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TREATABILITY STUDY INSTALLATION REPORT FOR BOCA CHICA FLYING CLUB WITH
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7/12/2002
TETRA TECH NUS



TETRA TECH NUS, INC.

AIK-02-0222

July 12, 2002

Project Number HK 4087

via U.S. Mail

Commander
Department of the Navy
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Reference: CLEAN Contract No. N62467-94-D-0888
Contract Task Order No. 0207

Subject: Treatability Study Installation Report for Boca Chica Flying Club, Rev. 0,
Naval Air Facility, Key West, Florida

Dear Mr. Glover:

TtNUS is pleased to submit the enclosed PDF file for the Treatability Study Installation Report for Boca Chica Flying Club, Rev. 0, Naval Air Facility, Key West, Florida. At your request, a hard copy of this final report is being distributed to the Florida Department of Environmental Protection (FDEP) for their review and comment or concurrence. I am planning on receiving comments or concurrence on this document from FDEP within the next 30 days.

Please call me at (803) 649-7963, extension 345, if you have any questions regarding the enclosed CD.

Sincerely,

C. M. Bryan
Project Manager

CMB:spc

Enclosure

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File 4087-7.2.1

Treatability Study Installation Report for **Boca Chica Flying Club**

Naval Air Facility Key West
Key West, Florida



Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0207

July 2002

**TREATABILITY STUDY INSTALLATION REPORT
FOR
BOCA CHICA FLYING CLUB**

**NAVAL AIR FACILITY
KEY WEST, FLORIDA**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:
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Naval Facilities Engineering Command
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CONTRACT TASK ORDER 0207**

JULY 2002

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ACRONYMS

| | |
|-----------------|---|
| ABB | ABB Environmental Services, Inc. |
| AS | Air Sparging |
| AST | Aboveground storage tank |
| AS/SVE | Air Sparging/Soil Vapor Extraction |
| AVGAS | Aviation Gas |
| BEI | Bechtel Environmental, Inc. |
| CAR | Contamination Assessment Report |
| cfm | Cubic feet per minute |
| CLEAN | Comprehensive Long-Term Environmental Action Navy |
| CO ₂ | Carbon dioxide |
| CTO | Contract Task Order |
| DO | Dissolved oxygen |
| EPA | United States Environmental Protection Agency |
| FAC | Florida Administrative Code |
| FID | Flame Ionization Detector |
| IDW | Investigation-derived waste |
| µg/L | Micrograms per liter |
| mg/L | Milligrams per liter |
| MW | Monitoring well |
| NAF | Naval Air Facility |
| O ₂ | Oxygen |
| O&M | Operation and Maintenance |
| OVA | Organic Vapor Analyzer |
| ppbv | Parts per billion volume |
| ppm | Parts per million |
| psi | Pounds per square inch |
| PVC | Polyvinyl chloride |
| RAP | Remedial Action Plan |
| scfm | Standard cubic feet per minute |
| SOPs | Standard Operating Procedures |
| SVE | Soil Vapor Extraction |
| TRPH | Total Recoverable Petroleum Hydrocarbons |
| TiNUS | Tetra Tech NUS, Inc. |
| USTs | Underground storage tank |
| VOA | Volatile Organic Aromatic |

VOC

Volatile Organic Compound

1.0 INTRODUCTION

1.1 PURPOSE/SCOPE

Tetra Tech NUS, Inc. (TtNUS) has prepared this Treatability Study Installation Report for Boca Chica Flying Club at Naval Air Facility (NAF) Key West. This report was prepared for the United States Navy Southern Division, Naval Facilities Engineering Command under Contract Task Order (CTO) 0207, for the Comprehensive Long-term Environmental Action Navy (CLEAN) III Contract Number N42467-94-D-0888. Under this CTO, TtNUS performed a short-term treatability study and collected short-term pilot test results. Based on those results, TtNUS commenced with a long-term air sparging/soil vapor extraction (AS/SVE) treatability study to test the applicability and effectiveness of the technology on site contamination. In addition, based on the conclusions from the Phase I testing, recommendations are included for system operations during Phase II Long-Term AS/SVE testing. The Phase I testing was performed in accordance with the AS/SVE Treatability Study Work Plan prepared by TtNUS in January 2002. The scope of this treatability study is limited to the soils and groundwater that have been affected by previous activities at the site.

