SITE: Carrier Air
BREAK: 6.8 v.2
OTHER:

FINAL DESIGN
SOIL VAPOR EXTRACTION

CARRIER COLLIERVILLE SITE
MAIN PLANT AREA

Prepared for:

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September 22, 1994

10663653

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1.0 INTRODUCTION

This document presents the final design for remediation of the primary trichloroethene (TCE) release area at the site, referred to in previous documents as the Main Plant Area (MPA). Generally, the area is between the main manufacturing and former A and F buildings. This document presents the results of borings and additional vapor recovery well installation, and the detailed design of a Soil Vapor Extraction (SVE) system to remediate vadose soil contaminated above the Record of Decision stipulated cleanup criterion of 533 micrograms per kilogram (μg/kg) TCE.

Based on information gathered during the Remedial Investigation, TCE is the contaminant of concern in the Memphis Sand aquifer. The objective of the SVE remediation is to remediate the source to prohibit continued leaching of TCE into the shallow aquifer which ultimately will reach the Memphis Sand aquifer.

The designed system will reduce vadose zone soil TCE concentration levels to below the cleanup criteria. All SVE wells were screened throughout the vertical depth of contamination and will encompass the horizontal extent of TCE contaminated soil at the remediation area.

Setting

Borings and installation of wells and probes indicate the subsurface consists of silty clays and clayey silts to about 25 feet below ground surface (bgs). This material is underlain by fine- to medium-grained sands to about 40 feet bgs. These sands are underlain by fine- to medium-grained sand with some gravel. In the remedial area, a layer of clay underlies this sand and gravel. A small thickness of shallow groundwater is typically present atop this clay.

Since the extent of TCE contamination above criterion is limited to shallow soil, borings and SVE wells/probes were completed only to 20 feet bgs, therefore, groundwater was not

encountered. Groundwater elevations from monitoring wells in the surrounding area indicate that groundwater is encountered around 55 to 60 feet bgs.

2.0 PARAMETER EVALUATION TESTS (PETs)

PETs were conducted at the Carrier Collierville site in three separate source areas to demonstrate the feasibility of utilizing vacuum extraction as the remedial technology at the MPA. The objectives of the PETs were to confirm the status of TCE contaminated soils as described in the Remedial Investigation/Feasibility Study, determine the air permeability of the shallow, silty clay zone and the deeper, sandy soils, evaluate treatment options based on air emission discharge rates, and determine site specific design criteria for a full-scale vacuum extraction system.

The PETs were initiated on December 1, 1993 and concluded on December 2, 1993. Based on results of the PETs, additional SVE drilling activities were conducted to concentrate on the delineation of the shallow soil contamination. Results of the additional drilling activities are described later in this report. This section summarizes findings during the PETs.

2.1 PET Borings

Prior to the PETs, one deep and one shallow SVE extraction well was installed at each potential source area. Each SVE extraction well was constructed of 2-inch inner diameter (ID), Schedule 40 polyvinyl chloride (PVC), consisting of ten feet of 0.010-inch slotted screen. Each shallow SVE extraction well was completed to 20 feet, and each deep SVE extraction well was completed to 40 feet. For each extraction well, three 1-inch ID Schedule 40 PVC probes were installed at varying distances away from its respective extraction well to measure vacuum influence.

During the installation of the SVE wells and probes, soil samples were taken to obtain TCE contamination data. Results of the sample analyses are shown in Table 2-1. Some monitoring points (MPs) were not sampled due to their proximity to SVE wells which were sampled. Soil samples collected during drilling of the PET wells were obtained using a continuous split-spoon sampler collected ahead of the augers. Each sample core was visually inspected and recorded

for lithology and field screened with a photoionization detector (PID). Samples were collected based on PID readings, or at least every 10 feet.

Table 2-1
PET Boring Sample Results

Identification	Total Depth (ft)	Sample Depth (ft)	TCE Conc. (µg/kg)
SVE-1A	36	8	118
		18	72
		29	13
SVE-2A	15	4	53
		14	26
MP-3A	32	8	<10
		31	<10
MP-4A	12	not sampled	not sampled
MP-5A	32	not sampled	not sampled
MP-6A	12	not sampled	not sampled
MP-7A	28	2	<10
		27	<10
MP-8A	12	not sampled	not sampled
SVE-1B	43	3	548 ←
		12	26
		22	38
		32	10
		39	38
		43	40
SVE-2B	17	3	1,600 ←
		8	2,400 ←
		13	650 ←
MP-3B	35	8	42
		33	<10

Table 2-1 (cont'd)			
Identification	Total Depth (ft)	Sample Depth (ft)	TCE Conc. (µg/kg)
MP-4B	15	not sampled	not sampled
MP-5B	36	not sampled	not sampled
MP-6B	15	13	850
MP-7B	34.5	5.5	250
		23	35
		33	19
MP-8B	15	15.5	60
SVE-1C	37	3	80
		13	72
		20	51
		23	34
		33	12
SVE-2C	22.5	3	116
		13	63
		23	29
MP-3C	33	28	<10
		33	<10
MP-4C	18	17	102
MP-5C	33	not sampled	not sampled
MP-6C	18	17	70
MP-7C	37.5	23	<10
		37	12
MP-8C	17	15	317

Notes:
Sample Area A - 1979 spill, west of Building F
Sample Area B - 1979 spill, south of main manufacturing building
Sample Area C - 1985 leak, east of main manufacturing building

2.2 Results of PETs

Three PETs were conducted, one PET per designated source area as described in the *MPA SVE Treatability Study Report*, dated January 7, 1994. Each PET was further broken down into separate PETs for the shallow SVE extraction well and the deep SVE extraction well. PETs were performed by using a blower to extract soil vapor through each SVE extraction well while monitoring pressure changes in the nearby SVE probes.

During each PET, vacuum levels of 41 to 54 inches of water were applied to shallow and deep extraction wells at each source area. These applied vacuums produced extracted vapor flowrates from 40 to 60 cubic feet per minute (cfm). Table 2-2 is a summary of the findings at each source area during the PETs.

Table 2-2
PET Summary

Area	Effective Radius of Influence (ft)	TCE Removal Rate (lb/day)	Vacuum at Wellhead (in. H_2O)
A, Shallow	15 - 25	0	47
A, Deep	55 - 65	0.017	47
B, Shallow	15 - 20	0.018	54
B, Deep	100 - 120	8.71	41
C, Shallow	30 - 50	0.003	54
C, Deep	50 - 100	11.43	41

When comparing the results of the shallow and deep soil PETs, it is evident that the resulting vacuum influence from extracting soil gas from the deep extraction wells results in a larger radial influence. This is due to the relatively more permeable soils in which the deep SVE wells are screened.

Soil vapor samples were taken during each PET to determine expected loading rates of contaminants for design purposes. The highest vapor concentration levels were obtained from the deep SVE well in Area B at 1,250 μg/l of TCE. Lower contaminant concentrations, 2.7 to 3.5 μg/l TCE, were extracted from the shallow wells in Area B, even though soil sample results from drilling activities indicate that soils in the shallow zone of Area B contain the highest levels of TCE. This is due to the relatively low air permeability of the shallow soils not allowing flow from the vacuum source as readily as the deeper, more permeable soils.

3.0 DESIGN BASIS

Scope

Design basis for this project initially focused on remediating three distinct areas which were identified during the Remedial Investigation/Feasibility Study (RI/FS) as source areas of TCE contamination at the MPA—the 1985 storage tank pipe leak area east of the main building (Area C), the 1979 spill area immediately south of the former degreaser location (Area B), and a third area southwest of the 1979 spill area (Area A), which apparently occurred during a fire department response (when wash water was used to push TCE from the 1979 spill area). Information gathered during Remedial Design indicates that the volume of soil requiring remediation (per the 533 μg/kg criterion) is smaller than was apparent during the RI/FS.

Pneumatics

As discussed in Section 2.0, an effective radius of influence (EROI) of 20 to 25 feet can be achieved in shallow soil (to 25 feet bgs) and an EROI of 100 to 120 feet in deep soil (fine- to medium-grained sands below the silty clay and clayey silts). Well location and conceptual design of the treatment system are presented in the plans and specification drawings for the site.

The number and location of the SVE wells then depends on the dimensions of the contaminated area, which were recently determined while installing the additional SVE wells. At Area C, borings were installed on 20-foot centers in a triangular pattern from existing SVE wells used during the pilot study. Borings drilled at Area C were installed directly over an underground storage tank area. Borings drilled at Area A were installed 75 and 120 feet south of the initial test wells, to confirm the absence of contamination above the 533 μg/kg threshold. The location selected for boring A-SB1 was intended to verify contaminant level in Area A off the former pavement (the exit point for TCE contaminated water as a result of fire department activities).

Borings were completed as SVE wells if sample analyses from soil indicated TCE concentrations above the 533 μg/kg criterion, however, an area was only considered for remediation if the

average of all boring sample analyses were above 533 μg/kg. Only borings in the area of the 1979 spill resulted in average TCE concentrations above 533 μg/kg. Borings were continuously sampled with a 5-foot, stainless-steel continuous split-spoon sampler. Each split spoon was analyzed immediately with a Photoionization Detector (PID), and samples were sent for laboratory analyses based on results of PID readings. Once laboratory results were received, the boring was either converted to a SVE well or grouted to the surface. Locations of the additional borings are shown on Figure 3-1 and results summarized in Table 3-1.

Seven borings were drilled and sampled in the 1979 spill area, each on 20-foot centers in a triangular pattern from the pre-existing shallow SVE well (SVE-2B). Five were converted to SVE wells. As shown on Sheet C-1, all SVE wells in this area lie in a straight line parallel with a fire main trench and the building. The fire main trench is believed to be a conduit for contaminant transport as all borings which were converted to SVE wells lie parallel to the trench. Each additional SVE well was completed to 20 feet bgs and constructed of 2-inch SCH 40 PVC with a 0.010-inch slotted well screen interval from 5 to 20 feet bgs.

The western most part of the contamination is bounded by a monitoring probe installed during SVE well/probe installations for the pilot study. The eastern most part of the contamination is bounded by SVE-2E, which was installed during the most recent drilling event. Further drilling east of SVE-2E was not performed because the fire main trench makes a turn into the building area. Also, several borings in this area drilled during the RI indicated TCE concentrations in soil below 533 μg/kg.

Based on previous SVE well/probe installation data, no deep borings were drilled during the second phase of SVE well installation. Soil sample results from deep wells/probes, drilled for PETs, in the remediation area did not contain TCE at concentrations above 533 μg/kg. The existing deep SVE well (SVE 1-B) will be integrated into the SVE system only to recover soil gas periodically. Deep well SVE 1-B is a 2-inch ID Schedule 40 PVC well and was completed

to 40 feet and contains 10 feet of 0.010-inch slotted well screen from 30 to 40 feet below ground surface.

Based on a calculated area of remediation of 5,400 square feet (ft^2), and contamination depths ranging from 4 to 16 feet, the volume of soil currently contaminated above the 533 μg/kg TCE criterion is approximately 3,220 cubic yards (yd^3).

Table 3-1
Additional SVE Boring Sample Results

Identification	Total Depth (ft)	Sample Depth (ft)	TCE Conc. (µg/kg)
A-SB1	35	12	10
		23	10
		32	20
A-SB2	23	7	50
		22	90
B-SB1	23	4	< 41,000 >
		18	370
		22	500
B-SB2	23	4	< 113,000 >
		14	< 1,050 >
		23	190
B-SB3	23	8	190
		16	130
		23	50
B-SB4	23	8	120
		12	60
		20	10
B-SB5	18	6	40
		12	30
		18	30
B-SB6	20	8	< 9,050 >

000,000 / 100,000,000 = x / 100

10%

Table 3-1 (cont'd)

Identification	Total Depth (ft)	Sample Depth (ft)	TCE Conc. (µg/kg)
B-SB6	20	13	1,290
		20	<10
B-SB7	20	8	40
		10	60
		20	4,590
C-SB1	28	7	< 550 >
		11	100
		14	400
		18	160
C-SB2	26	7	260
		23	350
		24	30
C-SB3	28	7	< 540 >
		17	190
		24	70
		27	70

Notes:
Sample Area A - 1979 spill, west of Building F
Sample Area B - 1979 spill, south of main manufacturing building
Sample Area C - 1985 leak, east of main manufacturing building

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FIGURE 3-1
SOIL BORING
LOCATIONS
COLLIERVILLE SITE
COLLIERVILLE, TN.

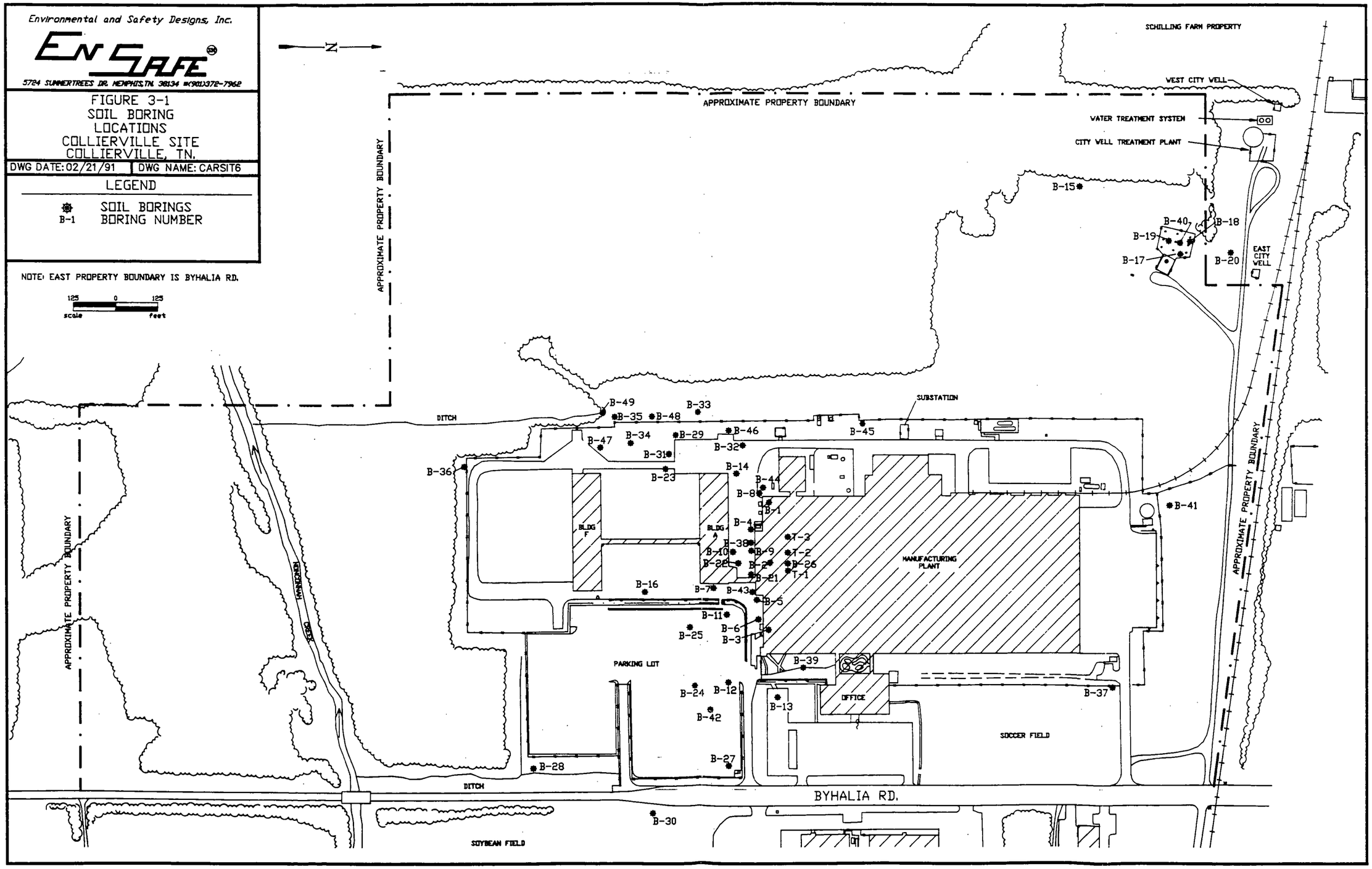
DWG DATE: 02/21/91 | DWG NAME: CARSIT6

LEGEND

✱ SOIL BORINGS
B-1 BORING NUMBER

NOTE: EAST PROPERTY BOUNDARY IS BYHALIA RD.

125 0 125
scale feet



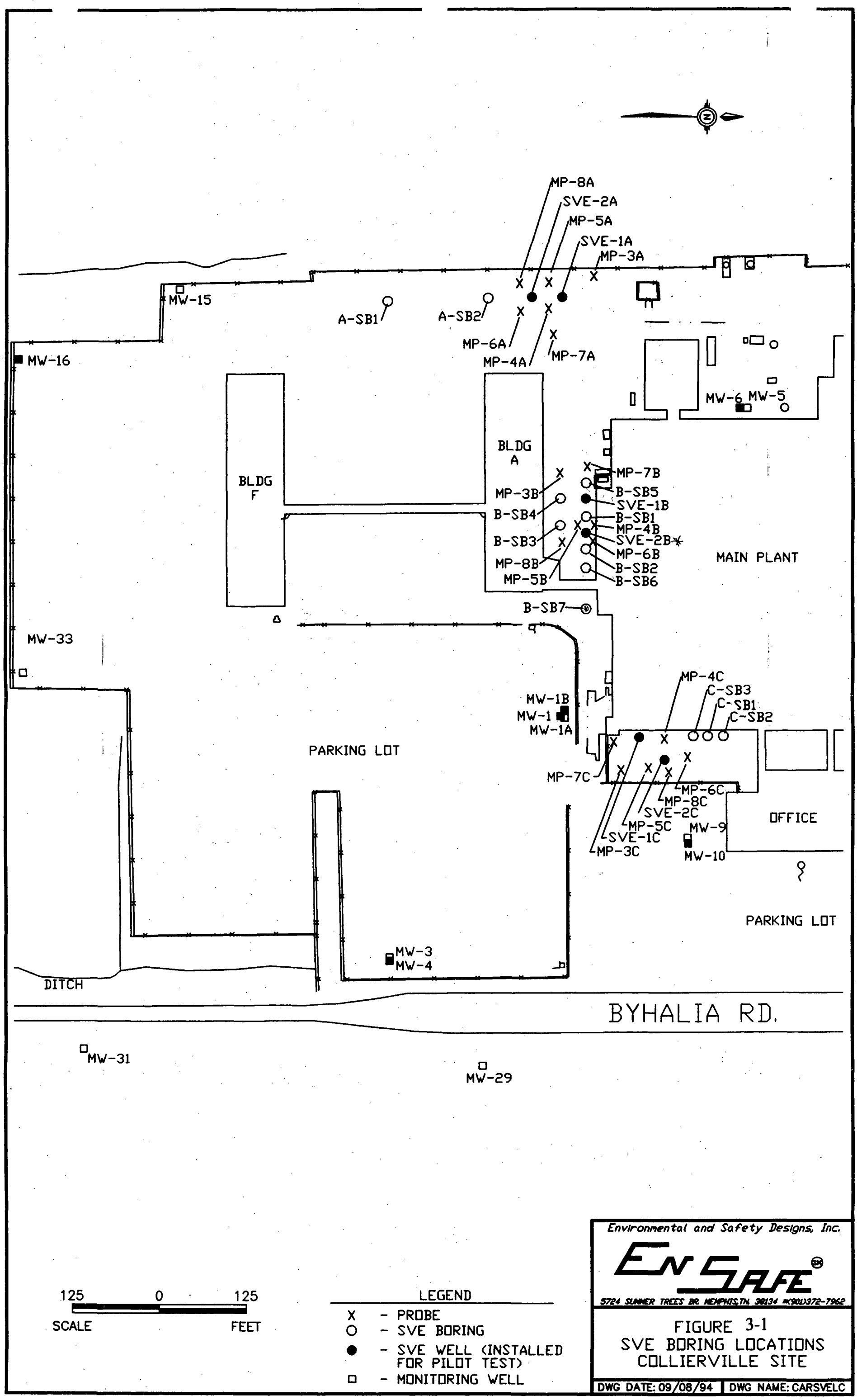

MP-8A
SVE-2A
MP-5A
SVE-1A
MP-3A
MW-15
A-SB1
A-SB2
MP-6A
MP-4A
MP-7A
MW-16
MW-6
MW-5
BLDG A
BLDG F
MP-7B
MP-3B
B-SB5
B-SB4
SVE-1B
B-SB1
B-SB3
MP-4B
SVE-2B
MP-6B
MP-8B
B-SB2
MP-5B
B-SB6
MAIN PLANT
B-SB7
MW-33
MP-4C
C-SB3
C-SB1
C-SB2
MW-1B
MW-1
MW-1A
PARKING LOT
MP-7C
MP-6C
MP-8C
SVE-2C
MP-5C
MW-9
SVE-1C
MP-3C
MW-10
OFFICE
PARKING LOT
MW-3
MW-4
DITCH
BYHALIA RD.
MW-31
MW-29
125 0 125
SCALE FEET
LEGEND
X - PROBE
O - SVE BORING
● - SVE WELL (INSTALLED FOR PILOT TEST)
□ - MONITORING WELL
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FIGURE 3-1
SVE BORING LOCATIONS
COLLIERVILLE SITE
DWG DATE: 09/08/94
DWG NAME: CARSVELC

4.0 GENERAL DESIGN REQUIREMENTS

4.1 Soil Vapor Extraction Wells

The SVE system to be installed consists of seven SVE wells in Area B (see Sheet M-1), a demister knock-out tank, an air emission control system, and a regenerative blower. SVE results indicate each well is capable of influencing 20 to 25 radial feet in the shallow soils, and 100 to 120 feet in the deep soil.

Two horizontal galleries will be installed parallel with the building and located on both sides of the fire main trench (H1 and H2, H1 will be located closest to the building). The purpose of the horizontal galleries is to remediate shallow contamination that may not be affected by the vertical SVE well network, and remediate any TCE contaminated soil immediately adjacent to the building foundation that may not be reached by the vertical SVE well network due to short circuiting from the fire main trench. Each gallery will consist of 100 feet of 2-inch I.D. Schedule 40 PVC, 0.010-inch slotted well screen. The center of the screen in H1 and H2 will be installed at a depth of 24 inches below grade, surrounded by approximately 3 inches of sand and 11 inches of compacted backfill above each pipe, and then sealed with a 10 inch concrete surface. All joints in the concrete surface will be sealed with joint sealer. To prevent air leakage through each trench, two concrete pours will be made to seal the entire trench, around the piping; 1) at the edge of the concrete cover where all piping joins the main trench, and 2) east of SVE-2D, at the existing concrete drive.

