	25.52	7.30	29.79	
S57MW02		1111	37.58	14.86	5.34	32.24	
S57MW12		1114	43.82	45.08	5.70	38.12	
S57MW13		1115	43.98	18.08	5.55	38.43	
S57MW11		1121	33.49	20.70	8.30	25.19	
S57MW04		1128	35.72	18.2	7.83	27.89	
S57MW03		1130	35.82	24.3	7.33	28.49	
416GW02		1154	9.33	18.5	4.70	4.63	
416W01		1158	14.97	18.5	6.33	8.64	
S57MW23		1204	40.54	23.10	12.94	27.60	
416W04	↓	1210	8.20	14.97	4.52	3.68	
S57MW24	5-16-03	1403	32.50	14.0	5.50	27.00	
S57MW25	5-16-03	1405	32.43	14.0	6.04	26.39	

* All measurements to the nearest 0.01 foot

APPENDIX A.11

Survey Data

H:\Indian Head\Site 57\HRC Pilot study\Survey Data\results HRC point distance data

	Distance between HRC points and reference points							
	S57SB06		S57MW03		S57MW11		Results	
	n	e	n	e	n	e		
HRC Pt #	335,289.18	1,263,703.78	335,285.64	1,263,748.26	335,222.16	1,263,751.17	n	e
2	59.2		14.8		59.9		335281.1257	1263762.392
1	63.6		19.9		56.9		335277.0203	1263766.031
3	59.9		17.6		53.1		335274.1332	1263761.524
4	62.5		21.1		50.5		335271.0091	1263763.302
5	50.6		8.6		56.6		335278.6199	1263753.162
7	53.7		18		46.3		335268.1906	1263753.212
6	49.8		13.2		57.8		335272.6661	1263750.812
8	49.6		18.7		45		335267.0505	1263748.141
9	43.3		15.1		49.3		335271.1023	1263743.887
10	43.9		22.3		44.2		335264.822	1263740.24
11	37.2		15.5		54		335274.5463	1263738.012
12	43.6		9.8		54.8		335276.3696	1263745.508
MW25	70.4		42.1		23.8		335244.8205	1263758.446
MW24	51.7		23.2		40.6		335262.4412	1263748.028

APPENDIX B

ANALYTICAL LABORATORY DATA

ANALYTICAL RESULTS - SOIL
IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

sample	S57SB0270104	S57SBDUP0101	S57SB0270204	S57SB0270304	S57SB0270404	S57SB0280104	S57SB0280204	S57SB0280304	S57SB0280404
matrix	SB	SB	SB	SB	SB	SB	SB	SB	SB
depth_rang	4 - 5	4 - 5	9 - 10	13 - 14	15 - 16	4 - 5	9 - 10	14 - 15	15 - 16
sample_dat	05/14/03	05/14/03	05/14/03	05/14/03	05/14/03	05/14/03	05/14/03	05/14/03	05/14/03
Volatile Organics (ug/kg)									
1,1,1-TRICHLOROETHANE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
1,1,2,2-TETRACHLOROETHANE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
1,1,2-TRICHLOROETHANE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
1,1-DICHLOROETHANE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
1,1-DICHLOROETHENE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
1,2-DICHLOROETHANE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
1,2-DICHLOROPROPANE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
CARBON TETRACHLORIDE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
CHLOROBENZENE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
CHLOROETHANE	13 U	9200 U	16000 U	6600 U	10 U	12 U	760 U	11 U	14 U
CHLOROFORM	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
CHLOROMETHANE	13 U	9200 U	16000 U	6600 U	10 U	12 U	760 U	11 U	14 U
CIS-1,2-DICHLOROETHENE	13 U	4600 U	13000	8400	10 B	27	5800	5 J	6 J
CIS-1,3-DICHLOROPROPENE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
DIETHYL ETHER	13 U	4600 U	8000 U	3300 U	42	12 U	380 U	6	14
METHYLENE CHLORIDE	13 U	4600 U	8000 U	3300 U	8 B	12 U	380 U	290 UR	16 B
TETRACHLOROETHENE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
TRANS-1,2-DICHLOROETHENE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
TRANS-1,3-DICHLOROPROPENE	13 U	4600 U	8000 U	3300 U	5 U	12 U	380 U	6 U	7 U
TRICHLOROETHENE	17 J	12000 J	110000	56000	42	63	380 U	6 B	22 B
VINYL CHLORIDE	13 U	9200 U	16000 U	6600 U	10 U	12 U	130 J	11 U	14 U
Inorganics (mg/kg)									
ARSENIC	32.8 J	6.3 J	1.8 J	7.3 J	0.22 J	11.4 J	2.4 J	0.64 J	2.6 J
Miscellaneous Parameters (%)									
TOTAL SOLIDS	72 %	71 %	77 %	82 %	84 %	78 %	78 %	87 %	82 %

from geoso57_sam.dbf
from geoso57_res.dbf
from geoso57_res.xls
from q:\sql_server\indian_head\upload