1.2 REMEDIAL ACTION OBJECTIVES

The following are the remedial action objectives for Boca Chica Flying Club, Key West:

- Remediate groundwater in the vicinity of monitoring wells (MW) MW-6 and MW-20 to levels acceptable with applicable State of Florida Chapters 62-770 and 62-777, Florida Administrative Code (FAC) cleanup goals.
- Remediate any residual hydrocarbons in the soil to levels below the State of Florida Chapters 62-770 and 62-777, FAC cleanup goals.

1.3 SITE DESCRIPTION

NAF Key West is located approximately 150 miles southwest of Miami, Florida, in Monroe County. The Flying Club site can be found on the Boca Chica Key, Florida, USGS Topographic 7.5 Minute Series Quadrangle (Figure 1-1) near latitude 24' 34.829" and longitude 81' 41.260". NAF Key West consists of several facilities located on a number of properties on the lower Florida Keys and encompasses approximately 5,000 acres. The majority of these properties are concentrated on Boca Chica Key and Key West. The goal of NAF Key West is to maintain and operate facilities that provide services and

materials to support operations of aviation activities and units designated by the Chief of Naval Operations.

The former Flying Club area is located along the northwest boundary of Taxiway H of Boca Chica Field, near Buildings A133, A126, A127, and A128. The former Flying Club area includes a former motor pool refueling point that used underground storage tanks (USTs) to store and dispense gasoline. An aviation gasoline aboveground storage tank (AST) area was located approximately 50 feet south of the former motor pool refueling area. The area is currently used as an electrical repair and maintenance facility (Building A126) and a transformer storage area (Building A133).

Most of the former Flying Club area is covered with broken asphalt, limestone, and grass. A 6-inch high concrete curb runs along the northern boundary of the concrete apron of Taxiway H. Underground utilities, a storm drain, and an 8-foot high chain-link fence parallel the curb on its north side. The fence is located approximately 75 feet from the taxiway and borders the southeast boundary of Building A133.

1.4 HISTORY OF ASSESSMENT ACTIVITIES

The proposed AS/SVE system is designed to address subsurface soil and groundwater contaminated with volatile organic compounds (VOCs). The following is a general discussion of the site contaminants.

1.4.1 Soils

Soils in the site area were field-screened with an Organic Vapor Analyzer (OVA) to assess for the presence of contaminated soil during the Contamination Assessment Report (CAR) conducted in April 1994 [ABB Environmental Services, Inc. (ABB), 1994]. A total of 71 soil borings were advanced, each to 6 feet deep. Screening results indicated the presence of excessively contaminated soils [greater than 50 parts per million (ppm)] in four areas. The largest area measured approximately 70 feet long by 40 feet wide and was located near Building A131. Smaller areas were noted near the former Aviation Gas (AVGAS) dispenser, north of Building A131 near MW-8, and north of Building A131 near MW-17. OVA readings greater than 500 ppm were identified in 20 samples.

1.4.2 Groundwater

Groundwater samples were collected from all existing wells and analyzed for Kerosene Analytical Group parameters during the CAR that was conducted in April 1994. The applicable Class G-III aquifer cleanup goals were exceeded for the compounds of benzene and total volatile organic aromatics (VOA). Two areas of VOA contamination were identified, one near the former AVGAS ASTs and dispenser and the

other near the former motor pool USTs. MW-4, located near the former AVGAS dispenser, had the highest VOA concentration [1,300 micrograms per liter ($\mu\text{g/L}$)]. MW-6 and MW-20, near the former motor pool gasoline USTs, had total VOA concentrations of 305 $\mu\text{g/L}$ and 156 $\mu\text{g/L}$, respectively.

The monitoring wells were resampled in August 1996, as part of the Remedial Action Plan (RAP) preparation (ABB, 1997). The 1996 data indicated significant changes in the degree and extent of contamination found during the CAR. Total VOAs in MW-4 was measured at 133 $\mu\text{g/L}$, putting the area of the former AVGAS dispenser within the Class III guidelines. The total VOA for MW-6 and MW-20 were 1,470 $\mu\text{g/L}$ and 35 $\mu\text{g/L}$, respectively. Based on those sampling results, the RAP recommended a remedial action consisting of excavation of contaminated soil (an estimated amount of 2,126 cubic yards) and treatment using ion collider technology on some of the excavated soils. The largest area recommended to be excavated was in the vicinity of the former motor pool USTs near Building A133.