The overall system design air flow rate will be 240 standard cubic feet per minute (scfm). The air flow from the SVE wells will be controlled using the ambient air inlet valve upstream of the blower, and the valves located at each well. Air flow will be configured to draw soil vapor from the SVE wells to optimize volatile organic compound (VOC) removal.

Based on the total system flow rate, and the calculated pore volume of 11,302 ft^3, the time required to remove one pore volume of soil vapor is 47 minutes.

4.2 Soil Vapor Extraction System Manifold

The vacuum source will be manifolded to the extraction wells and horizontal galleries using 4-inch Schedule 40 PVC pipe and fittings. Two-inch gate valves will be installed at each vertical SVE wellhead to allow flexibility in the SVE system operation and to balance flow. Also located at each wellhead will be a sample port for soil-gas sampling and a port for measuring flow from each well.

Ball valves will be located at the equipment compound to regulate flow between the deep and shallow zones. Operating modes are expected to alternate between extraction from all six shallow wells with periods of extraction from the single deep well. Also, the horizontal galleries will alternate operation to allow recharge of air from the opposite gallery. These activities will be accomplished manually by a Carrier technician on a schedule to be determined.

Each gallery will be separately routed to the equipment compound in the same trench as the vertical SVE well manifold piping. Piping from the horizontal galleries will contain ball valves located at the equipment compound, as well as valves open to the atmosphere on each gallery to act as an air recharge source during extraction at the opposite gallery.

4.3 Soil Vapor Extraction Vacuum Source

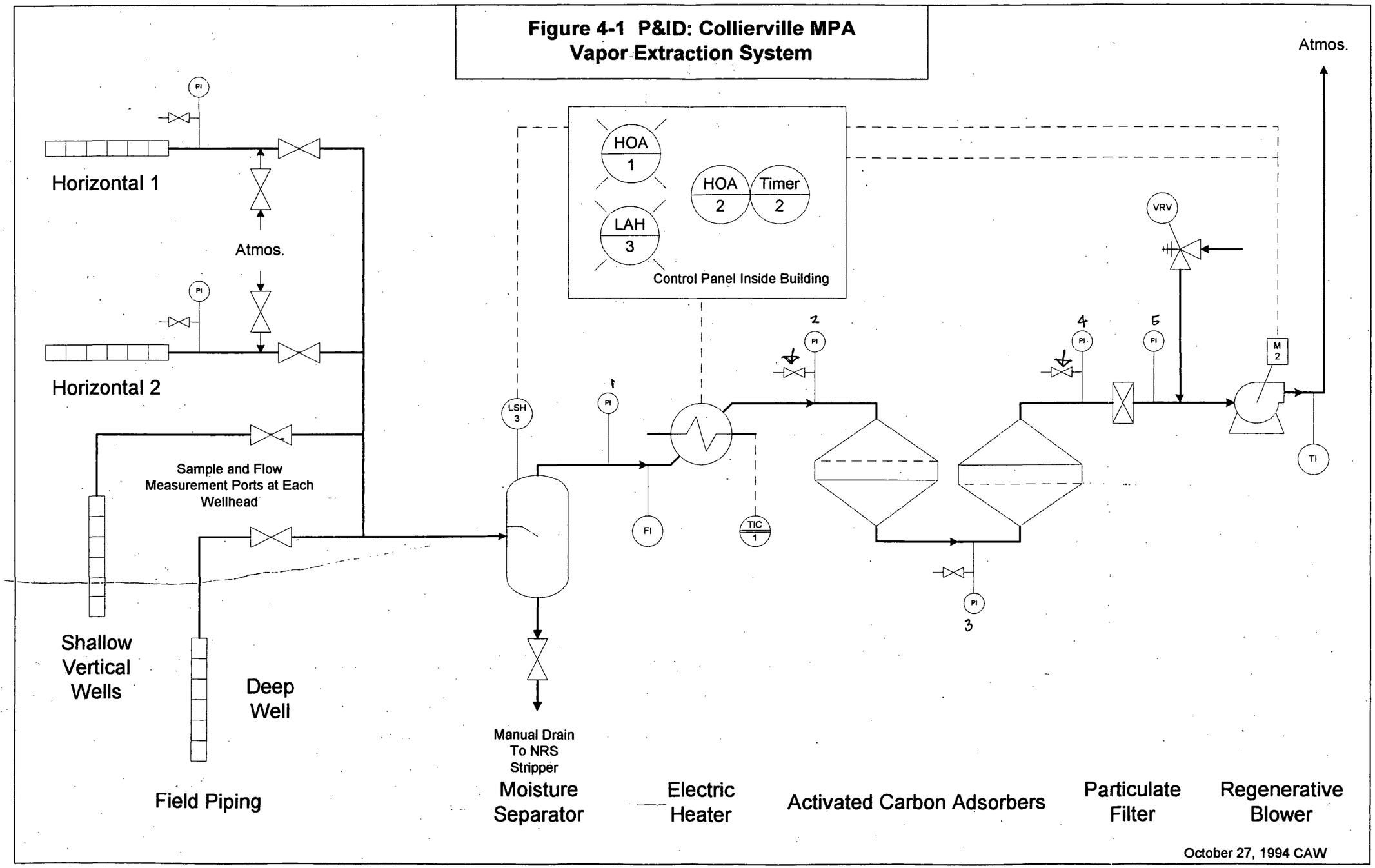
The SVE system includes a skid-mounted blower/vacuum pump system for removing air from the subsurface. A gauge will be located at the inlet of the blower to measure operating pressure, and a gauge at the oulet to measure the discharge temperature. A regenerative blower with the following characteristics will be used:

- 175 inch water column vacuum capacity
- 385-cfm capacity
- 230/460-volt, three-phase, 20-horsepower (HP), TEFC motor

- inlet particle filter
- in-line process air heater
- inlet adjustable relief valve
- discharge muffler

A Process and Instrumentation Diagram (P&ID) of the remediation system is shown in Figure 4-1. The P&ID depicts the process flow and instrumentation of the system.

Figure 4-1 P&ID: Collierville MPA Vapor Extraction System



4.4 Off-gas Control

Input/Output Rates

Based on concentrations of extracted TCE during the PETs, the maximum expected TCE emission rate for the entire SVE system will be 250—350 parts per million-volume (ppmv). Off-gas control will reduce concentrations by greater than 90%.

TCE is the major contaminant to be measured in the airstream, and initially TCE concentrations will be elevated. As the system is operated, the concentrations will decline as the removal rate becomes controlled by diffusion of contaminants in the airstream.

Influent/Effluent Qualities

Results of PETs indicate that the following contaminants may be present in the influent airstream:

- TCE
- Vinyl Chloride
- 1,1 Dichloroethene
- 1,2 trans Dichloroethene
- 1,2 cis Dichloroethene

All of the above contaminants were detected in soil gas from the deep SVE well, only TCE was detected in shallow SVE well soil gas.

Three options were considered for treatment of off-gas from the SVE system:

- Photolytic oxidation
- Carbon adsorption
- Regenerative adsorption (Purus)

Photolytic Oxidation

The treatment of air contaminated with VOCs by photolytic oxidation is performed by high energy ultraviolet lamps usually in combination with oxidants such as ozone or peroxide. Photolytic oxidation mineralizes VOC pollutants, as with incineration, but there is no flame and the reaction occurs at low temperatures. This process has, therefore, the desirable characteristic that no NO_x or CO compounds are formed. At this time, although photolytic oxidation is commercially available to treat organic pollutants in contaminated groundwater, the air treatment has not yet been commercialized.

Regenerative Adsorption (Purus)

An alternative VOC adsorption equipment vendor was evaluated in connection with the design: Purus, Incorporated of San Jose, California. The PURUS system purifies VOC-contaminated air streams by adsorption onto a bed of synthetic resins. The PURUS equipment is configured to alternate actively adsorbing beds, or control an SVE blower motor, while desorbing the bed. A more concentrated stream of VOC-laden purge gas (typically nitrogen), which is used to purge the bed during the desorption cycle, can then be chilled, condensing VOCs and collecting the recovered liquid for reuse or proper disposal.

The adsorbent is a synthetic polymer in the physical form of small diameter (0.3 to 0.8 millimeter) beads which have high surface area, good crush strength, and controlled pore size distribution. Although exact form is tailored to the stream conditions, the resins are generally described as methylene-bridged, styrene-divinylbenzene copolymers.

The capital cost of installing the modular PURUS equipment is relatively high ($120,000) compared to a (single-use, offsite-regeneration) carbon adsorption system. Based on the amount of TCE present in the remediation area, a regenerative adsorption system does not prove to be a cost efficient system.

Carbon Adsorption

Adsorption is a natural process in which molecules of a gas are attracted to and then held at the surface of a solid. Adsorption on activated carbon is of a physical nature. The characteristics of the contaminant molecule will determine the time required for the entire adsorption process.

Estimated capital costs for carbon adsorption equal $24,000. This cost includes two carbon adsorbers each containing 2,000 pounds of carbon. The units have the operational flexibility to operate in either series or parallel. Also, one unit can be in operation while the other is shut off. Again, based on the amount of TCE now present in the remediation area, carbon adsorption is the most efficient option for off-gas control.

4.5 Remediation Area Surface Cover

Soil sampling activities during SVE well installation indicate the highest concentration of TCE-contaminated soil exists at depths starting at 4 feet. Because of this, recovery wells were screened as close as reasonable to ground surface. To minimize ambient air flow from ground surface immediately around the wellhead, and encourage radial air flow toward the wells, the remediation area will be covered with concrete.

The remediation area is located in a high-traffic driveway, therefore, the concrete shall have a minimum 28-day compressive strength of 4,000 pounds per square inch (psi) and be jointed for expansion and contraction.

4.6 Residuals Management

Asphalt removed as a result of demolition activities for the new SVE system will be disposed of at an APAC asphalt production, or similar facility. The more heavily contaminated auger cuttings from SVE drilling activities, as well as soil excavated for pipe installation, will be distributed under the area of new pavement. Any additional excess soil removed to make room for new pavement, but not heavily contaminated, will be managed onsite.

Production water from SVE operations and generated decontamination water will be treated at the NRS.

4.7 SVE System Performance Standards Verification

Performance Monitoring Rationale

Typically, discharge concentrations from a SVE system are highest during the initial stages of operation and decline exponentially after start-up of SVE operations. The decline is due to the removal of VOC-laden soil gas in the very early stages of SVE system operation, preferential removal of the higher vapor pressure compounds, and the steadily decreasing mass of VOCs in the soils contacted by the system air flow. As the SVE system operates, the discharge of VOC concentrations will approach an asymptotic level which is indicative of contaminant removal limited by mass transfer (diffusion from soil particles). The rate of decline in the discharge concentrations at individual SVE wells will be directly related to the mass of VOCs that are remaining within the effective zone of influence of that well.

It is recommended that vapor samples be collected for Gas Chromatography (GC) analysis over the first several days during start-up to establish the initial VOC concentrations and allowable air flow rates from each of the SVE wells. The frequency of monitoring will vary depending on the performance of the system, the actual mass of VOCs to be removed, and economic considerations. Over the first one to two months of operation, monitoring will be conducted weekly. After the initial months of operation, monitoring frequency will be reduced to once per month. When the SVE system approaches an asymptotic level, the system will be shut-off and allowed to stabilize (approximately 1-month). The system will then be reactivated and vapor samples taken. If vapor concentrations rebound to relatively higher levels than existed before shut-down, the system will continue to operate and the process repeated. Table 4-1 illustrates the initial and follow up monitoring of the SVE system.

Table 4-1
MPA SVE System Monitoring

SVE Wells	Start-up, daily for 5 days
Before emission control	Start-up, daily for 5 days, weekly for 1-month, monthly thereafter
After emission control	Start-up, daily for 5 days, weekly for 1-month, monthly thereafter

The relatively high pneumatic permeabilities experienced during the PETs indicate that gas in shallow soils may be moving along preferential pathways, therefore, contaminant removal rate will be controlled by diffusion. To efficiently remove the mass of contaminants throughout the entire soil column, the system will be "pulsed". Pulsing the system will allow diffusion of contaminants into the flowpath region which otherwise may not be removed by the airflow stream. Pulsed operation of the systems means that the entire system will be shut down for a period of time to allow diffusion of contaminants into the flowpath region, and then reactivated. The time to shut down the system will be determined from observation extracted soil gas TCE concentrations over time. This method of pulsing the system will continue until pulsed vapor concentrations reach an asymptotic level.

Once EPA and Carrier believe that attainment goals have been achieved, a total of 5 confirmatory borings will be installed at the remediation area. The location of the borings is indicated on Sheet M-1 of the detailed design sheets and are equidistant between vertical wells, along the plant foundation. These locations are in the area of highest TCE concentration prior to remediation. They are also located at zones of likely gas stagnation, which would result in a slower remediation time. Each boring will be drilled with hollow stem augers after coring through the concrete, and completed to the top of the more permeable material (sand).

Each confirmatory boring will be installed to collect soil samples for laboratory screening analysis of VOCs by the co-distillation method used and approved during the RI (Woodsen-Tenent Method).

The Performance Standards Verification Field Sampling and Analysis Plan and the Performance Standards Verification Quality Assurance/Quality Control Plan describe sampling activities and protocol to be followed for sampling the SVE system. These plans are located in Appendices A and B.

Process Operation Monitoring

SVE performance will be monitored to insure efficient operation. Each SVE wellhead will contain the appropriate connections for the installation of flow device and vacuum measurement instruments. The SVE system will be balanced based on flow upon start-up, and checked once soil moisture removal rates have stabilized.

To insure that operation of the deep SVE well does not stress shallow soils, upon startup of the system the deep SVE well will be operated and the shallow monitoring probes be measured for vacuum stress. If the deep SVE well is inducing a vertical pressure gradient, the shallow monitoring probes will be influenced.

If pressure gradients are observed, the operation of the deep SVE well will include opening the deep monitoring probes to atmosphere, and allowing an air recharge source. If gradients persist, deep well extraction will be discontinued.

As stated in the Statement of Work (SOW) for Remedial Design/Remedial Actions at Carrier Collierville, an Operation and Maintenance Plan will be submitted once equipment procurement is complete. This plan will detail operational approach.

North Remediation Site (NRS) Monitoring

Monitoring data from the NRS SVE system is shown in Table 4-2. As seen from this table, a "rebound" effect occurred after shut-down of the system for 47 days, indicating that diffusion is controlling the removal rate of TCE. The majority of the contamination exists in the shallow wells, therefore, the deep well manifold will be shut off to concentrate extraction on shallow soils. The deep SVE well manifold will be periodically operated to degas the deep zone. Also, the shallow SVE wells will be periodically shut-down and reactivated to allow diffusion into the air flowpath, as described in operation of the MPA SVE system.

Table 4-2
NRS SVE Monitoring Data

Sample Date	Time	Deep SVE Well Conc. (µg/kg-vapor)	Shallow SVE Well Conc. (µg/kg-vapor)	Deep + Shallow Well Conc. (µg/kg-vapor)
02-Dec-93	Sample taken before shut-down	128	0.6	1.3
24-Jan-94	Sample taken at reactivation	48	1,673	340
31-Mar-94	Sample taken 65 days after reactivation	10	595	97
27-Jun-94	Sample taken 153 days after reactivation	8.8	1,020	165

5.0 CONSTRUCTION SCHEDULE

The following schedule outlines construction and implementation of the SVE remedial action. The dates are contingent upon weather and plant operations.

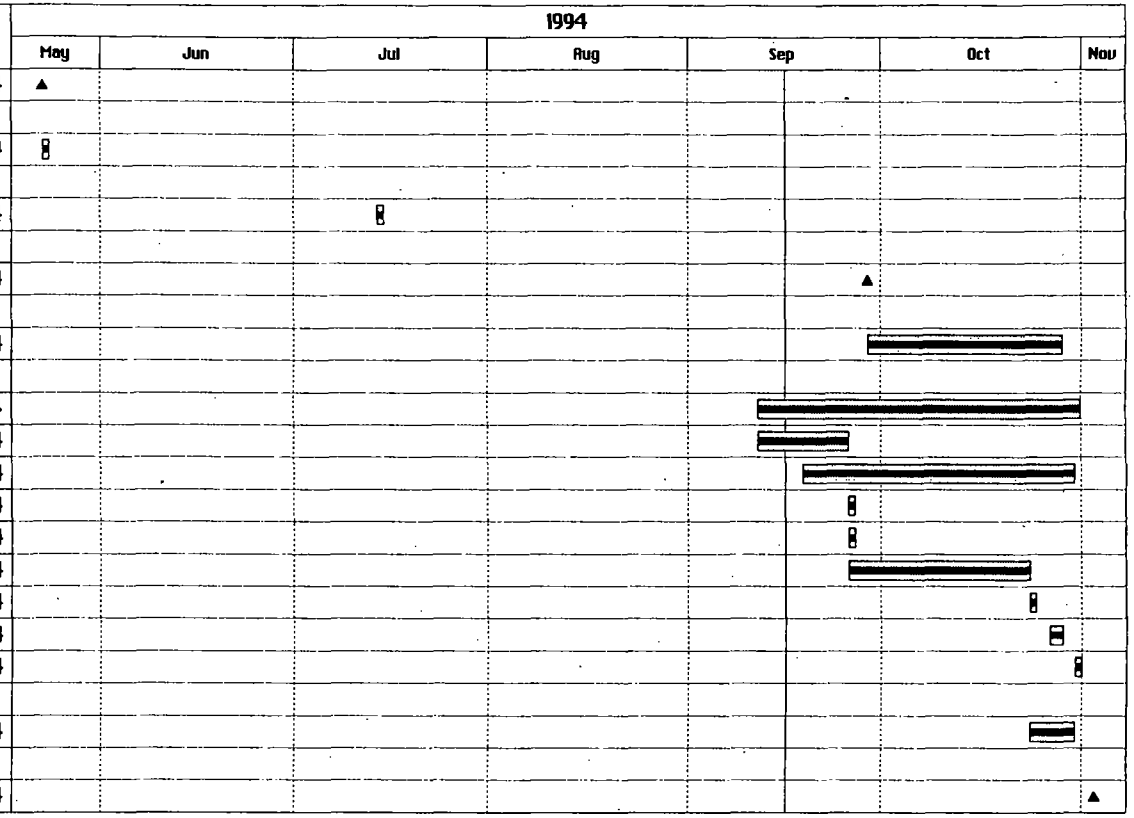
5.0 CONSTRUCTION SCHEDULE

The following schedule outlines construction and implementation of the SVE remedial action. The dates are contingent upon weather and plant operations.

Collierville Site SVE MPA Construction Schedule

As of September 16, 1994
G:\JDA\TL\CARRIER\SVECONST

Task Name	Start Date	End Date
Project Design Start	23-May-94	23-May-94
Begin Design Analyses	23-May-94	23-May-94
Complete Design Analyses	15-Jul-94	15-Jul-94
Submit Final Plans/Specs.	29-Sep-94	29-Sep-94
EPA Review/Approval	29-Sep-94	28-Oct-94
SVE System Installation	12-Sep-94	31-Oct-94
Contractor Bids	12-Sep-94	25-Sep-94
Equipment Shipment	19-Sep-94	30-Oct-94
Preconstruction Conference	26-Sep-94	26-Sep-94
Mobilize to Construct	26-Sep-94	26-Sep-94
Install SVE System	26-Sep-94	23-Oct-94
Prefinal Constr. Inspection	24-Oct-94	24-Oct-94
Startup/Debug System	27-Oct-94	28-Oct-94
Final Inspection	31-Oct-94	31-Oct-94
Performance Testing	24-Oct-94	30-Oct-94
Begin System Operation	3-Nov-94	3-Nov-94



Baseline

Actual

Milestone

A

APPENDIX A
PERFORMANCE STANDARDS VERIFICATION
FIELD SAMPLING AND ANALYSIS PLAN

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1.0 INTRODUCTION

This plan describes sampling and analysis procedures required to support operation and confirm effectiveness of soil vapor extraction (SVE) which is being conducted at the Carrier Collierville CERCLA site. Both extracted vapor, and soil will be sampled and analyzed under this plan, to verify performance of the soil remedy. The United States Environmental Protection Agency (USEPA) Region IV- Environmental Compliance Branch, *Standard Operating Procedures and Quality Assurance Manual*, February 1991 (USEPA SOP/QAM) was used as a basis for these sampling procedures.

The cleanup standard for the trichloroethene (TCE)-contaminated soil is 533 micrograms per kilogram (μg/kg) or until EPA's determination, it is demonstrated that contaminant concentrations have ceased to decline over time, and are remaining constant at some statistically significant level above remediation levels in the area of remediation, as verified by soil sampling.

2.0 SOIL VAPOR EXTRACTION SAMPLING ACTIVITIES

2.1 Soil Vapor Sampling and Analysis

Sample ports are located at each wellhead and at the equipment compound. Monitoring samples will be taken before and after the off-gas control. Samples for performance measurement will be taken at each wellhead in addition to before and after off-gas control.

Procedure

The procedure for obtaining a soil vapor sample is as follows:

1. Don a new pair of disposable latex gloves.
2. Label the sample container.
3. Locate the sample port where sample is to be withdrawn. Soil vapor samples will be drawn from the SVE system using a 50-ml gas-tight syringe. The detailed proedure for its use is as follows:
   - carefully insert the needle on the syringe into the sampling port septum.
   - alternately draw and purge at least 150 ml of gas
   - slowly draw a 50-ml vapor sample
   - inject the vapor into a 50-ml evacuated glass gas-tight septum container.
4. Withdraw and discard at least 150 ml of ambient air to flush the syringe, prior to moving to another sample location.
5. Place the container in a pre-labeled plastic bag.

Vapor samples will be submitted for laboratory analysis according to modified USEPA Method 8010 (an ECD-equipped Gas Chromatographic [GC] analysis for volatile organic compounds).

