DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 377TH AIR BASE WING (AFMC)

ENTERED

CERTIFIED RETURN-RECEIPT REQUESTED

Colonel Tom D. Miller
377 ABW/CC
2000 Wyoming Blvd SE
Kirtland AFB NM 87117

MAY 2 1 2014

RECEIVED

MAY 22 2014

NMED
Hazardous Waste Bureau

Mr. Tom Blaine, Manager
Environmental Health Division Director
Environmental Health Division
New Mexico Environment Department (NMED)
1190 St. Francis Drive, Room North 4050
Santa Fe, New Mexico 87502

Dear Mr. Blaine

Attached please find the Air Sparge and Soil-Vapor Extraction Pilot Implementation Work Plan for the remediation efforts at the Kirtland Air Force Base (KAFB) Bulk Fuels Facility. Comments from your letter dated 12 May 2014 have been incorporated and a Response to Comments matrix is attached.

This Work Plan outlines the activities and procedures needed to complete a pilot implementation designed to demonstrate the effectiveness of air sparging technology for treating light non-aqueous phase liquid (LNAPL) constituents immediately downgradient of the former LNAPL area.

Please contact Mr. L. Wayne Bitner at 505.853.3484 or ludie.bitner@us.af.mil, or Mr. Scott Clark at 505.846.9017 or scott.clark@us.af.mil, if you have any questions.

Sincerely

TOM D. MILLER, Colonel, USAF
Commander

Received
MAY 2 1 2014
District 1

Attachments:
1. KAFB Air Sparge Work Plan
2. Comment/Response Matrix

cc:
NMED-HWB (Kieling, Cobrain, Moats, McDonald, Brandwein)
NMED-GWQB (Schoeppner)
NMED-PSTB (Reuter)
NMED-OGC (Kendall)
EPA Region 6 (King)
AFCEC-CZRX (Oyelowo)

KAFB4146

	NMED COMMENT	RESPONSE TO COMMENT
1	Based on the well construction diagram and the estimated depth to groundwater provided in the Work Plan, the water table is approximately 12 feet above the top of the screen in well KAFB 10617. Therefore, the Permittee must install a monitoring well no more than 20 feet downgradient from the proposed sparge/ soil vapor extraction (SVE) well that is screened across the water table to more effectively monitor the effects of air sparging.	*The "approximate water table" in well KAFB-10617 shown at 470 ft bgs in Figure 2 – Well Details, is incorrect. The elevation of the water table and well screen during quarterly sampling events from first quarter 2009, as reported in Appendix E of the Quarterly Reports, is shown below. The most recent measurement (First Quarter 2014) showed the water table 2.58 feet above the top of the well screen, at 4959.84 ft amsl, or 482 ft bgs. This pilot test is schedule to continue for 6 months; should the water table rise to a level of greater than five (5) feet above the top of the screen, a new monitoring well will be installed, approximately 20 feet from the existing well and 20 feet from the AS/SVE well, as space allows.* *NMED's stated objective for this IM is to "to evaluate the use of air sparging to remove LNAPL constituents, such as EDB, migrating [in groundwater] past the observed northern limit of the LNAPL/BTEX plume." The SVE aspect of this IM is simply to remove the sparged vapors, rather than leaving them in the vadose zone. Since there are background vapor concentrations in the vicinity, and in light of the quarter-to-quarter variability in soil vapor concentrations observed across the site (see Quarterly Reports), we do not think reliable conclusions regarding the effectiveness of air sparging can be drawn based on soil vapor concentrations. As stated in the Air Sparge and Soil-Vapor Extraction Pilot Implementation Work Plan, soil vapor analytical results may not show significant increase in EDB or benzene in the SVE system inlet as compared to the baseline (pre-treatment) samples. Air-sparging performance at this site will be judged by its effect on the groundwater concentrations of EDB.* *We apologize for the confusion in the Work Plan regarding the placement of the air sparge/SVE well relative to well KAFB-10617. The introductory bullet (top of page 1) should read that the air sparge/SVE well will be placed 25 feet from KAFB-10617. The detailed text (under Installation of AS/SVE Wells, page 2) states "As shown on Figure 1, Site Layout... the AS/SVE wells will be installed 25 feet upgradient of the existing shallow groundwater monitoring well KAFB-10617".*
2	The screened interval in the newly installed SVE well must be no more than 30 feet in length and extend to 10 feet above the water table.	*Concur*
3	Baseline vapor measurements of percent oxygen and carbon dioxide and VOCs must be collected from the well casings of the newly installed soil vapor extraction (SVE) well and well KAFB 10617 and the newly installed monitoring well, required by Item 1 above (MW), after appropriate purging is conducted. In addition, the same measurements must be collected from the SVE well after the proposed vacuum is applied but before air is injected into the newly installed sparge well.	*We agree to collect baseline percent oxygen and CO2 measurements in the new SVE well prior to turning the blower on and as the soil vapor is monitored during the test (reduced oxygen and elevated CO2 implies there has been ongoing bioremediation in this anaerobic-to-aerobic transition zone). However, we do not agree that measuring percent oxygen and CO2 in the vadose zone would serve to meet NMED's objective to evaluate the use of air sparging to remove LNAPL constituents from the groundwater. As stated in #1 above, air-sparging performance at this site will be judged by its effect on the groundwater concentrations of EDB.*
4	Add diesel-range organics (DRO) by modified EPA Method 8015	*Concur*

	to the groundwater sample analytical suite. In addition, add gasoline-range organics (GRO) by modified EPA Method 8015 to the groundwater sample analytical suite for groundwater samples collected during system operation.	
5	Measure ambient air pressure/vacuum in the newly installed SVE well, the MW and KAFB 10617 prior to the start of any applied vacuum or air injection and include collection of barometric data for all monitoring events.	*We will measure air/vacuum pressure and barometric pressure in the SVE well as requested. However, since air is being "blown" into the groundwater (and therefore into the vadose zone) through the air sparge well, and "sucked" out of the vadose zone by the SVE well, whatever air/vacuum pressure that is measured at a monitoring well would be the net of the SVE vacuum applied and the air sparge pressure applied; thus nothing could be concluded.*
6	Record the injection pressure (sparge well) and applied vacuum (SVE well) during all monitoring events and measure pressures/vacuums in well KAFB 10617 and the MW during each monitoring event.	*Concur with requests for the sparge and SVE wells. As stated in response to #5, we do not believe that air/vacuum pressure data in the monitoring well would provide useful information.*
7	Collect all data that will be collected during baseline sampling 30 days after discontinuation of operation of the SVE/Sparge system pilot test.	*Concur.*

Quarter	Well	Top of Screen Elevation (feet)	Groundwater Elevation (feet)	Difference (feet)
Q1, 2009	KAFB-10617	4857.16	4,851.20	**5.96**
Q3, 2009	KAFB-10617	4857.16	4,850.75	**6.41**
Q4, 2009	KAFB-10617	4857.16	4,849.77	**7.39**
Q1, 2010	KAFB-10617	4857.16	4,850.81	**6.35**
Q2, 2010	KAFB-10617	4857.16	4,853.69	**3.47**
Q3, 2010	KAFB-10617	4857.16	4,853.81	**3.35**
Q4, 2010	KAFB-10617	4857.16	4,852.75	**4.41**
Q1, 2011	KAFB-10617	4857.16	4,855.82	**1.34**
Q2, 2011	KAFB-10617	4857.16	4,855.76	**1.40**
Q3, 2011	KAFB-10617	4857.16	4,854.38	**2.78**
Q4, 2011	KAFB-10617	4857.16	4,855.40	**1.76**
Q1, 2012	KAFB-10617	4857.16	4855.28	**1.88**
Q2, 2012	KAFB-10617	4857.16	4857.71	**-0.55**
Q3, 2012	KAFB-10617	4857.16	4857.57	**-0.41**
Q4, 2012	KAFB-10617	4857.16	4857.32	**-0.16**
Q1, 2013	KAFB-10617	4857.16	4857.77	**-0.61**
Q2, 2013	KAFB-10617	4857.16	4859.29	**-2.13**
Q3, 2013	KAFB-10617	4857.16	4859.31	**-2.15**
Q4, 2013	KAFB-10617	4857.16	4857.9	**-0.74**
Q1, 2014	KAFB-10617	4857.16	4859.84	**-2.68**