In 1998, excavations of contaminated soil took place, based on recommendations in RAP. Approximately 983 cubic yards of soil were excavated from the Flying Club site. The ion collider process was used to treat a portion of the contaminated soil. The excavated areas at the Flying Club site were then backfilled [Bechtel Environmental, Inc. (BEI), 1999].

A quarterly groundwater monitoring plan was implemented in August 1999. The most recent sampling results are dated April 11, 2001. Total VOA results for MW-6 and MW-20 were 51 $\mu\text{g/L}$ and 11 $\mu\text{g/L}$, respectively. These VOA results are below the applicable cleanup guidelines; however, naphthalene and total recoverable petroleum hydrocarbons (TRPH) concentrations increased in MW-20. Due to the lack of substantial decreases in the concentrations of some contaminants following several quarters of groundwater monitoring, TtNUS recommended a treatability study be performed to investigate the efficacy of enhancing the degradation of contaminants under aerobic conditions.

2.0 PHASE I TESTING RESULTS

The following section presents the Phase I results of the treatability study testing performed at the Boca Chica Flying Club, NAF Key West. The Phase I testing included installation of testing and observation wells, implementation of a short-term AS/SVE test, system monitoring, and air emission sampling and analysis. The results of the physical and analytical testing are summarized below. The work sheets used during the physical testing of the system are included as Appendix A. The air sampling results are included as Appendix B.

2.1 PHYSICAL PARAMETERS

Phase I was conducted using a temporary, trailer-mounted pilot test unit to test subsurface characteristics for AS/SVE suitability. Samples for VOCs, oxygen, and carbon dioxide were collected from the discharge of the vapor extraction blower. Dissolved oxygen (DO) and carbon dioxide in groundwater were collected in two monitoring wells, using field test kits. Estimated flow rates, pressures, vacuums, and horsepower were also evaluated during the test.

The Phase I test was performed in three steps. The first step included a soil vapor extraction (SVE) only test, the second step was an air sparging (AS) only test, and the third step was an AS/SVE combined test. During each of these steps, multiple physical and chemical parameters were tested to evaluate the effectiveness of the AS/SVE system at the site. The Work Plan (TtNUS, 2002) presented the testing requirements and details. A brief summary of the results is provided in this report.

2.1.1 SVE Only Test

The results of the SVE only test indicated that at a vacuum of 60 inches H₂O at the blower resulted in detectable vacuum of 0.02 inch H₂O at observation well MW-6 (Figure 2-1) located approximately 5 feet from the soil vapor extraction well SVE-1. At a vacuum of 60 inches H₂O at the blower, a vacuum of 0.01 inches H₂O was detected at the SVE-2 located approximately 32 feet away from SVE-1.

Typically, the changes in flow rate corresponded to the vacuum being increased or decreased. As the vacuum was increased the resulting flow rate also increased. The flow rate that corresponded to a vacuum of 60 inches H₂O was 30 cubic feet per minute (cfm) at the blower. This flow rate and the above vacuum produced a measurable radius of influence of approximately 30 feet.

2.1.2 AS Only Test

The results of the AS only test indicated that a pressure of 7.5 pounds per square inch (psi) at the blower resulted in a measurable pressure of 1.05 inches H₂O in observation well MW-6. Observations of water levels in MW-6 indicated that after 10 minutes of operations, the water level had risen by 1.42 feet; the water level in MW-5 had risen by 0.07 feet. After approximately 30 minutes of operation, the water levels returned to the pretest elevation and stabilized throughout the remainder of the test. The AS test continued for a period of 180 minutes. During this time the DO was measured in monitoring wells MW-5 and MW-6. The DO in MW-5 increased from 0.53 milligrams per liter (mg/L) at start-up to 1.50 mg/L after 180 minutes. The DO in MW-6 increased from 0.83 mg/L to 5.07 mg/L. DO levels stabilized at these levels after approximately 110 minutes of operation.

