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100-FR-3 Soil-Gas Survey Description of Work

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BHI-DIS JE 9-29-94

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CONTENTS

1.0 INTRODUCTION

1.1 Scope of Work

This document specifies the activities and procedures used to conduct a soil-gas survey to assess the lateral distribution of trichloroethene (TCE) associated with the groundwater of the 100-FR-3 Operable Unit. During a limited field investigation of the 100-FR-3 Operable Unit, TCE was detected in one groundwater well located in the southwest corner of the operable unit. Traces of TCE (below the laboratory detection limit) were also detected in several other groundwater wells northeast of well 199-F7-1.

The objective of this investigation is to assess the lateral distribution of TCE in soil gas in the southwest portion of 100-F Area. Soil-gas probes will initially be installed near several existing wells where TCE was detected and near two possible sources. Shortly after installation, soil-gas samples will be field screened for TCE and other similar volatile organic compounds using portable vapor monitoring instruments. Based on the field screening data, additional soil-gas probes will be installed and screened to determine the extent of soil-gas contamination. Soil-gas samples will be collected and analyzed to plot the extent and concentration of TCE contamination. Soil-gas concentration plots will be used to infer the distribution of TCE in the groundwater beneath 100-FR-3.

1.2 Site Description

The 100-FR-3 Operable Unit is located in the north-central portion of the Hanford Site along the southern shoreline of the Columbia River. The operable unit covers an area of approximately 2.8 km^2 and lies between Hanford grid coordinates N75500 and N82500 and W27600 and W33000. The operable unit includes the groundwater below the 100-F Area source units as well as the adjacent groundwater, surface water, sediment, and aquatic biota impacted by operations associated with 100-F Area.

About 28 parts-per-billion (ppb) of trichloroethylene were detected in a groundwater sample collected from well 199-F7-1, located in the southwest corner of the 100-FR-3 Operable Unit (DOE-RL 1994a). The depth to groundwater in this region is about 15 to 20 ft. The general direction of groundwater flow is from west to east. The soils in this region are characterized in the driller's log as large gravel and cobblestones to a depth of about 20 ft.

The White Bluffs Pickling Acid Cribs are located about 1 mi northwest of well 199-F7-1. These cribs received waste nitric and hydrofluoric acid etch solutions from a nearby pipe fabrication facility from 1943 to 1959. No organic solutions are known to have been disposed in the cribs. However, TCE was commonly used as a degreasing agent in these types of operations during this time and may have been spilled or disposed in the area (DOE-RL 1994b).

The 600-3 "Leisure Spur" Waste Dumping Area is located about 1 mi south of well 199-F7-1. Undocumented metal scrap and wastes were disposed in this area during the mid-1940's. This area is also considered a potential source of the TCE contamination.

1.3 Measurement Objectives

The data obtained by this investigation will be used to determine if TCE is present in the vadose zone in the southwest corner of the 100-FR-3 Operable Unit and surrounding regions. The TCE concentrations will be mapped and used to infer the presence of TCE in the underlying groundwater.

Trichloroethene concentrations will be measured and recorded as parts-per-million volume/volume (ppm-v) for each sampling location. Using estimates based on Henry's law equilibrium at 20 °C, the concentration of TCE in the vapor state above a 28-ppb solution of water is in the range of 1 to 2 ppm-v. TCE is relatively volatile and it is anticipated that the vadose zone concentrations will be detected by the field instruments intended for use in this study. In addition, the gas analyses conducted will also detect the degradation products of TCE (vinyl chloride and isomers of dichloroethylene) as well as other similar organic compounds.

2.0 GENERAL REQUIREMENTS

All personnel following this description of work will perform work in accordance with the following procedures.

- WHC-EP-0383, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990)
- WHC-CM-4-11, *ALARA Program Manual* (WHC 1988a)
- WHC-CM-4-3, *Industrial Safety Manual*, Volumes 1 through 3 (WHC 1987)
- WHC-CM-7-5, *Environmental Compliance Manual* (WHC 1988b)
- WHC-CM-7-7, *Environmental Investigations and Site Characterization Manual* (WHC 1988c)
- Site-specific safety documentation.

3.0 SAMPLING AND ANALYSIS ACTIVITIES

3.1 Sample Locations

Soil-gas probes will be installed and screened for TCE in three phases. For the first phase, about seven probes will be installed along a line running approximately east to west beginning at well 199-F7-3. The probes will be installed near existing groundwater wells or, where wells do not exist, at intervals of about 300 m (see Figure 1). These probes will be screened in the field for TCE, and the values will be compared to existing groundwater information. In addition, each of the probes will be sampled and analyzed using a portable gas chromatograph (GC). This will help characterize the soil gas for several common volatile organic compounds including TCE.