Groundwater elevation is above top of screen

Groundwater elevation is within two feet of top of screen

Groundwater elevation is at least two feet below top of screen

	ADDITIONAL NMED COMMENTS (16 May, 2014)	RESPONSE TO COMMENT
1	Resolution of NMED contention of well drilling log showing well screen at 482 feet below ground surface and Work Plan Figure 2 showing water level 470 feet below ground surface. Provide definitive documentation of well screen location in comparison to water level to support the chart in your response.	The revised Work Plan with the attached table from Appendix E in the QRs addresses this question. It states: The "approximate water table" in well KAFB-10617 shown at 470 ft bgs in Figure 2 – Well Details, is incorrect. The elevation of the water table and well screen during quarterly sampling events from first quarter 2009, as reported in Appendix E of the Quarterly Reports, is shown below. The most recent measurement (First Quarter 2014) showed the water table 2.58 feet above the top of the well screen (see table above).
2	Describe any special sampling techniques that will be used when the water level is above the well screen to insure representative samples of the water. NMED mentioned requirement to draw down the well during the purge process. Also include analysis (set expectations) of potential impact to sample results due to water levels above the well screen. Will higher water levels bias the results high/low?	We do not anticipate using any special sampling techniques when the water level is above the well screen to ensure representative samples of the water. As indicated in RTC #1, the water level in the KAFB-10617 has varied from 0.16 to 2.68 feet above the well screen. Well purging prior to sampling typically draws the water level in the well down a few tenths of a foot. We do not anticipate any impact to sample results due to water levels above the well screen.
3	Address the pros/cons of being able to sample or not sample the vapors in the vadose zone, with respect to the water level cutting off access to the vadose zone. What information could be gained from vapor samples, how important is it, and what is the impact of not being able to get it if the water level cuts off access to the vadose zone in the monitoring well.	The revised Work Plan addresses this question in RTC #1 and #3: NMED's stated objective for this IM is to "to evaluate the use of air sparging to remove LNAPL constituents, such as EDB, migrating [in groundwater] past the observed northern limit of the LNAPL/BTEX plume." The SVE aspect of this IM is simply to remove the sparged vapors, rather than leaving them in the vadose zone. Since there are background vapor concentrations in the vicinity, and in light of the quarter-to-quarter variability in soil vapor concentrations observed across the site (see Quarterly Reports), we do not think reliable conclusions regarding the effectiveness of air sparging can be drawn based on soil vapor concentrations. As stated in the Air Sparge and Soil-Vapor Extraction Pilot Implementation Work Plan, soil vapor analytical results may not show significant increase in EDB or benzene in the SVE system inlet as compared to the baseline (pre-treatment) samples. Air-sparging performance at this site will be judged by its effect on the groundwater concentrations of EDB.

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May 16, 2014

Subject: **Kirtland Air Force Base -Air Sparge and Soil-Vapor Extraction Pilot Implementation Work Plan – Revision 1**

This Kirtland Air Force Base (KAFB) Air Sparge (AS)/Soil-Vapor Extraction (SVE) Pilot Implementation Work Plan has been prepared by CB&I Federal Services LLC for the U.S. Army Corps of Engineers (USACE), Albuquerque District, under Contract No. W912DY-10-D-0014. This letter work plan outlines the activities and procedures needed to complete a pilot implementation designed to demonstrate the effectiveness of air sparging technology for treating light non-aqueous phase liquid (LNAPL) constituents immediately downgradient of the former LNAPL area. This pilot implementation includes air sparging of the shallow groundwater and recovery of the injected air by an SVE system. Components of the project include the following:

- Installing a combination of an air sparge well and an SVE well in a single boring 25 feet upgradient of the existing groundwater monitoring well KAFB-10617. The new wells are north of Bullhead Park parking areas and east of the new Veterans Affairs (VA) parking lot.
- Installing an AS (compressor)/SVE and treatment (AS/SVE) system very close to the new wells.
- Using granulated-activated carbon (GAC) adsorption to remove hydrocarbons and 1,2-dibromoethane (EDB) from the extracted soil vapor.
- Operating the AS/SVE system for 6 months.
- Sampling and analyzing groundwater in monitoring well KAFB-10617, and the soil vapor at the SVE wellhead and the exhaust of the GAC treatment system.

This pilot test is being conducted in response to direction by the New Mexico Environment Department (NMED) as described in a letter received April 24, 2014, titled "LNAPL and Dissolved Phase EDB Aerobic Remediation Interim Measure Work Plan."

Performance of AS/SVE Interim Measure

Except for EDB, the LNAPL constituents are being substantially attenuated by anaerobic biological mechanisms. EDB is also being attenuated within and at the edge of the historic LNAPL footprint but is more persistent than benzene and other hydrocarbons. Although EDB has a low Henry's constant compared to most volatile organic compounds (VOCs), air sparging has the potential to substantially increase removal of EDB from the groundwater. Air sparging should be able to reduce concentrations by 40 to 80 percent. This has the potential to reduce mass loading of EDB to the downgradient dissolved-phase plume.

Based on experience with air sparging wells at other sites and on air sparging literature, the maximum radius of influence (ROI) for air stripping is typically 25 feet. The ROI for increasing dissolved oxygen

can be as high as 50 feet. Since the removal mechanism for EDB is air stripping, an expected ROI of 25 feet is applicable for this test. The air sparging well will be installed 25 feet upgradient of the groundwater monitoring well. Since the groundwater at the Bulk Fuels Facility site moves at roughly 100 feet per year, and the ROI of the sparge well should extend to within 10 feet of the groundwater monitoring well, the effect of air sparging on EDB concentration in the well should be detectable in 4 to 8 weeks.

Air sparging is typically used to strip VOCs from groundwater into the soil vapor and increase the concentration of VOCs removed by SVE. Air sparging test results are often evaluated by the increase in detection of these VOCs in the soil vapor. While there are no soil vapor samples at this location, benzene and total VOCs have been detected inconsistently at soil vapor monitoring wells 450 to 600 feet from this location. Therefore, soil vapor analytical results may not show significant increase in EDB or benzene in the SVE system inlet as compared to the baseline (pre-treatment) samples. Air-sparging performance at this site will be judged by its effect on the groundwater concentrations of EDB.

Installation of AS/SVE Wells

As shown on Figure 1 (Site Layout) the AS/SVE wells will be installed 25 feet upgradient of the existing shallow groundwater monitoring well KAFB-10617. As shown on Figure 2, the air sparge and SVE well will be installed in the same borehole.

The sparge well will be installed into the shallow groundwater with a 1¼- or 1½-inch-diameter polyvinyl chloride riser and 5 feet of screen. The top of the screen will be installed approximately 20 feet below groundwater level. Based on water-level measurements in nearby wells, it is anticipated that the bottom of the air sparge well will be set at approximately 500 feet below ground surface (bgs).

The SVE well will be installed in the vadose zone soil with a 3-inch polyvinyl chloride riser and 60 feet of screen. The bottom of the screen will be set 20 feet above the groundwater level at approximately 450 feet bgs.

