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NAS KEY WEST
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TECHNICAL MEMORANDUM FOR SAMPLING AND ANALYSIS PLAN ADDENDUM FOR SOLID WASTE MANAGEMENT UNIT 9 FOR SUPPLEMENTAL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION/REMEDIAL INVESTIGATION NAS KEY WEST FL

5/1/1998

BROWN AND ROOT ENVIRONMENTAL

AIK-98-0219

TECHNICAL MEMORANDUM FOR SAMPLING AND ANALYSIS PLAN ADDENDUM

SUPPLEMENTAL RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION

FOR

NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
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North Charleston, South Carolina 29406

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1.0 BACKGROUND INFORMATION

1.1 INTRODUCTION

This Technical Memorandum has been prepared under Contract Task Order (CTO) No. 007, under the Comprehensive Long-term Environmental Navy (CLEAN) Contract No. N62472-94-D-1888. Under CTO No. 007, Brown & Root Environmental (B&R Environmental) has prepared RCRA documents for the 14 Environmental Navy Restoration Account (ENRA) sites including the Solid Waste Management Unit (SWMU) 9 Former Jet Engine Test Cell. In 1996, B&R Environmental performed a field data collection effort at SWMU 9 in accordance with the Supplemental RCRA RFI/RI Workplan and Sampling and Analysis Plan (SAP) prepared by ABB Environmental Services Inc. dated December 6, 1995. The B&R Environmental data was compiled with data from previous investigations perform at the site including the 1994 Contamination Assessment Report (ABB, 1994) and the 1997 BEI Project Completion Report (BEI, 1997) to prepare the RFI/RI Report.

Based upon recommendations provided in the BEI groundwater evaluation, a pump and treat system design was prepared. Subsequently, the pump and treat system was installed in 1996 and operated for 1 year. This interim remedial action paralleled the B&R Environmental Supplemental RFI/RI Investigation at the site. Low level concentrations of three chlorinated solvents (e.g., trichloroethene, cis 1,2 dichloroethene, and trans 1,2 dichloroethene) were observed during the monthly sampling of the recovery wells as well as benzene. The fundamental problem identified with the pump and treat system is that it could not achieve the final treatment standard for the groundwater.

Several discussions have been held by the NAS Key West Partnering Team concerning potential remedial alternatives that could be implemented that take advantage of monitored intrinsic bioremediation and natural attenuation processes at the site. Based upon the delineation of the site, the appreciable decline in contaminants levels (primarily chlorinated solvents and BETXs) from 1993 to 1996, and the low recovery of chlorinated solvents by the pump and treat system, it was thought that the groundwater cleanup standards could be achieved through monitored natural attenuation. Therefore, an additional study is proposed to identify the natural attenuation process that exist at the site and to determine if they are sufficient to be protective of the onsite lagoon. This document provides the details of the groundwater sampling event to be conducted at SWMU 9.

1.2 BACKGROUND

The USEPA and many state agencies have accepted monitored natural attenuation as a potentially effective bioremediation alternative. Consequently it is being considered as a remediation approach for many Navy sites, particularly where chlorinated solvents and/or petroleum hydrocarbons are present in groundwater systems. In order to demonstrate that natural attenuation is progressing, it is necessary to identify and monitor specific indicator parameters.

Based upon a comprehensive literature review as well as conversations with technical experts in the field, B&R Environmental has established a technical protocol and a consistent approach for collection and analysis of samples for natural attenuation indicator parameters. These protocols are continuously revised as more information is obtained, specific guidance is issued by the Navy, or as the USEPA issues alternate/revised guidance or analytical methods.

In general, to determine the efficiency of intrinsic processes to degrade a chlorinated solvent plume, the following data is required:

- Contaminant concentrations (e.g., VOCs)
- Hydrogeologic (e.g., hydraulic conductivity, hydraulic flow directions and gradient, and effective porosity)
- Estimated plume length (e.g., longitudinal, transverse, and vertical dispersivity)
- Adsorption parameters (e.g., soil bulk density, partition coefficient, and fraction organic carbon)
- Biodegradation indicators (e.g., dissolved oxygen, nitrate, ferrous iron, sulfate, methane, etc.)

Despite the extensive data collected at the SWMU 9 site to date, the bulk of the data included hydrogeological, plume configuration, and contaminant concentration information. Many of the remaining data requirements can be reasonably estimated based upon accepted literature values. The input parameters that should not, or cannot be estimated include the following adsorption and biogradation parameters:

- Total organic carbon (TOC)
- Chloride (Cl^-)
- Dissolved oxygen (DO)
- Nitrate/nitrite(NO_3/NO_2)
- Sulfide/sulfate (H_2S/SO_4)
- Phosphate (PO_4)

- Ferrous/ferric iron (Fe^2/Fe^3)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Alkalinity (as $CaCO_3$)/dissolved inorganic carbon (DIC)

Briefly, dissolved oxygen, nitrate, nitrite, ferrous iron, sulfate, phosphate, and carbon dioxide are primary components of the total biodegradation capacity of the groundwater as it flows through the source zone and contaminant plume. Methane is generated during methanogenic processes that utilize carbon dioxide during biodegradation. Sulfide is a byproduct of sulfate reduction. Calcium carbonate (i.e., alkalinity) acts as a pH buffer for organic acids that can be generated during biodegradation.

1.3 PROPOSED INVESTIGATIVE ACTIVITIES

This Technical Memorandum has been prepared to detail these required investigative activities at the project site. Sufficient information has been provided such that a separate work plan is not required for this additional study. All fieldwork shall be performed in accordance with this Technical Memorandum and the previous Work Plan, Quality Assurance Plans and applicable Standard Operating Procedures (SOPs) prepared by B&R Environmental.

During the investigation, the following activities are proposed at SWMU 9:

Determine the current groundwater plume configuration, measure baseline chlorinated solvent concentrations by volatile organic compound analysis in selected wells (e.g. S9MW12, -3, -10, -8, -21, -22, -23, -24, -15 -17, and -19D).

Using field meters and field test kits, determine the baseline natural attenuation conditions of groundwater including: temperature, pH, specific conductance, oxidation-reduction potential (ORP), carbon dioxide (CO_2), alkalinity ($CaCO_3$)/dissolved inorganic carbon (DIC), dissolved oxygen (DO), dissolved ferrous iron (Fe^{2+}), and sulfide (H_2S) in selected wells (e.g. S9MW12, -3, -10, -21, -24, -15 -17, and -19D).

Using fixed-based lab analysis, determine the baseline natural attenuation conditions of groundwater including anions: chloride, nitrate, nitrite, phosphate, and sulfate, dissolved ferric iron and manganese, methane, sulfide, total organic carbon (TOC), and alkalinity in selected wells (e.g. S9MW12, -3, -10, -21, -24, -15, -17, and -19D).

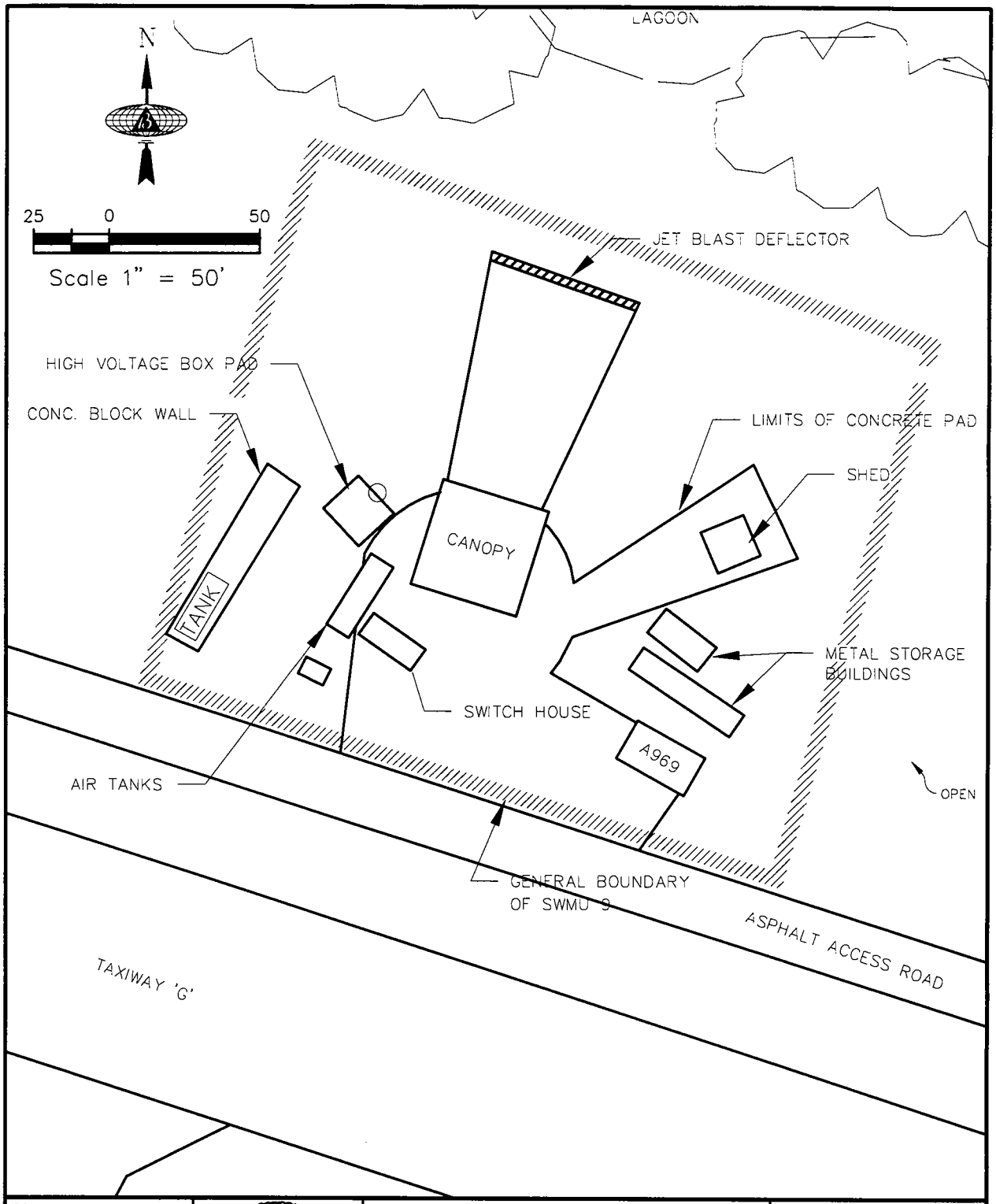
The more natural organic carbon is present is the parent material, the higher the adsorption of organic constituents on the aquifer matrix. Therefore, the total organic carbon value will be measured by collecting a hand-auger sample of the aquifer material from an uncontaminated area upgradient of the site.