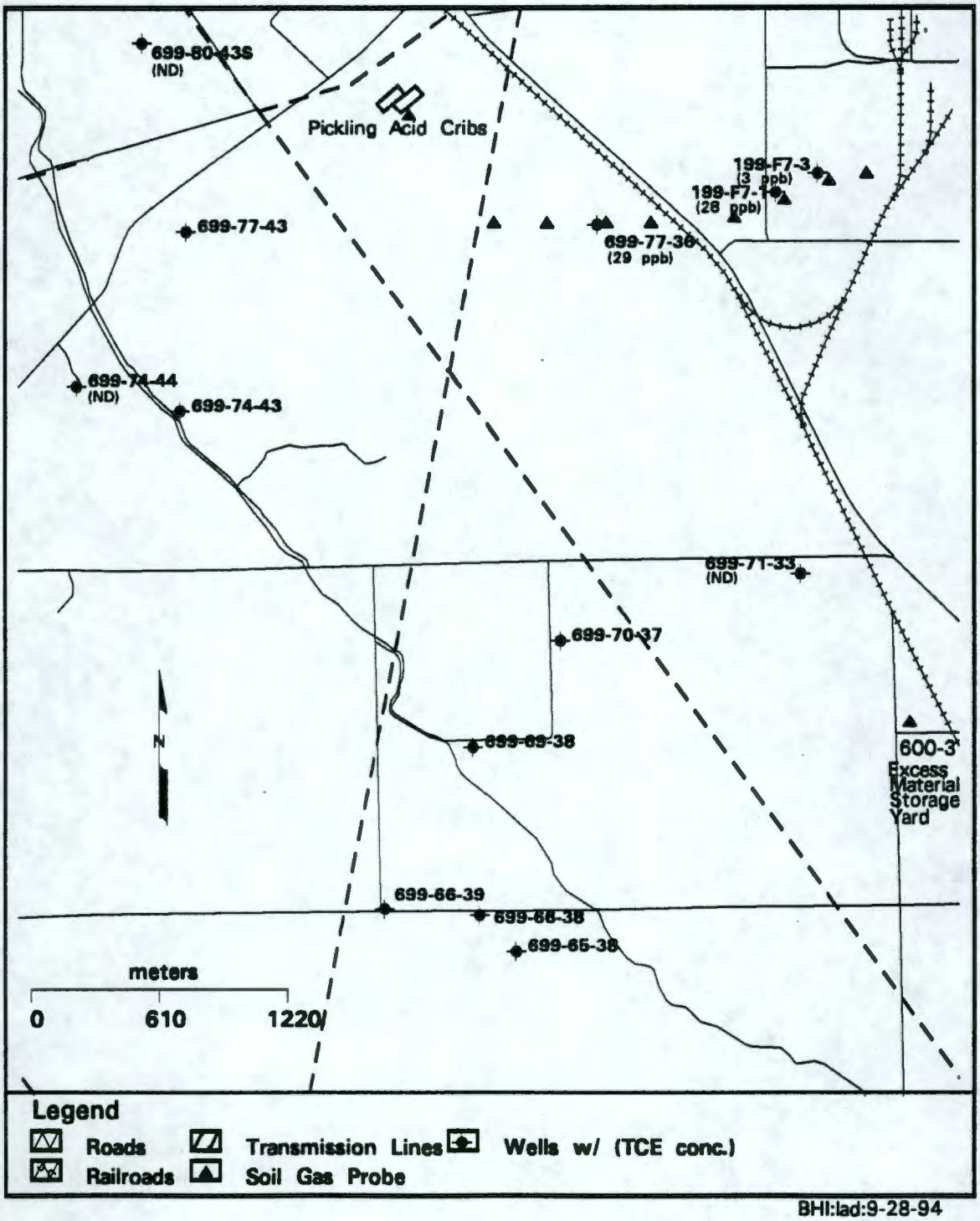
The second phase of this study will involve installing soil-gas probes near the two possible sources of TCE contamination. Two or three probes will be installed downgradient of the White Bluffs Pickling Acid Cribs and the 600-3 "Leisure Spur" Waste Dumping Area (see Figure 1). The probes will be screened for TCE and sampled for GC analysis before continuing on to the final phase of the survey.