The drilling and installation of the air sparge well will be similar in construction to the shallow groundwater monitoring wells installed as part of the Solid Waste Management Unit SS-111 groundwater investigation, as described in Sections 4.2.3 and 4.2.4 of the Groundwater Investigation Work Plan (USACE, 2011a). The SVE well will be similar in construction to the Pneulog® wells as described in the Interim Measures Work Plan (USACE, 2011b).

During the installation of the air sparge well, a continuous core sample will be obtained from 490 feet bgs (approximately at the water table) to 510 feet bgs (approximately 20 feet below the water table) using split-spoon sampling techniques. The continuous split-spoon sample will provide material for potential future bench-scale testing to provide upcoming interim measures. In addition, a section of the core will be submitted for vertical permeability testing.

AS/SVE System

As shown on Figure 1, the AS/SVE system will be a small skid or trailer-mounted system that is designed to provide 15 to 25 standard cubic feet per minute (SCFM) of air to the air sparge injection wellhead, and to pull 100 SCFM of soil vapor from the SVE well. The AS/SVE system will be installed within a fenced-in area near the AS/SVE wells. The system will be installed on a packed gravel pad, and electrical power for the AS/SVE equipment will be supplied by a new 200-amp, 230-volt single-phase service installed by Power New Mexico. The AS/SVE system will be operated 24 hours per day, 7 days per week unless it is determined that pulse operation may give better results. Pulsed operation is often used with air sparging to

eliminate the zone of lower permeability that air sparging can create, which allows groundwater to bypass the sparge zone.

Figure 3, "Process Flow Diagram," is a flow diagram for the AS/SVE system. The major components of the system are as follows:

- A 5-horsepower air compressor package sized to deliver up to 25 SCFM of clean, oil-free sparge air at an injection pressure of 28 pounds per square inch gauge (psig) at the wellhead. The sparge air compressor will be a scroll, rotary screw or sliding vane-type compressor and will include a small air tank to reduce the number of compressor on/off cycles. The compressor is designed for operation 24 hours per day, 7 days per week.

- A SVE blower skid that includes a 5- horsepower, lobe-type positive displacement SVE blower designed for 100 SCFM at up to 60 inches of water vacuum. The vacuum blower is equipped with an air/water separator for removal of any condensate or entrained water, and an outlet air cooler to reduce the temperature of the soil vapor going to the carbon adsorbers.

- Two carbon adsorbers that will remove any hydrocarbons or other VOCs from the soil vapor. Each adsorber will contain 2,000 pounds of virgin, coal-based, GAC. The two adsorbers are arranged in a lead-lag configuration.

As shown on Figure 3, the air sparge injection rate will be set using a flow meter and a manual control valve. Injection pressure and control-valve position will be adjusted to give air flow between 15 and 25 SCFM. Injection pressure is expected to be 15 to 20 psig, but the system is designed to be able to supply 28 psig at the wellhead. Injection air flow will be set as high as is possible, given what the aquifer can accept. Many air sparge injection systems are limited to 5 to 15 SCFM, but it may be possible to get higher air flow in the sandy, relatively high-permeability aquifer at Kirtland Air Force Base.

The SVE system is designed for a minimum flow of 100 SCFM, which will be sufficient to capture the 15 to 25 SCFM of sparge air. SVE flow will be limited to a maximum 150 SCFM. SVE well flow will be measured by a pitot tube at the wellhead. SVE well air flow will be controlled by the well and dilution-air valves at the wellhead. The air/water separator at the inlet of the SVE blower is not expected to collect any liquid. The SVE well is screened 20 feet above the groundwater level, and there is very little pipe or hose between the wellhead and the treatment system, so condensation should be minimal. If any liquid collects in the separator, the operators will observe its presence in the separator sight glass. The system will then be shut down so that the operators can manually pump the condensate into drums. A high-level switch on the separator will shut down the SVE blower and the air sparge compressor if excessive liquid collects in the separator. Moreover, a pressure/vacuum switch at the blower inlet will shut down the AS/SVE system if the blower malfunctions and there is no vacuum at the blower inlet.

The soil vapor from the blower outlet is cooled to within 20 degrees Fahrenheit of ambient temperature by an air cooler. The soil vapor then goes to the two carbon adsorbers, which remove the hydrocarbons and any other VOCs. The carbon beds are piped in series, or "lead/lag" configuration, and are oversized with respect to contact time for 150 SCFM in order to give at least 2 weeks between carbon change-outs.

Based on concentrations at soil vapor monitoring wells closest to the location of the proposed SVE well, the total hydrocarbons at the well are expected to be less than 200 parts per million by volume. Assuming worst-case conditions (soil vapor flow rate of 150 SCFM, hydrocarbon concentration of 500 parts per million by volume, and the concentrations of hazardous air pollutants in SVMW KAFB-106136), the hazardous air pollutants in the inlet to the AS/SVE system are 0.63 ton per year, and worst-case total

VOCs into the system are 5.45 tons per year. The two carbon beds included in the system should remove at least 99.5 percent of the inlet hydrocarbons to the system.

Sampling and Analysis

The sampling and analysis schedule is designed to detect the effect of the air sparging treatment on the concentrations of primarily benzene and EDB in the groundwater. In addition to VOCs, the groundwater will be monitored for GRO and DRO by modified EPA Method 8015, iron, sulfide/sulfate, pH, temperature, dissolved oxygen, and oxidation-reduction potential. Prior to start-up of the AS/SVE system, two baseline samples will be collected from KAFB-10617. These samples will be collected in mid-June and immediately prior to start-up of the air sparge system. Groundwater levels in KAFB-10617, 106082, and 106038 will also be measured. Samples will be collected and analyzed in accordance with the project-specific Quality Assurance Project Plan (USACE, 2011c).

The air injected into to the shallow groundwater is expected to strip out volatile hydrocarbons including benzene and EDB. If the ROI of the air sparging well is 25 feet or more, the effect of the air sparging should be detectable in the monitoring well within 4 to 8 weeks after start-up of the pilot test system. If the ROI is less than 25 feet, and given a groundwater velocity of roughly 100 feet per year, it may take 2 to 4 months for the effect to be detectable in the monitoring well. Groundwater monitoring well KAFB-10617 will be sampled weekly for the first 4 weeks after start-up, biweekly for the next 8 weeks, and once every 3 weeks thereafter. Groundwater will be analyzed for VOCs and EDB as well as iron, sulfide/sulfate, dissolved oxygen, and oxidation-reduction potential.

Soil vapor samples will be collected at the SVE wellhead prior to start-up of the air sparge system and after that on a monthly basis. Samples will also be collected at the GAC exhaust. Samples will be analyzed for total petroleum hydrocarbons and VOCs by TO-15 (U.S. Environmental Protection Agency, 1999) and Massachusetts Department of Environmental Protection (2008) air-phase petroleum hydrocarbons methods as well as for EDB by the California Air Resources Board 422 (1991) method, percent oxygen and percent CO2. Ambient air pressure/vacuum will be measured in the SVE well during each sampling event, and injection pressure will be measured at the air sparge well. In addition to the monthly soil vapor samples that will be sent out for analysis, the system operators will use the Horiba instrument twice per week to monitor total hydrocarbons at the SVE wellhead and the inlet and outlet of both carbon beds.

Schedule

2014

8 May:	Submit Air Sparge/SVE Interim Measure Work Plan to NMED
12 May:	Air Sparge Work Plan Approval from NMED
28 April – 21 May:	Albuquerque Environmental Health Department and Office of the State Engineer permitting
11 May – 15 May:	Move eastern fence of the western laydown yard 24 feet to the west.
19 May:	Start public outreach to Ridgecrest neighborhood
12 May – 3 June:	AS/SVE IM design and procurement
2 June – 13 June:	Install air sparge/SVE well
16 June – 25 June:	Install AS/SVE treatment system at site
25 June – 29 June:	System start-up and testing
30 June:	Start-up of AS/SVE IM system
1 July – 20 December:	Operation of AS/SVE system

2015
1 January – 31 January: AS/SVE Treatment Pilot Report

References

California Air Resources Board. 1991. Method 422, Determination of Volatile Organic Compounds in Emissions from Stationary Sources. December.