2.1.3 Combined AS/SVE Test

Following the completion of the SVE only and AS only testing, a third test was performed with both systems in operation. Information from the previous two tests was used to establish operation conditions for the AS and SVE equipment. The SVE vacuum was set at 60 inches H₂O at the blower with a corresponding flow rate of 30 cfm. The SVE system was allowed to operate alone for a period of 45 minutes to establish SVE conditions in the vadose zone and ensure that complete capture of volatilized contaminants would occur.

The AS system was operated at a pressure of 7.5 psi at the blower and a corresponding flow rate of 5.0 cfm. Typically, the injected air flow rate is a fraction of the extracted flow rate. Again, this will ensure that complete capture of volatilized contaminants occurs.

The combined system operated for a period of 120 minutes. During this time water-level measurements were taken from the observation wells. Fifteen minutes after the combined system was placed in operation, the water level in MW-6 had increased by 0.21 ft, while the water level in MW-5 remained unchanged.

2.2 AIR SAMPLING RESULTS

During each step of the treatability study testing, air sampling was conducted using an OVA equipped with a flame ionization detection (FID) to obtain real time results of VOC content in the offgas emissions. During the SVE testing, samples were collected from the SVE system. During the AS only testing, samples were collected in the form of soil gas samples from the well heads of the observation wells.

The results of the real time air sampling indicated that as the vacuum and the flow rate were increased during each phase of the SVE only test, the corresponding VOC reading also increased. In addition, during the AS/SVE test the concentrations of VOCs increased over the SVE only testing. VOCs were detected in the observation wells after approximately 30 minutes during the AS only test.

In addition, an air sample was collected for fixed-based laboratory analysis during the AS/SVE combined test. The results of the analysis are presented in Table 2-1. Laboratory analytical reports are presented in Appendix B.

Based on the sampling results, it is apparent that a combination of AS/SVE will result in the maximum quantity of VOCs being extracted from the site.

TABLE 2-1

**AIR EMISSIONS ANALYTICAL RESULTS
PHASE I AS/SVE TREATABILITY STUDY
NAVAL AIR FACILITY
KEY WEST, FLORIDA**

| Detected Volatile Organics | Concentrations (ppbv) |
|-----------------------------------|------------------------------|
| 1,3,5-Trimethylbenzene | 210 |
| Cyclohexane | 46000 |
| Ethylbenzene | 910 |
| Hexane | 88000J |
| M+P-xylenes | 390 |
| N-heptane | 84000J |

PPBV – part per billion volume

J = Estimated quantity below the practical quantitation limit and above the method detection limit.

3.0 PHASE II - LONG TERM TREATABILITY TEST

The Phase II long-term test system operation was started up on June 20, 2002 and is expected to continue for a duration of approximately six months. The test will be performed in accordance with the AS/SVE Treatability Study Work Plan (TtNUS, 2002).

Based on the results of the Phase I testing, it has been determined that no additional AS and SVE wells were necessary to provide adequate site coverage. As a result the long-term testing equipment was similar to the specifications outlined in the Work Plan.

3.1 PERMITS

The VOC results from the off-gas sample collected during Phase I emissions were below the Chapter 62-770, FAC requirement of 15 pounds per day. The pilot test unit, however, is equipped with two 250-lb vapor phase carbon drums. Air samples will be collected before and after carbon treatment for an additional two months of operation to verify VOC emissions from the system. If, after two sampling events, VOC levels stay below the 15 lbs/day limit, the carbon treatment will be taken off line.

3.2 INSTALLATION OF PILOT-SCALE SYSTEM

The pilot-scale system consists of an air injection system, a SVE system, and soil/vapor groundwater monitoring points. The air injection system is comprised of 16 injection wells, a 7.5 hp, three-phase Roots URAI-33 air injection blower, and the system piping and controls. The SVE system is comprised of two extraction wells, a 5.5 hp, one-phase Rotron EN 707 vacuum blower, offgas treatment, and system piping and controls. Installation of the system was consistent with the AS/SVE Work Plan described in the following sections.