ANALYTICAL RESULTS - GROUNDWATER

IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

sample matrix sample_dat	S57MW0030104 GW 05/13/03	S57MW0030104-F GW 05/13/03	S57MW0030105 GW 06/19/03	S57MW0030105 GW 06/19/03	S57MW0030106 GW 07/29/03	S57MW0030106-F GW 07/29/03	S57MW0030107 GW 09/24/03	S57GWDUP0107 GW 09/24/03	S57MW0030108 GW 11/19/03	S57GWDUP0108 GW 11/19/03
Volatile Organics (ug/L)										
1,1,1-TRICHLOROETHANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
1,1,2,2-TETRACHLOROETHANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
1,1,2-TRICHLOROETHANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
1,1-DICHLOROETHANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	25 U		2 J		3 J		5 U	5 U	5 U	5 U
1,2-DICHLOROETHANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
1,2-DICHLOROPROPANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
CARBON TETRACHLORIDE	25 U		25 U		25 U		5 U	5 U	0.5 J	0.5 J
CHLOROBENZENE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
CHLOROETHANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
CHLOROFORM	25 U		25 U		1 B		5 U	5 U	5 U	5 U
CHLOROMETHANE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
CIS-1,2-DICHLOROETHENE	9 J		8 J		9 J		2 J	1 J	4 J	4 J
CIS-1,3-DICHLOROPROPENE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
DIETHYL ETHER	180		200		600		88	62	160	160
ETHANE	10 U		10 U		10 U		10 U	10 U		
ETHENE	10 U		10 U		10 U		10 U	10 U		
METHANE	10 U		10 U		10 U		10 U	10 U		
METHYLENE CHLORIDE	4 B		25 U		25 U		5 U	5 U	5 U	5 U
TETRACHLOROETHENE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
TRANS-1,2-DICHLOROETHENE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
TRANS-1,3-DICHLOROPROPENE	25 U		25 U		25 U		5 U	5 U	5 U	5 U
TRICHLOROETHENE	570		490		380		160	180	220	260
VINYL CHLORIDE	10 U		10 U		10 U		2 U	2 U	2 U	2 U
Volatile Organic Gases (ug/L)										
ETHANE									10 U	10 U
ETHENE									10 U	10 U
METHANE									10 U	10 U
Inorganics (ug/L)										
IRON	33.8 B		23.7 B		4.8 B		10.6 B	9.4 B	10.3 B	11.5 B
MANGANESE	121		108		101		96.2	96.6	94.4	100
Inorganics, Filtered (ug/L)										
IRON		6.06 U		6.06 U		4.8 U	5.9 B	4.8 U	10 B	6.0 B
MANGANESE		123		102		97.2	84	98.3	93.1	93.3
Miscellaneous Parameters (mg/L)										
ACETIC ACID	1 U		1 U		1 U		16 J	1.1 J	1.0 U	1.0 U
ALKALINITY	6.694 J		6.513 J		6.177 J		4.684 B	4.562 B	5.4 L	5.3 L
BUTANOIC ACID	1 U		1 U		1 U		3.5 J	1 UJ	1.0 U	1.0 U
CARBON DIOXIDE (ug/L)	95000		98000		95000		92000	96000	93000	99000
CHLORIDE	16 K		17		16		17	17	17	18
LACTIC ACID	25 U		25 U		25 U		46	40	25 U	25 U
NITRATE	1.4		1.6		1.4					
NITRATE-N							1.6	1.6	1.6 L	1.6 L
NITRITE	0.05 U		0.05 U		0.05 U					
NITRITE-N							0.050 U	0.050 U	0.05 UL	0.05 UL
ORTHOPHOSPHATE	0.05 U		0.05 U		0.05 U		0.050 U	0.050 U	0.05 U	0.05 U
PROPIONIC ACID	1 U		1 U		1 U		9 J	0.31 J	1.0 U	1.0 U
PYRUVIC ACID	10 U		10 U		10 U		10 U	1.7 J	10 U	10 U
SULFATE	2		1 B		1		1	1	1.6	1.4
SULFIDE	1 U		1 B		0.65 B		1.0 U	1	1	0.85 J
TOTAL ORGANIC CARBON	0.5448 B		0.4779 B		0.4718 B		0.3848 B	0.4201 B	0.39 J	0.40 J