MA DEP. 2008. *Method for the Determination of Air-Phase Petroleum Hydrocarbons (APH)*. Revision 0. December.

U.S. Environmental Protection Agency. 1999. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed By Gas Chromatography/Mass Spectrometry (GC/MS),* 2nd ed. January.

USACE. 2011a. *Groundwater Investigation Work Plan, Bulk Fuels Facility (BFF) Spill, Solid Waste Management Units ST-106 and SS-111, Kirtland Air Force Base, Albuquerque, New Mexico.* Prepared by Shaw Environmental & Infrastructure, Inc. for the USACE Albuquerque District under USACE Contract No. W912DY-10-D-0014, Delivery Order 0002. March.

USACE. 2011b. *Interim Measures Work Plan, Bulk Fuels Facility (BFF) Spill, Solid Waste Management Units ST-106 and SS-111, Kirtland Air Force Base, Albuquerque, New Mexico.* Prepared by Shaw Environmental & Infrastructure, Inc. for the USACE Albuquerque District under USACE Contract No. W912DY-10-D-0014, Delivery Order 0002. March.

USACE. 2011c. *Quality Assurance Project Plan, Bulk Fuels Facility (BFF) Spill, Solid Waste Management Units ST-106 and SS-111, Kirtland Air Force Base, Albuquerque, New Mexico.* Prepared by Shaw Environmental & Infrastructure, Inc. for the USACE Albuquerque District under USACE Contract No. W912DY-10-D-0014, Delivery Order 0002. April.

40 CFR 270.11
DOCUMENT CERTIFICATION
MAY 2014

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

TOM D. MILLER, Colonel, USAF
Commander, 377th Air Base Wing

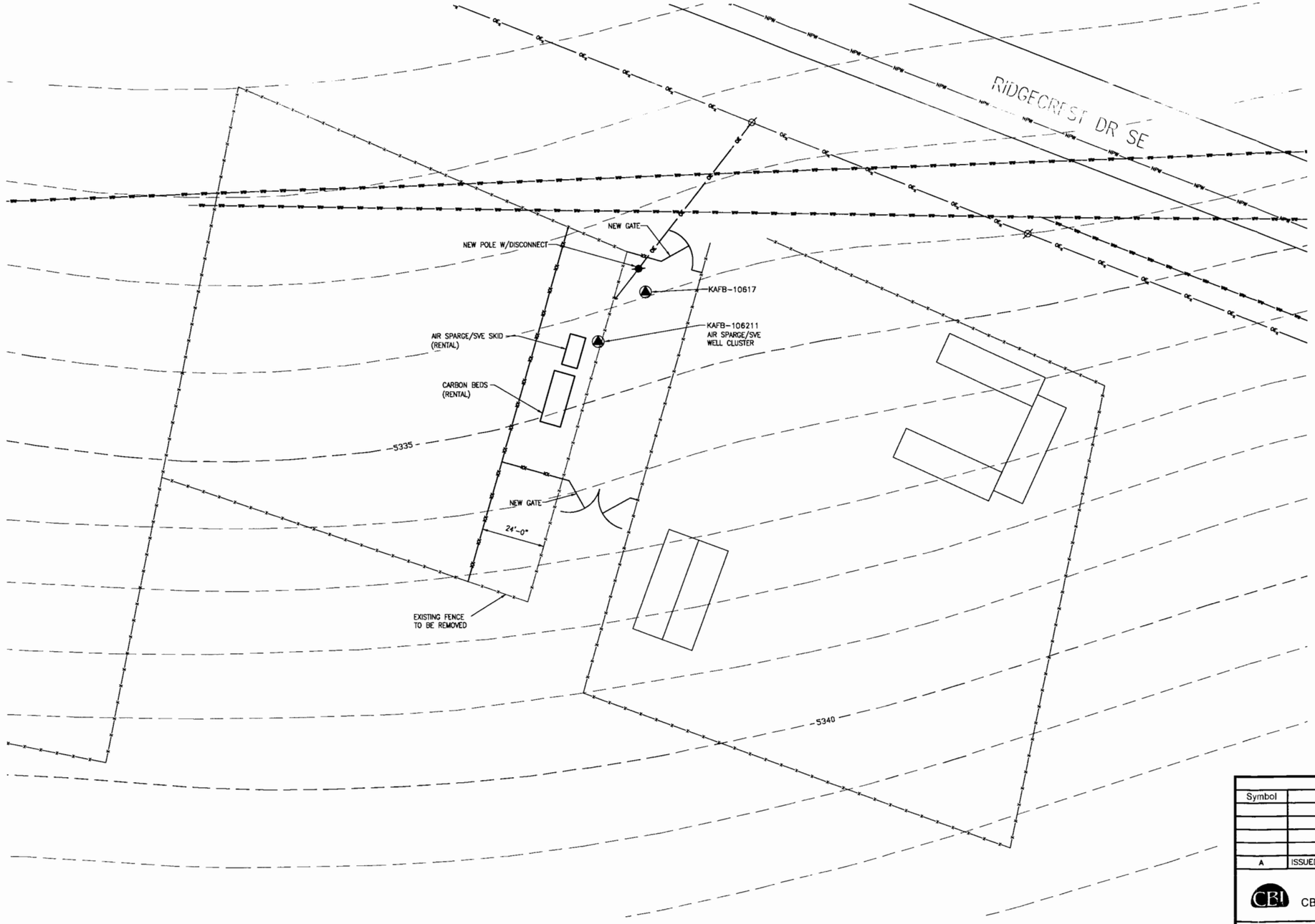
This document has been approved for public release.

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

FIGURES

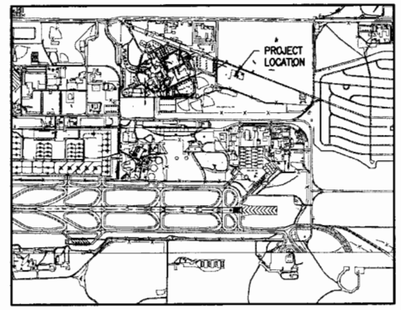
13 12 11 10 9 8 7 6 5 4 3 2 1

A B C D E F G H I



LEGEND:

- BUILDING
- ROAD
- EXISTING FENCE
- EXISTING FENCE TO BE REMOVED
- NEW FENCE
- 5350 MAJOR CONTOURS
- MINOR CONTOUR
- GAS LINE
- STORM SEWER
- WASTE WATER LINE
- NON-POTABLE WATER IRRIGATION
- WATER LINE
- ELECTRICAL CABLE
- EXISTING OVERHEAD ELECTRICAL LINE
- NEW OVERHEAD ELECTRICAL LINE
- FUEL LINE
- FORMER FUEL LINE
- INDUSTRIAL WASTE LINE
- EXISTING POWER POLE
- NEW POWER POLE
- VALVE
- KAFB-106211 EXTRACTION WELLS



PROJECT LOCATION MAP:
SCALE: NTS

Revisions			
Symbol	Descriptions	Date	Approved
A	ISSUED FOR REVIEW	05/02/14	

CB&I Federal Services LLC

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBURQUERQUE, NEW MEXICO

FOR REVIEW ONLY! – NOT FOR CONSTRUCTION

PRELIMINARY PROGRESS DRAWINGS ARE NOT FOR CONSTRUCTION OR FABRICATION. BILL OF MATERIALS, SHOP DRAWINGS, ETC., CREATED FROM THESE DRAWINGS MAY BE REVISED AT THE EXPENSE OF THE CONTRACTOR.