Upon collection of the preliminary data, the current natural attenuation potential of the aquifer can be determined by performing a qualitative analysis of the indicator parameters.

1.4 SITE DESCRIPTION

SWMU 9, the Jet Engine Test Cell site associated with Building A-969, is in the northeastern portion of the Boca Chica Airfield (Figure 1-1). Beginning in 1969, the site was used for the testing of recently repaired jet engines. No other activities are conducted near the site. Jet engine testing activities were performed under a canopy in the middle of a circular concrete pad approximately 60 feet in diameter in the central part of the site. Jet blast deflectors are located at the ends of two concrete pads (100 feet and 80 feet long, respectively) that connect with the north and northeast portion of the circular concrete pad. The jet engines were fueled from a bermed, 5,000-gallon aboveground storage tank containing JP-5 fuel that was in use from 1987 through 1995. Building A-969 is 50 feet southeast of the testing area. The concrete area that extends east of the canopy was the former jet engine testing area. A small shed at the eastern end of the concrete pad was used for storage of various equipment, oils, and jet fuel. Gas path cleaners were also stored on the eastern side of the shed. An asphalt parking area extends from these structures to the asphalt road. In addition, a switch house, air tanks, voltage box, and the 5,000-gallon aboveground storage tank (AST) for JP-5 fuel are adjacent to the southwestern edge of the circular pad. A strip of mowed grass approximately 30 feet wide surrounds the east and west ends of the site. A narrow strip of red mangroves is located along the shoreline north of the site.

In January 1989, a filter fuel system leak resulted in the release of approximately 700 gallons of JP-5 fuel on the west side of the AST. Approximately 600 gallons of the spilled fuel were recovered from puddles by pumping free product during initial remediation activities. The observed maximum depth of soil contamination was two inches. About 10 cubic yards of contaminated soil were excavated and removed from the spill site, which underwent weathering treatment for decontamination in accordance with State of Florida guidelines for petroleum-contaminated soils. Furthermore, an overturned lubrication oil drum and stained soil in a small area adjacent to the northwest edge of the circular pad were observed by ABB in November 1992 (ABB, 1994).



DRAWN BY DATE: MDB 4/23/98		SWMU 9 TECHNICAL MEMORANDUM FOR SAMPLING AND ANALYSIS PLAN ADDENDUM FIGURE 1-1. SITE LOCATION MAP SWMU 9 NAVAL AIR STATION, KEY WEST BOCA CHICA KEY, FLORIDA	CONTRACT NO. 7046
CHECKED BY DATE:			APPROVED BY DATE:
COST/SCHED-AREA:			APPROVED BY DATE:
SCALE: AS NOTED			DRAWING NO. ---- REV. 0

FORM CADD NO. SDV_AV12.DWG - REV 0 - 1/20/98

For informational purposes, the analytical results for the three previous groundwater investigations and the pump and treat recovery sampling are summarized in Tables 1-1 (B&RE, 1997) and 1-2 (BEI, 1997). Figure 1-2 depicts the 1996 groundwater chemical concentrations (B&RE, 1997). The static water level measurements collected from selected permanent site wells are depicted in Figure 1-3 (B&RE, 1997).

The site is bordered to the south by an asphalt road that parallels a runway and to the east and west by grassy areas. The entire area is flat, open, and covered with grass where it is not paved. An inlet of Florida Bay is located north of the site, approximately 250 feet from the former location of the canopy.

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
NAS KEY WEST
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Location	Date	Parameter	Result	Qual.[1]
INORGANICS (µg/L)				
S9MW 3	01/18/96	Arsenic	7.6	
S9MW 9	01/18/96	Arsenic	5.3	
S9MW 17	01/18/96	Arsenic	5.075	
S9MW 24	01/18/96	Barium	11.7	
S9MW 3	01/18/96	Barium	9.3	
S9MW 17	01/18/96	Barium	8.05	
S9MW 21	01/18/96	Barium	7.8	
S9MW 6	01/18/96	Barium	7.7	
S9MW 19D	01/18/96	Barium	5.6	
S9MW 15	01/18/96	Barium	5.5	
S9MW 9	01/18/96	Barium	5.4	
S9MW 21	01/18/96	Calcium	198,000	
S9MW 17	01/18/96	Calcium	189,000	
S9MW 24	01/18/96	Calcium	166,000	
S9MW 19D	01/18/96	Calcium	94,600	
S9MW 9	01/18/96	Calcium	75,300	
S9MW 3	01/18/96	Calcium	69,000	
S9MW 15	01/18/96	Calcium	67,000	
S9MW 6	01/18/96	Calcium	61,900	
S9MW 6	01/18/96	Cyanide	6.6	
S9MW 17	01/18/96	Cyanide	1.45	
S9MW 19D	01/18/96	Cyanide	0.89	
S9MW 24	01/18/96	Cyanide	0.88	
S9MW 15	01/18/96	Cyanide	0.83	
S9MW 3	01/18/96	Iron	360	
S9MW 15	01/18/96	Iron	196	
S9MW 9	01/18/96	Lead	2.4	
S9MW 21	01/18/96	Magnesium	377,000	
S9MW 24	01/18/96	Magnesium	195,000	
S9MW 19D	01/18/96	Magnesium	139,000	
S9MW 9	01/18/96	Magnesium	79,400	

Location	Date	Parameter	Result	Qual.[1]
S9MW 6	01/18/96	Magnesium	68,600	
S9MW 3	01/18/96	Magnesium	43,500	
S9MW 15	01/18/96	Magnesium	41,500	
S9MW 17	01/18/96	Magnesium	24,150	
S9MW 21	01/18/96	Manganese	8.5	
S9MW 9	01/18/96	Manganese	5.3	
S9MW 3	01/18/96	Manganese	5	
S9MW 15	01/18/96	Manganese	2.1	
S9MW 17	01/18/96	Manganese	1.04	
S9MW 6	01/18/96	Manganese	0.97	
S9MW 21	01/18/96	Potassium	142,000	
S9MW 19D	01/18/96	Potassium	58,100	
S9MW 24	01/18/96	Potassium	57,000	
S9MW 9	01/18/96	Potassium	23,000	
S9MW 6	01/18/96	Potassium	15,200	
S9MW 15	01/18/96	Potassium	12,300	
S9MW 3	01/18/96	Potassium	9,380	
S9MW 17	01/18/96	Potassium	270	
S9MW 15	01/18/96	Selenium	6	
S9MW 24	01/18/96	Selenium	4.9	
S9MW 3	01/18/96	Silver	6	
S9MW 21	01/18/96	Sodium	3,290,000	
S9MW 24	01/18/96	Sodium	1,410000	
S9MW 19D	01/18/96	Sodium	1,130,000	
S9MW 9	01/18/96	Sodium	471,000	
S9MW 3	01/18/96	Sodium	235,000	
S9MW 15	01/18/96	Sodium	161,000	
S9MW 6	01/18/96	Sodium	116,000	
S9MW 17	01/18/96	Sodium	43,400	
S9MW 3	01/18/96	Vanadium	4.4	
S9MW 24	01/18/96	Vanadium	0.93	
S9MW 9	01/18/96	Vanadium	0.89	