ANALYTICAL RESULTS - GROUNDWATER

IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

sample matrix sample_dat	S57MW0040104 GW 05/13/03	S57GWDUP0101 GW 05/13/03	S57MW0040104-F GW 05/13/03	S57GWDUP0101-F GW 05/13/03	S57MW0040105 GW 06/20/03	S57MW0040105 GW 06/20/03	S57MW0040106 GW 07/29/03	S57MW0040106-F GW 07/29/03	S57MW0040107 GW 09/24/03	S57MW0040108 GW 11/19/03	S57MW0110104 GW 05/13/03
Volatile Organics (ug/L)											
1,1,1-TRICHLOROETHANE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
1,1,2,2-TETRACHLOROETHANE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
1,1,2-TRICHLOROETHANE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
1,1-DICHLOROETHANE	250 U	100 U			250 U		100 U		5 U	0.7 J	50 U
1,1-DICHLOROETHENE	250 U	100 U			250 U		100 U		3 J	2 J	50 U
1,2-DICHLOROETHANE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
1,2-DICHLOROPROPANE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
CARBON TETRACHLORIDE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
CHLOROBENZENE	250 U	100 U			250 U		100 U		5 U	10	50 U
CHLOROETHANE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
CHLOROFORM	250 U	100 U			12 J		6 B		5 U	1 B	50 U
CHLOROMETHANE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
CIS-1,2-DICHLOROETHENE	1100	1200			980		760		920	1000	14 J
CIS-1,3-DICHLOROPROPENE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
DIETHYL ETHER	170 J	130			91 J		360		93	120	1800
ETHANE	10 U	10 U			10 U		10 U		10 U		10 U
ETHENE	10 U	10 U			10 U		10 U		10 U		10 U
METHANE	10 U	10 U			10 U		12		10 U		16
METHYLENE CHLORIDE	250 U	16 B			140 J		100 U		5 U	2 B	50 U
TETRACHLOROETHENE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
TRANS-1,2-DICHLOROETHENE	250 U	28 J			250 U		100 U		9	10 J	50 U
TRANS-1,3-DICHLOROPROPENE	250 U	100 U			250 U		100 U		5 U	10 U	50 U
TRICHLOROETHENE	2800	3000			2700		1300		1600	1200	310
VINYL CHLORIDE	100 U	40 U			100 U		56		7	29	20 U
Volatile Organic Gases (ug/L)											
ETHANE										10 U	
ETHENE										10 U	
METHANE										14	
Inorganics (ug/L)											
IRON	94.8 B	96.8 B			109 B		34.6 B		8.4 B	33.2 B	15.2 B
MANGANESE	83	83.6			68		110		47.3	74.1	151
Inorganics, Filtered (ug/L)											
IRON			6.06 U	6.06 U		20.7 B		36.0 B	6.3 B	22.0 B	
MANGANESE			68.9	66.1		41		109	52.3	75.6	
Miscellaneous Parameters (mg/L)											
ACETIC ACID	1 U	1 U			1 U		1 U		4.3	1.0 U	1 U
ALKALINITY	62	69			100		30		67	34 L	80
BUTANOIC ACID	1 U	1 U			1 U		1 U		1.1	1.0 U	1 U
CARBON DIOXIDE (ug/L)	100000	110000			110000		98000		120000	100000	91000
CHLORIDE	9.8 K	9.6 K			8		13		11	14	19 K
LACTIC ACID	25 U	25 U			25 U		25 U		43	25 U	25 U
NITRATE	0.4	0.41			0.25		0.6				0.66
NITRATE-N									0.45	0.59 L	
NITRITE	0.05 U	0.05 U			0.05 U		0.05 U				0.05 U
NITRITE-N									0.050 U	0.05 UL	
ORTHOPHOSPHATE	0.05 U	0.05 U			0.05 U		0.05 U		0.050 U	0.05 U	0.05 U
PROPIONIC ACID	1 U	1 U			1 U		1 U		2.6	1.0 U	1 U
PYRUVIC ACID	10 U	10 U			10 U		10 U		10 U	10 U	10 U
SULFATE	12	13			17		8.9		9.4	8.9	8.3
SULFIDE	1 U	0.9 J			0.65 B		1 U		3	0.70 J	1 U
TOTAL ORGANIC CARBON	1 B	1 B			2 B		0.6915 B		0.9396 B	0.72 J	1 B