SCALE: 1"=20'
0 20 40 FEET

ARCHITECT/ENGINEER SEAL

Designed by: JS
Drawn by: JW
Checked by: AS
Reviewed by:
Submitted by:

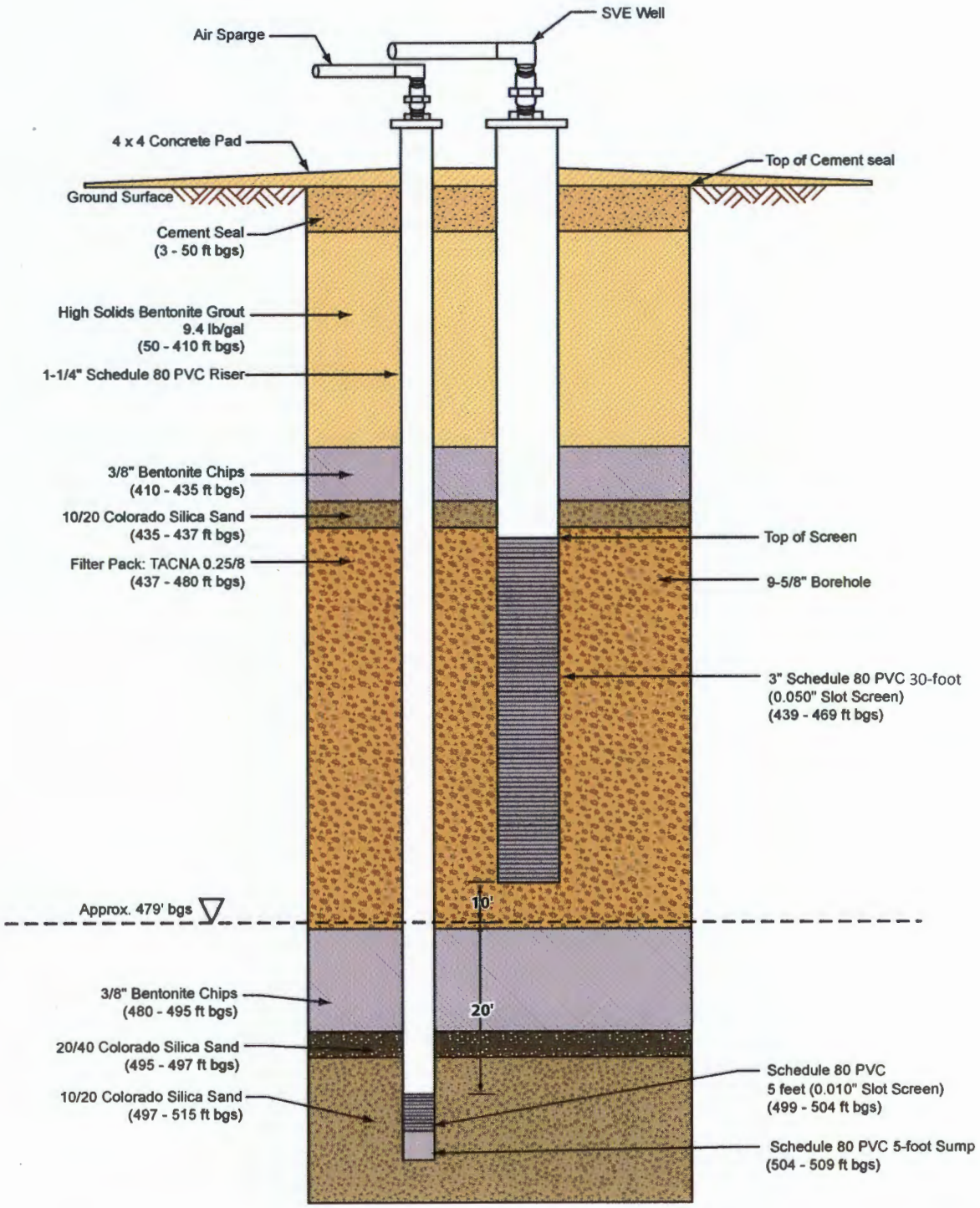
KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO

KAFB-106211 SVE/AIR SPARGE PILOT TEST SITE PLAN

Plot Scale Ratio: 1 = 1
Design File: 140705-AS_SVE-FIG1.dwg
Date: 05/02/14
Spec. No.:
Contract No.:
Drawing Code: FIGURE 1
Sheet reference number: FIG 1

File: 140705-AS_SVE-FIG 1.dwg
Plot Date/Time: May 08, 2014 – 10:27am
Plotted By: Jeffery.waters
22 x 34

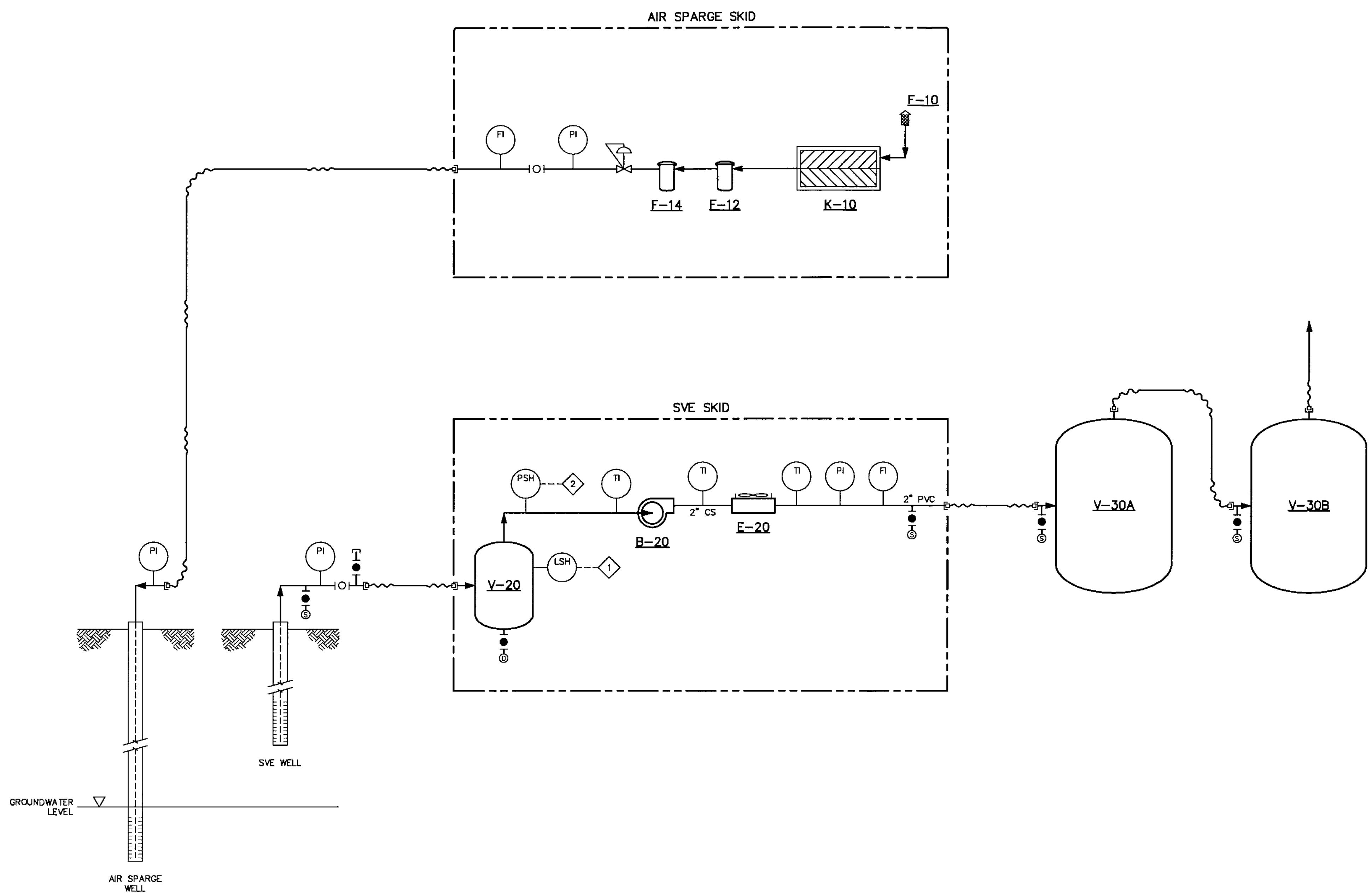
Air Sparge/SVE Well Construction



Not to Scale
BGS = Below Ground Surface
Depths Subject to Change
Based on Field Observations