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
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Location	Date	Parameter	Result	Qual.[1]
PESTICIDIES/PCBs (µg/L)				
S9MW 3	01/18/96	4,4'-DDT	0.26	J
S9MW 24	01/18/96	Beta-BHC	0.029	
S9MW 3	01/18/96	Delta-BHC	0.43	
S9MW 3	01/18/96	Dieldrin	0.19	J
S9MW 3	01/18/96	Endrin	0.25	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
S9MW 1	10/93	1,4-dichlorobenzene	2	
S9MW 15	10/93	1,4-dichlorobenzene	2	
S9MW 16	10/93	1,4-dichlorobenzene	2	
S9MW 4	10/93	1,4-dichlorobenzene	2	
S9MW 5	10/93	1,4-dichlorobenzene	2	
S9MW 11	10/93	1,4-dichlorobenzene	1	
S9MW 17	10/93	1,4-dichlorobenzene	1	
S9MW 20D	10/93	1,4-dichlorobenzene	1	
S9MW 3	10/93	1,4-dichlorobenzene	1	
S9MW 5	10/93	1-methylnaphthalene	110	
S9MW 2	10/93	1-methylnaphthalene	59	
S9MW 4	10/93	1-methylnaphthalene	55	
S9MW 3	10/93	1-methylnaphthalene	19	
S9MW 10	10/93	1-methylnaphthalene	10	
S9MW 5	10/93	2-methylnaphthalene	130	
S9MW 2	10/93	2-methylnaphthalene	57	
S9MW 4	10/93	2-methylnaphthalene	53	
S9MW 17	01/18/96	Bis(2-ethylhexyl)phthalate	9	
S9MW 2	06/28/95	Chlorodibromomethane	13.5	
S9MW 16	06/28/95	Chlorodibromomethane	2	X
S9MW 18	06/28/95	Chlorodibromomethane	2	X
S9MW 19D	06/28/95	Chlorodibromomethane	2	X
S9MW 23	06/27/95	Chlorodibromomethane	2	X
S9MW 6	06/27/95	Chlorodibromomethane	2	X
S9MW 8	06/28/95	Chlorodibromomethane	2	X
HY03	07/25/95	Chlorodibromomethane	0.324	JB
S9MW 2	10/93	Naphthalene	110	
S9MW 5	10/93	Naphthalene	100	
HY03	07/25/95	Naphthalene	91.1	
S9MW 4	10/93	Naphthalene	79	
S9MW 2	06/28/95	Naphthalene	67.55	
S9MW 17	06/28/95	Naphthalene	19.1	
S9MW 10	06/28/95	Naphthalene	18.8	
S9MW 16	06/28/95	Naphthalene	10.8	
S9MW 10	10/93	Naphthalene	9	
S9MW 17	01/18/96	Naphthalene	6	J
S9MW 19D	06/28/95	Naphthalene	3.42	
S9MW 6	01/18/96	Naphthalene	3	J
S9MW 3	01/18/96	Naphthalene	2	J
TOTAL PETROLEUM HYDROCARBONS (µg/L)				
S9MW 5	10/93	TPH	46,000	
S9MW 4	10/93	TPH	6,000	
S9MW 3	10/93	TPH	2,000	
S9MW 17	06/28/95	TPH	1,920	
S9MW 20D	06/28/95	TPH	1,700	
S9MW 1	06/28/95	TPH	1,580	
S9MW 10	06/28/95	TPH	1,410	
S9MW 19D	06/28/95	TPH	1,240	
S9MW 3	06/29/95	TPH	1,120	
S9MW 13	06/28/95	TPH	1,050	
S9MW 2	10/93	TPH	1,000	
VOLATILE ORGANIC COMPOUNDS (µg/L)				
S9MW 2	06/28/95	1,1,1-trichloroethane	13.5	
S9MW 15	12/93	1,1,1-trichloroethane	3.9	
S9MW 16	06/28/95	1,1,1-trichloroethane	2	X
S9MW 18	06/28/95	1,1,1-trichloroethane	2	X
S9MW 19D	06/28/95	1,1,1-trichloroethane	2	X

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
NAS KEY WEST
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Location	Date	Parameter	Result	Qual.[1]
VOLATILE ORGANIC COMPOUNDS (µg/L) (cont.)				
S9MW 23	06/27/95	1,1,1-trichloroethane	2	X
S9MW 6	06/27/95	1,1,1-trichloroethane	2	X
S9MW 8	06/28/95	1,1,1-trichloroethane	2	X
S9MW 2	06/28/95	1,1,2,2-tetrachloroethane	13.5	
S9MW 16	06/28/95	1,1,2,2-tetrachloroethane	2	X
S9MW 18	06/28/95	1,1,2,2-tetrachloroethane	2	X
S9MW 19D	06/28/95	1,1,2,2-tetrachloroethane	2	X
S9MW 23	06/27/95	1,1,2,2-tetrachloroethane	2	X
S9MW 6	06/27/95	1,1,2,2-tetrachloroethane	2	X
S9MW 8	06/28/95	1,1,2,2-tetrachloroethane	2	X
S9MW 2	06/28/95	1,1,2-trichloroethane	13.5	
S9MW 16	06/28/95	1,1,2-trichloroethane	2	X
S9MW 18	06/28/95	1,1,2-trichloroethane	2	X
S9MW 19D	06/28/95	1,1,2-trichloroethane	2	X
S9MW 23	06/27/95	1,1,2-trichloroethane	2	X
S9MW 6	06/27/95	1,1,2-trichloroethane	2	X
S9MW 8	06/28/95	1,1,2-trichloroethane	2	X
S9MW 2	06/28/95	1,1-dichloroethane	13.5	
S9MW 16	06/28/95	1,1-dichloroethane	2	X
S9MW 18	06/28/95	1,1-dichloroethane	2	X
S9MW 19D	06/28/95	1,1-dichloroethane	2	X
S9MW 23	06/27/95	1,1-dichloroethane	2	X
S9MW 6	06/27/95	1,1-dichloroethane	2	X
S9MW 8	06/28/95	1,1-dichloroethane	2	X
S9MW 2	06/28/95	1,1-dichloroethene	13.5	
S9MW 16	06/28/95	1,1-dichloroethene	2	X
S9MW 18	06/28/95	1,1-dichloroethene	2	X
S9MW 19D	06/28/95	1,1-dichloroethene	2	X
S9MW 23	06/27/95	1,1-dichloroethene	2	X
S9MW 24	01/18/96	1,1-dichloroethene	2	J
S9MW 6	06/27/95	1,1-dichloroethene	2	X
S9MW 8	06/28/95	1,1-dichloroethene	2	X
S9MW 2	06/28/95	1,2-dichloroethane	13.5	
S9MW 16	06/28/95	1,2-dichloroethane	2	X
S9MW 18	06/28/95	1,2-dichloroethane	2	X
S9MW 19D	06/28/95	1,2-dichloroethane	2	X
S9MW 23	06/27/95	1,2-dichloroethane	2	X
S9MW 6	06/27/95	1,2-dichloroethane	2	X
S9MW 8	06/28/95	1,2-dichloroethane	2	X
S9MW 14	10/93	1,2-dichloroethene (total)	35	
S9MW 15	10/93	1,2-dichloroethene (total)	25	
S9MW 2	06/28/95	1,2-dichloropropane	13.5	
S9MW 16	06/28/95	1,2-dichloropropane	2	X
S9MW 18	06/28/95	1,2-dichloropropane	2	X
S9MW 19D	06/28/95	1,2-dichloropropane	2	X
S9MW 23	06/27/95	1,2-dichloropropane	2	X
S9MW 6	06/27/95	1,2-dichloropropane	2	X
S9MW 8	06/28/95	1,2-dichloropropane	2	X
S9MW 2	06/28/95	2-butanone	67.5	
S9MW 16	06/28/95	2-butanone	10	X
S9MW 18	06/28/95	2-butanone	10	X
S9MW 19D	06/28/95	2-butanone	10	X
S9MW 23	06/27/95	2-butanone	10	X
S9MW 6	06/27/95	2-butanone	10	X
S9MW 8	06/28/95	2-butanone	10	X
S9MW 2	06/28/95	2-hexanone	67.5	
S9MW 16	06/28/95	2-hexanone	10	X
S9MW 18	06/28/95	2-hexanone	10	X
S9MW 19D	06/28/95	2-hexanone	10	X
S9MW 23	06/27/95	2-hexanone	10	X
S9MW 6	06/27/95	2-hexanone	10	X
S9MW 8	06/28/95	2-hexanone	10	X
HY03	07/25/95	2-hexanone	2.32	JB