ANALYTICAL RESULTS - GROUNDWATER

IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

sample matrix sample_dat	S57MW0110104-F GW 05/13/03	S57MW0110105 GW 06/19/03	S57MW0110105 GW 06/19/03	S57MW0110106 GW 07/29/03	S57GWDUP0106 GW 07/29/03	S57MW0110106-F GW 07/29/03	S57GWDUP0106-F GW 07/29/03	S57MW0110107 GW 09/24/03	S57MW0110108 GW 11/19/03	S57MW0240104 GW 05/15/03
Volatile Organics (ug/L)										
1,1,1-TRICHLOROETHANE		250 U		250 U	250 U			5 U	25 U	500 U
1,1,2,2-TETRACHLOROETHANE		250 U		250 U	250 U			5 U	25 U	500 U
1,1,2-TRICHLOROETHANE		250 U		250 U	250 U			5 U	25 U	500 U
1,1-DICHLOROETHANE		250 U		250 U	250 U			5 U	25 U	500 U
1,1-DICHLOROETHENE		250 U		250 U	250 U			5 U	25 U	500 U
1,2-DICHLOROETHANE		250 U		250 U	250 U			5 U	25 U	500 U
1,2-DICHLOROPROPANE		250 U		250 U	250 U			5 U	25 U	500 U
CARBON TETRACHLORIDE		250 U		250 U	250 U			5 U	25 U	500 U
CHLOROBENZENE		250 U		250 U	250 U			5 U	14 J	500 U
CHLOROETHANE		250 U		250 U	250 U			5 U	25 U	500 U
CHLOROFORM		250 U		12 B	12 B			5 U	1 B	500 U
CHLOROMETHANE		250 U		250 U	250 U			5 U	25 U	500 U
CIS-1,2-DICHLOROETHENE		30 J		250 U	250 U			81	30	3900
CIS-1,3-DICHLOROPROPENE		250 U		250 U	250 U			5 U	25 U	500 U
DIETHYL ETHER		3200		5600	5700			890	2700	270 J
ETHANE		10 U		10 U	10 U			10 U		19
ETHENE		10 U		10 U	10 U			10 U		50
METHANE		86		10 U	10 U			100		230
METHYLENE CHLORIDE		250 U		250 U	250 U			5 U	3 B	86 B
TETRACHLOROETHENE		250 U		250 U	250 U			5 U	25 U	500 U
TRANS-1,2-DICHLOROETHENE		250 U		250 U	250 U			2 J	25 U	500 U
TRANS-1,3-DICHLOROPROPENE		250 U		250 U	250 U			5 U	25 U	500 U
TRICHLOROETHENE		170 J		58 J	49 J			600	210	8600
VINYL CHLORIDE		100 U		100 U	100 U			2 J	10 U	410
Volatile Organic Gases (ug/L)										
ETHANE									10 U	
ETHENE									10 U	
METHANE									24	
Inorganics (ug/L)										
IRON		482		567	639			16.0 B	107 B	2420
MANGANESE		353		294	322			382	271	164
Inorganics, Filtered (ug/L)										
IRON	220		346			480	455	63.9 B	84.6 B	
MANGANESE	158		395			355	347	372	276	
Miscellaneous Parameters (mg/L)										
ACETIC ACID		1 U		1 U	1 U			1 U	1.0 U	1 U
ALKALINITY		40		30	30			190	56 L	10.84 J
BUTANOIC ACID		1 U		1 U	1 U			0.54 J	1.0 U	1 U
CARBON DIOXIDE (ug/L)		120000		120000	130000			110000	100000	98000
CHLORIDE		22		28	28			10	21	16 K
LACTIC ACID		25 U		25 U	25 U			59	25 U	25 U
NITRATE		0.1		0.17	0.17					0.82
NITRATE-N								0.81	0.37 L	
NITRITE		0.05 U		0.05 U	0.05 U					0.05 U
NITRITE-N								0.050 U	0.04 J	
ORTHOPHOSPHATE		0.05 U		0.05 U	0.05 U			0.050 U	0.05 U	0.05 U
PROPIONIC ACID		1 U		1 U	1 U			0.27 J	1.0 U	1 U
PYRUVIC ACID		1 U		10 U	10 U			1.9 J	10 U	10 U
SULFATE		4.9		3	3			11	5.6	6.5
SULFIDE		3		1 B	1 U			1.0 U	0.85 J	1 U
TOTAL ORGANIC CARBON		0.6738 B		4.4	4.3			2 B	0.70 J	1 B