140705.DA010040.A1

Figure 2
Well Details



NOTES:

1. ELECTRICAL SERVICES SHALL BE 230V, 200A, SINGLE PHASE.

LEGEND:

F – FLOW INDICATOR
P – PRESSURE INDICATOR
T – TEMPERATURE INDICATOR
LSH – LEVEL SWITCH HIGH
PSH – PRESSURE SWITCH HIGH (LOW VACUUM)
– SAMPLE PORT

INTERLOCKS:

1. HIGH LEVEL IN KNOCK-OUT POT SHUTS DOWN SVE BLOWER & SPARGE AIR COMPRESSOR.
2. HIGH PRESSURE (LOW VACUUM) SHUTS DOWN SPARGE AIR COMPRESSOR.

FOR REVIEW ONLY! – NOT FOR CONSTRUCTION

PRELIMINARY PROGRESS DRAWINGS ARE **NOT** FOR CONSTRUCTION OR FABRICATION. BILL OF MATERIALS, SHOP DRAWINGS, ETC., CREATED FROM THESE DRAWINGS MAY BE REVISED AT THE EXPENSE OF THE CONTRACTOR.

V-20	B-20	E-20	F-10	F-12	F-14	K-10	V-30A/B
KNOCKOUT POT	SVE VACUUM BLOWER 100 SCFM @ 40"-60" W.C. VACUUM	AFTER-COOLER 20 F° APPROACH TO AMBIENT AIR TEMPERATURE	AIR FILTER	AIR FILTER	OIL FILTER	SPARGE AIR COMPRESSOR 25 SCFM @ 35 PSIG	CARBON ADSORBER 2,000 LB. CARBON EACH

File: K:\Kirtland AFB\140705\Process\Kirtland-Figure 3.dwg
XREF Files: Border 24X36 IMAGE Files:
Plot Date/Time: May 01, 2014 - 4:34pm
Plotted By: mark.lawson

Revisions			
Symbol	Descriptions	Date	Approved
A	ISSUED FOR REVIEW	05/02/14	

Shaw Environmental & Infrastructure, Inc.
(A CB&I Company)
312 DIRECTORS DRIVE KNOXVILLE, TENNESSEE 37923

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBURQUERQUE, NEW MEXICO

KIRTLAND AIR FORCE BASE ALBUQUERQUE, NEW MEXICO

FIGURE 3

AIR SPARGE / SVE PILOT SYSTEM

Designed by: SES
Drawn by: JWH
Checked by: SES
Reviewed by:
Submitted by:

Plot Scale Ratio: 1 = 1
Design File: Kirtland-Figure 3.dwg
Date: 05/02/14
Spec. No.:
Contract No.:
Drawing Code:
Sheet reference number:

ATTACHMENT A

CH2MHILL

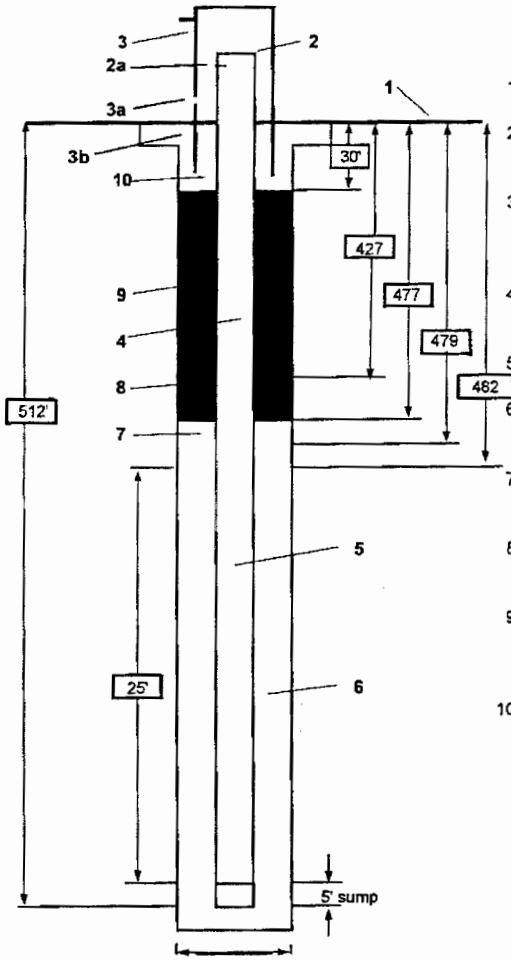
PROJECT NUMBER

WELL NUMBER
KAFB-10617

SHEET 1 OF 1

ESTIMATED WELL COMPLETION DIAGRAM

PROJECT : ST-106 KAFB Bulk Fuels Facility
LOCATION : VA Field
DRILLING CONTRACTOR : WDC Exploration & Wells
COORDINATES : 1542923.45 ft E 1475228.99 ft N (NAD 83 NM central)
DRILLING METHOD AND EQUIPMENT USED : Air Rotary Casing Hammer, Speedstar 30K
WATER LEVEL : 488 7/12'
START :
END :
LOGGER : K. Mouzakis and T. Arowwood



1- Ground elevation at well	5339.5 ft msl (NADV88)
2- Top of casing elevation	5342.51 ft msl (NADV88)
a) vent hole?	no
3- Wellhead protection cover type	above ground 8" dia. steel pipe w/locking lid
a) weep hole?	no
b) concrete pad dimensions	4' x 4' with 4 concrete filled bollards
4- Dia./type of well casing	4" schedule 80 PVC
5- Type/slot size of screen	stainless steel 0.010" slot
6- Type screen filter	10/20 Colorado Silica Sand
a) thickness to be installed	46 bags
7- Transition sand	20/40 Colorado Silica Sand
a) thickness to be installed	
8- Type of seal	hydrated bentonite chips
a) thickness to be installed	
9- Grout	
a) Grout mix used	volclay bentonite grout
b) thickness to be installed	397'
10- Cement	
a) Cement mix used	portland cement grout
b) thickness to be installed	30' (from ground surface to 30' bgs)
Development method	bail, swab, bail, pump
Estimated purge volume	See development log
Development time	See development log

11 3/4" 0 - 300 ft bgs

9 5/8" 300 - 520 ft bgs

Comments

Not to scale

CH2MHILL

PROJECT NUMBER

WELL ID KAFB-10617

WELL DEVELOPMENT FIELD DATA SHEET

PROJECT: ST106 T0313 LOCATION: 10617 S of Ridgecrest

WEATHER (wind/temp/ppt): cloudy + windy, cold OTHER NOTABLE FIELD CONDITIONS:

INITIAL ORGANIC VAPOR METER READINGS:

INITIAL DEPTH TO WATER: 491.10' btoc TOTAL DEPTH OF WELL: 512' bgs SCREENED INTERVAL: 482-502' bgs

PURGE VOLUME CALCULATION:

METHOD OF PURGING: bailing + submersible pump.