2.2 Soil Sampling and Analysis

The cleanup criterion for vapor extraction of TCE-contaminated soil is as described in the introduction. This section describes the procedures and sampling plan for confirming achievement of this goal. This goal was derived from modeling of the partitioning of soil contamination to shallow groundwater, and the transport of shallow groundwater contaminants to the underlying Memphis Sand aquifer. Compliance with the standard is thus expected to be one of average. In other words, the vadose soil TCE concentration is to be lowered to, *on average*, 533 μg/kg to prevent further contamination of the Memphis Sand above 5 μg/L. In order to conservatively establish compliance with this standard, four discrete areas of contamination identified during the RI/FS are treated individually, with the standard applied to each area. Two of these areas are subject to active remediation. Sampling planned for the other areas, if any, is to confirm the conclusion reached during Remedial Design that active remediation was unnecessary. In all cases the procedure for confirmatory soil sampling is the same:

Procedure

A new pair of nitrile disposable gloves will be donned before collecting each soil sample. Using 2-inch outer diameter, 5-foot-long, stainless steel split spoons, soil samples will be collected continuously ahead of the augers beginning at 5 feet below ground surface (bgs). Split spoons may be hydraulically pushed or hammered at the site geologist's discretion. Contents of all auger spoils will be containerized in 55-gallon drums.

One sample from each spoon will be submitted for laboratory analysis. Soil will be transferred to 125 ml precleaned glass jars with septa lids for submittal to Woodson-Tenent Laboratories for VOC analysis by the co-distillation method approved for this site by the USEPA during the Remedial Investigation (RI). Additional sample volumes will be collected for analysis by EPA Method 8240 for volatiles in soil.

All soil samples will be stored in a cooler containing ice and water placed in re-sealable plastic bags, or blue ice, to provide temperature preservation at 4°C. All samples to be shipped for analysis will be delivered to the laboratory within 24 hours of collection.

Sampling Plan: Main Plant Area Remediation (Area B)

A total of 5 confirmatory borings will be installed (after extracted vapor concentrations indicate that the standard is likely to have been achieved) at the remediation area to verify that remediation has been achieved. The location of the borings is indicated on Sheet M-1 of the detailed design sheets. The rationale for sampling these locations is biased: samples are planned for in the area of highest contaminant concentration prior to remediation, at specific locations likely to be the last to be extracted under normal operation of the vapor extraction system. These specific locations are equidistant from adjacent shallow vertical extraction wells, and between horizontal wells in shallow soil immediately adjacent to the former degreaser room.

Borings will be installed to a depth of approximately 20-feet bgs, this equates to a total of 4 samples from each borehole.

Sampling Plan: Area A

During installation of the Area B extraction wells, two borings were installed at Area A south of the test well SVE 2A, along the edge of the pavement, where TCE reportedly entered the soil in 1979. As with the SVE test wells, soil sampling and analysis indicated TCE concentrations below 533 μg/kg. One of the latter borings is installed immediately adjacent to two RI borings at which much higher contamination levels were observed (the RI borings results are summarized in Attachment A to this plan).

This, and other site sampling conducted during Remedial Design indicate that vadose soil contamination has attenuated significantly since the RI. However, since this approximately 500-foot square area is the site of these early, higher contamination results, this is the specific area at which Area A compliance will be confirmed. The approach will be to advance three

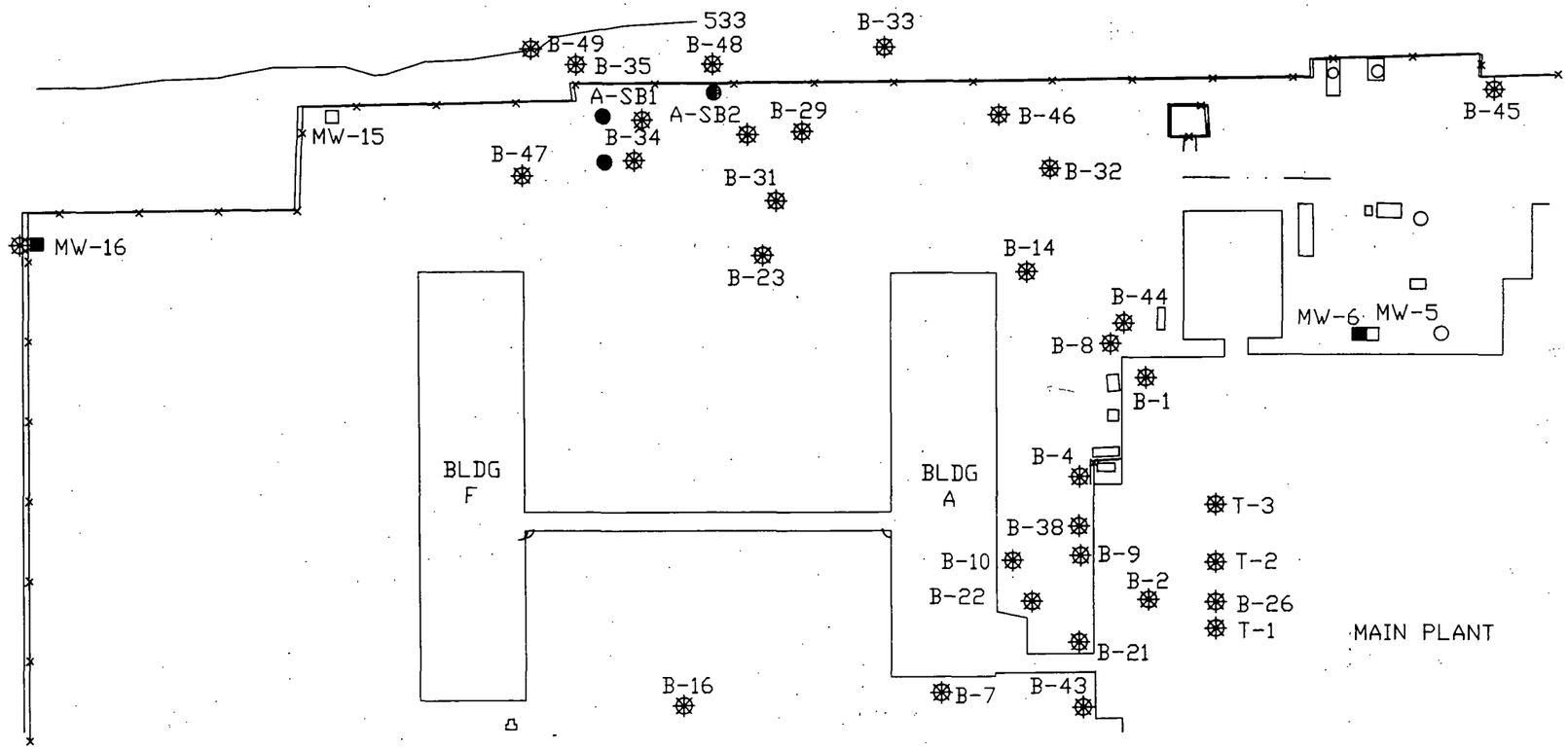
additional borings which bracket A-SB1 (the boring installed most recently), RI boring B-35, and analyze soil samples on 4 depth strata (directed by field photoionization detector response, if any) to a depth of 20 feet bgs (Figure 2-1). If the results of analyses from the four borings do not confirm compliance in comparison of the average results with the 533 μg/kg standard, Carrier will propose additional sampling to establish compliance, up to the sampling levels calculated from the RI boring data-set in Attachment A.

Sampling Plan: Area C

A total of 11 borings have been installed at Area C for Parameter Evaluation Testing and additional SVE well installation activities. Although 2 of the borings contained TCE concentrations slightly above 533 μg/kg (540 and 550 μg/kg), this area is not considered for remediation or confirmatory borings because the average of all samples in this area is below 533 μg/kg.

Sampling Plan: North Remediation Site

The current SVE system in operation at this area (refered to as the North Remediation System, or NRS) will continue to be operated to extract soil gas until concentrations indicate that remedial goals have been achieved. The system is apparently in an operational phase where diffusion of contaminants controls removal rate, especially in the shallow soils. Since the installation of extraction wells was directed by soil gas results, it is assumed that, as with Area B sampling, the confirmation of completed remediation should be conducted by sampling the formerly most contaminated soil, equidistant from the shallow extraction wells. Four borings are planned for the area between adjacent shallow and deep wells (Figure 2-2). Each boring will be installed to a depth of 50 feet bgs.



125 0 125

SCALE FEET

LEGEND

- SOIL BORING
- MONITORING WELL
- PROPOSED SOIL BORING LOCATION

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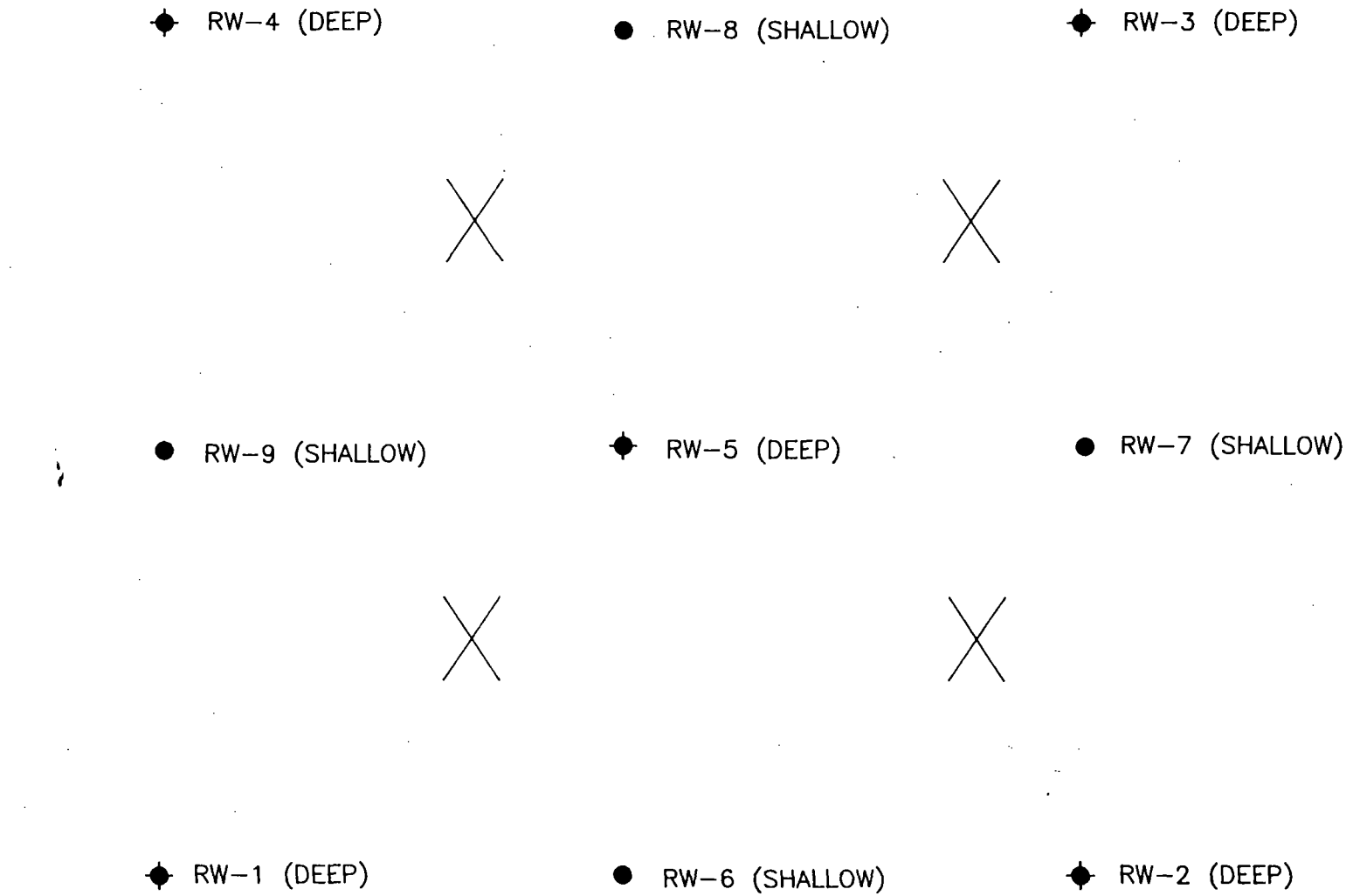
FIGURE 2-1
AREA A
CONFIRMATORY BORING
LOCATIONS

DWG DATE:02/21/95 | DWG NAME:CARCBL02



= PROPOSED SOIL BORING LOCATIONS

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NASHVILLE, TN, PENSACOLA, FL, AND RALEIGH, NC.

FIGURE 2-2
NRS CONFIRMATORY SOIL
BORING LOCATIONS

DWG DATE: 02/21/95 | DWG NAME: CARCSBL1

3.0 QUALITY CONTROL SAMPLES

Precision will be assessed by evaluating results of duplicate and spike samples. Accuracy will be assessed by evaluating field blanks, and trip blanks. Table 3-1 summarizes QC sampling frequencies.

Table 3-1
Quality Control Sample Collection Frequencies

Quality Control Sample	Frequency of Collection	Additional Sample Volumes
Field Blank	One per sampling event or every ten samples.	1 50-ml. evacuated glass cylinder for soil gas 1 125-ml for soil
Duplicates	One per 10 samples	1 50-ml. evacuated glass cylinder (performed by lab) 1 125-ml-for soil
Field Spike (SVE)	One per 10 samples	1 50-ml. evacuated glass cylinder

4.0 EQUIPMENT DECONTAMINATION

Soil vapor sampling equipment will be decontaminated before, and between samples using the decontamination procedures listed below.

1. Don a new pair of disposable latex gloves before handling sampling equipment to be decontaminated.
2. Wash with tap water and laboratory detergent.
3. Rinse with tap water.
4. Rinse thoroughly with deionized water.
5. Rinse twice with pesticide-grade isopropanol.
6. Rinse thoroughly with organic-free water and allow to air dry. ***It is important that any sampling equipment is completely dry to prevent any water from being introduced into the sample containers during sampling.***
7. Wrap with aluminum foil, or place in plastic bag to prevent contamination.

The drill rig will be steam cleaned and wire brushed before being brought onsite. The drill rig will then be inspected to ensure no oil, grease, hydraulic fluid, etc., are leaking. Drilling equipment will be decontaminated at the onsite decontamination pad between drilling of each boring using the decontamination procedures listed below.

1. Don a new pair of disposable nitrile gloves before handling equipment to be decontaminated.
2. Steam-clean with a pressure washer using tap water and laboratory detergent to remove particulate matter and surface film.
3. Pressure rinse with tap water.
4. Rinse thoroughly with deionized water.
5. Rinse twice with pesticide-grade isopropanol.
6. Rinse thoroughly with organic-free water and allow to air dry.
7. Wrap with polysheeting to prevent contamination.

All non-dedicated stainless-steel sampling equipment and the split-spoon samplers will be decontaminated between boreholes using the procedures listed below.

1. Don a new pair of disposable nitrile gloves before handling sampling equipment for decontamination.
2. Steam clean with a pressure washer using tap water and laboratory detergent to remove particulate matter and surface film.
3. Rinse thoroughly with tap water.
4. Rinse thoroughly with deionized water.
5. Rinse twice with pesticide-grade isopropanol.
6. Rinse with organic-free water and air dry.
7. Sampling equipment will be wrapped in aluminum foil until ready for use. Non-sampling equipment may be wrapped in plastic to avoid contamination.

5.0 SAMPLE MANAGEMENT

Sample management will consist of sample labeling, chain-of-custody seals and records, and associated field documentation procedures. The purpose of these procedures will be to ensure the quality of the samples is maintained during their collection, transportation, storage and through analysis to the final data deliverables. All sample management documentation and sample handling protocols have been developed using, as guidance, the EPA Region IV-Environmental Compliance Branch *Standard Operating Procedures and Quality Assurance Manual, (February 1, 1991)* and are discussed below.

Sample Identification Documents:

- Sample label
- Custody seals
- Chain-of-custody records
- Field notebooks
- Corrective Action Documentation

5.1 Sample Labeling

Sample container labels, as shown in Figure 5-1, will be required for identifying each submitted sample. Sample label information will include the site name, sample identification, preservation, required analysis, date of collection with time, and the sampler's name. Each label must be printed legibly using waterproof black ink.

Table 5-1 outlines the sample designation system to be used to identify each sample. Should additional sample designations be required, this table will be amended. Additional sampling information including date and time of collection will be provided on the chain-of-custody (COC) form.

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SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE
SAMPLE IDENTIFICATION	
PROJECT NUMBER	
SAMPLERS NAME	

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FIGURE 5-1
SAMPLE BOTTLE LABEL

DATE: 04/22/93

DWG NAME: SAMP

Table 5-1
Sample Designation System
(Soil)

Location	Sample Type	QA Sample Type	Sample Location and Depth
CC = Carrier, Collierville Site	S = Soil	RB = Rinsate Blank FB = Field Blank DP = Duplicate MS = Matrix Spike	B = Boring SVW = SVE Well
(SVE System)			
Line Location(s)	**Process Location**	**QA Sample Type**	**Other**
2a..2f = Well Location D = Deep Manifold S = Shallow Manifold H1 = Horizontal 1 H2 = Horizontal 2 T = All Lines	BC = Before all carbon AC1 = After carbon #1 AC = After all carbon	FB = Field Blank MS = Matrix Spike	Samples taken from the same point more than once per day, will have the time following the sample identification.

Example:

CC-S-B1	sample from soil boring #1
T-AC1	vapor sample from all lines after carbon vessel #1
D-BC-1020	vapor sample from the deep manifold before carbon at 10:20 a.m.
2b	vapor sample from vertical SVE well 2b

5.2 Custody Seals

Sample custody seals, shown in Figure 5-2, will be used to ensure that samples are not tampered with during transportation. Custody seals are placed on the shipping containers (and on the samples themselves) in a manner such that the containers cannot be opened without breaking the seals.

5.3 Chain-of-Custody

Chain-of-custody forms, as shown in Figure 5-3, will be fully completed by field personnel and shall accompany the samples during shipment. The form shall contain pertinent information regarding the samples, such as the sampler's name, sample identification, date and time of collection, and description of the cooler's contents (number of sample containers). In addition, information to be relayed to the laboratory shall be written in the "Remarks" section of the chain-of-custody, e.g., a sample accompanied with this chain-of-custody requires quicker

attention for analysis. For chain-of-custody purposes, all Quality Control (QC) samples are subject to exactly the same custodial procedures and documentation as real samples.

Upon transfer of custody, the chain-of-custody form will be signed by an EnSafe representative, who also notes the date and time. Because common carriers will not sign chain-of-custody forms, the records will be sealed within each cooler. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory sample custodian and returned to EnSafe following receipt or as part of the data reporting package.

5.4 Daily Logs (Field Log)

All samples will be documented in accordance with the EPA SOP/QAM, Chapter 3 — Sample Control, Field Records and Document Control. Sampling personnel will use bound, ruled or gridded logbooks with sequentially numbered waterproof pages for activity documentation pertaining to the project. These logbooks will be the master reference for all site activities and accomplishments. These records will also document all visual observations, calculations and equipment calibrations. The logbooks are accountable documents that will be properly maintained and retained as part of the project files.

Each logbook will have labeled on the front cover as follows:

Site name (Carrier Site RD, Collierville, TN)

EnSafe

Sampler's name

Book number (sequentially numbered by distribution or as assigned by the Quality Assurance Officer [QAO])

Starting and completion dates

EN SAFE® ENVIRONMENTAL AND SAFETY DESIGNS, INC. 5724 Summer Trees Dr. Memphis, Tennessee 38134 OFFICIAL SAMPLE SEAL	SAMPLE #	DATE:	SEAL BROKEN BY:
	SIGNATURE:		DATE:
	PRINT NAME & TITLE:		

Environmental and Safety Designs, Inc.

EN SAFE®

5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962

FIGURE 5-2
SAMPLE SEAL

DWG DATE: 04/22/93 | DWG NAME: SECSEAL

FIGURE 5-3
CHAIN OF CUSTODY RECORD

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PAGE _____ OF _____

CLIENT _____ PROJECT MANAGER _____

ADDRESS _____ TELEPHONE NO. _____

PROJECT NAME/NUMBER _____ FAX. NO. _____

MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) _____

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED								REMARKS
					TEMP.	CHEMICAL										

RELINQUISHED BY:	DATE	RECEIVED BY	DATE	RELINQUISHED BY:	DATE	RECEIVED BY	DATE
SIGNATURE _____		SIGNATURE _____		SIGNATURE _____		SIGNATURE _____	
PRINTED _____	TIME	PRINTED _____	TIME	PRINTED _____	TIME	PRINTED _____	TIME
COMPANY _____		COMPANY _____		COMPANY _____		COMPANY _____	
REASON _____		REASON _____		REASON _____		REASON _____	

METHOD OF SHIPMENT: _____

SHIPMENT NO. _____

SPECIAL INSTRUCTION: _____

COMMENTS: _____

AFTER ANALYSIS, SAMPLES ARE TO BE:

- ☐ DISPOSED OF (ADDITIONAL FEE)
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS (ADDITIONAL FEE)
- ☐ RETURNED TO CUSTOMER

The logbook must be labeled with indelible black ink. The following steps shall be followed when making entries into the field logbook:

- Enter the date and time the task begins, weather conditions, and the names and titles of individuals involved. When possible, include the names and titles of personnel visiting the task area.
- Describe all activities in detail and list which forms were used to record such information (e.g., boring logs, field change request forms). It is good practice to duplicate the most important information throughout the field logbooks.

Examples of some pertinent information for specific activities are as follows:

  — SVE sampling activities: document the weather conditions, document the flow rate and vacuum readings, detail any change in operation of the system (such as differing flow rates/vacuums since last sampling event), document the sample location.

  — Installation of soil boring activities: document the size and depth, sampling equipment used and methods used, details on the soil lithology and the samples collected.

  — Levels of PPE worn by the sampling team. If the PPE levels are changed for any reason, state the change in protection and the reasons for the change.

- Describe in detail any field tests that were conducted (e.g., PID/OVA measurements) and reference any forms or data records used. Document the results, if obtainable in the field.

- Describe in detail how the samples were collected or how the blanks/duplicates were prepared. List all label information, sample containers and volume, preservation, packaging, chain-of-custody form number and analytical parameters applicable to each

sample. Also, note the time of transfer, and if possible the name of the individual to whom custody was transferred.

- List the equipment type, serial or identification number, time and procedures used, calibration records or logs used, and equipment failures or breakdowns that occurred. Also, include the changes, repairs and results of the equipment failure or breakdown.