ANALYTICAL RESULTS - GROUNDWATER

IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

sample	S57MW0240104-F	S57MW0240105	S57MW0240105	S57MW0240106	S57MW0240106-F	S57MW0240107	S57MW0240108	S57MW0250104	S57MW0250104-F	S57MW0250105	S57GWDUP0105
matrix	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
sample_dat	05/15/03	06/20/03	06/20/03	07/30/03	07/30/03	09/25/03	11/20/03	05/15/03	05/15/03	06/19/03	06/19/03
Volatile Organics (ug/L)											
1,1,1-TRICHLOROETHANE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
1,1,2,2-TETRACHLOROETHANE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
1,1,2-TRICHLOROETHANE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
1,1-DICHLOROETHANE		500 U		500 U		5 U	0.6 J	500 U		1000 U	1000 U
1,1-DICHLOROETHENE		500 U		500 U		2 J	2 J	500 U		1000 U	1000 U
1,2-DICHLOROETHANE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
1,2-DICHLOROPROPANE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
CARBON TETRACHLORIDE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
CHLOROBENZENE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
CHLOROETHANE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
CHLOROFORM		23 J		500 U		5 U	5 U	500 U		1000 U	1000 U
CHLOROMETHANE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
CIS-1,2-DICHLOROETHENE		7500		7300		600	1300 J	12000		12000 J	1100 J
CIS-1,3-DICHLOROPROPENE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
DIETHYL ETHER		240 J		560		220	180	93 J		1000 U	1000 U
ETHANE		10 U		12		10 U		380		180	180
ETHENE		20		37		350		430		330	320
METHANE		36		210		2200		6100		2900	2900
METHYLENE CHLORIDE		270 J		500 U		5 U	5 U	95 B		1000 U	1000 U
TETRACHLOROETHENE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
TRANS-1,2-DICHLOROETHENE		500 U		500 U		8	5	92 J		1000 U	1000 U
TRANS-1,3-DICHLOROPROPENE		500 U		500 U		5 U	5 U	500 U		1000 U	1000 U
TRICHLOROETHENE		1200		60 J		250	280	9100		1000 U	1000 U
VINYL CHLORIDE		470		150 J		390	710	2300		1500	400 U
Volatile Organic Gases (ug/L)											
ETHANE							18				
ETHENE							250				
METHANE							3500				
Inorganics (ug/L)											
IRON		38800		185000		152000	139000	29900		63900	62800
MANGANESE		7220		13600		8070	5280	596		793	776
Inorganics, Filtered (ug/L)											
IRON	2340		38200		180000	153000	136000		31100		
MANGANESE	173		7110		13700	8180	5220		557		
Miscellaneous Parameters (mg/L)											
ACETIC ACID		100		160		86	71	1 U		38	38
ALKALINITY		110		240		130 L	160 L	63		93	94
BUTANOIC ACID		58		24		4.7	7.1	1 U		47	48
CARBON DIOXIDE (ug/L)		210000		180000		190000	160000	150000		180000	170000
CHLORIDE		15		16		27	21	32 K		36	39
LACTIC ACID		33		25 U		57	25 U	25 U		25 U	25 U
NITRATE		0.05 U		0.1 U				0.07		0.026 J	0.026 J
NITRATE-N						0.10 U	0.05 UR				
NITRITE		0.05 U		0.089 J				0.05 U		0.05 U	0.05 U
NITRITE-N						0.10 U	0.02 J				
ORTHOPHOSPHATE		0.07		0.05 U		0.1	0.50 U	0.05 U		0.05 U	0.05 U
PROPIONIC ACID		150		420		160	120	1 U		79	78
PYRUVIC ACID		10 U		10 U		4.4 J	10 U	10 U		10 U	10 U
SULFATE		1 B		1 U		2	1.7	4.3		4.8	2 B
SULFIDE		1 U		1 U		0.95 J	0.25 J	0.15 J		0.2 B	2
TOTAL ORGANIC CARBON		410		220		130	130	3.7		85	85