3.2.1 Well Installation

Sixteen 2-inch diameter, 20-foot deep AS wells were installed in a 20-foot grid pattern in the area of monitoring wells MW-6 and MW-20. Two 5-inch diameter, 8-foot deep vapor extraction wells were installed proximal to MW-6 and MW-20. The locations of the vapor extraction wells and air sparge injection wells are shown on Figure 3-1. Well construction details are shown on Figure 3-2. Well installation was generally consistent with the requirements of Section 3.2.1 of the AS/SVE Work Plan (TtNUS, 2002).

3.2.2 AS/SVE Equipment

The pilot test unit consists of a rotary, positive-displacement blower and one compressor for extraction and injection of air through the system, all of which are mounted on a wheeled trailer. The injection blower is capable of delivering 60 standard cubic feet per minute (scfm) at 7.5 psi at the blower. This flow rate produces an injection rate of 3 to 5 scfm per well. The desired pressure or vacuum is regulated by throttling valves. The injection blower is capable of evacuating the water column in the injection well plus head losses from friction in the transfer line. The pilot test unit also includes a moisture separator, activated carbon canisters for off-gas treatment, flow meters, gauges, sampling ports, and a noise silencer. A plan view of the pilot test unit is illustrated in Figure 3-1.

Power for the treatment unit is supplied by NAF Key West near the southwest end of Building A133 using a 100-amp service panel.

3.2.3 Piping

Air transfer piping between the blowers and the injection and extraction wells was installed above ground using 2-inch diameter schedule 40 polyvinyl chloride (PVC) pipe and ½-inch diameter neoprene hosing. The PVC pipes are connected to the blowers using 2-inch hoses equipped with quick-disconnect camlocks.

3.2.4 Investigation-Derived Waste

Drill cuttings and development water produced during well installation were containerized in sixteen 55-gallon, Department of Transportation approved metal drums. Samples were collected from the soil for disposal parameters. The drums were labeled, with the following: contents, date, and source. All IDW was handled in accordance with the United States Environmental Protection Agency (EPA) guidance document "Management of Investigation-Derived Wastes During Site Inspections", (EPA 1991).

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4.0 SYSTEM OPERATION

The activities associated with Phase II include installation of a semi-permanent power source to the equipment, and operation and maintenance (O&M) of the system. The O&M of the system will include monthly upkeep of the equipment and air and groundwater sampling. A quarterly evaluation of the system will be used to assess if system operation is progressing toward the remedial action objectives. If it is identified that the goals have been achieved or the system is no longer effectively reducing the levels of contamination, then this phase of study will be considered complete. The overall Phase II testing is scheduled to take approximately six months.

5.0 FIELD SAMPLING

Field samples for Phase II will be performed in accordance with the AS/SVE Work Plan (TtNUS, 2002) and will include collection of both air and groundwater samples. The proposed analytical testing for the Phase II AS/SVE Treatability operations is summarized in Table 5-1.

The sampling activities to be conducted in conjunction with this treatability study are outlined below.

5.1 AIR SAMPLING

5.1.1 Field VOC Analysis

An OVA equipped with a FID will be used for VOC analysis. The samples will be collected from the SVE system at two locations during each event. The first location will be prior to carbon treatment and the second location will be following carbon treatment. If it is determined that carbon treatment is no longer necessary, samples will only be collected at the system discharge.

Samples will be obtained by attaching a flexible hose between a sampling port and a sampling pump, and attaching a second flexible tube from the pump to a Tedlar sample bag. With the sampling port opened, the sample pump will be used to extract air for the SVE system and pump the air into the Tedlar bag. Once full, the bag's valve is closed and connected to the OVA for analysis.

5.1.2 FIXED-BASED LABORATORY SOIL VAPOR SAMPLING

During Phase II, vapor samples for laboratory analysis will be collected. Two samples will be collected per event from sample ports located prior to and following carbon treatment. If during Phase II testing it is determined that carbon treatment is no longer required, one sample will be collected per event from the system discharge.

The samples will be analyzed for VOCs, oxygen, and carbon dioxide by EPA Method 18. The results of the analyses will be used to evaluate the effectiveness of the AS/SVE system, quality of VOCs removed by the system, and the effectiveness of the carbon unit for off-gas treatment. The results of the analysis will also determine when and if the off-gas treatment may be discontinued. Oxygen and carbon dioxide will be analyzed for potential natural biodegradation.