5.5 Corrections to Documentation

Notebooks — As with any data logbooks, no pages may be removed for any reason. If corrections are necessary, these must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction must be initialed and dated. Some corrected errors will require a footnote explaining the correction. Corrections to errors shall be made by the individual responsible for the entries in the field logbook.

Sampling Forms — As previously stated, all sample identification tags, chain-of-custody records, and other forms must be written in indelible black ink. None of these documents is to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on a document, the individual responsible for preparation of the document may make corrections by crossing a single line through the error and entering the corrected information. Any subsequent errors discovered on a document should be corrected by the person who made the entry. All corrections must be initialed and dated.

5.6 Corrective Action

During the course of any investigation, field personnel are responsible for seeing that field instruments and equipment are functioning properly and that work progresses satisfactorily. The field personnel are also responsible for ensuring that routine preventive maintenance and QC

procedures are performed. If a problem is detected by field personnel, the project manager shall be notified immediately. Similarly, if a problem is identified during a routine audit by the project QA officer or the regulatory QA officer, then an immediate investigation will be undertaken and corrective action deemed necessary will be taken as early as possible.

5.7 Out-of-control Situations

Potentially out-of-control situations include field instrument breakdown, mislabeling or loss of samples, inadvertent contamination of samples, or circumstances which preclude performance of field activities in accordance with the Remedial Design Workplan Quality Assurance Plan (QAP) (or other work plan documents). If an out-of-control event occurs, field sampling personnel shall make appropriate contacts and document any remedial efforts taken to bring field activities under control. The immediate contacts shall be the EnSafe project manager and/or the EnSafe QA officer. The EnSafe project manager shall decide whether further contacts are to be made to Carrier, EPA or the Tennessee Department of Environment and Conservation (TDEC). Formal documentation of out-of-control occurrences and any associated corrective actions recommended or initiated shall be written on the EnSafe Field Change Request Forms. Field personnel shall also record out-of-control occurrence in the field logbooks.

All variances or changes from project QAP are subject to approval by the EPA remedial project manager (RPM) and the TDEC representative. If circumstances arise that require significant changes in the protocols, methods, or techniques outlined in the work plan and/or the QAP, the EPA RPM and/or the TDEC project manager may be contacted. Any EPA or TDEC alterations will be documented and implemented with the agency's written consent.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

EnSafe personnel will calibrate all field instrumentation in accordance with manufacturer's recommendations. All equipment calibration and/or standardization procedures will be recorded in the field logbook and equipment logs. Calibration records will be maintained at the home office in Memphis, Tennessee.

Records shall include the source of the field standards with lot numbers and expiration dates, and a brief description of the procedures used. When necessary, procedures will be recorded step-by-step into the records. Field equipment calibration is summarized in Table 6-1.

Table 6-1
Field Equipment Calibration

Equipment/Measurement	Calibration Method	Frequency
Combustible Gas/PID	standard gas	daily/each use

7.0 PREVENTIVE MAINTENANCE

Sampling equipment requiring preventive maintenance will be checked for proper operation before and after use on a daily basis. Any replacements of parts or repairs will be in accordance to the manufacturer's operations manual or the parts will be sent to the manufacturer for repairs. Records of calibration and maintenance activities for each piece of equipment are contained in logbooks assigned to the equipment. The preventive maintenance program for all laboratory equipment will be handled solely by the laboratory's personnel in accordance with the laboratory's Quality Assurance Plan. Equipment or instruments potentially requiring preventive maintenance are listed in Table 7-1.

Table 7-1
Field Testing Equipment

Item	Manufacturer	Model #	Serial #
Photoionization Detectors	Photovac	TIP II	2580147
	HNu	PI 101	—

Note:

The actual make and model of each above instrument may be substituted by a similar model.

Preventive maintenance procedures for sampling equipment that is routinely serviced are described below.

Photoionization Detectors

Each use: The TIP II and HNu are zeroed and calibrated using TCE span gas for the TIP II and isobutylene (benzene mimic) for the HNu, at a minimum of before and after each sampling day. The battery's charge, the cleanliness of the ultraviolet (UV) lamp window, and the dust filter must be checked daily.

Quarterly: The instrument is inspected quarterly whether or not it has been used. The instrument bulb will be cleaned monthly or more frequently as needed. The inspection consists of a general examination of the probe, wires, electrical system (esp. battery check) and a calibration check. Any malfunctioning equipment is returned to the manufacturer for repair and recalibration.

Attachment A — Area A Confirmation Sampling Calculations

Sampling data obtained from RI drilling activities exhibited a wide variability in TCE contaminant levels. As a basis for determining sampling required to confirm subsequent sampling and analysis results (conducted during Remedial Design and Construction), a calculation following *EPA Publication No. SW-846, third edition, (Part II), Chapter 9 — Sampling Plan,* was performed. For the purposes of the calculations, a probability level (confidence interval) of 80% was selected. The result of this calculation is the appropriate number of samples to obtain a sufficiently precise estimate of the true mean concentration of TCE in the soil. In other words, this number is the minimum number of samples needed to demonstrate that the upper limit of the confidence interval around the sample estimator of mean is less than the applicable regulatory threshold (RT) of 533 μg/kg.

RI data in the area indicate that all contamination above 533 μg/kg ranges from 0 to 20 feet below ground surface, with the majority of the contamination in this interval located at 5 to 10 feet bgs and 15 to 20 feet bgs (Table A-1). Therefore, the study area was stratified into four intervals: 0 to 5 feet, 5 to 10 feet, 10 to 15 feet, and 15 to 20 feet bgs.

Table A-1
RI Soil Sample Results (TCE in ppb)

Boring I.D.	0-5 feet	5-10 feet	10-15 feet	15-20 feet
29	5,800[1] 4,000[2]	4,500	no sample	340
31	5,800[1] 4,000[2]	4,500	no sample	340
33	10[1] 10[2]	10	no sample	10
34	10[1] 10[2]	30	no sample	40
35	230[1] 100[2]	980	no sample	22,000
47	10	10	10	10
48	10	200	440	10
49	10	10	10	10

[1]sample taken from 0.5 to 2.0 feet
[2]sample taken from 3.0 to 5.0 feet

An example calculation is shown for the 0 to 5 feet interval:

The mean of all possible measurements of the variable:

$$\mu = \frac{\sum_{i=1}^{N} x_i}{N} = 1{,}538$$

Where: x_i = individual sample point concentration
N = the number of possible measurements

The variance of the sample:

$$s^2 = \frac{\sum_{i=1}^{N} x_i^2 - \frac{(\sum_{i=1}^{N} x_i)^2}{N}}{N - 1} = 5{,}714{,}531$$

The standard deviation of the sample:

$$s = \sqrt{s^2} = 2{,}391$$

The appropriate number of samples to collect:

$$n = \frac{t_{0.2}^2 \, s^2}{(RT - \mu)^2} = 11$$

Where: $t_{0.2}$ = student's "t" value for a two-tailed confidence interval and a probability of 0.20.
RT = regulatory threshold, 533 μg/kg

Results for all four intervals are shown below:

0 to 5 feet	11 samples
5 to 10 feet	10 samples
10 to 15 feet	1 sample
15 to 20 feet	14 samples

As discussed in the text, this level of sampling may be unnecessary, because the more recent sampling events indicate that contaminant levels have declined significantly. For this reason, the sampling plan calls for a phased approach (beginning with 3 borings at the site of the highest

contaminant results during the RI), which at maximum should not exceed the number of samples shown above.

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Appendix B Performance Standards Verification Quality Assurance/ Quality Control Plan

Production water from SVE operations and generated decontamination water will be treated at the NRS.

4.7 SVE System Performance Standards Verification

Performance Monitoring Rationale

Typically, discharge concentrations from a SVE system are highest during the initial stages of operation and decline exponentially after start-up of SVE operations. The decline is due to the removal of VOC-laden soil gas in the very early stages of SVE system operation, preferential removal of the higher vapor pressure compounds, and the steadily decreasing mass of VOCs in the soils contacted by the system air flow. As the SVE system operates, the discharge of VOC concentrations will approach an asymptotic level which is indicative of contaminant removal limited by mass transfer (diffusion from soil particles). The rate of decline in the discharge concentrations at individual SVE wells will be directly related to the mass of VOCs that are remaining within the effective zone of influence of that well.

Vapor samples will be collected for GC analysis upon startup of the system at each vertical SVE wellhead (wellhead samples), before carbon vessel no. 1, after carbon vessel no. 1, and after carbon vessel no. 2 (carbon performance sampling). Additional wellhead and carbon performance samples will be taken each week until stability has been reached (i.e., when plotted data begin to indicate a decline in concentration with continuing operation of the system), at this time, carbon performance sampling will be reduced to monthly and wellhead sampling will only be taken one week after each carbon changeout.

The time for carbon changeout of both carbon vessels will be projected based on carbon performance sampling results. When projections indicate that breakthrough will occur in approximately 3 weeks, an additional carbon performance sampling event will be performed and wellhead samples taken 1 week after carbon changeout.

Table 4-1
MPA SVE System Monitoring

Startup	*Weekly	Monthly	After Carbon Change
Carbon Performance/ Wellheads	Carbon Performance/ Wellheads	Carbon Performance	Wellheads

*Weekly sampling to stop after concentrations stabilize
Carbon Performance Samples: before/after carbon vessel #1, after carbon vessel #2

When vapor concentrations reach an asymptotic level, the system will be shut off and allowed to stabilize (approximately 2-weeks). The system will then be reactivated and individual well samples collected. If vapor concentrations rebound to relatively higher levels than existed before shutdown, the system will be operated in a pulsed-operation mode, and extraction resumed where concentration rebounded. The presumption is that diffusion from soil controls removal rate at this point in the extraction process and the increased operating cost of continuous operation has no benefit.

Once EPA and Carrier believe that attainment goals have been achieved, a total of 5 confirmatory borings will be installed at the remediation area. The location of the borings is indicated on Sheet M-1 of the detailed design sheets and are equidistant between vertical wells, along the plant foundation. These locations are in the area of highest TCE concentration prior to remediation. They are also located at zones of likely gas stagnation, which would result in a slower remediation time. Each boring will be drilled with hollow stem augers after coring through the concrete, and completed to the top of the more permeable material (sand).

Each confirmatory boring will be installed to collect soil samples for laboratory screening analysis of VOCs by the co-distillation method used and approved during the RI (Woodsen-Tenent Method).

The Performance Standards Verification Field Sampling and Analysis Plan and the Performance Standards Verification Quality Assurance/Quality Control Plan describe sampling activities and protocol to be followed for sampling the SVE system. These plans are located in Appendices A and B.

Process Operation Monitoring

SVE performance will be monitored to insure efficient operation. Each SVE wellhead will contain the appropriate connections for the installation of flow device and vacuum measurement instruments. The SVE system will be balanced based on flow upon start-up, and checked once soil moisture removal rates have stabilized.

To insure that operation of the deep SVE well does not stress shallow soils, upon startup of the system the deep SVE well will be operated and the shallow monitoring probes be measured for vacuum stress. If the deep SVE well is inducing a vertical pressure gradient, the shallow monitoring probes will be influenced.

If pressure gradients are observed, the operation of the deep SVE well will include opening the deep monitoring probes to atmosphere, and allowing an air recharge source. If gradients persist, deep well extraction will be discontinued.

As stated in the Statement of Work (SOW) for Remedial Design/Remedial Actions at Carrier Collierville, an Operation and Maintenance Plan will be submitted once equipment procurement is complete. This plan will detail operational approach.

North Remediation Site (NRS) Monitoring

Monitoring data from the NRS SVE system is shown in Table 4-2. As seen from this table, a "rebound" effect occurred after shut-down of the system for 47 days, indicating that diffusion is controlling the removal rate of TCE. The majority of the contamination exists in the shallow

wells, therefore, the deep well manifold will be shut off to concentrate extraction on shallow soils. The deep SVE well manifold will be periodically operated to degas the deep zone. Also, the shallow SVE wells will be periodically shut-down and reactivated to allow diffusion into the air flowpath, as described in operation of the MPA SVE system.

Table 4-2
NRS SVE Monitoring Data

Sample Date	Time	Deep SVE Well Conc. (μg/kg-vapor)	Shallow SVE Well Conc. (μg/kg-vapor)	Deep + Shallow Well Conc. (μg/kg-vapor)
02-Dec-93	Sample taken before shut-down	128	0.6	1.3
24-Jan-94	Sample taken at reactivation	48	1,673	340
31-Mar-94	Sample taken 65 days after reactivation	10	595	97
27-Jun-94	Sample taken 153 days after reactivation	8.8	1,020	165

3. Locate the sample port where the sample is to be withdrawn and carefully insert the needle on the syringe into the septum.

   Soil-vapor samples will be drawn from the SVE system using a 50-ml Gastight syringe and injected into a 50-ml evacuated glass gas-tight container containing a polyethylene septum.
4. Withdraw and discard approximately 100 ml of soil-gas to flush the syringe.
5. The next 50 ml of soil-gas are withdrawn and transferred to a 50-ml evacuated gas-tight container.
6. Place the container in a pre-labeled plastic bag.

The soil-vapor samples will be submitted for laboratory analysis according to modified EPA Method 8010 using an ECD equipped GC to analyze for VOCs.

5.2 Soil Sampling and Analysis

The cleanup standard for the TCE-contaminated soil is 533 μg/kg or until in EPAs determination, it is demonstrated that contaminant levels have ceased to decline over time, and are remaining constant at some statistically significant level, as verified by soil sampling. The following describes sampling and analysis of soil for verification of cleanup levels.

A new pair of nitrile disposable gloves will be donned prior to collecting each soil sample. Using 2-inch outer diameter, 24-inch long, stainless-steel split spoons, soil samples will be collected ahead of the augers at 10 foot intervals beginning at 5 feet bgs. Split spoons may be hydraulically pushed or hammered at the site geologist's discretion. Contents of all auger spoils will be containerized in 55-gallon drums for subsequent onsite treatment.

Soil will be transferred to 125-ml precleaned glass jars with Teflon lids for submittal to Woodson-Tenent Laboratories for VOC analysis by the co-distillation method approved for this

site by the USEPA during the RI. Additional sample volumes will be collected for analysis by EPA Methods 8240 for volatiles in soil.

All soil samples will be stored in a cooler containing ice and water placed in sealable plastic bags, or blue ice, to provide temperature preservation at 4 °C. All samples to be shipped for analysis will be delivered to the laboratory within 24 hours of collection.

A total of 5 confirmatory borings will be installed at the remediation area to verify that remediation has been achieved. The location of the borings is shown on Sheet M-1 of the detailed design sheets.

The location of other confirmatory borings (for Areas A and C) will be as described in Section 2.2 of the *Field Sampling Activities Plan.*

5.3 Equipment Decontamination

The drill rig will be steam cleaned and wire brushed before being brought onsite. The drill rig will then be inspected to ensure there is no leakage of oil, grease, hydraulic fluid, etc. Drilling equipment will be decontaminated between drilling of each boring using the decontamination procedures listed below.

1. Decontamination of equipment will be performed on the onsite decontamination pad.
2. Steam-clean with a pressure washer using tap water and laboratory detergent to remove particulate matter and surface films.
3. Pressure rinse with tap water.
4. Rinse thoroughly with deionized water.
5. Rinse twice with pesticide-grade isopropanol.
6. Rinse thoroughly with organic-free water and allow to air dry.
7. Wrap with aluminum foil or polysheeting to prevent contamination.

Table 6-1 Sample Designation System (Soil)			
Location	**Sample Type**	**QA Sample Type**	**Sample Location and Depth**
CC = Carrier, Collierville Site	S = Soil	RB = Rinsate Blank FB = Field Blank DP = Duplicate MS = Matrix Spike	B = Boring SVW = SVE Well
(SVE System)			
Line Location(s)	**Process Location**	**QA Sample Type**	**Other**
1b, 2a..2f = Well Location D = Deep Manifold S = Shallow Manifold H1 = Horizontal 1 H2 = Horizontal 2 T = All Lines	BC = Before all carbon AC1 = After carbon #1 AC = After all carbon	FB = Field Blank MS = Matrix Spike	Samples taken from the same point more than once per day, will have the time following the sample i.d.

6.2 Custody Seals

Custody seals (also called security seals), as illustrated in Figure 6-2, will be used to ensure that samples are not tampered with during transportation. Custody seals are placed on the shipping containers and the sample containers in a manner such that the containers cannot be opened without breaking the seal.

6.3 Chain-of-Custody

Chain-of-custody records, as shown in Figure 6-3, will be fully completed by field personnel and shall accompany the samples during shipment. The chain-of-custody shall contain pertinent information regarding the samples, such as the samplers name, sample identification, date and time of collection, and description of the cooler's contents (number of sample containers). In addition, information to be relayed to the laboratory shall be written in the Remarks section of the chain-of-custody form (Figure 6-3). For chain-of-custody purposes, all QC samples are subject to exactly the same custodial procedures and documentation as real samples.

APPENDIX B

PERFORMANCE STANDARDS VERIFICATION QUALITY ASSURANCE PROJECT PLAN

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents specific policies, project organization and objectives, functional activities, and quality assurance (QA) and quality control (QC) measures intended to achieve data quality goals for Soil Vapor Extraction (SVE) at the Main Plant Area (MPA) at the Carrier site in Collierville, Tennessee. The QAPP is intended to satisfy the requirements of the United States Environmental Protection Agency (USEPA) for assuring and documenting the quality of environmental monitoring and measurement data. The goals described within this document have been established to meet project-specific data quality objectives (DQOs).

The objectives of SVE at the MPA are:

- To prevent the migration of contaminants from soils that cause the Memphis Sand aquifer groundwater to exceed Maximum Contaminant Levels (MCLs); and
- Prevent further contamination of the Memphis Sand aquifer.

2.0 PROJECT BACKGROUND AND DESCRIPTION

This project is being carried out under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986. The design is based upon the findings of the Remedial Investigation and decisions regarding remedial actions that where presented by the USEPA in a Record of Decision, and results of the SVE pilot study performed at the MPA.

A history and description of the site can found in Section 2 of the Remedial Design (RD) work plan.

3.0 PROJECT ORGANIZATION AND REPORTING

The Declaration for the Record of Decision presents Carrier Air Conditioning (Carrier), in Collierville, Tennessee, as the respondent for remedial action to the site. Carrier has designated Nelson Wong, P.E. as the Carrier coordinator pursuant to the ROD and has delegated EnSafe as the prime contractor with regard to the site.

3.1 Oversight

Project oversight will be the responsibility of the USEPA in Region IV. The USEPA remedial project manager for this project is Beth Brown. Sharon Everett will be the Tennessee Department of Environment & Conservation (TDEC) state project manager for the site.

3.2 Investigation Performance

EnSafe will serve as the prime engineering subcontractor for the Carrier Air Conditioning Site Remedial Design/Remedial Action (RD/RA). As the engineering subcontractor, EnSafe is responsible for designing, implementing, and coordinating all project RD activities. The organizational structure for the design phase of this project is presented in Figure 3-1.

The Project Manager for this project is Philip G. Coop, CHMM. As the Project Manager, Mr. Coop will be responsible for the project's technical, financial, and scheduling aspects.

The Site Manager for this project is Craig A. Wise. The Site Manager (or designated representative) will be responsible for all field operations and will remain onsite during the field activities. The Site Manager is also responsible for the production of projects work plans and reports. While onsite, the Site Manager will serve as the point of contact for all site activities and will report directly to the Project Manager.

The project Quality Assurance Officer (QAO) for this project is Andrew C. Kim. The QAO is responsible for ensuring that the procedures outlined in the QAPP are employed. The QAO

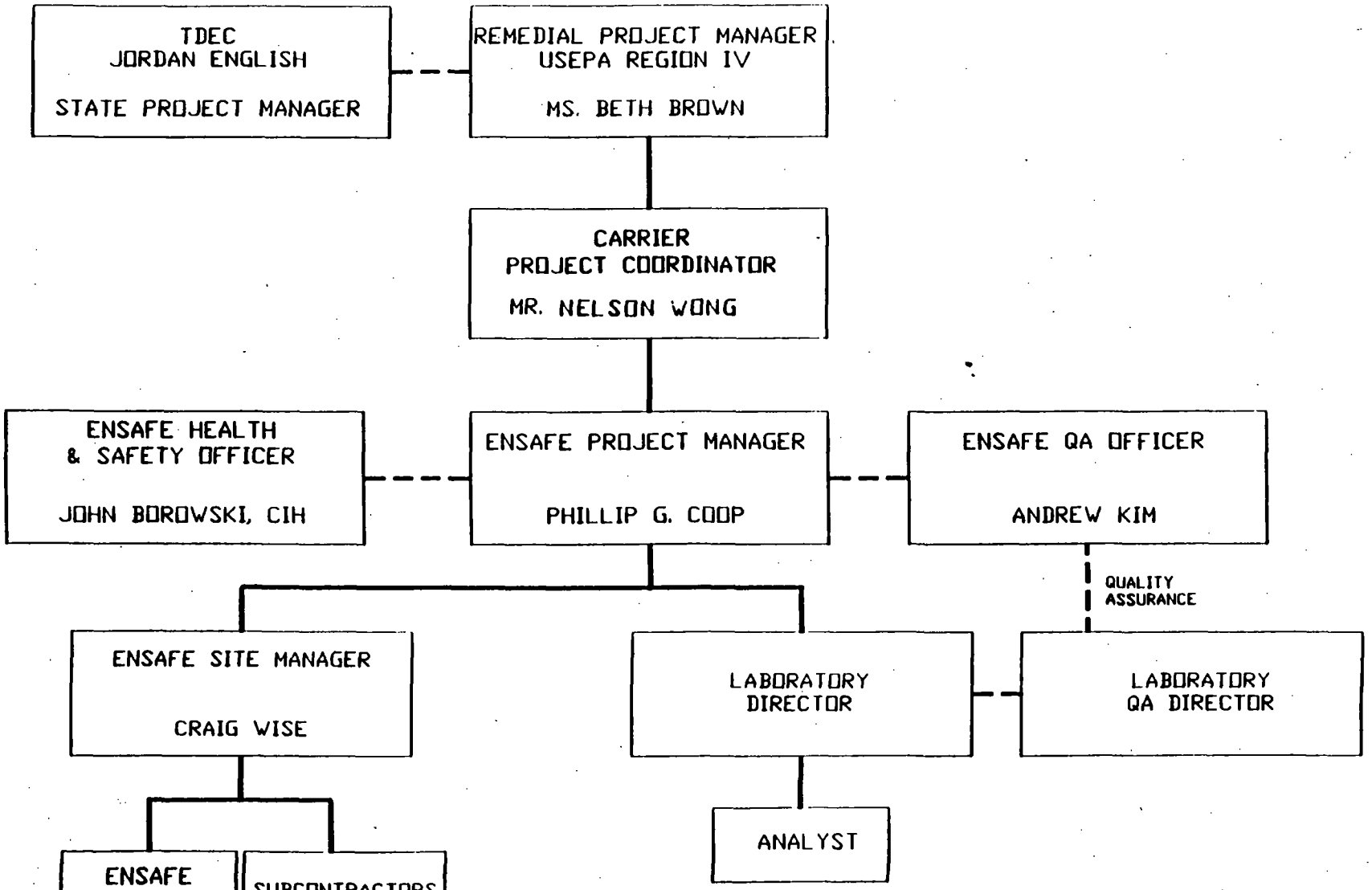

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FIGURE 3.1
PROJECT ORGANIZATION
COLLIERVILLE SITE
REMEDIAL DESIGN WORK PLAN

DWG DATE: 05/03/93 | DWG NAME: CARLORG

operates independently of the Site Manager in the review of procedures and documentation. The QAO will also have the authority to recommend, implement, and halt project activities as deemed necessary. In most cases when non-conformances are identified, the QAO will evaluate the problem, generate a solution, document all pertinent information, and report the non-conformance to the Site Manager and/or the Project Manager.