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
NAS KEY WEST
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Location	Date	Parameter	Result	Qual.[1]
VOLATILE ORGANIC COMPOUNDS (µg/L) (cont.)				
S9MW 2	06/28/95	4-methyl-2-pentanone	67.5	
S9MW 16	06/28/95	4-methyl-2-pentanone	10	X
S9MW 18	06/28/95	4-methyl-2-pentanone	10	X
S9MW 19D	06/28/95	4-methyl-2-pentanone	10	X
S9MW 23	06/27/95	4-methyl-2-pentanone	10	X
S9MW 6	06/27/95	4-methyl-2-pentanone	10	X
S9MW 8	06/28/95	4-methyl-2-pentanone	10	X
HY09	07/27/95	Acetone	100	
S9MW 3	01/18/96	Acetone	68	
S9MW 2	06/28/95	Acetone	67.5	
S9MW 19D	01/18/96	Acetone	29	
HY08	07/28/95	Acetone	19	
HY03	07/25/95	Acetone	11.9	B
S9MW 13	06/28/95	Acetone	10.9	
HY02	07/25/95	Acetone	10.7	B
S9MW 16	06/28/95	Acetone	10	X
S9MW 18	06/28/95	Acetone	10	X
S9MW 19D	06/28/95	Acetone	10	X
S9MW 23	06/27/95	Acetone	10	X
S9MW 6	06/27/95	Acetone	10	X
S9MW 8	06/28/95	Acetone	10	X
HY01	07/25/95	Acetone	8.14	JB
HY03	07/25/95	Acetone	7.58	JB
HY04	07/25/95	Acetone	5.925	JB
HY06	07/25/95	Acetone	5.36	JB
HY05	07/25/95	Acetone	5.17	JB
HY10	07/27/95	Acetone	5	J
S9MW 5	10/93	Benzene	56	
S9MW 23	06/27/95	Benzene	55.2	X
S9MW 2	06/28/95	Benzene	13.5	
S9MW 16	06/28/95	Benzene	13.2	X
S9MW 19D	06/28/95	Benzene	11.8	X
S9MW 15	12/93	Benzene	9.3	
S9MW 24	06/27/95	Benzene	7	
S9MW 24	01/18/96	Benzene	4	
S9MW 24	02/94	Benzene	3.8	
S9MW 18	06/28/95	Benzene	2	X
S9MW 4	10/93	Benzene	2	
S9MW 6	06/27/95	Benzene	2	X
S9MW 8	06/28/95	Benzene	2	X
S9MW 14	12/93	Benzene	1.6	
S9MW 2	06/28/95	Bromodichloromethane	13.5	
S9MW 16	06/28/95	Bromodichloromethane	2	X
S9MW 18	06/28/95	Bromodichloromethane	2	X
S9MW 19D	06/28/95	Bromodichloromethane	2	X
S9MW 23	06/27/95	Bromodichloromethane	2	X
S9MW 6	06/27/95	Bromodichloromethane	2	X
S9MW 8	06/28/95	Bromodichloromethane	2	X
HY03	07/25/95	Bromodichloromethane	0.202	J
S9MW 2	06/28/95	Bromoform	13.5	
S9MW 16	06/28/95	Bromoform	2	X
S9MW 18	06/28/95	Bromoform	2	X
S9MW 19D	06/28/95	Bromoform	2	X
S9MW 23	06/27/95	Bromoform	2	X
S9MW 6	06/27/95	Bromoform	2	X
S9MW 8	06/28/95	Bromoform	2	X
S9MW 2	06/28/95	Bromomethane	13.5	
S9MW 16	06/28/95	Bromomethane	2	X
S9MW 18	06/28/95	Bromomethane	2	X
S9MW 19D	06/28/95	Bromomethane	2	X
S9MW 23	06/27/95	Bromomethane	2	X
S9MW 6	06/27/95	Bromomethane	2	X
S9MW 8	06/28/95	Bromomethane	2	X

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
NAS KEY WEST
PAGE 5 OF 8

Location	Date	Parameter	Result	Qual.[1]
VOLATILE ORGANIC COMPOUNDS (µg/L) (cont.)				
S9MW 2	06/28/95	Carbon disulfide	67.5	
S9MW 16	06/28/95	Carbon disulfide	10	X
S9MW 18	06/28/95	Carbon disulfide	10	X
S9MW 19D	06/28/95	Carbon disulfide	10	X
S9MW 23	06/27/95	Carbon disulfide	10	X
S9MW 6	06/27/95	Carbon disulfide	10	X
S9MW 8	06/28/95	Carbon disulfide	10	X
S9MW 21	01/18/96	Carbon disulfide	0.14	J
S9MW 19D	01/18/96	Carbon disulfide	0.11	J
S9MW 2	06/28/95	Carbon tetrachloride	13.5	
S9MW 16	06/28/95	Carbon tetrachloride	2	X
S9MW 18	06/28/95	Carbon tetrachloride	2	X
S9MW 19D	06/28/95	Carbon tetrachloride	2	X
S9MW 23	06/27/95	Carbon tetrachloride	2	X
S9MW 6	06/27/95	Carbon tetrachloride	2	X
S9MW 8	06/28/95	Carbon tetrachloride	2	X
S9MW 2	06/28/95	Chlorobenzene	13.5	
S9MW 16	06/28/95	Chlorobenzene	2	X
S9MW 18	06/28/95	Chlorobenzene	2	X
S9MW 19D	06/28/95	Chlorobenzene	2	X
S9MW 23	06/27/95	Chlorobenzene	2	X
S9MW 6	06/27/95	Chlorobenzene	2	X
S9MW 8	06/28/95	Chlorobenzene	2	X
S9MW 2	06/28/95	Chloroethane	13.5	
S9MW 16	06/28/95	Chloroethane	2	X
S9MW 18	06/28/95	Chloroethane	2	X
S9MW 19D	06/28/95	Chloroethane	2	X
S9MW 23	06/27/95	Chloroethane	2	X
S9MW 6	06/27/95	Chloroethane	2	X
S9MW 8	06/28/95	Chloroethane	2	X
S9MW 2	06/28/95	Chloroform	13.5	
S9MW 16	06/28/95	Chloroform	2	X
S9MW 18	06/28/95	Chloroform	2	X
S9MW 19D	06/28/95	Chloroform	2	X
S9MW 23	06/27/95	Chloroform	2	X
S9MW 6	06/27/95	Chloroform	2	X
S9MW 8	06/28/95	Chloroform	2	X
HY04	07/25/95	Chloroform	1.07	
S9MW 2	06/28/95	Chloromethane	13.5	
S9MW 16	06/28/95	Chloromethane	2	X
S9MW 18	06/28/95	Chloromethane	2	X
S9MW 19D	06/28/95	Chloromethane	2	X
S9MW 23	06/27/95	Chloromethane	2	X
S9MW 6	06/27/95	Chloromethane	2	X
S9MW 8	06/28/95	Chloromethane	2	X
S9MW 24	06/27/95	Cis-1,2-dichloroethene	1,560	D
S9MW 15	12/93	Cis-1,2-dichloroethene	1,300	E
S9MW 15	12/93	Cis-1,2-dichloroethene	980	
S9MW 14	12/93	Cis-1,2-dichloroethene	950	E
S9MW 24	02/94	Cis-1,2-dichloroethene	770	
S9MW 24	06/27/95	Cis-1,2-dichloroethene	752	E
S9MW 14	12/93	Cis-1,2-dichloroethene	480	
S9MW 24	02/94	Cis-1,2-dichloroethene	410	E
S9MW 15	06/27/95	Cis-1,2-dichloroethene	196	D
S9MW 15	06/27/95	Cis-1,2-dichloroethene	159	E
S9MW 15	02/94	Cis-1,2-dichloroethene	120	
S9MW 14	02/94	Cis-1,2-dichloroethene	74	
S9MW 21	02/94	Cis-1,2-dichloroethene	73	
HY01	07/25/95	Cis-1,2-dichloroethene	56.7	
S9MW 21	06/27/95	Cis-1,2-dichloroethene	51.3	
S9MW 14	06/27/95	Cis-1,2-dichloroethene	18.4	
S9MW 22	06/27/95	Cis-1,2-dichloroethene	15	
S9MW 2	06/28/95	Cis-1,2-dichloroethene	13.5	

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
NAS KEY WEST
PAGE 6 OF 8

Location	Date	Parameter	Result	Qual.[1]
VOLATILE ORGANIC COMPOUNDS (µg/L) (cont.)				
S9MW 23	06/27/95	Cis-1,2-dichloroethene	13.2	X
S9MW 22	06/27/95	Cis-1,2-dichloroethene	13	
S9MW 22	02/94	Cis-1,2-dichloroethene	4.2	
S9MW 16	06/28/95	Cis-1,2-dichloroethene	2	X
S9MW 18	06/28/95	Cis-1,2-dichloroethene	2	X
S9MW 19D	06/28/95	Cis-1,2-dichloroethene	2	X
S9MW 6	06/27/95	Cis-1,2-dichloroethene	2	X
S9MW 8	06/28/95	Cis-1,2-dichloroethene	2	X
S9MW 2	06/28/95	Cis-1,3-dichloropropene	13.5	
S9MW 16	06/28/95	Cis-1,3-dichloropropene	2	X
S9MW 18	06/28/95	Cis-1,3-dichloropropene	2	X
S9MW 19D	06/28/95	Cis-1,3-dichloropropene	2	X
S9MW 23	06/27/95	Cis-1,3-dichloropropene	2	X
S9MW 6	06/27/95	Cis-1,3-dichloropropene	2	X
S9MW 8	06/28/95	Cis-1,3-dichloropropene	2	X
S9MW 5	10/93	Ethylbenzene	70	
S9MW 4	10/93	Ethylbenzene	54	
S9MW 2	10/93	Ethylbenzene	33	
S9MW 2	06/28/95	Ethylbenzene	14.5125	
S9MW 3	10/93	Ethylbenzene	4	
S9MW 16	06/28/95	Ethylbenzene	2	X
S9MW 18	06/28/95	Ethylbenzene	2	X
S9MW 19D	06/28/95	Ethylbenzene	2	X
S9MW 23	06/27/95	Ethylbenzene	2	X
S9MW 6	06/27/95	Ethylbenzene	2	X
S9MW 8	06/28/95	Ethylbenzene	2	X
HY09	07/27/95	Isopropyl alcohol	23	NJ
S9MW 23	06/27/95	Methylene chloride	92.2	JDB
S9MW 6	06/27/95	Methylene chloride	77.5	JDB
S9MW 18	06/28/95	Methylene chloride	21.2	JDB
S9MW 16	06/28/95	Methylene chloride	20.7	JDB
S9MW 8	06/28/95	Methylene chloride	20	JDB
S9MW 19D	06/28/95	Methylene chloride	19.7	JDB
S9MW 2	06/28/95	Methylene chloride	12.7	JDB
S9MW 16	06/28/95	Methylene chloride	5	X
S9MW 18	06/28/95	Methylene chloride	5	X
S9MW 19D	06/28/95	Methylene chloride	5	X
S9MW 23	06/27/95	Methylene chloride	5	X
S9MW 6	06/27/95	Methylene chloride	5	X
S9MW 8	06/28/95	Methylene chloride	5	X
S9MW 9	06/28/95	Methylene chloride	3.87	JB
S9MW 17	06/28/95	Methylene chloride	3.76	JB
S9MW 13	06/28/95	Methylene chloride	3.64	JB
S9MW 10	06/28/95	Methylene chloride	3.54	JB
S9MW 11	06/29/95	Methylene chloride	3.06	JB
S9MW 20D	06/28/95	Methylene chloride	2.9	JB
S9MW 12	06/29/95	Methylene chloride	2.43	JB
S9MW 3	06/29/95	Methylene chloride	2.19	JB
S9MW 1	06/28/95	Methylene chloride	0.695	JB
S9MW 7	06/27/95	Methylene chloride	0.602	JB
HY03	07/25/95	Methylene chloride	0.508	JB
HY03	07/25/95	Methylene chloride	0.501	JB
HY02	07/25/95	Methylene chloride	0.494	JB
HY06	07/25/95	Methylene chloride	0.45	JB
HY01	07/25/95	Methylene chloride	0.418	JB
S9MW 2	06/28/95	Styrene	67.5	
S9MW 16	06/28/95	Styrene	10	X
S9MW 18	06/28/95	Styrene	10	X
S9MW 19D	06/28/95	Styrene	10	X
S9MW 23	06/27/95	Styrene	10	X
S9MW 6	06/27/95	Styrene	10	X
S9MW 8	06/28/95	Styrene	10	X
S9MW 2	06/28/95	Tetrachloroethene	13.5	