5.2 GROUNDWATER SAMPLING

5.2.1 Fixed-based Laboratory Sampling

Groundwater samples will be collected monthly from three site monitoring wells (MW-5, MW-6, and MW-20) throughout Phase II AS/SVE testing, and analyzed for EPA Methods 602 and 610 parameters. Samples will be collected in accordance with the FDEP Standard Operating Procedures (SOP) for monitoring well sampling (FDEP, 1992) and the AS/SVE Work Plan (TtNUS, 2002). Samples will be analyzed for VOCs and the results compared against the most recent results to gauge the effectiveness of the testing as well as to determine the status of groundwater cleanup.

5.2.2 Field Natural Attenuation Monitoring

Groundwater samples will be collected from the three monitoring wells for DO and dissolved carbon dioxide. Analysis for both DO and carbon dioxide will be conducted using field test kits.

**TABLE 5-1
PROPOSED ANALYTICAL TESTING FOR AS/SVE PILOT TEST
PHASE II
NAVAL AIR FACILITY
KEY WEST, FLORIDA**

| Task | Event | Media | Location | No. of Sample Rounds | Fixed-based Laboratory Analysis | Field Analysis |
|-------------|---|--------------------------------------|-------------------------|-----------------------------|--|------------------------------------|
| Start-up | Initial sampling | Soil vapor (untreated and undiluted) | Vacuum pump exhaust | 1 sample | VOCs, O ₂ , CO ₂ | OVA/FID reading from vapor stream |
| Start-up | Initial sampling | Air (treated) | After first carbon drum | 1 plus 1 blank | VOCs, O ₂ , CO ₂ | OVA/FID reading |
| O&M | Monthly (until emission requirements are met) | Soil vapor (untreated and undiluted) | Vacuum pump exhaust | 1 sample | VOCs, O ₂ , CO ₂ | OVA/FID reading |
| O&M | Monthly (until emission requirements are met) | Soil vapor | After first carbon drum | 1 sample | VOCs, O ₂ , CO ₂ | OVA/FID reading |
| O&M | Monthly | Groundwater | MW-5, MW-6, MW-20 | 1 each | N/A | DO, CO ₂ , free product |
| O&M | Quarterly | Groundwater | MW-5, MW-6, MW-20 | 1 each | EPA Methods 602, 610 | DO, CO ₂ , free product |

CO₂ = carbon dioxide
O₂ = Oxygen

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the physical testing it appears that AS/SVE is an effective method for removing site contaminants. This technology can only be fully evaluated after Phase II of the test is complete and results of air and groundwater samples are evaluated.

System parameters that were determined during performance of the short-term treatability study testing are summarized below. These parameters will be used to establish the optimum conditions for the system during Phase II.

- The SVE system will operate at a minimum of 60 inches H₂O at the blower.
- The SVE flow rate will be approximately 30 cfm per well.
- The AS system will be operated at a pressure of 7.0 psi which is sufficient to evacuate the water column in the well.
- The maximum AS flow rate will be 3 to 5 cfm per well.
- The off-gas treatment of the SVE system will be operated until it is determined it is not necessary.

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APPENDIX A
PHASE I -PILOT TEST WORK SHEETS

TABLE A-1

PHASE I SVE PILOT TEST
NAVAL AIR FACILITY
KEY WEST, FLORIDA

| Time | Pump | SVE1 | Flow Rate | VOC | MW-5 | MW-6 | SVE2 |
|-------|--------------------------|--------------------------|-----------|-------|--------------------------|--------------------------|--------------------------|
| | (" H ₂ O Vac) | (" H ₂ O Vac) | (scfm) | (ppm) | (" H ₂ O Vac) | (" H ₂ O Vac) | (" H ₂ O Vac) |
| 10:30 | 30 | 5.5 | 10 | 350 | 0.0 | 0.01 | 0.0 |
| 10:40 | 30 | 5.5 | 10 | 200 | 0.0 | 0.01 | 0.0 |
| 10:50 | 30 | 5.5 | 10 | 120 | 0.0 | 0.01 | 0.0 |
| 11:00 | 50 | 6.0 | 20 | 100 | 0.0 | 0.01 | 0.0 |
| 11:10 | 50 | 6.0 | 20 | 100 | 0.0 | 0.01 | 0.0 |
| 11:20 | 50 | 6.0 | 20 | 80 | 0.0 | 0.02 | 0.0 |
| 11:30 | 60 | 7.0 | 30 | 80 | 0.0 | 0.02 | 0.0 |
| 11:40 | 60 | 7.0 | 30 | 80 | 0.0 | 0.02 | 0.01 |
| 11:50 | 60 | 7.0 | 30 | 50 | 0.0 | 0.02 | 0.01 |
| 12:00 | 60 | 7.0 | 30 | 50 | 0.0 | 0.02 | 0.01 |