The Health and Safety Officer (HSO) for this project is John H. Borowski. In general, the HSO is responsible for the development and implementation of the project Health and Safety Plan (HASP). The HSO customarily works with the other appropriate state/local/federal agencies in implementing the requirements of the HASP.

3.3 Deliverables

Project deliverables are detailed in Section 3.3 of the RD work plan.

4.0 PROJECT QUALITY ASSURANCE OBJECTIVES

In general, QA objectives of this project are to assess and document the precision, accuracy, representiveness, completeness, and comparability of all sampling and analysis performed. QC is established herein to assure suitability of the data for the intended use and to meet the established goals for the project in compliance with the USEPA. The following discusses project-specific levels of effort of QA/QC and DQOs.

4.1 Project Data Quality Objectives

DQOs for the design phase have been developed based upon the proposed data end uses. Table 4-1 summarizes the DQOs.

Table 4-1
Summary of Data Quality Objective, Design Phase

Sample Type	Sampled Medium	Data End Use
Soil	TCE Leak and Spill Area	To assess the status of TCE content in the area soils for use in design.
Soil Gas	TCE Leak and Spill Area	To assess the contaminant loading rates during remediation and assess performance.

4.2 Field Measurements

QA objectives for field measurement parameters are presented in Table 4-2.

Table 4-2
QA Objectives of Field Measurements

Parameter	Reference	Matrix	Precision	Accuracy	Completeness
Photoionization Detector/HNu	Manufacturer SOPs[a]	Air	± 10 ppm	± 20 ppm	90%

Notes:

[a]Manufacturer SOPs will be used for operations, calibrations, and analysis.
ppm = parts per million
SOP = Standard Operating Procedures

4.3 Sampling and Analysis for Contamination Levels

The QA objectives for the analytical parameters to be used in this project will be categorized by the analytical method in use. The first, a screening level method, will be performed on the soil samples collected from the confirmation soil borings. Primarily, these soil samples will be collected to assess the level of TCE concentrations encountered and will be used to confirm cleanup levels have been achieved. The analytical method will be one devised by Woodson-Tenent Laboratories, Memphis, Tennessee. A copy of the method is presented in Attachment A to this plan.

Other analyses utilized will include USEPA Method 8240 for the analysis of volatiles in soils.

5.0 SAMPLING ACTIVITIES

The general sampling procedures that EnSafe will follow are described in the Field Sampling Activities Plan (FSAP) for this project. Sample media and methods of collection are summarized in the following subsections. The USEPA Region IV-Environmental Compliance Branch, *Standard Operating Procedures and Quality Assurance Manual*, February 1991 (USEPA SOP QAM) was used as the procedural basis for the sampling methods employed. Where appropriate, excerpts from the USEPA SOP QAM for specific field measurement techniques have been provided in Attachment B to this plan.

5.1 Soil Vapor Sampling and Analysis

The vadose zone soils in the remediation area are known to contain TCE which, at its current concentration, is contributing unacceptable levels of on-going contamination to the Memphis Sand aquifer.

A SVE pilot study was performed in the TCE spill and leak areas during remedial design. The pilot study included a series of SVE parameter evaluation tests (PETs) and point permeability tests (PPTs). To perform these tests, a network of SVE wells and monitoring probes were installed. During installation of the wells and probes and throughout the SVE pilot study, soil samples were collected and screened for TCE concentrations. Additional SVE wells were installed based on results of the SVE pilot study to yield the full-scale SVE system for remediation of contaminated soils.

Monitoring of the SVE system will consist of periodic sampling to determine the effectiveness of the system and the amount of contamination removed from the soils. The following procedure will be followed for soil-vapor sampling:

1. Don a new pair of disposable latex gloves.
2. Label the sample container following labelling procedures found in this report.

3. Locate the sample port where the sample is to be withdrawn and carefully insert the needle on the syringe into the septum.

   Soil-vapor samples will be drawn from the SVE system using a 50-ml Gastight syringe and injected into a 50-ml evacuated glass gas-tight container containing a polyethylene septum.
4. Withdraw and discard approximately 100 ml of soil-gas to flush the syringe.
5. The next 50 ml of soil-gas are withdrawn and transferred to a 50-ml evacuated gas-tight container.
6. Place the container in a pre-labeled plastic bag.

The soil-vapor samples will be submitted for laboratory analysis according to modified EPA Method 601/602 using an ECD equipped GC to analyze for VOCs.

5.2 Soil Sampling and Analysis

The cleanup standard for the TCE-contaminated soil is 533 μg/kg or until in EPAs determination, it is demonstrated that contaminant levels have ceased to decline over time, and are remaining constant at some statistically significant level, as verified by soil sampling. The following describes sampling and analysis of soil for verification of cleanup levels.

A new pair of nitrile disposable gloves will be donned prior to collecting each soil sample. Using 2-inch outer diameter, 24-inch long, stainless-steel split spoons, soil samples will be collected ahead of the augers at 10 foot intervals beginning at 5 feet bgs. Split spoons may be hydraulically pushed or hammered at the site geologist's discretion. Contents of all auger spoils will be containerized in 55-gallon drums for subsequent onsite treatment.

Soil will be transferred to 125-ml precleaned glass jars with Teflon lids for submittal to Woodson-Tenent Laboratories for VOC analysis by the co-distillation method approved for this

site by the USEPA during the RI. Additional sample volumes will be collected for analysis by EPA Methods 8240 for volatiles in soil.

All soil samples will be stored in a cooler containing ice and water placed in sealable plastic bags, or blue ice, to provide temperature preservation at 4 °C. All samples to be shipped for analysis will be delivered to the laboratory within 24 hours of collection.

A total of 5 confirmatory borings will be installed at the remediation area to verify that remediation has been achieved. The location of the borings is shown on Sheet M-1 of the detailed design sheets.

One boring will be installed at Area A to confirm that soils do not exceed 533 μg/kg. Location of the boring will be determined by the field geologist, and will be located south of A-SB1.

5.3 Equipment Decontamination

The drill rig will be steam cleaned and wire brushed before being brought onsite. The drill rig will then be inspected to ensure there is no leakage of oil, grease, hydraulic fluid, etc. Drilling equipment will be decontaminated between drilling of each boring using the decontamination procedures listed below.

1. Decontamination of equipment will be performed on the onsite decontamination pad.
2. Steam-clean with a pressure washer using tap water and laboratory detergent to remove particulate matter and surface films.
3. Pressure rinse with tap water.
4. Rinse thoroughly with deionized water.
5. Rinse twice with pesticide-grade isopropanol.
6. Rinse thoroughly with organic-free water and allow to air dry.
7. Wrap with aluminum foil or polysheeting to prevent contamination.

All non-dedicated stainless-steel sampling equipment and the split-spoon samplers will be decontaminated between samples using procedures listed below.

1. Equipment will be washed thoroughly with laboratory detergent (i.e. Liquinox) and followed by a hot water rinse using a brush to remove any particulate matter or surface film.
2. Equipment will be rinsed with potable water to remove any remaining detergent.
3. Following the potable water rinse, the equipment will be rinsed with deionized water.
4. Rinse twice with pesticide-grade isopropanol.
5. Rinse with organic-free water and air dry.
6. Sampling equipment will be wrapped in aluminum foil until ready for use. Non-sampling equipment may be wrapped in plastic to avoid contamination.

Field personnel will don a new pair of disposable gloves before handling sampling equipment for decontamination and between contact with each piece of sampling equipment. Gloves will also be donned before use of any equipment for sampling. Disposable gloves, as well as other disposable personnel protective equipment, will be properly disposed of in a manner to prevent contamination of samples and equipment.

5.4 Sample Preservation, Handling, and Shipping

Soil-vapor samples to be shipped for analysis will be wrapped in bubble wrap to prevent breakage. The shipping container shall be packed so as to prevent movement of the sample containers.

Soil samples to be shipped for analysis will be containerized in glass containers with Teflon-lined septum lids. Each container will be sealed immediately to prevent loss of any volatile compounds. A note regarding any insufficiently obtained sample volumes should be recorded in

the project field logbook. Any observations on the soil geology and sampling conditions will also be recorded in the field logbook.

5.5 Quality Control Samples

The project data precision will be assessed by evaluating the results of the duplicate and matrix spike duplicate samples. Accuracy will be assessed by evaluating the analyses of the field blanks, trip blanks, laboratory matrix and surrogate spikes, and laboratory reagent blanks and blank spike samples. This project will utilize the blank frequencies outlined in Table 5-1.

Table 5-1
Quality Control Sample Collection Frequencies

Quality Control Sample	Frequency of Collection	Additional Sample Volumes Required
Field Blank	One per sampling event or every ten samples.	1 50-ml. evacuated glass cylinder-for soil gas 1 125 ml-for soil
Duplicates	One per ten samples.	1 50-ml. evacuated glass cylinder (performed by lab) 1 125 ml-for soil
Matrix Spike	One per 20 samples per matrix; duplicate sample may be used for matrix spike.	1 50-ml. evacuated glass cylinder-for soil gas 1 125 ml-for soil

5.6 Analytical Parameters and Approach

One of the analytical laboratories for this project will be Woodson-Tenent Laboratories in Memphis, Tennessee. Woodson-Tenent will be primarily responsible for the screening analysis of soils for TCE concentrations. Other analytical parameters will be submitted to a separate

qualified analytical laboratory upon selection. The analytical methods and the approach to be applied to the project media are outlined as follows:

1. As already mentioned, the TCE screening will be performed by Woodson-Tenent Laboratories. The actual number of samples will be determined in the field by the number of confirmation borings installed. One sample is to be collected at each 10-foot interval. Each boring is estimated to produce five to six soil samples for TCE screening, based on the known depth to the water table. The analytical method is unique and is presented in Attachment A. The method has already been reviewed and approved for use by the USEPA during previous activities at the Carrier site. Additional sample volumes will be submitted for analysis by EPA Method 8240.

2. A minimum of 2 soil samples will be tested for humic and fulvic acid contents. Since the two acids are not commonly noted to be environmental contaminants, the chosen method is from the *American Society of Agronomy*, Method of Soils Analysis, Part 2. This analytical work will be subcontracted to a qualified laboratory familiar with the ASA.

5.6.1 Analytical Laboratories

The selected analytical laboratory will be employed by EnSafe and will adhere to all applicable USEPA QA and method requirements. The laboratories will be required to prepare and submit a laboratory QAP, to analyze and submit the results of proficiency evaluation samples, to submit to an onsite inspection (by all project involved agencies including EnSafe), and to correct any deficiencies cited during the inspection. The laboratories are required to designate a laboratory QA coordinator (LQAC) responsible for overall QA/QC. The LQACs must not be responsible for items such as schedule, costs, or personnel other than laboratory QA staff. It is preferred that the LQACs report to the laboratory director. It is important that the LQACs have the

authority to cease work on projects if QC problems arise that may affect the quality of the data produced.

In addition to conforming to all USEPA QA and method requirements, work shall be performed in a manner consistent with the following environmental guidelines and regulations.

Guidelines and Regulations

- The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended,

- The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 of the Code of Federal Regulations (CFR), Part 300, as amended, and

- All other state and local guidelines, rules and regulations applicable for analytical laboratories.

5.6.2 Procurement of Other Subcontractors

The employment and responsibility for other subcontractors (other than the analytical laboratory) will be accomplished through a services agreement. The contract will specify the scope of services to be performed by the subcontractor, the specific level of QA requirements to be expected, and the information to be developed and reported, as necessary. The maintenance of the subcontractor's compliance with the appropriate project requirements and elements specified in the scope of services will be regulated by the EnSafe project manager (or designated representative).

6.0 SAMPLE CUSTODY

Sample management will consist of chain-of-custody records, sample labels and custody seals. The purpose of these procedures will be to ensure that the quality of the samples is maintained during their collection, transportation, and storage and through analysis to the final data deliverables. All sample management documentation and sample handling protocols have been developed using the USEPA Region IV-Environmental Compliance Branch *Standard Operating Procedures and Quality Assurance Manual, (February 1, 1991).*

Sample Identification Documents:

- Sample label
- Custody seals
- Chain-of-custody records
- Field notebooks

6.1 Sample Labels

Sample container labels, as shown in Figure 6-1, will be required for identifying each submitted sample. The sample labels are affixed on each sample container for identification. Sample label information will include the site name, sample identification, preservation, required analysis, date of collection with time and the sampler's name. Each label must be printed in a legible manner using waterproof black ink.

Table 6-1 outlines the sample designation system to be used to identify each sample. Should additional sample designations be required, this table will be amended. Further details on the sample collection setting will be provided on the chain-of-custody record including date and time of collection.

EnSafe®

Environmental and Safety Designs, Inc.

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE
SAMPLE IDENTIFICATION	
PROJECT NUMBER	
SAMPLERS NAME	

Environmental and Safety Designs, Inc.

EnSafe®

5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962

FIGURE 6-1
SAMPLE BOTTLE LABEL

DATE: 04/22/93

DWG NAME: SAMPLAB

Table 6-1
Sample Designation System

Location	Sample Type	QA Sample Type	Sample Location and Depth
CC = Carrier, Collierville Site	S = Soil BHG = Borehole Gas Samples IN = Influent EF = Effluent OG = SVE Off Gas SG = Soil Gas	RB = Rinsate Blank FB = Field Blank DP = Duplicate MS = Matrix Spike MSD = Matrix Spike Duplicate	B = Boring MW = Monitoring Well HA = Hand Auger Boring MP = SVE Monitoring Probe SVW = SVE Well SVE = SVE System GWT = Groundwater Treatment System Sampling depth or location is based upon a numeric system (ex. sampling interval depth, sampling point along a treatment train)

Examples:
Solid Matrix — CCSB1 = Carrier Collierville soils from boring 1
Air Matrix — CCOGSVE1 = Carrier Collierville off gas from SVE system at location 1

6.2 Custody Seals

Custody seals (also called security seals), as illustrated in Figure 6-2, will be used to ensure that samples are not tampered with during transportation. Custody seals are placed on the shipping containers and the sample containers in a manner such that the containers cannot be opened without breaking the seal.

6.3 Chain-of-Custody

Chain-of-custody records, as shown in Figure 6-3, will be fully completed by field personnel and shall accompany the samples during shipment. The chain-of-custody shall contain pertinent information regarding the samples, such as the samplers name, sample identification, date and time of collection, and description of the cooler's contents (number of sample containers). In addition, information to be relayed to the laboratory shall be written in the Remarks section of the chain-of-custody form (Figure 6-3). For chain-of-custody purposes, all QC samples are subject to exactly the same custodial procedures and documentation as real samples.

EN SAFE® ENVIRONMENTAL AND SAFETY DESIGNS, INC. 5724 Summer Trees Dr. Memphis, Tennessee 38134 OFFICIAL SAMPLE SEAL	SAMPLE #	DATE:	SEAL BROKEN BY:
	SIGNATURE:		DATE:
	PRINT NAME & TITLE:		

Environmental and Safety Designs, Inc. EN SAFE® 5724 SUMMER TREES DR. MEMPHIS TN. 38134 ☎(901)372-7962	FIGURE 6-2 SAMPLE SEAL
	DWG DATE: 04/22/93 DWG NAME: SECSEAL

FIGURE 6-3
CHAIN OF CUSTODY RECORD

EN SAFE®

5724 SUMMER TREES DR. MEMPHIS, TN 38134 ☎(901)372-7962

PAGE _____ OF _____

CLIENT _____ PROJECT MANAGER _____

ADDRESS _____ TELEPHONE NO. _____

PROJECT NAME/NUMBER _____ FAX. NO. _____

MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) _____

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED								REMARKS
					TEMP.	CHEMICAL										

RELINQUISHED BY:	DATE	RECEIVED BY	DATE	RELINQUISHED BY:	DATE	RECEIVED BY	DATE
SIGNATURE _____		SIGNATURE _____		SIGNATURE _____		SIGNATURE _____	
PRINTED _____	TIME	PRINTED _____	TIME	PRINTED _____	TIME	PRINTED _____	TIME
COMPANY _____		COMPANY _____		COMPANY _____		COMPANY _____	
REASON _____		REASON _____		REASON _____		REASON _____	

METHOD OF SHIPMENT: _____
SHIPMENT NO. _____
SPECIAL INSTRUCTION: _____

COMMENTS: _____

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☐ DISPOSED OF (ADDITIONAL FEE)
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS (ADDITIONAL FEE)
- ☐ RETURNED TO CUSTOMER

Upon transfer of custody, the chain-of-custody form will be signed by an EnSafe representative, who will note the date and time. Because common couriers will not sign chain-of-custody forms, the chain-of-custody records will be sealed within each cooler. A signed, dated security seal will be placed over the lid opening to indicate if the cooler has been tampered with during shipment to the laboratory. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory sample custodian and returned to EnSafe following receipt, or as part of, the data reporting package.

6.4 Field Logs

All samples will be documented in accordance with the USEPA SOP/QAM, Chapter 3 — Sample Control, Field Records and Document Control. Sampling personnel will use bound, ruled or gridded logbooks with sequentially numbered waterproof pages for activity documentation pertaining to the project. These logbooks will be the master document for all site activities and accomplishments. These records will also document all visual observations, calculations and equipment calibrations. The logbooks are accountable documents that will be properly maintained and retained as part of the project files.

Each logbook will be labeled on the front cover as follows:

Carrier Site RD
Collierville, TN
EnSafe
the sampler's name
book number (books are to be sequentially numbered by distribution or as assigned by the QAO)
the starting date and the date when completed.

The logbook must be labeled with indelible black ink. The following steps shall be followed when making entries into the field logbook:

- Enter the date and time of the task's starting time, weather conditions, and the names and titles of individuals involved in the task. When possible, include the names and titles of personnel visiting the task area.

- Describe all activities in detail and include which forms, if used, were used to record such information (e.g., boring logs, field change request forms). It is considered good practice to duplicate the most important information throughout the field logbooks. Examples of some pertinent information for specific activities are:

  — **Soil-vapor sampling:** Document sample location, vacuum levels, and flowrate.
  — **Soil boring activities:** Document the size and depth of the borehole, sampling equipment used and methods used, details on the soil lithology and the samples collected.
  — **Levels of personnel protection for the sampling team:** If the levels of protection are changed for any reason, state the change in protection and the reasons for the change.

- Detail any field tests that were conducted (e.g., PID/OVA measurements) and reference any forms that were used or other data records. Document the results, if obtainable in the field.

- Detail how the samples were collected or how the blanks/duplicates were prepared. List all label information, sample containers and volume, preservation, packaging, chain-of-custody form number and analytical parameters applicable to each sample. Also, note the time of transfer, and if possible the name of the individual to whom custody was transferred.

- List the time, equipment type and serial or identification number, and the procedures used for equipment used onsite. List the calibration records and when possible, the calibration logs used.

- List all equipment failures or breakdowns that occurred. Also, include the changes, repairs and results of the equipment failure or breakdown.

6.5 Corrections to Documentation

Notebooks — As with any data logbooks, no pages may be removed for any reason. If corrections are necessary, these must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction must be initialed and dated. Some corrected errors will require a footnote explaining the correction. Corrections to errors shall be made by the individual responsible for the entries in the field logbook.

Sampling Forms — As previously stated, all sample identification tags, chain-of-custody records, and other forms must be written in indelible black ink. None of these documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on a document, the individual responsible for preparation of the document may make corrections by crossing a line through the error and entering the corrected information. The incorrect information should not be obliterated. Any subsequent errors discovered on a document should be corrected by the person who made the entry. All corrections must be initialed and dated.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

EnSafe personnel will calibrate all field instrumentation in accordance to the manufacturer's recommendations. Field instruments listed in Table 7-1 are expected to be used at some point in the sampling program. All equipment calibration and/or standardization procedures will be recorded in the field logbook and in the equipment logs, maintained at the home office in Memphis, Tennessee. Records shall include the source of the field standards with lot numbers and expiration dates, and a brief description of the procedures used. When necessary, the procedures will be recorded step-by-step into the records.

Table 7-1
Field Equipment Calibration

Equipment/Measurement	Calibration Method	Frequency
Combustible Gas/Photoionization Detector	standard gas	daily/each use

8.0 PREVENTIVE MAINTENANCE

Sampling equipment employed by EnSafe which may require preventive maintenance will be checked for proper operation before and after use on a daily basis. Any replacements of parts or repairs will be conducted in accordance to the manufacturer's operations manual or will be sent to the manufacturer for repairs. Equipment or instruments potentially requiring preventive maintenance are listed in Table 8-1. Preventative maintenance procedures for sampling equipment which are routinely serviced are described below. Records of calibration and maintenance activities for each piece of equipment are contained in logbooks assigned to the equipment. The preventive maintenance program for all laboratory equipment will be handled solely by the laboratory's personnel in accordance with the laboratory's Quality Assurance Plan.