DISPOSITION OF DISCHARGE WATER: poly drums

MONITORING EQUIPMENT USED: U-22, turbidimeter, PID

Well Purging Information

Date / Time	Total volume (gals)	Temp (°C)	pH	Conductivity (mS/cm)	Turbidity (NTU)	DO	ORP	Remarks (color, odor, sheen, sediment, etc.)
1/6/08 0745	MBMSCun + Nick Cooper (WDC) onsite for well development set up equipment tag well							
1005	~50 gallons bailed from well							
1138	~~~080~~ gallons bailed from well, done bailing							
1338	pump turned on, problem w/ connection, nick fitting							
1/7/08 0937	pump turned on ~~→~~ set at ~3 gpm water out at 9:42							
0953	30	16.4	7.03	0.392	16.8	7.34	3	
0959	50	18.1	7.35	0.390	5.87	6.75	-9	
1004	~~75~~ 65	18.5	7.44	0.388	15.7	6.92	-16	
1009	~~90~~ 80	18.9	[illegible]	0.393	23.1	7.36	-13	PH = 7.54
1014	~~105~~ 95	19.1	7.57	0.389	6.77	7.06	-23	
1019	~~120~~ 110	19.3	7.54	0.389	6.19	6.99	-29	
~~1024~~	~~125~~ 125			0.			T.A.	
1020	pump turned off							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 1 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Joe Villegas

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
0		GOOD	GB		WELL GRADED SAND (SW), brownish yellow (10 YR dry to damp, no plasticity, fine sand	VOC = 0.2 ppm
10		GOOD	GB		WELL GRADED SAND (SW), strong brown (7.5 YR 5/6), dry to damp, low plasticity, trace clay	VOC = 0.3 ppm
20		GOOD	GB		WELL GRADED SAND (SW), yellowish brown (10 YR 5/6) damp, low to medium plasticity, trace clay	VOC = 0.1 ppm 1128 Making 20-40' connection 1135 Drilling to 40'
30		GOOD	GB		POORLY GRADED SAND WITH CLAY (SP-SC), strong brown (7.5 YR 5/8), damp, medium plasticity	VOC = 0.0 ppm
40		GOOD	GB		POORLY GRADED SAND (SP), yellowish brown (10 YR 5/6), damp, low to medium plasticity, trace clay	VOC = 0.0 ppm 1210 Making 40-60' connection 1220 Drilling to 60'
50		GOOD	GB		POORLY GRADED SAND (SP), yellowish brown (10 YR 5/8), damp, medium plasticity, trace gravel	VOC = 0.0 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 2 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Joe Villegas

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
60		6"6"0"	S.S.	14-24-32	SAME AS ABOVE	VOC = 0.2 ppm Sample ID: ST106-SS-10617-60 collected on 11/13/2008 at 13:30
		GOOD	GB		POORLY GRADED SAND (SP), strong brown (7.5 YR damp, medium plasticity	1335 making 60-80' connection 1345 Drilling to 80' VOC = 0.2 ppm
70		GOOD	GB		WELL GRADED SAND (SW), brownish yellow (10 YR 6/6), dry to damp, no plasticity	VOC = 0.0 ppm
80		GOOD	GB		SAME AS ABOVE	VOC = 0.0 ppm 1410 Making 80-100' connection 1420 Drilling to 100'. Hose is starting to clog.
90		GOOD	GB		POORLY GRADED SAND (SP), strong brown (7.5 YR 5/6), moist, low plasticity, trace weathered rock and clay	VOC = 0.0 ppm
100		FAIR	GB		SAME AS ABOVE	VOC = 0.0 ppm 1505 Making 100-120' connection 1515 Drilling to 120' 1545 Trip Blank labeled ST106TB10613112(1545 Hose clogged. Joe injecting water.
110		FAIR	GB		SAME AS ABOVE except strong brown (7.5 YR 5/8)	VOC = 0.0 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 3 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Joe Villegas

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
120		6"6"4"	S.S.	19-20-39	SANDY LEAN CLAY (CL), yellowish brown (10 YR 5/8) moist, medium plasticity	VOC = 0.0 ppm Sample ID: ST106-SS-10617-120 collected on 11/13/2008 at 1700
		FAIR	GB		SAME AS ABOVE	Sample ID: ST106-SS-10617-120DUP collected on 11/13/2008 at 1700 1710 Making 120-140' connection 10/14: 0720 Drilling to 140' VOC = 0.0 ppm 0800 Cyclone clogged.
130					NO SAMPLE. CYCLONE CLOGGED.	1010 Unclogged.
140		POOR	GB		SAME AS 121.5-130' SAMPLE, but wet from injected water.	VOC = 0.0 ppm 1030 Making 140-160' connection. 1040 Drilling to 160'.
150		FAIR	GB		SAME AS ABOVE	VOC = 0.0 ppm
160		FAIR	GB		SAME AS ABOVE	VOC = 0.0 ppm 1142 Making 160-180' connection 1213 Drilling to 180'
170		FAIR	GB		WELL GRADED SAND (SW), yellowish brown (10 YR 5/6), wet from injected water, coarse sand - no fines, trace gravel and twigs	VOC = 0.2 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 4 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Joe Villegas

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
180						Driller stopped injecting water 1310 Making 180-200' connection 1310 Drilling to 200'
		FAIR	GB		WELL GRADED SAND (SW), yellowish brown (10 YR wet, trace fines	VOC = 0.0 ppm
190		GOOD	GB		WELL GRADED SAND (SW), yellowish brown (10 YR 5/6), wet, trace gravel	VOC = 0.0 ppm
200		6"6"3"	SS	12-17-19	200-200.5: SAME AS ABOVE 200.5-201.5: LEAN CLAY (CL), yellowish brown (10 YF damp, medium to high plasticity	Sample ID: ST106-SS-10617-200 collected on 11/14/2008 at 1410 VOC = 0.4 ppm 1415 Tripping out Drill pipe 1430 Tripping in 9 5/8" Practice 5 foot split spoon - 2.5' recovery La
		GOOD	GB		WELL GRADED SAND (SW), yellowish brown (10 YR 5/6), moist, coarse grained, trace gravel and weathered rock	VOC = 0.0 ppm 11/15: 0940 Making 200-220' connection 0957 Drilling to 220'
210		GOOD	GB		SAME AS ABOVE but 5% gravel	VOC = 0.0 ppm
220		GOOD	GB		WELL GRADED SAND (SW), pale brown (10 YR 6/3), dry, loose	VOC = 0.0 ppm 1020 Making 220-240' connection 1030 Drilling to 240'
230		GOOD	GB		WELL GRADED GRAVEL WITH SAND (GW), light brownish grey (10 YR 6/2), damp	VOC = 0.0 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 5 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Juan