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
NAS KEY WEST
PAGE 7 OF 8

Location	Date	Parameter	Result	Qual.[1]
VOLATILE ORGANIC COMPOUNDS (µg/L) (cont.)				
S9MW 16	06/28/95	Tetrachloroethene	2	X
S9MW 18	06/28/95	Tetrachloroethene	2	X
S9MW 19D	06/28/95	Tetrachloroethene	2	X
S9MW 23	06/27/95	Tetrachloroethene	2	X
S9MW 6	06/27/95	Tetrachloroethene	2	X
S9MW 8	06/28/95	Tetrachloroethene	2	X
HY06	07/25/95	Tetrachloroethene	0.0681	J
S9MW 2	06/28/95	Toluene	13.5	
S9MW 16	06/28/95	Toluene	2	X
S9MW 18	06/28/95	Toluene	2	X
S9MW 19D	06/28/95	Toluene	2	X
S9MW 6	06/27/95	Toluene	2	X
S9MW 8	06/28/95	Toluene	2	X
S9MW 23	06/27/95	Toluene	0.618	J
HY03	07/25/95	Toluene	0.308	J
HY02	07/25/95	Toluene	0.248	J
HY04	07/25/95	Toluene	0.194	JB
HY03	07/25/95	Toluene	0.171	JB
HY06	07/25/95	Toluene	0.061	JB
S9MW 24	01/18/96	Trans-1,2-dichloroethene	3,060	
S9MW 15	12/93	Trans-1,2-dichloroethene	2,800	
S9MW 24	06/27/95	Trans-1,2-dichloroethene	2,420	D
S9MW 24	06/27/95	Trans-1,2-dichloroethene	1,920	E
S9MW 15	12/93	Trans-1,2-dichloroethene	1,700	E
S9MW 14	12/93	Trans-1,2-dichloroethene	1,400	
S9MW 14	12/93	Trans-1,2-dichloroethene	1,300	E
S9MW 24	02/94	Trans-1,2-dichloroethene	890	
S9MW 15	06/27/95	Trans-1,2-dichloroethene	495	D
S9MW 15	06/27/95	Trans-1,2-dichloroethene	469	E
S9MW 24	02/94	Trans-1,2-dichloroethene	390	E
S9MW 15	02/94	Trans-1,2-dichloroethene	280	
S9MW 14	02/94	Trans-1,2-dichloroethene	180	
S9MW 14	06/27/95	Trans-1,2-dichloroethene	56.2	
S9MW 15	01/18/96	Trans-1,2-dichloroethene	53	
S9MW 22	06/27/95	Trans-1,2-dichloroethene	23.5	
S9MW 22	06/27/95	Trans-1,2-dichloroethene	19.2	
S9MW 2	06/28/95	Trans-1,2-dichloroethene	13.5	
S9MW 21	06/27/95	Trans-1,2-dichloroethene	6.82	
S9MW 21	02/94	Trans-1,2-dichloroethene	6.6	
S9MW 19D	01/18/96	Trans-1,2-dichloroethene	5	
S9MW 21	01/18/96	Trans-1,2-dichloroethene	5	
HY01	07/25/95	Trans-1,2-dichloroethene	4.58	
S9MW 16	06/28/95	Trans-1,2-dichloroethene	2	X
S9MW 18	06/28/95	Trans-1,2-dichloroethene	2	X
S9MW 19D	06/28/95	Trans-1,2-dichloroethene	2	X
S9MW 23	06/27/95	Trans-1,2-dichloroethene	2	X
S9MW 6	06/27/95	Trans-1,2-dichloroethene	2	X
S9MW 8	06/28/95	Trans-1,2-dichloroethene	2	X
S9MW 2	06/28/95	Trans-1,3-dichloropropene	13.5	
S9MW 16	06/28/95	Trans-1,3-dichloropropene	2	X
S9MW 18	06/28/95	Trans-1,3-dichloropropene	2	X
S9MW 19D	06/28/95	Trans-1,3-dichloropropene	2	X
S9MW 23	06/27/95	Trans-1,3-dichloropropene	2	X
S9MW 6	06/27/95	Trans-1,3-dichloropropene	2	X
S9MW 8	06/28/95	Trans-1,3-dichloropropene	2	X
S9MW 15	12/93	Trichloroethene	44	
S9MW 15	12/93	Trichloroethene	41	
S9MW 2	06/28/95	Trichloroethene	13.5	
S9MW 22	02/94	Trichloroethene	4.6	
S9MW 22	06/27/95	Trichloroethene	2.41	
S9MW 24	02/94	Trichloroethene	2.4	
S9MW 22	06/27/95	Trichloroethene	2.34	
S9MW 16	06/28/95	Trichloroethene	2	X

TABLE 1-1

CONTAMINANTS DETECTED IN GROUNDWATER AT SWMU 9
NAS KEY WEST
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Location	Date	Parameter	Result	Qual.(1)
VOLATILE ORGANIC COMPOUNDS (µg/L) (cont.)				
S9MW 18	06/28/95	Trichloroethene	2	X
S9MW 19D	06/28/95	Trichloroethene	2	X
S9MW 23	06/27/95	Trichloroethene	2	X
S9MW 6	06/27/95	Trichloroethene	2	X
S9MW 8	06/28/95	Trichloroethene	2	X
S9MW 15	02/94	Trichloroethene	1.8	
S9MW 14	12/93	Trichloroethene	1.5	
S9MW 3	10/93	Trichlorofluoromethane	3	
S9MW 5	10/93	Trichlorofluoromethane	3	
S9MW 2	06/28/95	Vinyl acetate	67.5	
S9MW 16	06/28/95	Vinyl acetate	10	X
S9MW 18	06/28/95	Vinyl acetate	10	X
S9MW 19D	06/28/95	Vinyl acetate	10	X
S9MW 23	06/27/95	Vinyl acetate	10	X
S9MW 6	06/27/95	Vinyl acetate	10	X
S9MW 8	06/28/95	Vinyl acetate	10	X
S9MW 24	01/18/96	Vinyl acetate	5	
S9MW 9	01/18/96	Vinyl acetate	3	J
S9MW 2	06/28/95	Vinyl chloride	13.5	
S9MW 16	06/28/95	Vinyl chloride	2	X
S9MW 18	06/28/95	Vinyl chloride	2	X
S9MW 19D	06/28/95	Vinyl chloride	2	X
S9MW 23	06/27/95	Vinyl chloride	2	X
S9MW 6	06/27/95	Vinyl chloride	2	X
S9MW 8	06/28/95	Vinyl chloride	2	X
S9MW 2	06/28/95	Xylenes (total)	131.6025	
S9MW 16	06/28/95	Xylenes (total)	20	X
S9MW 18	06/28/95	Xylenes (total)	20	X
S9MW 19D	06/28/95	Xylenes (total)	20	X
S9MW 23	06/27/95	Xylenes (total)	20	X
S9MW 6	06/27/95	Xylenes (total)	20	X
S9MW 8	06/28/95	Xylenes (total)	20	X
S9MW 3	10/93	Xylenes (total)	4	
S9MW 5	10/93	Xylenes (total)	3	
S9MW 4	10/93	Xylenes (total)	2	

Shading indicates a concentration in excess of the most restrictive ARAR or SAL criteria (see Table 2-6).