The final phase of the survey will attempt to define the lateral distribution of TCE in the survey area based on the soil-gas data collected during the first two phases of the study. The strategy will be to install additional probes along transects beginning at the areas with the highest TCE concentrations. The direction of the transects and the spacing between the probes will be determined by the data obtained during the first two phases and the field screening data collected as the probes are installed. The intent of this portion of the survey is to locate regions of high TCE concentration using as few probes as possible. Once a region of high concentration is identified, the gradient will be further defined by installing and screening additional probes. No more than 50 probes will be used for this final phase of the survey.

3.2 Sampling Methods

Soil-gas probes will be installed in accordance with Environmental Investigations Instruction (EII) 5.9, "Soil-Gas Sampling" (WHC 1988c). Each soil-gas probe will consist of an expendable stainless-steel point connected to a 6-in. section of stainless-steel inlet screen. The gas inlet section is connected to ¼-in. outer diameter (OD) teflon (a trademark of E.I. DuPont De Nemours Company) tubing which extends to the soil surface. The probes will be driven to a depth of 6 to 10 ft using 1-in.-OD, hollow, steel driving rod. Once the probe has been driven to the prescribed depth, the driving rod is extracted leaving the probe tip, screen inlet, and teflon tubing in place. The drive rods will be installed and removed using a Model 5400 hydraulic soi probe (a trademark of Geoprobe Systems).

Figure 1. Initial Sample Grid for the 100-FR-3 Soil-Gas Survey.



The annular space between the screen inlet and emplacement will be backfilled with clean 20/40 silica sand and capped with a mixture of clean 20/40 silica sand and bentonite. The remainder of the emplacement hole will be backfilled using native soil or clean silica sand to seal the tubing. The tubing will be capped at the surface with a plastic cap. The actual sampling depth will depend on field conditions and will be documented in the field logbook.

3.3 Sample Numbering

The Hanford Environmental Information System (HEIS) will be used to track sample data obtained during this soil-gas survey. Each quantitative sample will be identified by a unique HEIS sample number. The HEIS numbers will be assigned in the field and documented in the field logbook.

3.4 Sample Analysis

The objective of the 100-FR-3 soil-gas survey is to determine the source of TCE in well 199-F7-1 by assessing the distribution of TCE in the vadose zone. Because the source and extent of contamination is unknown, each probe will be field screened for TCE shortly after it is installed. The data will be used to direct the placement of the next probes.

Each sample point will be purged before samples are collected. A minimum of three tube-volumes will be withdrawn to ensure the sample is representative of the vadose zone vapors. For ¼-in. tubing, the tube volume is approximately 10 mL/ft of tubing. Purge times will be determined by taking into account the length of tubing and the flow rate of the instrument or sample pump used. The purge rate for each instrument or sample pump will be documented in the field logbook. If measurements are made with a second instrument immediately after the first measurement, a second purging will not be required.

Table 1 lists instruments available for onsite soil-gas analysis. All instruments will be operated by trained individuals in accordance with vendor manuals. Initial screening measurements will be made at all sample points using one or more total organic vapor monitor. Other instruments may also be used if needed. The results will be recorded in the field logbook.

After initial screening, soil-gas samples will be collected from selected sample points based on the field screening results. The sampling will focus primarily on the identified regions of contamination in order to characterize the contaminants. Samples will also be collected from selected uncontaminated areas in order to establish background levels of the contaminants. The samples will be analyzed using a portable GC. Sample collection and analysis will be conducted in accordance with EII 5.9, "Soil-Gas Sampling" (WHC 1988c).

Table 1. Field Screening Instruments Used for Soil-Gas Surveys.