H₂O = Water

TABLES A-2

PHASE I AS PILOT TEST
NAVAL AIR FACILITY
KEY WEST, FLORIDA

| Time | Blower Pressure | Injection Press. (psig) | | Pressure (" H ₂ O) | | |
|-------|-----------------|-------------------------|------|-------------------------------|------|------|
| | (psig) | AS-1 | AS-2 | SVE1 | MW-5 | MW-6 |
| 12:25 | 7.5 | 2.0 | 2.0 | 0.00 | 0.00 | 0.00 |
| 12:35 | 7.5 | 4.4 | 5.7 | 0.00 | 0.00 | 0.50 |
| 12:45 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.52 |
| 12:55 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.50 |
| 13:05 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.55 |
| 13:15 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.55 |
| 13:25 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.55 |
| 13:35 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.70 |
| 13:45 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.70 |
| 13:55 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.95 |
| 14:05 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 0.90 |
| 14:15 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |
| 14:25 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |
| 14:35 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |
| 14:45 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |
| 14:55 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |
| 15:05 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |
| 15:15 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |
| 15:25 | 7.5 | 4.1 | 5.0 | 0.00 | 0.00 | 1.05 |

| Time | Depth to Water (ft) | | GW Dissolved Oxygen (mg/L) | |
|-------|---------------------|------|----------------------------|------|
| | MW-5 | MW-6 | MW-5 | MW-6 |
| 12:25 | 4.33 | 4.39 | 0.53 | 0.83 |
| 12:35 | 4.26 | 2.97 | 0.89 | 0.90 |
| 12:45 | 4.29 | 3.65 | 0.69 | 0.98 |
| 12:55 | 4.29 | 4.25 | 0.70 | 1.60 |
| 13:05 | 4.33 | 4.39 | 0.80 | 1.90 |
| 13:15 | 4.33 | 4.39 | 0.84 | 2.34 |
| 13:25 | 4.33 | 4.39 | 0.90 | 2.90 |
| 13:35 | 4.33 | 4.39 | 1.05 | 3.61 |
| 13:45 | 4.33 | 4.39 | 1.05 | 3.97 |
| 13:55 | 4.33 | 4.39 | 1.14 | 4.10 |
| 14:05 | 4.33 | 4.39 | 1.16 | 4.30 |
| 14:15 | 4.33 | 4.39 | 1.25 | 5.07 |
| 14:25 | 4.33 | 4.39 | 1.35 | 5.07 |
| 14:35 | 4.33 | 4.39 | 1.38 | 5.07 |
| 14:45 | 4.33 | 4.39 | 1.40 | 5.07 |
| 14:55 | 4.33 | 4.39 | 1.42 | 5.07 |
| 15:05 | 4.33 | 4.39 | 1.45 | 5.07 |
| 15:15 | 4.33 | 4.39 | 1.47 | 5.07 |
| 15:25 | 4.33 | 4.39 | 1.50 | 5.07 |

TABLES A-2 (CONTINUED)