ANALYTICAL RESULTS - GROUNDWATER

IN SITU ANAEROBIC BIOREMEDIATION PILOT STUDY
SITE 57 - FORMER DRUM LOADING AREA
NDW, IH, INDIAN HEAD, MARYLAND

sample matrix sample_dat	S57MW0250105 GW 06/19/03	S57GWDUP0105 GW 06/19/03	S57MW0250106 GW 07/30/03	S57MW0250106-F GW 07/30/03	S57MW0250107 GW 09/25/03	S57MW0250108 GW 11/20/03
Volatile Organics (ug/L)						
1,1,1-TRICHLOROETHANE			250 U		5 U	50 U
1,1,2,2-TETRACHLOROETHANE			250 U		5 U	50 U
1,1,2-TRICHLOROETHANE			250 U		5 U	50 U
1,1-DICHLOROETHANE			250 U		6	50 U
1,1-DICHLOROETHENE			250 U		70	18 J
1,2-DICHLOROETHANE			250 U		5 U	50 U
1,2-DICHLOROPROPANE			250 U		5 U	50 U
CARBON TETRACHLORIDE			250 U		5 U	50 U
CHLOROBENZENE			250 U		5 U	50 U
CHLOROETHANE			250 U		5 U	50 U
CHLOROFORM			12 B		5 U	4 B
CHLOROMETHANE			250 U		5 U	50 U
CIS-1,2-DICHLOROETHENE			6600		49000	10000
CIS-1,3-DICHLOROPROPENE			250 U		5 U	50 U
DIETHYL ETHER			250		100	120
ETHANE			130		110	
ETHENE			270		340	
METHANE			2100		2100	
METHYLENE CHLORIDE			250 U		5 U	10 B
TETRACHLOROETHENE			250 U		5 U	50 U
TRANS-1,2-DICHLOROETHENE			35 J		190	86
TRANS-1,3-DICHLOROPROPENE			250 U		5 U	50 U
TRICHLOROETHENE			250 U		130	110
VINYL CHLORIDE			2000		2800	2600
Volatile Organic Gases (ug/L)						
ETHANE						150
ETHENE						330
METHANE						2300
Inorganics (ug/L)						
IRON			76500		159000	74000
MANGANESE			864		1610	1020
Inorganics, Filtered (ug/L)						
IRON	62000	62800		74500	160000	75400
MANGANESE	762	772		840	1630	1040
Miscellaneous Parameters (mg/L)						
ACETIC ACID			65		110	48
ALKALINITY			110		100 L	90 L
BUTANOIC ACID			68		27	7.6
CARBON DIOXIDE (ug/L)			160000		240000	160000
CHLORIDE			26		140	44
LACTIC ACID			25 U		41	25 U
NITRATE			0.1 U			
NITRATE-N					0.0168 J	0.05 J
NITRITE			0.1 U			
NITRITE-N					0.091 J	0.02 J
ORTHOPHOSPHATE			0.05 U		0.26	0.02 J
PROPIONIC ACID			120		42	18
PYRUVIC ACID			10 U		1.2 J	10 U
SULFATE			1 U		2	2.1
SULFIDE			1 U		1.0 U	0.25 J
TOTAL ORGANIC CARBON			100		110	53

APPENDIX C

FIELD INSTALLATION PHOTOGRAPHS

Photo 1

Site 57 pilot study area. Building 292 in background with monitoring wells MW003 and MW004 in front of building.

Photo 2

Monitoring wells MW003 and MW004.

Photo 3

Mobile drilling equipment and HRC drilling/installation equipment.

Photo 4

Boring for monitoring well.

Photo 5

Installed monitoring well riser.

Photo 6

Flush mounted monitoring well.

Photo 7

Tank for heating HRC®

Photo 8

Feed hopper for positive-displacement pump.

Photo 9

Pouring heated HRC® into feed hopper.

Photo 10

Interior of feed hopper.

Photo 11

Positioning direct-push rig over injection point.

Photo 12

Positioning injection rod over injection point.

Photo 13

Pushing injection rod into subsurface.

Photo 14

Installed injection rod.

Photo 15

Injection point fittings for hose from pump.

Photo 16

Pumping HRC® through injection rod.

Photo 17

Extracting injection rod as HRC® is pumped into the subsurface.

Photo 18

Decontamination pad.

Photo 19

Pilot study area following installation of new monitoring wells and HRC®.