Table 8-1
Field Testing Equipment

Item	Manufacturer	Model Number	Serial Number
Photoionization Detectors	Photovac	TIP II	2580147
	HNu	PI 101	–

Note: The actual make and model of each above instrument may be substituted by a similar model.

Preventive Maintenance for Field Equipment

Photoionization Detectors

Each use: The TIP II and HNu are zeroed and calibrated using TCE span gas for the TIP II and isobutylene (benzene mimic) for the HNu, at least before and after each sampling day. Also, to be checked after each use will be the battery for a proper charge, cleanliness of the UV lamp window and the dust filters.

Quarterly: The instrument is inspected on a quarterly basis whether or not it has been used. The instrument bulb will be cleaned monthly or more frequently as needed. The inspection consists of a general examination of the probe, wires, electrical system (esp. battery check) and a calibration check. Any malfunctioning equipment is returned to the manufacturer for repair and recalibration.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 Data Management

EnSafe is currently using a database management system for the acceptance of analytical data from the laboratories into an ASCII format on a 3½-inch or 5¼-inch diskette.. The database has several functions. It will store the data and allow for quick and easy retrieval of specific data, e.g., knowing a specific sample number, one may easily access the analytical data corresponding to that sample number. In addition, the database can be printed, in tabular format, for easy placement into a report. Safeguards within the system prevent accidental alterations of data. In the future, EnSafe expects the system to allow for statistical analysis of data.

9.2 Data Validation

The field data package will include all field records and measurements obtained during the activity by EnSafe sampling personnel. The package will include information such as the field log books, chain-of-custody records, well/boring logs, field equipment calibration and maintenance records, and any field analytical results.

The field data package will be compiled for validation by the EnSafe's project QAO. The field data package consists of the field blanks, rinsate blanks, and trip blanks, check on field analyses for equipment calibration and condition, chain-of-custody forms for proper completion with signatures of field personnel and the laboratory sample custodian, and dates. The field data package will be reviewed by the project QAO for completeness and accuracy using the appropriate methods and the data validation guidelines provided by the SW-846 and USEPA Region IV as guidance.

The analytical data package validation will be performed by the EnSafe project QAO, but not before completion of field data validation and prior to any submittal to the USEPA. The validation procedures will be performed in accordance with the following USEPA documents:

- Contract Laboratory Program, *National Functional Guidelines for Organic and Inorganic Data Review*. Multi-Media, Multi-Concentration (OLM01.0) and Low Concentration Water (OLC01.0), Revised June 1991.

- Office of Emergency Remedial Response, *Quality Assurance/Quality Control Guidance for Removal Activities — Sampling QA/QC Plan and Data Validation Procedures, USEPA/540/G-90/004*, April 1990.

Also to be taken into consideration are the USEPA precision and accuracy statements for the analytical methods employed. The project's data validation reports and QA summaries will be reported utilizing the forms presented in Attachment E. The analytical data package validation will include as a summary, but is not limited to, the procedures outlined below.

Data Validation Procedures:

- Comparison of sampling dates, sample extraction dates and analysis dates to check that samples were extracted and/or analyzed within the proper holding times. Failure in this area may render the data unusable.

- Review of analytical methods and required detection limits to verify that they agree with the QAP and the laboratory contract. Non-compliance in this area without reasonable justification (i.e., severe matrix interferences) may render the data unusable.

- Review of field and laboratory blanks to evaluate possible contamination sources. The preparation techniques and frequencies, and the analytical results, if appropriate, will be considered. All internal laboratory QC sample results will also be reviewed.

- Evaluation of all blanks, i.e., rinsate blanks, field blanks, trip blanks, reagent blanks, method reagent blanks and extraction blanks. These blanks should be relatively free from

contamination of the target compounds, except for common laboratory artifacts. All blank contaminants must be explained or the data applicable to those blanks labeled suspect and sufficient only for qualitative purposes.

The use of the laboratory will be accomplished by a services agreement or contract. The contract will specify the scope of services to be performed by the laboratory, the specific analytical quality assurance requirements to be met, and the information to be developed and reported.

10.0 INTERNAL QUALITY CONTROL CHECKS

Internal laboratory control checks used by the laboratory will be conducted in the laboratory by its staff. The EnSafe QA officer will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will consist of preparation and submittal of sampler rinsate blanks, trip blanks, field blanks, and field duplicates for analysis and an evaluation of the laboratory analytical package. Data validation guidelines will be followed in evaluating all reported data. Analyses for which these guidelines may not directly apply (e.g., wet chemistry methods) will be reviewed by employing applicable guidelines, compliance with the analytical method and, as with any data validation, best professional judgment. The usability of data to the project will be determined by evaluating the data packages with respect to these criteria.

Analytical data quality will be assured through the use of the USEPA guidelines for QA/QC. Where screening analyses will be performed, producing data which may not be used for evidentiary purposes in subsequent investigative phases, the data may not be subject to validation.

11.0 PERFORMANCE AND SYSTEM AUDITS

Audits will be performed before and during the work to evaluate the capability and performance of the entire system of measurement and reporting. The system includes experimental design, sampling, data collection, analysis, and attendant quality control activities.

11.1 Field System Audits

The QAO and the project manager may make routine visits to the project site to evaluate the performance of field personnel, general field operations and progress. Observations will also include the performance of the field operations personnel during each type of activity, i.e., water level measurements and sampling rounds. A formal systems audit of field operations by the project QAO will be performed on a biannual basis and a field audit report of the sampling team will be maintained on file at EnSafe.

11.2 Laboratory Systems Audit

A laboratory systems audit of the contracted laboratories is routinely conducted (at least biannually) by EnSafe. These audits test methodology and ensure that systems and operational capability is maintained. They also verify that quality control measures are being followed as specified in the laboratory SOPs and the EnSafe project QAPP. The systems audit checklist used by the USEPA forms the procedural basis for conducting these audits. The results of audits are maintained on file at the EnSafe office.

11.3 Performance Evaluation Audits

A performance evaluation (PE) audit evaluates a laboratory's ability to obtain accurate and precise results in the analysis of known check samples by a specific analytical method. The laboratory was chosen on the basis of ability to meet the QA/AC requirements of this project. The laboratory selection was also based on previous work performance for EnSafe. During or following the analytical data validation described in Sections 9 and 10 of this QAPP, a performance evaluation audit of the laboratory may be initiated by the project QA officer. This

audit may be conducted if it is determined that the QA data provided are outside acceptable control limits. These PE audits may include a review of all raw data developed by the laboratory and not reported (laboratory non-reportables) and the submission of blind spiked check samples for the analysis of the parameters in question. These check samples may be submitted disguised as field samples. In this case, the laboratory will not know the purpose of the samples; or the samples may be obvious (known) check samples or National Bureau of Standards traceable.

PE audits also may be conducted by reviewing the laboratory's results from round-robin certification testing and/or USEPA initiated evaluation samples. An additional component of PE audits includes the review and evaluation of raw data generated from the analysis of PE samples and actual field samples that may be in question.

11.4 Regulatory Audits

It is understood that EnSafe field personnel and subcontract laboratories also are subject to quality assurance audits by the USEPA and the TDEC.

12.0 PROCEDURES TO ASSESS DATA ACCURACY, PRECISION, AND COMPLETENESS

Performance of the following calculations will be documented and included in the applicable QC reports.

12.1 Accuracy

Accuracy is the difference between an average value and the *true* value when the latter is known or assumed. The term *accuracy* is normally used interchangeably with *percent recovery*, and describes either recovery of a known amount of analyte (spike) added to a sample of known value, or recovery of a synthetic standard of known value.

$$PercentRecovery = \frac{SSR - SR}{SA} \times 100\%$$

Where:

SSR = Spike sample results;

SR = Sample result; and

SA = Spike added.

Note: The units for the concentrations of spikes, samples, and observed and true values vary based on the analysis. However, they are typically μg/L or mg/L for water samples and μg/kg or mg/kg for soil samples.

12.2 Precision

Relative to the data from a single test procedure, precision is the degree of mutual agreement among individual measurements made under prescribed conditions. An estimate of standard deviation is normally used to describe the precision of a method.

Standard Deviation Estimate

The standard deviation estimate is the most widely used measure to describe the dispersion of a set of data. Normally, + SD will include 68 percent, and + 2SD will include about 95 percent of the data from a study.

Relative Standard Deviation (RSD)

The estimate of precision of a series of replicate measurements will be expressed as the RSD.

Relative Percent Difference (RPD)

A measure of the difference between two samples assumed to be identical through dividing (splitting) an original sample, analyzing each portion, identifying the values of the first replicate (X1) and that of the second replicate (X2), and dividing the difference by the mean (X) of X1 and X2 is expressed as the RPD.

12.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the total amount expected to be obtained under normal conditions. A 95 percent completeness figure is usually required for a particular analysis and overall project objective.

12.4 Quality Control Charts

QC charts are prepared after every 20 determinations of precision and accuracy. The charts are prepared by determining the means of the determinations, setting warning limits of +2 standard deviations, and setting control limits of +3 standard deviations from the mean. The following equations are used:

$$\textit{Mean} = \frac{\sum_{i=1}^{n} X_i}{n}$$

Where:

$$\textit{Standard Deviation} = \frac{\sum_{i=1}^{n} X_i}{n-1}$$

n = the number of determinations

x_i = the numerical value for the ith determination.

Analysis is considered *out of control* whenever one of the following occurs:

- One or more values are outside control limits.
- Two consecutive values fall outside warning limits.
- Seven consecutive values fall on the same side of the mean.

In the event of an *out-of-control* analysis, corrective action will be initiated as described in Section 13.

13.0 CORRECTIVE ACTION

During the course of any investigation, field personnel are responsible for seeing that field instruments and equipment are functioning properly and that work progresses satisfactorily. The field personnel are also responsible for ensuring performance of routine preventive maintenance and quality control procedures. If a problem is detected by the field personnel, the project manager shall be notified immediately. Similarly, if a problem is identified during a routine audit by the project QAO or the regulatory QA officer, an immediate investigation will be undertaken and corrective action deemed necessary will be taken as early as possible.

Potentially out-of-control situations include field instrument breakdown, mislabelling or loss of samples, inadvertent contamination of samples, or circumstances which preclude performance of field activities in accordance with the QAPP or other work plan documents. If an out-of-control event occurs, field sampling personnel shall make appropriate contacts and document any remedial efforts taken to bring field activities under control. The immediate contacts shall be the EnSafe project manager and/or the EnSafe QAO. The EnSafe project manager shall decide whether further contacts are to be made to Carrier, USEPA or the TDEC. Formal documentation of out-of-control occurrences and any associated corrective actions recommended or initiated shall be written on the EnSafe — Field Change Request Forms. Field personnel shall also make notes and comments of the out-of-control occurrence in the field logbooks.

All variances or changes from project QAP are subject to approval by the USEPA remedial project manager and the TDEC representative. If circumstances arise which require significant changes in the protocols, methods, or techniques outlined in the work plan and/or the QAPP, the USEPA RPM and/or the TDEC project manager may be contacted. Any USEPA or TDEC alterations will be documented and implemented with the agency's written consent.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Internal QA Reports

The QA officer will provide internal QA reports to the Project Manager. The reports address the following, as applicable during the course of the project.

- quality assurance activities and quality of collected data
- equipment calibration and preventive maintenance activities
- results of data precision and accuracy calculations
- evaluation of data completeness
- QA problems with recommendations and/or implemented corrective actions
- QA performance and system audit findings

Reports to Oversight Agencies

Carrier will provide QA reports to the appropriate agency QA officer(s) along with sampling reports to be submitted at completion of each project phase. QA (or Data Validation) reports will include, but are not limited to, a discussions of the following.

QA or Data Validation Report

- numbers, locations and types of samples collected
- analyses performed
- field and laboratory QA sample results and implications
- data qualification, validity and overall quality
- analytical problem areas with corrective actions taken, if any
- impact of data quality on subsequent data usage

A quality assurance section of the final report will be submitted at the conclusion of the project.

Status Reports

Periodic status reports shall be submitted to the USEPA with respect to the project activities undertaken in accordance with the RD Scope of Work (SOW). The status reports shall be submitted on or before the fifteenth day of each month beginning on the effective date of the Unilateral Administrative Order (UAO) and continuing until the USEPA, in the form of a written notice, determines the terms of the UAO to be completed.

The status report shall describe: (1) all significant onsite and offsite activities, whether they are administrative or operational, including the progress of those activities, (2) the results of all sampling and testing with other data obtained during the course of the activities relevant to the RD, (3) activities planned for the following period with schedules of the anticipated dates, (4) all site problems and delays, corrective measures, public relations activities, or any significant event that occurs during the site activities. Status reports will not be submitted when there are no field activities or data collected.

Status reports will also be submitted in conjunction with the site's monitoring program with all information as described above in the monthly status reports. A copy of the status report will remain on file at EnSafe's Memphis office.

Attachment A

Analytical Methods

DETERMINATION OF VOLATILE HALOGENATED ORGANIC COMPOUNDS IN VARIOUS MATRICES

SCOPE AND APPLICATION

This is an in-house method developed by Woodson-Tenent Laboratories, Inc. based on FDA and other methods to determine the concentration of various halogenated compounds in water, liquid, and solid matrices. Among others, this method has been shown to give good recovery and sensitivity for the following compounds:

1,2-dibromoethane (EDB)
1,1,2-trichloroethene (trichloroethylene)
carbon tetrachloride
ethylene dichloride (EDC)

SUMMARY OF METHOD

This method provides conditions for the chromatographic determination of halogenated volatile organic compounds. Steam is generated *in situ* to co-distill iso-octane and halogenated compounds. The halogenated compounds partition into the iso-octane phase-effectively concentrating the sample and separating the compounds of interest form extraneous substances. The iso-octane is injected into a gas chromatograph and detection is achieved by an electron capture detector. Quantitative analysis is achieved through integration of peak area or measurement of peak height.

INTERFERENCES AND QUALITY CONTROL

Contamination can come from the presence of high levels of the halogenated compounds in the air, water, solvents, and glassware. Water can be made free of interferences by passing it through a bed of activated carbon. Trihalomethane grade iso-octane can be further purified by storing it over sodium amide. Contamination from the air is avoided by preventing exposure to the air. Glassware is cleaned and oven-dried at 105 degrees to prevent carryover. Standard response is regularly noted to monitor potential contaminants leached from septa and plastic caps. Procedural blanks should be prepared and carried through all phases of the analysis to demonstrate that the analyst has interferences under control. In cases where doubt exists as to the identify and/or concentration of the analyte, confirmation should be performed by gas chromatograph/mass spectrometer.

Apparatus and Materials

20 ml graduated Barret trap with 24/40 ground glass joint.
250 ml Erlenmeyer flask with 24/40 ground glass joint.
Graham reflux condenser with 24/40 ground glass joint.
Rheostat controlled hotplate/magnetic stirrer.
Butt extraction tube with 24/40 ground glass joint (see Figure 1)
20 ml culture tubes with Teflon™ lined screw cap.
Gas chromatograph equipped with an electron capture detector.

G.C. column: 8'x 4mm I.D. glass column of 20% SP2100/0.1% Carbowax 1500 on 100/120 mesh Supelcoport (Supelcoport, Inc.).

The recommended gas chromatographic conditions are as follows:
Column temperature: 80 degrees celsius
Injector temperature: 175 degrees celsius

Detector temperature: 365 degrees celsius

Injection Volume: 5uL

REAGENTS

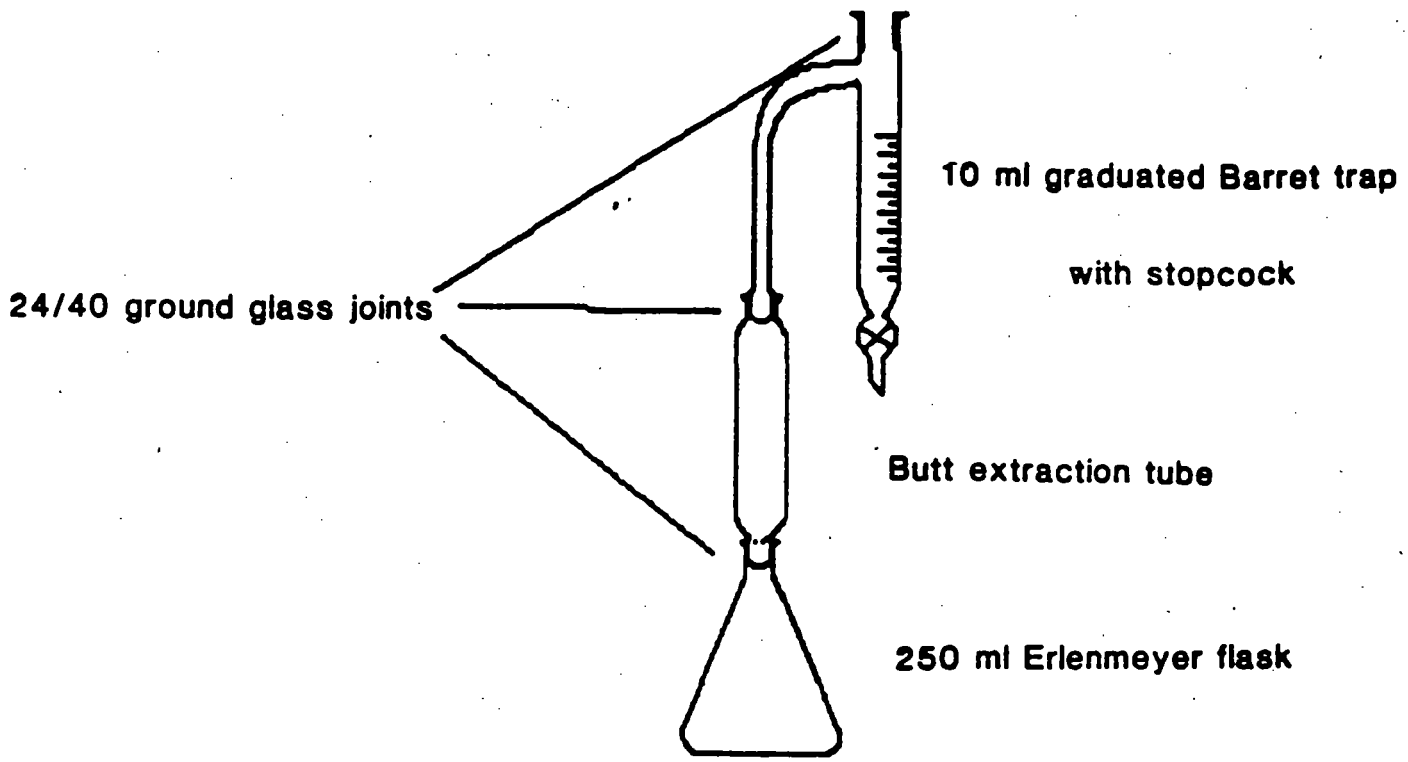
Iso-octane, trihalomethane grade (Burdick and Jackson).

Organic-free water.

Calibration standards.

Figure 1

Woodson-Tenent's Co-Distillation Apparatus



PROCEDURE

Water samples should be decanted directly in to the Erlenmeyer flask. Solid samples should be weighed into the flasks and wet with enough reagent water to maintain a uniform suspension under vigorous stirring (typically 50-150 ml of water are added). Solid samples with a tendency to form pastes (such as grain or grain products) can be suspended in the Butt tube with a glass wool plug over approximately 100 ml reagent water. In all cases, iso-octane (typically 10 ml) is pipetted volumetrically onto the sample and the apparatus is assembled quickly to avoid contact with the air.

The Erlenmeyer flask is rapidly heated to boiling with vigorous stirring until the iso-octane distills over. Heating is continued until 1-2 ml of water is collected in the Barret trap. When the water is collected, it may be assumed that no more iso-octane can be collected. The volume of iso-octane distillate is recorded and collected. The distillate is now ready for injection. After collecting the iso-octane, wash a few milliliters of acetone down the condenser and allow the Barret trap to drain.

Method Performance

The method detection limit is defined as the minimum concentration that can be measured and reported with confidence that the value is above zero. The detection limits listed below were obtained using reagent water, but the detection limits actually achieved will depend on instruments sensitivity and matrix effects. Spike recoveries of 85% - 115% can be routinely be achieved for samples spiked in the 1-50 part-per-billion range but again these will depend on instrument sensitivity to the particular compound and matrix effects.

Compound	Detection limit
Carbon Tetrachloride	0.2 ng/gm
1,2-dibromoethane (EDB)	0.5 ng/gm
1,1,2-trichloroethene (TCE)	0.5 ng/gm

The method has been used extensively to determine halogenated organics in a variety of matrices.