**PHASE I AS PILOT TEST
NAVAL AIR FACILITY
KEY WEST, FLORIDA**

| Time | OVA (ppm) | | | CO ₂ mg/L | |
|-------|-----------|------|-------|----------------------|-------|
| | MW-5 | MW-6 | SVE-2 | MW-5 | MW-6 |
| 12:25 | 0 | 25 | 10 | >2500 | >2500 |
| 12:35 | 0 | 100 | 50 | >2500 | >2500 |
| 12:45 | 0 | 100 | 50 | >2500 | >2500 |
| 12:55 | 0 | 250 | 50 | >2500 | >2500 |
| 13:05 | 0 | 250 | 50 | >2500 | >2500 |
| 13:15 | 0 | 250 | 100 | >2500 | >2500 |
| 13:25 | 0 | 250 | 100 | >2500 | >2500 |
| 13:35 | 0 | 250 | 100 | >2500 | >2500 |
| 13:45 | 5 | 250 | 100 | >2500 | >2500 |
| 13:55 | 5 | 300 | 100 | >2500 | >2500 |
| 14:05 | 5 | 300 | 300 | >2500 | >2500 |
| 14:15 | 0 | 300 | 300 | >2500 | >2500 |
| 14:25 | 0 | 400 | 300 | >2500 | >2500 |
| 14:35 | 3 | 400 | 300 | >2500 | >2500 |
| 14:45 | 3 | 400 | 300 | >2500 | >2500 |
| 14:55 | 5 | 350 | 300 | >2500 | >2500 |
| 15:05 | 5 | 300 | 250 | >2500 | >2500 |
| 15:15 | 5 | 300 | 250 | >2500 | >2500 |
| 15:25 | 5 | 250 | 250 | >2500 | >2500 |

TABLE A-3

PHASE I AS/SVE PILOT TEST
NAVAL AIR FACILITY
KEY WEST, FLORIDA

| Time | SVE | | | | AS | | | | |
|-------|--------------------------------------|---------------------------------------|---------------------|--------------|------------------------|----------|------|-----------|------|
| | Pump Vacuum (in H ₂ O) | SVE-1 Vacuum (in H ₂ O) | Flow Rate (scfm) | OVA (ppm) | Pump Pressure (psi) | Pressure | | Flow Rate | |
| | | | | | | AS-1 | AS-2 | AS-1 | AS-2 |
| | (psi) | | (scfm) | | | | | | |
| 15:40 | 60 | 7.5 | 30 | 60 | - | - | - | - | - |
| 15:50 | 60 | 7.5 | 30 | 80 | - | - | - | - | - |
| 16:00 | 60 | 7.5 | 30 | 100 | - | - | - | - | - |
| 16:10 | 60 | 7.5 | 30 | 250 | - | - | - | - | - |
| 16:20 | 60 | 7.5 | 30 | 250 | - | - | - | - | - |
| 16:25 | 60 | 7.5 | 30 | 250 | Start AS system | | | | |
| 16:35 | 60 | 7.5 | 30 | 500 | 5 | 4 | 5 | 5 | 5 |
| 16:45 | 60 | 7.5 | 30 | 750 | 5 | 4 | 5 | 5 | 5 |
| 16:55 | 60 | 7.5 | 30 | 1000 | 5 | 4 | 5 | 5 | 5 |
| 17:05 | 60 | 7.5 | 30 | 1000 | 5 | 4 | 5 | 5 | 5 |
| 17:15 | 60 | 7.5 | 30 | 800 | 5 | 4 | 5 | 5 | 5 |
| 17:25 | 60 | 7.5 | 30 | 810 | 5 | 4 | 5 | 5 | 5 |
| 17:35 | 60 | 7.5 | 30 | 810 | 5 | 4 | 5 | 5 | 5 |
| 17:45 | 60 | 7.5 | 30 | 800 | 5 | 4 | 5 | 5 | 5 |

| Time | OVA (ppm) | | | Depth to Water (ft) | |
|-------|-----------|------|-------|---------------------|------|
| | MW-5 | MW-6 | SVE-2 | MW-5 | MW-6 |
| 16:35 | 2 | 300 | 200 | 4.35 | 4.57 |
| 16:45 | 2 | 660 | 280 | 4.35 | 4.49 |
| 16:55 | 2 | 850 | 350 | 4.35 | 4.49 |
| 17:05 | 2 | 1000 | 420 | 4.35 | 4.46 |
| 17:15 | 5 | 1000 | 420 | 4.35 | 4.42 |
| 17:25 | 5 | 1000 | 500 | 4.35 | 4.42 |
| 17:35 | 5 | 950 | 500 | 4.35 | 4.42 |
| 17:45 | 5 | 950 | 560 | 4.35 | 4.42 |

APPENDIX B
LABORATORY ANALYTICAL REPORTS

AIK-02-0222

B-6

CTO 0207