1 Refer to the lab data sheets from the appropriate investigation for an explanation of the qualifier codes. Appendix L of this report contains the data sheets for samples analyzed in conjunction with the Supplemental RFI/RI. Data sheets from previous investigations can be found as follows: Appendix C of the 1987 Geraghty and Miller Verification Study, Appendix G of IT's 1991 RI Report, Appendix I of the 1994 RFI/RI Report, and Appendices 1, 2, and 3 of the 1995 BEI Delineation Study.

TABLE 1-2

SWMU 9 MONTHLY TREATMENT SAMPLING RESULTS (PPB)

Compound	Applied Standard (ppb)	Recovery Well 1 (Sampling Port 1)					
		KW02886	KW02890	KW02894	KW02898	KW02902	
		11/6/96	12/3/96	1/14/97	2/14/97	3/19/97	
Trans 1,2-DCE	100	937	5.6	1.6	nd	.9	
TCE	3	245	1.0	0.3	nd	nd	
Benzene	1.18	2.1	16.1	22.9	5.2	4.8	
Ethylbenzene	70	1.3	50.2	40.1	15.6	16.0	
Cis 1,2-DCE	70	434	2.6	nd	nd	nd	
Total naphthalenes	100	1.7	75.2	79.1	29.5	30.2	

Compound	Applied Standard (ppb)	Recovery Well 2 (Sampling Port 2)					
		KW02887	KW02891	KW02895	KW02899	KW02903	
		11/6/96	12/3/96	1/14/97	2/14/97	3/19/97	
Trans 1,2-DCE	100	19.3	19.7	23.6	29.9	106.0	
T C E	3	1.4	0.8	0.6	0.69	5.4	
Benzene	1.18	1.8	2.8	3.8	3.5	nd	
Ethylbenzene	70	3.8	7.7	13.8	12.8	3.4	
cis 1,2-DCE	70	8.1	8.7	10.8	12.8	60.5	
Total naphthalenes	100	9.3	22.6	44.5	23.6	12.3	

Compound	Applied Standard (ppb)	Recovery Well 3 (Sampling Port 3)					
		KW02888	KW02892	KW02896	KW02900	KW02904	KW02908
		11/6/96	12/3/96	1/14/97	2/14/97	3/19/97	4/19/97
Trans 1,2-DCE	100	1,090	1,410	1,030	730	531	946
TCE	3	320	342	76.5	35.6	40.1	35.1
Benzene	1.18	2.0	1.8	nd	nd	nd	1.0
Ethylbenzene	70	0.69	1.2	1.3	1.0	0.5	nd
Cis 1,2-DCE	70	566.0	763	586	503	281	382
Total naphthalenes	100	0.81	1.5	1.7	1.3	1.1	nd

The shading represents concentrations above the applied standard (BEI, 1997).

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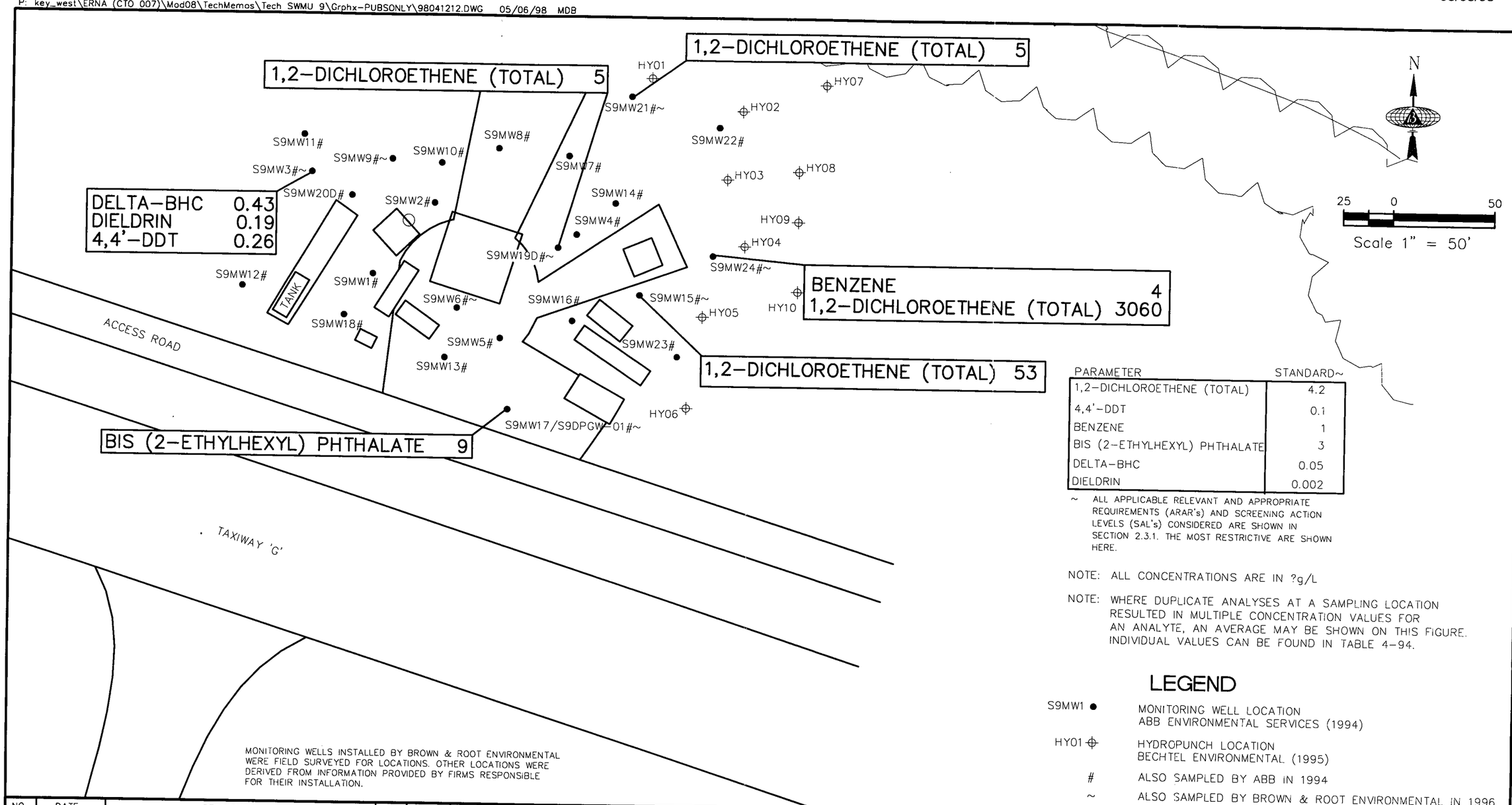


PARAMETER	STANDARD~
1,2-DICHLOROETHENE (TOTAL)	4.2
4,4'-DDT	0.1
BENZENE	1
BIS (2-ETHYLHEXYL) PHTHALATE	3
DELTA-BHC	0.05
DIELDRIN	0.002

~ ALL APPLICABLE RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR's) AND SCREENING ACTION LEVELS (SAL's) CONSIDERED ARE SHOWN IN SECTION 2.3.1. THE MOST RESTRICTIVE ARE SHOWN HERE.

NOTE: ALL CONCENTRATIONS ARE IN ?g/L

NOTE: WHERE DUPLICATE ANALYSES AT A SAMPLING LOCATION RESULTED IN MULTIPLE CONCENTRATION VALUES FOR AN ANALYTE, AN AVERAGE MAY BE SHOWN ON THIS FIGURE. INDIVIDUAL VALUES CAN BE FOUND IN TABLE 4-94.

MONITORING WELLS INSTALLED BY BROWN & ROOT ENVIRONMENTAL WERE FIELD SURVEYED FOR LOCATIONS. OTHER LOCATIONS WERE DERIVED FROM INFORMATION PROVIDED BY FIRMS RESPONSIBLE FOR THEIR INSTALLATION.

LEGEND

S9MW1 ● MONITORING WELL LOCATION
ABB ENVIRONMENTAL SERVICES (1994)

HY01 ⊕ HYDROPUNCH LOCATION
BECHTEL ENVIRONMENTAL (1995)

\# ALSO SAMPLED BY ABB IN 1994

~ ALSO SAMPLED BY BROWN & ROOT ENVIRONMENTAL IN 1996

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MDB DATE 4/23/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