Typical results are as follows:

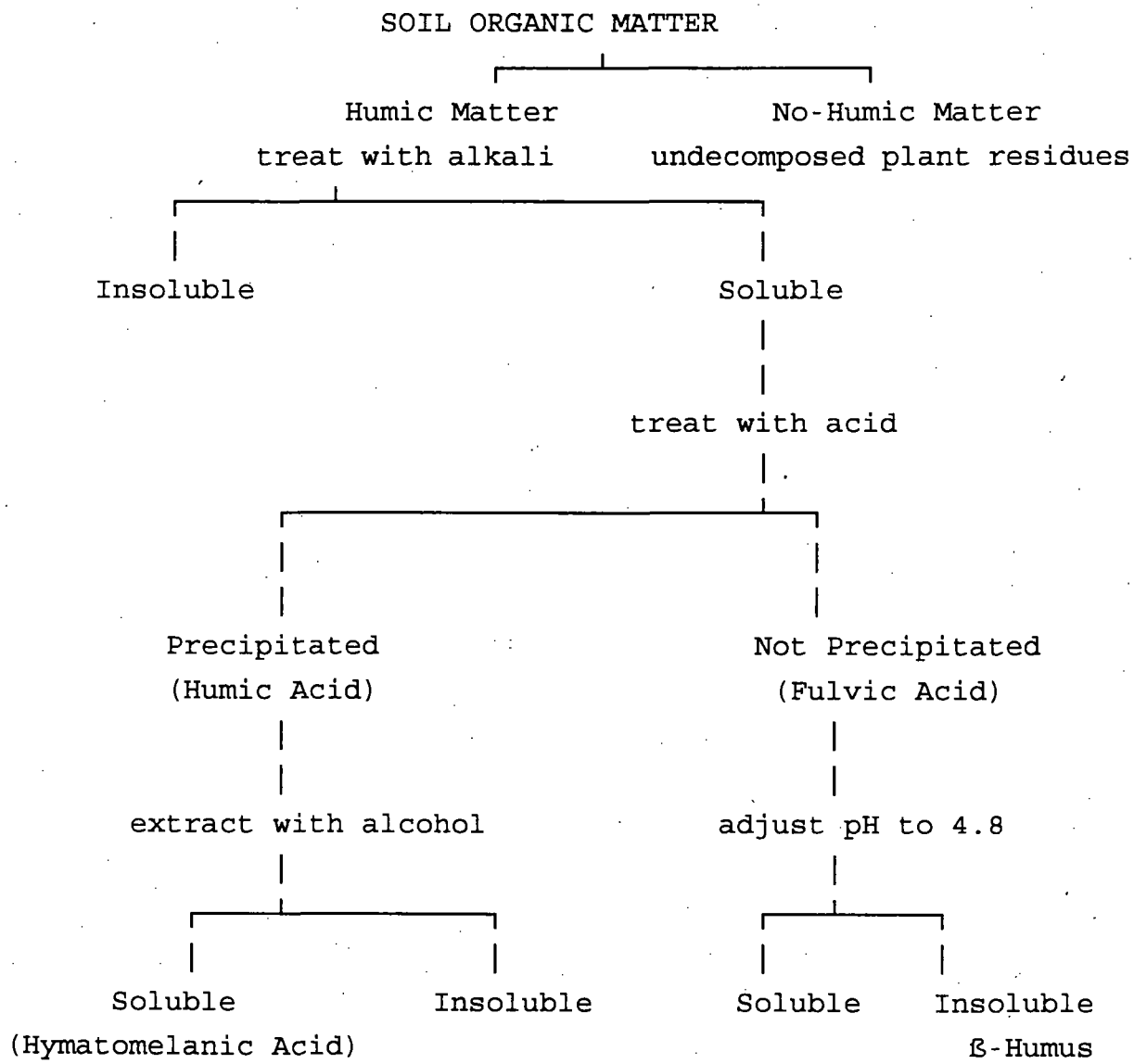
Matrix	Spike Level	Recovery	Compound
Water	30ppb	100%	
Water	5ppb	85%	CCl_4
Soil	630ppb	89%	TCE
Water	113ppb	110%	TCE
Water	1.1ppb	101%	TCE

CHEMICAL FRACTIONATION OF ORGANIC MATTER

94-3 FRACTIONATION OF HUMUS

94-3.1 Introduction

The classical method of fractionated humus is based on the extraction of organic matter from soil with caustic alkali and the further subdivision and extracted material by partial precipitation with mineral acids, and by partial solubility in alcohol. By this scheme the following groups are obtained: the "humin fraction," insoluble in alkali; the "humic acid fraction," soluble in alkali, insoluble in acid; the "hymatomelanic acid fraction," alcohol soluble part of the humic acid precipitate; the "fulvic acid fraction," soluble in alkali, soluble in acid insoluble at pH 4.8. The method of fractionation is as follows:



The names given to these preparations have not been accepted universally. Humic acid is sometimes defined as that part of the acid-insoluble material which is insoluble in alcohol, in which case the term α-humus is used to designate the original acid-insoluble fraction (Russell, 1950). The separation of hymatomelanic acid from the humic acid fraction, and of ß-humus from fulvic acid, is frequently omitted.

German scientists further subdivide humic acid into 2 parts by controlled solution in 5% NaOH solution, in which case the "brown humic acids" are dissolved, leaving the "gray humic acids" as a precipitate.

The usefulness of chemical fractionation procedures is emphasized by the fact that the majority of studies conducted on soil humus involve preliminary separations by these methods. A review of humus fractionation procedures, and of the results obtained by their use, is given by Russell (1950).

The designation of humus as a separate fraction may be inappropriate, as this material may consist of portions of the other fractions which are so intimately associated with mineral matter that they cannot be extracted with alkali.

At present, it is not known whether hymatomelanic acid is a distinct chemical entity. This material may be an artifact produced from humic acid during fractionation. Similarly, it is not certain that ß-humus represents a definite fraction. The ß-humus has a high ash content (largely aluminum), and the organic matter in this fraction may be material that has been entrapped by mineral matter during fractionation.

The extraction of soil with caustic alkali may seriously affect the physico-chemical properties of the isolates obtained; therefore, some of the preparations obtained may be artifacts. This difficulty can be avoided by the use of milder reagents to extract the organic matter, but the

proportion of the organic matter extracted will be less. A discussion of problems relation to the extraction of organic matter from soils is given in section 93.

As most workers probably will continue to prefer the more complete extraction of organic matter which requires the use of caustic alkali, this reagent will be utilized in the following procedure. For specific purposes, extraction with milder reagents may be preferred.

Progress towards characterization of the isolates obtained by chemical fractionation procedures awaits the application of modern techniques of organic chemistry. Soil scientists throughout the world are now engaged in such studies, and rapid progress towards the complete characterization of soil organic complexes can be expected.

94-3.2 Method

94-3.2.1 Special Apparatus

1. Soxlet extractor.

9.4-3.2.2 Reagents

1. Sodium Hydroxide (NaOH), 0.1N, 0.5N, and 5N solutions.
2. Hydrochloric acid (Hcl), 0.1N solutions and concentrated.
3. Ethyl alcohol, absolute.

9.4-3.2.3 Procedure

Place a 40-g. sample of acid-washed (0.1N HC1) soil (20g. for peat and muck samples) in an 8-oz. polyethylene centrifuge bottle, add 200 ml. of 0.5N NaOH solution, and stopper the bottle tightly with a rubber stopper. Shake the mixture for 12 hours on a mechanical shaker, wash down the sides of the bottle with distilled water, and centrifuge the mixture. Decant off the dark-colored supernatant liquor, filter it through glass wool to remove suspended plant material, and adjust the pH of the solution to about 1.0 with concentrated HCl. Add an additional

200mL. of 0.5N NaOH solution to the soil, shake the mixture for 1 hour, and repeat the centrifuging and decanting procedures. Dispense the residue in 200 ml. of distilled water, centrifuge the mixture, and add the supernatant liquor to the previous extracts. Adjust the pH of the resulting solution to 1.0 with concentrated HCl and allow the humic acid to settle.

If a larger quantity of soluble organic matter is required, repeat the extraction procedure, using additional 40-g. aliquots (20 g. for peat and muck samples) of original soil.

Siphon off the excess supernatant liquor (fulvic acid) from the acidified extract, transfer the remainder of the suspension to an 8-oz. polyethylene bottle, and centrifuge off the humic acid. Redissolve the humic acid in 0.5N NaOH solution, reprecipitate it by adjusting the pH of the solution to 1.0 with concentrated HCl, and then centrifuge out the humic acid. In each case, add the supernatant liquor to the original acid filtrate. Repeat the purification procedure a second time, and them wash the humic acid precipitate with distilled water until it is free of chlorides. Dry the humic acid (preferably by freeze-drying), and grind it to a brown powder.

To recover the material referred to as hymatomelanic acid, extract an aliquot to the humic acid in Soxlet apparatus for 24 to 30 hours with ethyl alcohol. Evaporate the alcohol from the extract by heating it at 40° to 50°C in a vacuum, and them complete the drying in a vacuum desiccator.

To separate ß-humus, adjust the pH of the fulvic acid preparation (the acid filtrate) to 4.8. For this purpose, add 5N NaOH solution to the extract until practically all of the acid is neutralized, and then complete the neutralization by the cautious addition of 0.1N NaOH solution. After the precipitate has settled, siphon off as much of the supernatant liquor as possible, transfer the remainder of the suspension to an 8-oz. polyethylene bottle, and centrifuge out the ß-humus. Wash the ß-humus once with distilled water, and then dry it in an over at 50° C.

94-3.2.4 Comments

If desired, the various preparations can be analyzed for carbon and nitrogen, from which the relative amounts of the soil carbon and nitrogen in the form of humin, humic acid, fulvic acid, hymatomelanic acid, and ß-humus can be determine. In the case of the of humin fraction, the residue remaining after alkaline extraction is washed with distilled water and dried in an oven at 50° C. Aliquots of this sample, together with those from the other humus fractions, are analyzed for carbon and nitrogen by the procedures described in sections 90-2 and 83-7, respectively.

Autoxidation of organic matter during extraction can be kept at a minimum by extracting the soil in a nitrogen atmosphere. Choudhri and Stevenson (1957) removed oxygen from the mixture of soil and alkali by adding a small amount of SnCl2 to the extractant (SnCl2 becomes autoxidized in the presence of atmospheric oxygen). Reducing the length of time under which the soil remains in contact with the alkali may be desirable.

The pretreatment of the soil with dilute acid can be eliminated; however, the quantity of organic matter extracted will be less.

By this procedure, relatively small amounts of the individual fractions are obtained. If larger quantities are required, the soil can be extracted in large carboys, as done by Forsythe (1947a, 1947b).

94-4 FRACTIONATION OF FULVIC ACID

94-4.1 Introduction

Forsythe (1947a) found that the fulvic fraction of soil organic matter could be separated into the following fractions by partial adsorption on activated charcoal and serial elution of the adsorbed material with 90% acetone, distilled water, and 0.5 NaOH:

Fraction A: The colorless effluent from the charcoal pad. Simple water soluble organic compounds are present, such as sugars and amino acids.

Fraction B: A pigmented substance eluted with 90% acetone. Forsythe (1947a) concluded that this material consisted chiefly of phenolic glycosides or tannins.

Fraction C: A colorless polysaccharide recovered with distilled water. The constituent sugars include glucose, galactose, mannose, arabinose, xylose, ribose, and a uronic acid fraction containing glucuronic acid (Forsyth, 1950). The preparation also contains nitrogen, a part of which exists as amino sugars (Stevenson, 1960).

Fraction D: A highly pigmented material obtained by elution with 0.5N NaOH. Besides being rich in nitrogen compounds, pentose sugars and organic phosphorus compounds are present.

This method is particularly useful for the preliminary separation of constituents of fulvic acids, the eventual characterization of which will provide valuable information about the chemical mature of humus. The method is time consuming; therefore, it does not lend itself to routine soil investigations.

Except for Fraction C, very little is known about the chemical nature of various preparations. Fractions B and D may be mixtures of several pigments (Stevenson, 1960). The application of several chromatographic techniques, coupled with electrophoretic procedures, may eventually yield more homogenous preparations.

The main disadvantage of the method is that 0.5N NaOH is used to extract organic matter from the soil and to recover Fraction D from the charcoal pad. The use of 0.5N NaOH leads to deamination of nitrogen compounds in the fulvic extract (Stevenson, 1960), and possibly to other changes. Bremner and Lees (1949) found that the material extracted from soil with sodium pyrophosphate can be separated into the same fractions as can the material removed with caustic alkali. It is not known if milder reagents could be used to recover Fraction D from the charcoal pad.

By analysis of the preparations for carbon and nitrogen, the distribution of fulvic carbon and nitrogen in the various fractions can be determined. Forsyth (1947a) recovered and average of about one-fourth of the fulvic nitrogen in Fraction A, one-tenth in Fraction B, and slightly more than one-half in Fraction D. A very small amount of the nitrogen, estimated to be 5% or less, occurred in Fraction C.

In the procedure described below, the fulvic material obtained from the soil by extraction with 0.5N NaOH is adjusted to a pH of from 2.5 to 3.0 and passed onto a layer of activated charcoal. The charcoal is then eluted successively with 90 % acetone, distilled water, and 0.5N NaOH. The material recovered by elution with 90 % acetone (Fraction B) is purified by repeated precipitation from alcoholic solution, using ethyl ether,; that is recovered with distilled water (Fraction C) is purified by repeated precipitation from aqueous solution, using acetone. The alkali of Fraction D is removed by dialysis.

94-4.2 Method

94-4.2.1 Reagents

1. Sodium Hydroxide (NaOH), 0.5N, and 1.0N solutions.
2. Hydrochloric acid (HCl), 0.1N solutions.
3. Acetone solution, Dilute 90 ml of acetone to 100 ml with water.
4. Ethyl alcohol, absolute.
5. Ethyl ether, reagent grade.

94-4.3.2 Procedure

Add an amount of dried and pulverized soil containing 100 g of organic matter to a large carboy, add 10 liters of 0.5N NaOH solution, and stir the mixture periodically over a 48-hour period. Allow the soil to settle, and then siphon off the dark colored supernatant liquor. Pass the extract first through a large funnel provided with a pad of glass wool, and then through a sintered-glass funnel (pore size 5 to 10μ). Add an additional 10 liters of 0.5N NaOH solution to the residue, and repeat the stirring, settling and siphoning procedures. Wash the residue by adding and siphoning off 10 liters of distilled water. Combine the filtrate and washings, and acidify the resulting solution by adding HCl. Allow the humic acid to settle, and then siphon off the acid supernatant solution. Redissolve the humic acid in 1 liter of 0.5N NaOH, reprecipitate it as before, and add the supernatant liquor to the original acid solution. Adjust the pH of this solution to from 2.5 to 3.0, and then filter the solution through a very fine filter paper to remove any sediment present.

Filter the extract on a Bûchner funnel (with suction applied) through pads of acid washed (0.1N HCl) animal charcoal. The pads should be about 2 inches thick and 6 inches in diameter. After passage of the extract, wash the pad with 500 ml of 0.1N HCl. Combine the colorless filtrate and washings, and label the resulting solution Fraction A.

Wash the charcoal pad with acetone solution. The first 500 ml of filtrate will generally contain most of the color extractable by this solvent. Continue the extraction until the solvent comes through colorless (about 4.5 liters). If a white precipitate forms in the extract, centrifuge it off and add it later to the distilled water effluent (Fraction C). This material is identical to the water-soluble polysaccharide removed by the distilled water.

Transfer the acetone eluate to the distillation apparatus, distill off the acetone on a water bath at 50° to 60° C., and then dry the residue under reduced pressure at the same temperature. Extract the residue with absolute ethyl alcohol, filter the insoluble residue, and distill off the bulk of the ethanol under reduced pressure. Add ethyl ether to the solution until precipitation of organic matter is complete, filter off the dark red amorphous precipitate, wash it with ether, redissolve it in ethanol, and reprecipitate it by adding ether. Repeat this procedure several times for purposes of purification. Dry the final product in a vacuum, and grind it to a powder. This is Fraction B.

Wash the charcoal pad with distilled water until the extract no longer gives a precipitate on addition of acetone. Add three volume of acetone to the distilled water eluate, and follow the flocculent white precipitate to settle. Remove as much of the supernatant liquor as possible by decondition, and recover the precipitate from the remaining suspension by filtration. Add to this material the white precipitate obtained in Fraction B. Redissolve the combined product in distilled water, filter the solution, and reprecipitate the polysaccharide by addition of 3 volume of acetone. Disperse the residue in acetone, decant off as much of the acetone as possible, filter the solution, and wash the residue thoroughly in ethyl ether. Transfer the residue to a petri dish, dry it in a vacuum, and grind it to a fine powder. This is the water-soluble polysaccharide of Fraction C.

Elute the next fraction of the organic matter from the charcoal pad with 0.5N NaOH (about 4 liters will be required to elute off the color). Remove the alkali by dialysis against running

distilled water. Continue the dialysis until the color just starts to come through the membrane, dry it in a vacuum, and grind it to a fine powder. This is Fraction D.

94-4.3.2 Comments

Care must be exercised in the selection of dialysis tubing for removing the alkali from Fraction D. If the pore size of the tubing is large, part of the material may pass through with the alkali. Organic matter may also be lost through electrodialysis. An alternative procedure is to remove the alkali by passing the neutralized extract onto an ion exchange column (Stevenson, 1960).

The amount of fulvic material removed from the soil can be increased by leaching the soil with dilute acid (0.1N HCl) prior to extraction.

The extracts themselves can be used as indicators for the adjustment of pH prior to passage through the charcoal pad (Forsyth, 1947a). The fulvic extract has a straw-yellow color at low pH values and turn to wine-red at high pH values, passing through an orange color when the pH ranges from 2.5 to 3.0.

94-5 Literature Cited

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Attachment B

Excerpts from USEPA SOP QAM

Attachment B

Excerpts from USEPA SOP QAM

APPENDIX G
AIR MONITORING SAFETY EQUIPMENT CALIBRATION PROCEDURES

G.1 GENERAL

G.1.1 Introduction

This appendix gives specific procedures to be followed when calibrating air monitoring instrumentation. The calibrations defined in these procedures will result in instrument response accuracy within the capabilities of the instruments. While it is not imperative that the instruments be capable of operating at a high degree of analytical precision and accuracy, it is necessary that calibrations demonstrate proper operation of the monitor and insure that results give an acceptably accurate indication of conditions upon which to base safety decisions and actions.

G.1.2 Calibration Gases

All calibration gasses will be certified by their supplier to be of a specified and known concentration. The concentrations of calibration gases will be within a relevant range of response for the air monitors, but will not exceed any flammability or toxic exposure limits. Calibration mixtures and approximate concentrations for specific air monitors will be as follows:

Monitor	Gas Mixture	Concentration
Combustible Gas	Pentane in Air	0.75%
Flame Ionization Detector	Methane in Air	75 ppm
Photo-Ionization Detector	Toluene in Air	100 ppm

Gas cylinders will not be sent to the field if they contain less than one-fifth of their full capacity. Cylinders below the required volume will be utilized in the warehouse for equipment checkout and maintenance.

G.1.3 Calibration Equipment

All calibrations will consist of introducing a gas of known concentration to the monitor at atmospheric pressure. Under no circumstances will it be acceptable to attempt calibration when the monitor is measuring gas concentrations below or above atmospheric pressure.

To insure stable pressure of the calibration gas, a calibration manifold system will be used. The manifold will consist of a "T" fitting, a Teflon® bag, Teflon® tubing, and fittings. The Teflon® bag is omitted for calibration of the OVA. The calibration gas cylinder will be connected to the "T" fitting with Teflon® tubing so that gas will flow straight through the top of the "T" to a

Teflon® bag. The "T" fitting and tubing will be purged with calibration gas prior to connection of the Teflon® bag. The bottom or side port of the "T" will be connected via Teflon® tubing to a stainless steel quick disconnect. Once the Teflon® bag has been filled with gas, the gas cylinder flow will be turned off. The monitor's probe will be connected to the manifold via the quick disconnect and allowed to sample the contents of the teflon bag.

G.1.4 Calibration Frequency

It is required that monitors be calibrated each time they are turned on. More frequent calibrations are encouraged if samplers feel that field conditions and hazards warrant. Frequent checking of monitor response or proper setting and operation of alarms is encouraged. Prior to turning off the monitor, a post calibration check will be performed. This check will follow the same procedures as the initial calibration except that no adjustments will be made to the monitor. Instead, the response will simple be logged in the field book.

G.1.5 Documentation

Calibrations will be documented in the field log book. The entry needs to include the following information:

Date
Time
Monitor's ID #
Battery Check Response
Alarm Response
Fuel Level (FID)
Calibration Gas Concentration
Instrument Response
Operator's Initials

G.4 PHOTOVAC TIP II PHOTOIONIZATION DETECTOR

G.4.1 Introduction

The Photovac TIP II is designed to detect primarily organic materials in air. It uses a photoionization detector (PID) as its method of operation. The instrument is capable of measuring concentrations down to about 1 ppm sensitivity for certain compounds. It is important to realize that this sensitivity is not achievable for all compounds. Some materials will result in a very low response on the PID in relation to their actual concentrations, while others well not respond at all to the detector's ionization energy. As a general rule, the PID should not be used to monitor for compounds whose structures contain only single bonds.

THE LACK OF A RESPONSE ON THIS METER DOES NOT GUARANTEE THAT THE ENVIRONMENT IS SAFE.

G.4.2 Operational Checks

1. Press the "POWER" switch to turn the instrument on. After a few seconds, the pump motor should start running.

2. Observe that the "LOBAT" (Low Battery) indication is not displayed on the LCD.

G.4.3 Calibration

1. Unlock the "ZERO" control by turning the locking ring clockwise.

2. In a "Background" type of atmosphere, adjust the "ZERO" potentiometer until the LCD reads approximately zero. Return the locking ring to the locked position.

3. Assemble a calibration manifold as described in G.1.3 using toluene as the calibration gas.

4. Connect the instrument's probe to the calibration manifold and allow it to sample the calibration gas.

5. The LCD should indicate close to the concentration of the calibration gas. If not, unlock the "SPAN" control by turning the locking ring clockwise. Adjust the "SPAN" control until the LCD reads approximately the concentration of the calibration gas. Return the locking ring to the locked position.

G.5 HNU MODEL PI 101 PHOTOIONIZATION DETECTOR

G.5.1 Introduction

The HNU model PI 101 is designed to detect primarily organic materials in air. It uses a photoionization detector (PID) as its method of operation. The instrument is capable of measuring concentrations down to about 1 ppm sensitivity for certain compounds. It is important to realize that this sensitivity is not achievable for all compounds. Some materials will result in a very low response on the PID in relation to their actual concentrations, while others will not respond at all to the detector's ionization energy. As a general rule, the PID should not be used to monitor for compounds whose structures contain only single bonds.

THE LACK OF A RESPONSE ON THIS METER DOES NOT GUARANTEE THAT THE ENVIRONMENT IS SAFE.

G.5.2 Operational Checks

1. Connect the probe to the meter case of the instrument.

2. Place the function/range switch in the "BATT" position and note the meter's response.

3. Place the function/range switch in any of the three range positions. Listen closely to the probe for a humming sound which indicates that the sample fan is operating.

G.5.3 Calibration

1. Place the function/range switch in the "STANDBY" position. Use the "ZERO" potentiometer to adjust the meter reading to zero.

2. Assemble a calibration train as described in 6.1.3 using toluene as the calibration gas.

3. Place the instrument's function/range switch in the appropriate range for the calibration gas (usually 0-200).

4. Connect the instrument's probe to the calibration manifold and allow it to sample the calibration gas.

5. The readout should indicate close to the concentration of the calibration gas. If not, use the "SPAN" potentiometer to adjust the meter to the appropriate response.