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
240		6"4"0"	S.S.	40	WELL GRADED SAND WITH GRAVEL (SW), light brownish gray (10 YR 6/2), moist, coarse sand	VOC = 0.0 ppm Sample ID: ST106-SS-10617-240 collected on 11/15/2008 at 1050
		GOOD	GB		WELL GRADED SAND (SW), light brownish gray (10 YR 6/2), dry, fine to coarse sand	VOC = 0.0 ppm 1100 Making 240-260' connection 1120 Drilling to 260'
250		GOOD	GB		WELL GRADED SAND WITH GRAVEL (SW), light brownish gray (10 YR 6/2), dry	VOC = 0.0 ppm
260		GOOD	GB		WELL GRADED SAND (SW), light yellowish brown (10 YR 6/4), dry, loose	VOC = 0.0 ppm 1130 Making 260-280' connection 1140 Drilling to 280'
270		GOOD	GB		WELL GRADED SAND (SW), light yellowish brown (10 YR 6/4), dry, loose, trace gravel	VOC = 0.0 ppm
280		GOOD	GB		WELL GRADED SAND WITH GRAVEL (SW), pinkish gray (7.5 YR 7/2), dry, loose	VOC = 0.0 ppm 1200 Making 280-300' connection 1210 Drilling to 300'
290		GOOD	GB		WELL GRADED SAND (SW), light yellowish brown (10 YR 6/4), dry, loose	VOC = 0.0 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 6 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : Short

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Juan

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
300		6"4"0"	S.S.	8-10-15	WELL GRADED SAND WITH GRAVEL (SW), pale brown (10 YR 6/3), dry, loose, gravel up to 1"	VOC = 0.0 ppm Sample ID: ST106-SS-10617-300 collected on 11/15/2008 at 1250
		GOOD	GB		WELL GRADED SAND WITH GRAVEL (SW), very pal brown (10 YR 7/4), dry, loose, gravel up to 2 inch	Downhole VOC = 0.0 ppm 1325 Making 300-320 connection 1340 Drilling to 320' VOC = 0.0 ppm
310		GOOD	GB		WELL GRADED GRAVEL WITH SAND (GW), light brownish gray (10 YR 6/2), dry, loose, gravel vary in si from 1/4" to 2"	VOC = 0.0 ppm
320		GOOD	GB		WELL GRADED GRAVEL (GW), light brownish gray (10 YR 6/2), dry, loose, gravel up to 2.5"	VOC = 0.0 ppm 1410 Making 320-340' connection 1416 Drilling to 340'
330		GOOD	GB		WELL GRADED GRAVEL WITH SAND (GW), yellowish brown (10 YR 5/4), damp, loose, coarse sand	VOC = 0.0 ppm
340		GOOD	GB		WELL GRADED SAND (SW), very pale brown (10 YR 7/4), dry, loose, fine to coarse sand, trace gravel	VOC = 0.0 ppm 1445 Making 340-360' connection 1455 Drilling to 360'
350		GOOD	GB		WELL GRADED SAND WITH GRAVEL (SW), light yellowish brown (10 YR 6/4), dry, loose	VOC = 0.0 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 7 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Juan

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
360		6"2"0"	S.S.	6-10-25	WELL GRADED SAND WITH GRAVEL (SW), very pale brown (10 YR 7/3), moist, loose, gravel up to 1"	VOC = 0.0 ppm Sample ID: ST106-SS-10617-360 collected on 11/15/2008 at 1520
		GOOD	GB		WELL GRADED GRAVEL WITH SAND (GW), light yel brown (10 YR 6/4), damp, loose	1530 Making 360-380' conneciton 1540 Drilling to 380' VOC = 0.0 ppm
370		GOOD	GB		SAME AS ABOVE	VOC = 0.0 ppm
380		GOOD	GB		WELL GRADED SAND (SW), light yellowish brown (10 YR 6/4), damp, loose, trace gravel	VOC = 0.0 ppm 1605 Making 380-400' connection 1623 Drilling to 400'
390		GOOD	GB		SAME AS ABOVE but 10% gravel	VOC = 0.0 ppm
400		GOOD	GB		WELL GRADED SAND (SW), light yellowish brown (10 YR 6/4), moist, coarse grained	VOC = 0.0 ppm 11/16 0740 Making 400-420' conneciton 0750 Drilling to 420'
410		GOOD	GB		SAME AS ABOVE trace gravel	VOC = 0.0 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 8 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Juan

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
420		6"6"3"	S.S.	6-6-30	WELL GRADED SAND (SW), very pale brown (10 YR 7/3) damp	VOC = 0.1 ppm Sample ID: ST106-SS-10617-420 collected on 11/16/2008 at 0856
		GOOD	GB		WELL GRADED SAND WITH GRAVEL (SW), pale bro (10 YR 6/3), damp to moist	Sample ID: ST106-SS-10617-420MS collected on 11/16/2008 at 0856 Sample ID: ST106-SS-10617-420SD collected on 11/16/2008 at 0856 0905 Making 420-440' conneciton 0915 Drilling to 440'
430		GOOD	GB		SAME AS ABOVE	VOC = 0.0 ppm VOC = 0.0 ppm
440		GOOD	GB		WELL GRADED GRAVEL (GW), light yellowish brown (10 YR 6/4), damp, trace sand, varied color in rocks, s gray and red rocks, size in gravel varies from very small to 1.5"	VOC = 0.0 ppm 0930 Making 440-460' conneciton 0943 Drilling to 460'
450		GOOD	GB		WELL GRADED SAND (SW), light yellowish brown (10 YR 6/4), moist, fine to coarse sand	VOC = 0.0 ppm
460		GOOD	GB		SAME AS ABOVE but trace clay	VOC = 0.0 ppm 1020 Making 460-480' conneciton 1030 Drilling to 480' 1100 Ear on hammer broke
470		GOOD	GB		WELL GRADED SAND (SW), very pale brown (10 YR 7/3), dry to damp, fine sand	VOC = 0.0 ppm

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
376920.05.02.01	KAFB-10617	SHEET 9 OF 9

SOIL BORING LOG

PROJECT : ST106 TO313 LOCATION : VA Field

ELEVATION : COORDINATES :

DRILLING METHOD AND EQUIPMENT USED : ARCH 30K Pullstar Rig DRILLING CONTRACTOR : WDC Exploration & Wells / Juan

WATER LEVEL 488 7/12' START : 11/13/2008 10:50 END : 11/19/2008 1045 LOGGER : K. Mouzakis

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, TESTS, INSTRUMENTATION, SAMPLE ID, AND ORGANIC VAPOR READING (PID)
480		6"2"0"	S.S.		WELL GRADED SAND WITH GRAVEL (SW), very pale brown (10 YR 7/3), dry, gravel up to 1.5"	VOC = 0.1 ppm Sample ID: ST106-SS-10617-480
482.5		GOOD	S.S.		482.5-484 8/12" - WELL GRADED SAND (SW), very pale brown (10 YR 7/3), moist, loose	collected on 11/16/2008 at 1150 VOC = 0.0 ppm
485		GOOD	S.S.		484 8/12" - 485 - WELL GRADED GRAVEL (GW) very pale brown (10 YR 7/3), moist	Sample ID: Core A collected on 11/17/2008 at 1114
		GOOD	GB		WELL GRADED SAND WITH GRAVEL (SW), yellowish brown (10 YR 5/4), moist	VOC = 0.0 ppm
489		GOOD	S.S.		489-491.5-WELL GRADED SAND (SW), dark yellowish brow	VOC = 0.0 ppm
490					(10 YR 4/4), saturated	Sample ID: Core B
491.5					491.5-493 - SAME AS ABOVE	collected on 11/17/2008 at 1630
493						Sample ID: Core C collected on 11/17/2008 at 1620
		GOOD	GB		WELL GRADED GRAVEL (GW), yellowish brown (10 YR 5/4)	VOC = 0.0 ppm
494.8		GOOD	S.S.		WELL GRADED SAND (SW), yellowish brown (10 YR saturated	VOC = 0.0 ppm
497						Sample ID: Core F collected on 11/18/2008 at 1456
500		GOOD	GB		WELL GRADED GRAVEL WITH SAND (GW), yellowish brown (10 YR 5/4), wet	VOC = 0.0 ppm
510		GOOD	GB		SAME AS ABOVE	VOC = 0.0 ppm
515						End of hole at 515'