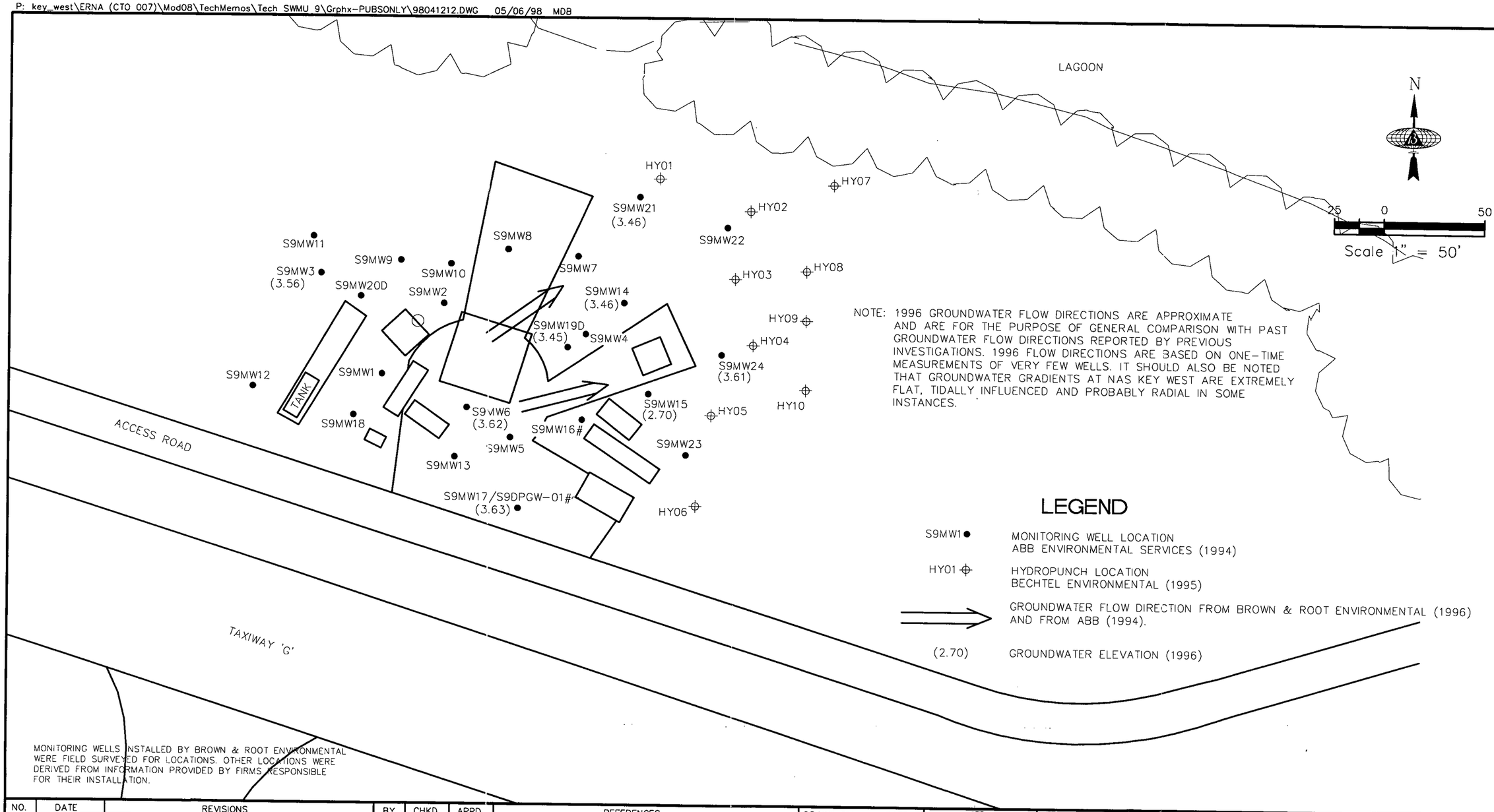
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

SWMU 9 TECHNICAL MEMORANDUM FOR SAMPLING AND ANALYSIS PLAN ADDENDUM FIGURE 1-2. 1996 GROUNDWATER CHEMICAL CONCENTRATIONS FOR SELECTED COIs SWMU 9 NAVAL AIR STATION, KEY WEST BOCA CHICA KEY, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. ----
REV. 0

FORM CADD NO. SDV_BH12.DGN - REV 0 - 1/20/98

P: key_west\ERNA (CTO 007)\Mod08\TechMemos\Tech SWMU 9\Grphx-PUBSONLY\98041212.DWG 05/06/98 MDB



NOTE: 1996 GROUNDWATER FLOW DIRECTIONS ARE APPROXIMATE AND ARE FOR THE PURPOSE OF GENERAL COMPARISON WITH PAST GROUNDWATER FLOW DIRECTIONS REPORTED BY PREVIOUS INVESTIGATIONS. 1996 FLOW DIRECTIONS ARE BASED ON ONE-TIME MEASUREMENTS OF VERY FEW WELLS. IT SHOULD ALSO BE NOTED THAT GROUNDWATER GRADIENTS AT NAS KEY WEST ARE EXTREMELY FLAT, TIDALLY INFLUENCED AND PROBABLY RADIAL IN SOME INSTANCES.

LEGEND

S9MW1●	MONITORING WELL LOCATION ABB ENVIRONMENTAL SERVICES (1994)
HY01⊕	HYDROPUNCH LOCATION BECHTEL ENVIRONMENTAL (1995)
⟹	GROUNDWATER FLOW DIRECTION FROM BROWN & ROOT ENVIRONMENTAL (1996) AND FROM ABB (1994).
(2.70)	GROUNDWATER ELEVATION (1996)

MONITORING WELLS INSTALLED BY BROWN & ROOT ENVIRONMENTAL WERE FIELD SURVEYED FOR LOCATIONS. OTHER LOCATIONS WERE DERIVED FROM INFORMATION PROVIDED BY FIRMS RESPONSIBLE FOR THEIR INSTALLATION.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

FORM CADD NO. SDV_BH12.DGN – REV 0 – 1/20/98

DRAWN BY MDB DATE 4/23/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DEPARTMENT OF THE NAVY · NAVAL FACILITIES ENGINEERING COMMAND · WASHINGTON DIV

SWMU 9 TECHNICAL MEMORANDUM FOR SAMPLING AND ANALYSIS PLAN ADDENDUM FIGURE 1-3. GROUNDWATER FLOW AND ELEVATIONS SWMU 9 NAVAL AIR STATION, KEY WEST BOCA CHICA KEY, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. ----
REV. 0

2.0 FIELD OPERATIONS

2.1 GENERAL FIELD OPERATIONS

This section discusses the general sampling operations, procedures, and proper documentation for the proposed field operations to be performed at the SWMU 9 Former Jet Engine Test Cell. All field procedures will be conducted in accordance with the previous SAP prepared by ABB Environmental Services Inc. (ABB, 1995). The previous SAP presents the necessary criteria for performance of these field activities, including sampling procedures and field recording of activities. In addition, the previous SAP presents the necessary QA elements for site activities.

2.1.1 Mobilization/Demobilization

Following approval of this Technical Memorandum, B&R Environmental will begin mobilization activities. Field team members will review this memorandum as well as the Work Plan, SAP, QA elements and HASP prepared previously for this site.

The Field Operations Leader (FOL) will be designated as the lead in coordinating all day-to-day site activities during the investigation. The FOL will be responsible for all sampling operations, QA/QC, field documentation requirements, and field change orders. The FOL will coordinate the mobilization activities upon arrival at the facility. Prior to the initiation of fieldwork, the FOL will arrive at the site to begin onsite mobilization activities. These activities will include the purchasing expendable equipment and preparation of the field sampling equipment. All of the equipment required for the field activities will be driven to the site by the FOL. After field activities are completed, the FOL will demobilize the equipment.

2.1.2 Water Level Measurements

Synoptic water-level measurements will be taken from selected existing monitoring wells at the site. All measurements will be taken within a 4-hour period of consistent weather conditions to minimize atmospheric and evapotranspiration effects on groundwater levels. The sequence of measuring water levels will be determined in the field by the FOL.

Measurements will be taken with an M-scope (electrical water-level indicator) using the top of the well casing as the reference point for determining depths to water. A notch will be used at the top of the PVC

to assure that measurements are taken consistently between measuring events. Water-level measurements will be recorded to the nearest 0.01-foot in the appropriate field logbook and on a groundwater level measurement form.

2.1.3 Groundwater Sampling

Prior to obtaining samples, water levels will be measured and the wells will be purged using a low-flow peristaltic pump. Three to five well volumes will be purged. If the wells are purged dry with less than three well volumes removed, the water level in the well will be allowed to recover to a level sufficient for sample acquisition; then a sample will be collected. In the event that recovery is slow, samples will be collected within 24 hours of purging or after the water level has recovered to 80 percent of its static level. Field measurements of pH, temperature, specific conductance and turbidity will be taken at the beginning of every well volume purged. Stabilization is defined as follows: temperature ± 1.0°C, pH ± 0.1 units, and specific conductance ± 5 percent. If these parameters do not stabilize after three volumes, up to five volumes will be removed.

Dedicated teflon tubing and a low-flow peristaltic pump will be used for sample collection. Immediately prior to sampling, the temperature, pH, specific conductance, and turbidity of the water sample will be measured and recorded on the groundwater sample form. The peristaltic pump will be shut off and the tubing crimped. The tubing will be withdrawn from the well and the sample will be discharged directly from the tubing into the 40-ml VOA sample bottle for VOC analysis.

The 11 monitoring wells to be sampled are depicted in Figures 1-2 and 1-3. The number and type of samples proposed for collection and subsequent laboratory analyses are listed in Table 2-1.

2.1.4 Field Measurements

Field measurements will be recorded during sampling operations, including groundwater temperature, pH, specific conductance, oxidation-reduction potential (ORP), carbon dioxide (CO_2), alkalinity ($CaCO_3$)/dissolved inorganic carbon (DIC), dissolved oxygen (DO), dissolved ferrous iron (Fe^{2+}), and sulfide (H_2S). Field test kits will be used to perform the analysis of CO_2, $CaCO_3$/DIC, DO, Fe^{2+} and H_2S. The remaining parameters will be measured using field water-quality meters. All instruments used in the field to record this data will be calibrated daily according to the manufacturer's recommendations.