Type	Instrument	Measurement Principle	Comments
PID[1]	Thermo Environmental Model 580B OVM PHOTOVAC Microtip	Uses ultraviolet lamp to ionize sample and measures ions produced.	Responds well to aromatics and many alkenes. Response is lower for aliphatics. Does not respond to methane. Results are total organic vapor concentration in ppm. Typically calibrated to isobutene.
FID[2]	Foxboro Century OVA128-GC	Burns compound in hydrogen flame and measures carbon ions produced.	Responds well to most organic carbon compounds. Results are total organic vapor concentration in ppm. Generally calibrated to methane. Does not detect CO_2. Affected by high relative humidity. May not operate in depleted oxygen.
IRA[3]	Geotechnical Instruments GA 90 Infrared Gas Analyzer	Measures infrared absorption of both CH_4 and CO_2. O_2 measurement by electrochemical cell.	Detects methane and carbon dioxide. Oxygen measurement also. Not affected by low O_2. Measurements are compensated for water vapor and temperature. Results are $\%CH_4$, $\%CO_2$, $\%O_2$ and differential pressure in inches of water.
GC[4] PID	PHOTOVAC 10S Plus Portable GC	Sample is collected in a sample loop or injected. Dual PIDs are available for both total vapor and GC analysis.	A capillary column and PID provide compound separation and identification. A second PID provides total vapor concentration, and can be used to trigger a chromatograph run. The PHOTOVAC has a nominal ionization potential of 10.6 eV, but compounds such as CCl_4 (IP = 11.47 eV) can be detected.
GC AID[5]	SENTEX "SCENTOGRAPH" Portable GC	Sample is drawn over a Tenax trap by an internal pump and desorbed onto a packed column for compound separation.	A packed column provides compound separation. The AID is a broad-spectrum detector with an effective ionization potential of 11.7 eV. If necessary, it can be re-configured to function as an electron capture detector (ECD) for increased sensitivity to halogenated compounds. The Sentex GC can be configured to draw a soil-gas sample directly from the soil-gas tube onto the preconcentrator, eliminating the need for sample collection and handling.

1. Photoionization detector
2. Flame ionization detector
3. Infrared Analyzer
4. Gas chromatograph
5. Gas chromatograph with argon ionization detector.

4.0 QA/QC REQUIREMENTS

Quality control samples or measurements will be made to ensure the overall reliability of the soil-gas data. All instruments will be calibrated according to the manufacturer's procedures. Instrument response will be checked on a routine basis to ensure the instrument operates within an acceptable range. Instrument calibration data will be recorded in the field logbook.

Quality control samples for the GC analyses will include blanks, equipment blanks, ambient samples, and duplicate samples. Table 2 describes the frequency and purpose of these QA/QC samples. Calibration standards will be run on a regular basis to ensure instrument accuracy and precision. The QA/QC samples will be documented in the field logbook.

Table 2. Quality Control Samples for the 100-FR-3 Soil-Gas Survey.

Sample	Description	Purpose	Frequency
Blank	Clean air analyzed as a sample.	Evaluate potential for cross contamination from instrument flow line or trap or preconcentrator on GC.	Minimum of once per day or 1 per 20 samples. The equipment blank may serve both purposes if no compounds of interest are detected.
Equipment Blank	Ambient air drawn through probe and sampling equipment.	Evaluate potential for contamination from sampling equipment.	
Ambient Sample	Ambient air analyzed as sample.	Evaluate presence of compounds of interest in ambient air.	Minimum of once per day. The equipment blank may also serve this purpose if no compounds of interest are detected.
Duplicate Sample	Second sample from the same soil-gas point.	Demonstrate repeatability of sampling method.	Minimum of once per day or 1 per 20 samples. Also for any anomalous result.
Calibration Standard	Measurement of a known analyte at a known concentration.	Demonstrate ability of instrument to detect a specific compound and determine response factor. Determine correct retention time and detector response for GC under field conditions.	Daily and as required to confirm instrument calibration and/or analyte identification.

5.0 SCHEDULE

5.1 Probe Installation and Field Screening

The soil-gas probes are scheduled to be installed during October 1994. The soil-gas samples should be completely field screened during the same time period.

5.2 Sample Analysis and Final Report

Soil-gas samples will be collected from selected sample points for GC analysis. Sample collection and analysis should be completed by the end of November 1994. A final report will be prepared and issued by February 1995.

6.0 CHANGES TO DESCRIPTION OF WORK

Changes to this description of work will be submitted on the project change form (Attachment 1). The change will require, as a minimum, the verbal approval of the field team leader for this investigation and a representative for the 100-FR-3 Operable Unit. If needed, this document will be revised to include any changes and reissued to the regulatory agencies and appropriate personnel.

7.0 REFERENCES

DOE-RL, 1994a, *Limited Field Investigation Report for the 100-FR-3 Operable Unit*, DOE/RL-93-83, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1994b, *Pickling Acid Cribs Feasibility Study*, DOE/RL-94-20, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WHC, 1987, *Industrial Safety Manual*, WHC-CM-4-3, Volumes 1 through 3, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988a, *ALARA Program Manual*, WHC-CM-4-11, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988b, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988c, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan*, WHC-EP-0383, Westinghouse Hanford Company,. Richland, Washington.

ATTACHMENT 1

DESCRIPTION OF WORK CHANGE FORM

Date: _____

Person Initiating Change: _____Change: _____

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_____Reason For Change: _____

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_____APPROVAL

Field Team Leader: _____Closure Plan

Coordinator: _____Other: _____

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