TABLE 2-1

SWMU 9 SAMPLE NUMBER AND ANALYTICAL FRACTION

The following is a summary of the aqueous, solid and QC samples that will be obtained during this field investigation:

Analytical Fraction	Analytical Method	Bottles[a,b,]	Number of Samples	Duplicate Samples	Trip Blanks (Aqueous)	Total Samples
Appendix IX Volatile Organic Compounds	SW-846/8260B	(2)40 ml pre HCL	11	2	3	16
Anions: chloride, nitrate, nitrite, phosphate, sulfate	EPA 300	40 ml	8	1	–	9
Dissolved iron and manganese	SW-846/6010B	500 ml pre $HN0_3$	8	1	-	9
Methane	SW-846/3810 Modified	50 ml pre H_2SO4	8	1	–	9
Sulfide	Std-Methods 9th Edition	500 ml glass pre NaOH and Zn acetate	8	1	–	9
Total organic carbon (TOC) aqueous	SW-846/9060	500 ml glass pre HCL	8	1	–	9
Alkalinity	EPA 310	40 ml	8	1	–	9
Total organic carbon (TOC) solid	SW-846/9060 Modified	100g soil 8oz glass	2	–	–	2
TOTAL			61	8	3	72

a All bottles are plastic unless otherwise noted.
b Chloride, nitrate, nitrite, phosphate, sulfate, and alkalinity can all come from the same container (48-hour hold time on nitrate and phosphate).

The parameters discussed in the following paragraphs are specifically selected for the evaluation of natural attenuation processes related to chlorinated solvent plumes. Field parameters for natural attenuation evaluation will be obtained from selected permanent monitoring well installations as specified in Section 1.3. Low-flow peristaltic pumps will be used for field parameter collection. All readings will be recorded on the groundwater sample form.

A Horiba® Model U-10 water-quality meter will be used to collect temperature, specific conductance, pH, and turbidity measurements. The Horiba is intended to determine general ground water quality parameters. The Horiba is calibrated for pH, specific conductance, and turbidity by using a single, purchased standard phthalate pH solution. All readings will be recorded on the groundwater sample form.

Calibration of the Horiba® water-quality meter is performed as follows: After filling the Horiba® U-10 calibration beaker to the line indicated with the standard solution, the probe is fitted over the beaker. The MODE key is pushed to put the unit into the MAINT mode and to move the lower cursor on the readout to the AUTO sub-mode. After pressing the ENT key, the meter will automatically calibrate for each of the three parameters. When the calibration is complete, the readout will briefly show "End" and then will switch to the MEAS mode. If the unit does not switch to the MEAS mode and the readout shows an error code, the instrument must be re-calibrated by first pressing the CLR key and then the ENT key.

Natural attenuation field parameter of ORP will be analyzed using a high quality portable water-quality meter. The portable water-quality meter will be utilized using a flow-through sample chamber to reduce sample aeration and contact with the atmosphere. The discharge hose from the pump will be connected to the flow-through chamber with a silicon fitting. All readings will be recorded on the groundwater sample form.

All equipment calibration will be documented on an Equipment Calibration Log. During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact on the instrument's performance, the instrument will be removed from service until the defective parts are repaired or replaced.

Field measurements for dissolved carbon dioxide (CO_2) will be made in the field using a high-resolution, low-range test kit (Hach® field kit CA-23). The test kit for CO_2 utilizes drop-count titration, and sodium hydroxide and phenolphthalein reagents, and can obtain accurate determination of CO_2 at concentrations down to 1.25 mg/L.

Field measurements for alkalinity ($CaCO_3$)/dissolved inorganic carbon (DIC) will be made in the filed using a high resolution, low range test kit (Hach® field kit OX-DT). The test for $CaCO_3$ utilizes drop count titration, and sulfuric acid (H2SO4) and phenolphthalein reagents, and can obtain accurate determination of $CaCO_3$ at concentrations down to 10-40 mg/L.

The determination of DO will be made in the field using a high-resolution, low-range test kit (Hach® field kit OX-DT). DO is the most important of the four parameters and is also the most difficult to accurately collect. The test kit for DO utilizes digital titration and modified-Winkler methodology, and can obtain accurate determination of DO at concentrations down to 0.02 mg/L.

Field measurements for dissolved ferrous iron (Fe^{2+}) will be made in the field using a high-resolution, low-range test kit (Hach® field kit IR-18C). The test kit for Fe^{2+} utilizes a color disc and phenanthroline reagents, and can obtain accurate determination of Fe^{2+} at concentrations down to 0.1 mg/L.

Field measurements for sulfide (H_2S) will be made in the field using a colormetric test kit (Hach® field kit HS-C). The test for H_2S utilizes test paper and effervescing tablets to activate the test paper. The test paper is then compared with the color chart provided in the kit.

2.1.5 Quality Control (QC) Samples

In addition to periodic calibration of field equipment and appropriate documentation, minimal quality control samples will be collected during environmental sampling activities. As this study is for engineering purposes, and in an effort to reduce the analytical costs on this project, quality control samples will include only field duplicates of the VOC samples.

The field duplicate is a water sample collected independently at a sampling location during a single act of sampling under representative field conditions. The duplicate sample will be collected from two of the eleven groundwater monitoring wells. The duplicate shall be analyzed for VOCs and shall be identified so laboratory personnel are unable to distinguish them from normal field samples.

2.1.6 Decontamination

Only dedicated sampling equipment will be used for the upcoming field sampling activities. Therefore, no decontamination solvents or rinsate blanks will be required. Deionized water and phosphate-free soap (e.g., Alconox®) will be used for incidental cleaning of equipment. Field analytical equipment such as water-quality meters and probes will be rinsed with deionized water first and then with the sample liquid.

2.1.7 Waste Handling

All purge liquids will be collected and stored in DOT-approved (specification 17-C/H) 55-gallon drums at the site. Based on the results of the groundwater analyses, a determination will be made whether offsite disposal or treatment is required. B&R Environmental will provide the information required by NAS Key West Public Works for proper removal and disposal of the drummed wastes. NAS Key West will be responsible for the final disposition of all IDW.

3.0 MANAGEMENT AND REPORTING

3.1 HEALTH AND SAFETY

B&R Environmental staff will adhere to the Health and Safety Plan Addendum (based on the NAS Key West Health and Safety Plan, January 1996) since the field activities are identical to those utilized in the recent fieldwork at NAS Key West. The revised plan will address SWMU 9 contaminants since B&R Environmental performed fieldwork at this unit during January 1996. The Field Operations Leader will be Marty Ray, B&RE Aiken who will be performing a parallel field effort.

3.2 FIELD STAFF

- Scott Flickinger B&RE Aiken, Environmental Scientist
- Andy Kendrick B&RE Pittsburgh, Senior Geologist

3.3 SCHEDULE

It is anticipated that the initial groundwater contaminant sampling activities and water level measurements will require approximately 1 week to complete and will take place in late April or early May 1998. Based on the groundwater VOC sampling a determination of the contaminants and the plume size will be made. A second field mobilization will be undertaken to collect the natural attenuation indicator parameters. This activity will require 1 week to complete and will take place in late June or early July 1998.

The standard laboratory turn-around time is 30 days per sampling round from receipt of the last sample. Therefore, the evaluation report will be completed within 60 days of the last sampling round.

3.4 REPORTING

At the completion of the sampling activities, a summary report will be prepared. The summary report will present the current potentiometric flow map of the shallow groundwater system, current isoconcentration maps for VOC compounds detected in excess of ARARs, a comparison of temporal changes identified in the groundwater plume, an evaluation of the current natural attenuation processes in operation at the site, and recommendations for remediation of the site. All field screening and laboratory data collected will be evaluated and presented.

3.5 BASE SUPPORT

The CLEAN Remedial Project Manager (RPM) is:

Dudley Patrick, Code 1858
Southern Division
Naval Facilities Engineering Command
P.O. Box 190010
N. Charleston, SC 29419-9010
(803) 820-5541

The NAS Key West Point of Contact is:

Phillip Williams, Code 1883
Commanding Officer
Public Works Department
Naval Air Station
P.O. Box 9007
Key West, Florida 33040-9001
(305) 293-2061

Throughout the duration of the sampling activities, various support functions will be provided by NAS Key West personnel as described below:

Take custody of any purge fluids requiring disposal according to applicable state or Federal regulations.

If available, provide access to the former jet engine test cell buildings for storage of equipment and power connection.

3.6 CONTINGENCY PLAN

In the event of problems which may be encountered during the site activities, the B&R Environmental Project Manager will notify immediately the NAS Key West Point of Contact. The Project Manager will determine a course of action so as to not interfere with the schedule or budget. All contingency plans will be approved through the NAS Key West Point of Contact and the RPM before being enacted.

REFERENCES

ABB (ABB Environmental Services, Inc.), 1994, *Contamination Assessment Report Jet Engine Test Cell, Building A969*, prepared for Department of the Navy, Southern Division Naval Facilities Engineering Command, Tallahassee, Florida.

ABB (ABB Environmental Services, Inc.), 1995, *Facility and Remedial Investigation NAS Key West, Workplan*, Volume 1, and Sampling and Analysis Plan, Volume 2, prepared for SOUTHNAVFACENGCOM, Tampa, Florida, June.

BEI (Bechtel Environmental, Inc.), 1997, *Project Completion Report*, prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina, October.

B&RE (Brown & Root Environmental), 1997, *Supplemental RCRA Facility Inspection and Remedial Investigation Report*, prepared for Southern Division Naval Facilities Engineering Command, Charleston, South Carolina, July 4.