6. Place the function/range switch in the "0-20 ppm" position before entering the site.

Attachment C

EnSafe Data Validation Worksheets

DQO SUMMARY FORM

1. SITE

NAME _____
LOCATION _____
NUMBER _____

EPA REGION _____

PHASE _____
RI1 RI2 RI3 ERA FS RD RA
(Circle One)

2. MEDIA *(Circle one)*	SOIL	GW	SW/SED	AIR	BIO	OTHER

3. USE *(Circle All That Apply)*	SITE CHARAC. (H&S)	RISK ASSESS.	EVAL ALTS.	ENG'S DESIGN	PRP DETER	MONITORING REMEDIAL ACTION	OTHER

4. OBJECTIVE _____

5. SITE INFORMATION
AREA _____ DEPTH TO GROUNDWATER _____
GROUNDWATER USE _____
SOIL TYPES _____
SENSITIVE RECEPTORS _____

6. DATA TYPES *(Circle Appropriate Data Types)*

A. ANALYTICAL DATA

pH	PESTICIDES	TOX
CONDUCTIVITY	PCB	TOC
VOA	METALS	BTX
BNA	CYANIDE	COD
TCLP	____	____

B. PHYSICAL DATA

PERMEABILITY	HYDRAULIC HEAD
POROSITY	PENETRATION TEST
GRAIN SIZE	HARDNESS
BULK DENSITY	_____
_____	_____

7. SAMPLING METHOD *(Circle Method(s) To Be Used)*

ENVIRONMENTAL	BASED	GRAB	NON INTRUSIVE	PHASED
SOURCE	GRID	COMPOSITE	INTRUSIVE	_____

8. ANALYTICAL LEVELS *(Indicate Level(s) And Equipment & Methods)*
LEVEL 1 FIELD SCREENING — EQUIPMENT _____
LEVEL 2 FIELD ANALYSIS — EQUIPMENT _____
LEVEL 3 NON-CLP LABORATORY — METHODS _____
LEVEL 4 CLP/RAS — METHODS _____
LEVEL 5 NON STANDARD _____

9. SAMPLING PROCEDURES
BACKGROUND — 2 PER EVENT OF _____
CRITICAL (LIST) _____
PROCEDURES _____

10. QUALITY CONTROL SAMPLES *(Confirm Or Set Standard)*

A. FIELD
COLLOCATED — 5% OR _____
REPLICATE — 5% OR _____
FIELD BLANK — 5% OR _____
TRIP BLANK — 1 PER DAY OR _____

B. LABORATORY
REAGENT BLANK — 1 PER ANALYSIS BATCH OR _____
REPLICATE — 1 PER ANALYSIS BATCH OR _____
MATRIX SPIKE — 1 PER ANALYSIS BATCH OR _____
OTHER _____

11. BUDGET REQUIREMENTS
BUDGET _____ SCHEDULE _____
STAFF _____

CONTRACTOR _____ PRIME CONTRACTOR _____
SITE MANAGER _____ DATE _____

ENSAFE
Data Review Worksheets

Site Name _____
Project Number _____

REGION I REVIEW OF ORGANIC CONTRACT LABORATORY DATA PACKAGE

The hard copied (laboratory name) _____ data package received at Region __ has been reviewed and the quality assurance and performance data summarized. The data review included:

Case No. _____ SAS No.___ Sampling Date(s)_____
SDG No. _____ Matrix ____ Shipping Date(s)_____
No. of Samples _____ Date Rec'd by Lab _____

Traffic Report Nos: _____

_____

Trip Blank No.: _____
Equipment Blank No.: _____
Field Dup Nos.: _____

SOW No._____ requires that specific analytical work be done and that associated reports be provided by the laboratory to the Regions, EMSL-LV, and SMO. The general criteria used to determine the performance were based on an examination of:

- Data Completeness
- Holding Times
- GC/MS Tuning
- Calibrations
- Blanks
- Surrogate Recoveries
- Matrix Spike/Matrix Spike Dup
- Field Duplicates
- Internal Standard Performance
- Pesticide Inst. Performance
- Compound Identification
- Compound Quantitation

Overall comments _____

_____

_____

_____

_____

Definitions and Qualifiers:

A — Acceptable data.
J — Approximate data due to quality control criteria.
R — Reject data due to quality control criteria.
U — Compound not detected.

Reviewer: _____ **Date:**_____

ENSAFE
Data Review Worksheets

I. DATA COMPLETENESS		
Missing Information	Date Lab Contacted	Date Rec'd

Complete table for all samples and circle the fractions which are not within criteria.

II. HOLDING TIMES						
SAMPLE ID	DATE SAMPLED	VOA DATE ANAL	DATE EXTR	DATE ANAL	DATE EXTR	DATE ANAL

VOA — Unpreserved: Aromatic within 7 days, non-aromatic within 14 days of sample collection.
Preserved: Both within 14 days of sample collection.
Soils: Both within 14 days of sample collection.

ACTION:

1. If holding times are exceeded all positive results are estimate (J) and non-detects are estimated (UJ).
2. If holding times are grossly exceeded, the reviewer may determine that non-detects are unusable(*).

III. GC/MS TUNING

—— The DFTPP performance results were reviewed and found to be within the specified criteria.

If no,
Samples affected: _____

—— The BFB performance results were reviewed and found to be within the specified criteria.

If no,
Samples affected: _____

If mass calibration is in error refer to the Region guidelines for expanded criteria. If necessary, all associated data as unusable (R).

ENSAFE
Data Review Worksheets

IV A. VOLATILE CALIBRATION VERIFICATION

Date of Initial Calibration: _____
Dates of Continuing Calibrations: _____
Instrument ID: _____
Matrix/Level: _____

DATE	CRITERIA OUT				COMPOUND (VALUE)
	RF	%RSD	RF	%D	

NOTES:

1. All $\overline{RF}$'s, and RF's must be >0.05
2. All %RSD's must be <30%
3. All %D's must be <25%

* - Compounds do not apply to the maximum %RSD or %D.

ACTION:

1. If any compound has an initial $\overline{RF}$ or a continuing RF of <0.05:
   a. Flag positive results for that compound as estimated (J).
   b. Flag non-detects for that compound as unusable (R).

2. If any compound has a %RSD >30% or a %D >25%:
   a. Flag positive results for that compound as estimated (J).
   b. Flag non-detects for that compound as estimated (UJ) if the %RSD of %D is >50%.

A separate worksheet should be filled out for each initial curve.

ENSAFE
Data Review Worksheets

V A. BLANK ANALYSIS RESULTS

List the contamination in the blanks below.

1. Laboratory Blanks				Level:
Date	Lab ID	Fraction/ Matrix	Compound	Concentrations/ Units

2. Equipment and Trip Blanks				
Date	SAMPLE #	Fraction/ Matrix	Compound	Concentrations/ Units

A separate worksheet should be used for low and medium level blanks.

V B. BLANK ANALYSIS RESULTS

3. Blank Actions

Action levels should be based upon the highest concentration of contaminant determined in any blank. The action level for samples which have been concentrated or diluted should be multiplied by the concentration/dilution factor. No positive sample result should be reported unless the concentration of the compound in the sample exceeds the action level of 10 x's the amount in the blank for the common contaminants, or 5 x's the amount for any other compound. Specific actions are as follows:

1. The concentration is less than the CRQL, report the CRQL.

2. The concentration is greater than the CRQL, but less than the action level, report the concentration found U.

3. The concentration is greater than the action level, report the concentration unqualified.

For examples refer to the Regional Guidelines.

Common contaminants = methylene chloride, acetone, 2-butanone, toluene, and phthalates.

LEVEL:			
Compound	Max. Conc./ Units	Action Level/ Units	CRQL.

A separate worksheet should be used for low and medium level blanks.

ENSAFE
Data Review Worksheets

VI. SURROGATE SPIKE RECOVERIES

List the percent recoveries which do not meet the criteria for surrogate recovery.

Matrix: _____

SAMPLE#	VOA		
	TOL	BFB	DCF
QC LIMITS			
	TO	TO	TO

Surrogate Actions: ***-Advisory Only**

PERCENT RECOVERY

	<10%	10% — CRR	>CRR
Positive sample results	J	J	J
Non-detected results	R	UJ	A

CRR = Contract Required Recovery Range.
Surrogate action should be applied:

1. If one surrogate in the VOA fraction is out of specification, but have recoveries of >10%.
2. If any one surrogate in a fraction shows <10% recovery.

ENSAFE
Data Review Worksheets

VII A. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

1. Matrix Spike/Matrix Spike Duplicate Recoveries and Precision

SAMPLE Nos. _____ , _____ Level: _____ Matrix: _____

List the percent recoveries and RPD's of compounds which do not meet the criteria stated on Form 3.

FRACTION/ MS OR MSD	COMPOUND	%REC/ RPD	QC LIMITS

QUALIFICATION IS LIMITED TO THE UNSPIKED SAMPLE ONLY.

1. If any compound does not meet the Contract Required Recovery range (CRR) follow the actions stated below:

	PERCENT RECOVERY		
	<10%	10% — CRR	>CRR
Positive Sample Results	J	J	J
Non-detected Results	R	A	A

2. If any compound does not meet the RPD criteria, flag positive results for that compound as estimated (J).

A separate worksheet should be used for each MS/MSD pair.

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Data Review Worksheets

VII B. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

3. Matrix Spike Duplicate — Unspike Compounds

SAMPLE Nos. _____ , _____

List the concentrations of the unspiked compounds and determine the percent RSD's of the unspiked sample, matrix spike, and matrix spike duplicate. No limits have been developed for the RSD values of the unspiked compounds..

FRACTION	COMPOUND	SAMPLE MS MSD CONC	%RSD

The reviewer must use professional judgement to determine if there is a need to qualify any of the unspiked compounds in the sample.

ENSAFE
Data Review Worksheets

VIII. FIELD DUPLICATE PRECISION

SAMPLE Nos. _____ , _____ **Matrix: ____**

List the concentrations of the compounds which do not meet the following RPD criteria:

1. An RPD of <30% for water duplicates.
2. An RPD of <50% for soil duplicates.

FRACTION	COMPOUND	SAMPLE CONC	DUP SAMPLE CONC	RPD

ACTIONS:

1. If the results for any compounds do not meet the RPD criteria, flag the positive results for that compound as estimated.

2. If one value is non-detected, and one is above the CRQL:
   a. Flag the positive result as estimated (J).
   b. Flag the non-detected result as estimated (UJ).

Note: Professional judgement may be utilized to apply duplicate actions to all samples of a similar matrix.

A separate worksheet should be filled out for each field duplicate pair.

IX. INTERNAL STANDARD PERFORMANCE

List the internal standard areas of samples which do not meet the criteria or +100% of -50% of the internal standard area in the associated continuing calibration standard.

SAMPLE ID	DATE	IS OUT	IS AREA/RT	ACCEPTABLE RANGE	ACTION

ACTION:

1. If an IS area count is outside the criteria -50% or +100% of the associated standard:
   a. Positive results for compounds quantitated using that IS are flagged as estimated (J) for that sample fraction.
   b. Non-detects for compounds quantitated using that IS are flagged as estimated (UJ) for that sample fraction.
   c. If extremely low area counts are reported, or if performance exhibits a major drop-off, then a severe loss of sensitivity is indicated. Non-detects should then be flagged as unusable (R).

2. If an IS retention time varies more than 30 seconds, the chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection of the data for that sample fraction.

X. SAMPLE QUANTITATION

In the space below, please show a minimum of one sample calculation per fraction:

VOA:

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Data Review Worksheets

Site Name _____
Project Number _____

EVALUATION OF METALS
CONTRACT LABORATORY DATA PACKAGE

The hard copied (laboratory name) _____ data package received at Region __ has been reviewed and the quality assurance and performance data summarized. The data review included:

Case No. _____ SAS No.____ Sampling Date(s)_____
SDG No. _____ Matrix _____ Shipping Date(s)_____
No. of Samples _____ Date Rec'd by Lab _____
Traffic Report Nos: _____

Trip Blank No.: _____
Equipment Blank No.: _____
Field Dup Nos.: _____

SOW No._____ requires that specific analytical work be done and that associated reports be provided by the laboratory to the Regions, EMSL-LV, and SMO. The general criteria used to determine the performance were based on an examination of:

- — Data Completeness
- — Holding Times
- — Calibrations
- — Blanks
- — ICP Interference Check Results
- — Matrix Spike Recoveries
- — Laboratory & Field Duplicates
- — Lab Control Sample Results
- — Furnace AA Results
- — ICP Serial Dilution Results
- — Detection Limit Results
- — Compound Quantitation

Overall comments _____
_____
_____
_____
_____

Definitions and Qualifiers:

A — Acceptable data.
J — Approximate data due to quality control criteria.
R — Reject data due to quality control criteria.
U — Compound not detected.

Reviewer: _____ Date:_____

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A. SAMPLE HOLDING TIMES

Sample ID	Date Sample Collected	Date Sample Analyzed	Comments

QC Criteria: All samples for metals analysis should be analyzed within 6 months of sample collection except mercury, which should be analyzed with 28 days.

Action: If holding times are exceeded, all positive results are estimated (J) and non-detects are estimated (UJ). If holding times are grossly exceeded, the reviewer may reject non-detects as unusable (R).

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I. DATA COMPLETENESS		
Missing Information	Date Lab Contacted	Date Rec'd

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B—1 BLANK ANALYSIS RESULTS (Sections 1, 2 & 3)

List the contamination in the blanks below.

1. Laboratory Blanks

Level: _____

PREPARATION

Date	ICB/CCB ID	Blank	Analyte	Concentration/Units

2. Equipment and Method Blanks

Date	Sample ID	Analyte	Concentration/Units

3. Frequency Requirements

A. Was a preparation blank analyzed for each matrix, for every 20 samples and for each digestion batch? Yes or No

B. Was a calibration blank run every 10 samples? Yes or No

If No,

The date may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below, and list the samples affected.

_____

_____

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Data Review Worksheets

B—2. BLANK ANALYSIS RESULTS (Section 4)

4. Blank Actions

Action levels should be based upon the highest concentration of contaminant determined in any blank. The action level for samples which have been concentrated or diluted should be multiplied by the concentration/dilution factor. No positive sample result should be reported unless the concentration of the analyte in the sample exceeds the action level of 5 times the amount in the blank. Specific actions are as follows:

1. If the concentration is less than the instrument detection limit (IDL), and also less than the action level, report the IDL and flag as non-detected (U).

2. If the concentration is greater than the IDL, but less than the action level, report the concentration found and flag as non-detected (U).

3. If the concentration is greater than the action level, report the concentration unqualified.

Level: _____

Analyte	Max. Conc./Units	Action Level/Units	IDL

A separate worksheet should be used for low and medium level blanks

C-1. LABORATORY CONTROL SAMPLE (Sections 1 & 2)

1. Aqueous LCS

List the LCS recoveries which do not meet the 80-120% criteria and the samples affected.

Element	% Recovery	Action	Samples Affected

2. Solid LCS

List the analytes which are not within the control windows set by the EPA for the solid LCS samples. (Note: 80-120% criteria is not used to evaluate solid LCS results.)

Element	LCS Concentration	Control Windows	Action	Samples Affected

C-2. LABORATORY CONTROL SAMPLE (Section 3)

3. LCS Actions

Action levels should be based on the LCS recovery criteria as follows:

1. For aqueous samples —

	% Recovery		
	<50%	50-79%	>120%
Positive Sample Results	R	J	J
Non-detected Results	R	UJ	A

2. For soil/sediment samples —

	% Recovery	
	< EPA Control Windows	EPA Control Windows
Positive Results	J	J
Non-detected Results	UJ	A

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Data Review Worksheets

D. MATRIX SPIKE RECOVERY

Sample No. _____ **Matrix:** _____

List the percent recoveries for analytes which do not meet the QC criteria.

Analytes	SSR	SR	S	% Recovery	Actions

Where, SSR = spikes sample result
SR + sample result
S = amount of spike added

Matrix spike action is applied to all samples of the same matrix.

ACTIONS

1. If any compound does not meet the Contract Required Recovery range (CRR) as stated in the Validation Guidelines. Follow the actions stated below:

	% Recovery		
	<30%	30 to lower CRR	>higher CRR
Positive Sample Results	R	J	J
Non-detected Results	R	UJ	A

2. If the sample concentration exceeds the spike concentration by a factor of 4 or more, no action is taken.

A separate worksheet should be used for each MS sample.

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Data Review Worksheet

E. FIELD DUPLICATES

Sample Nos. _____,_____ Matrix: ____

Element	CRDL		Sample	Duplicate	RPD	Action
	Water ug/L	Soil mg/kg				
Lead	5					
Zinc	20					

Field Duplicate Actions should be applied to all other samples of the same matrix type.

ACTIONS:

1. For sample results greater than 5 times the CRDL, positive results for analytes which have an RPD >30% for waters and >50% for soils should be qualified as estimated (J).

2. For sample results less than 5 times the CRDL, qualify the positive results as estimated (J) and the non-detected results as estimated (UJ), for analytes whose absolute difference is greater than 2 times the CRDL for aqueous matrices and greater than 4 times the CRDL for soil matrices.

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Data Review Worksheet

F. LABORATORY REPLICATES

Sample Nos. _____,_____ Matrix: ____

List the concentrations of all analytes not meeting the criteria for laboratory replicate precision. For soil replicates calculate the CRDL in mg/kg. Indicate which criteria was used to evaluate precision by circling either the RPD or CRDL for each analyte.

Element	CRDL		Sample	Duplicate	RPD	Action
	Water ug/L	Soil mg/kg				
Lead	5					
Zinc	20					

Laboratory Replicate Actions should be applied to all other samples of the same matrix type.

ACTIONS:

1. For sample results greater than 5 times the CRDL, positive results for analytes which have an RPD >20% for waters and >35% for soils should be qualified as estimated (J).

2. For sample results less than 4 times the CRDL, qualify the positive results as estimated (J) for analytes whose absolute difference is greater than the CRDL for aqueous matrices and greater than 2 times the CRDL for soil matrices.

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Data Review Worksheets

G-1. CALIBRATION (Section 1)

1. Recovery Criteria

List the analytes which did not meet the percent recovery (%R) criteria for Initial or continuing Calibration.

Date	ICV/CCV ID	ANALYTE	%R	Action	Samples Affected

ACTIONS:

If any analyte does not meet the %R criteria follow the actions stated below:

For Positive Sample Results:

	Reject (R)	Estimate (J)	Accept
Metals	<75%R, >125%R	75-89%R, 111-125%R	90-110%R
Mercury	<65%R, >135%R	65-79%R, 121-135%R	80-120%R
Cyanide	<70%R, >130%R	70-80%R, 116-130%R	85-115%R

For Non-Detected Sample Results:

	Reject (R)	Estimate (J)	Accept
Metals	<75%R, >125%R	75-89%R	90-125%R
Mercury	<65%R, >135%R	65-79%R	80-135%R
Cyanide	<70%R, >130%R	70-84%R	85-130%R

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G-2. CALIBRATION (Section 2)

2. Analytical Sequence

A. Did the laboratory use the proper number of standards for calibration as described in the data evaluation guidelines? Yes or No

B. Were calibrations performed at the beginning of each analysis? Yes or No

C. Were calibration standards analyzed at the beginning of sample analysis and at a minimum frequency of ten percent or every two hours during analysis, whichever is more frequent? Yes or No

D. Were the correlation coefficients for the calibration curves for AA analyses $\geq$ 0.995? Yes or No

E. Was a standard at 2 X CRDL or 2 X IDL, whichever is greater, analyzed to verify linearity near the IDL for all ICP analyses? Yes or No

If No,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below and list the samples affected.

_____

_____

_____

_____

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Data Review Worksheets

H-1. ICP INTERFERENCE CHECK SAMPLE (Section 1 & 2)

1. Recovery Criteria

List any elements in the ICS AB solution which did not meet the criteria for %R.

DATE	ELEMENT	%R	ACTION	SAMPLES AFFECTED

ACTIONS:

If an element does not meet the %R criteria, follow the actions stated below:

	% RECOVERY		
	<50%	50-79%	>120%
Positive Sample Results	R	J	J
Non-detected Sample Results	R	UJ	A

2. Frequency Requirements

Were Interference QC samples run at the beginning and end of each sample analysis run or a minimum of twice per 8 hour working shift, whichever is more frequent? Yes or No

If No,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below and list the samples affected.

_____

_____

H-2. ICP INTERFERENCE CHECK SAMPLE (Section 3)

3. Report the concentration of any elements detected in the ICS A solution >2 X IDL that should not be present.

ELEMENT	CONC. DETECTED IN THE ICS	CONC. OF INTERFERENCES			
		Al	Ca	Fe	Mg

Estimate the concentration produced by the interfering element in all affected samples. List the samples affected by interferences below:

SAMPLE AFFECTED	ELEMENT AFFECTED	SAMPLE CONC. (ug/L)	SAMPLE INTERFERENCE CONC.				ESTIMATED INTERF. (ug/L)
			Al	Ca	Fe	Mg	

ACTIONS:

1. In general, the sample data can be accepted without qualification if the sample concentrations of Al, Ca, Fe, and Mg are less than 50% of their respective levels in the ICS solution.

2. Qualify positive results as estimated (J) for affected elements for samples with levels of interferents 50% of more of that in the ICS solution.

3. Quality positive results as rejected or unusable (R) if the reported concentration is due entirely to the interfering element.

4. Qualify non-detected results as estimated (UJ) for which false negatives are suspect.

Give explanations for any actions taken below:

_____

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Data Review Worksheets

I. ICP SERIAL DILUTION ANALYSIS

Serial Dilutions were performed for each matrix and results of the diluted sample analysis agreed within ten percent of the original undiluted analysis.

Serial Dilutions were not performed for the following:
Serial Dilutions were performed, but analytical results did not agree within 10% for analyte concentrations greater than 50 X the IDL before dilution.

Report all results below that do not meet the required laboratory criteria for ICP serial dilution analysis.

MATRIX: _____

Element	IDL	50 X IDL	Sample Result (I)	Serial Dilution (S)	%D	Action
Lead						
Zinc						

Actions apply to all samples of the same matrix.

ACTIONS:
Qualify positive results for elements with %D > 15 as estimated (J)..

J. FURNACE ATOMIC ABSORPTION ANALYSIS

1. Duplicate Precision

Duplicate injections and one-point analytical spikes were performed for all samples: duplicate injections agreed within ±20%.

Duplicate injections and/or spikes were not performed for the following samples/elements:

_____

Duplicate injections did not agree within ± 20% for samples/elements:

_____

_____

2. Post Digestion Spike Recoveries

Spike recoveries met the 85-115% recovery criteria for all samples.

Spike recoveries did not meet the 85-115% criteria but did not require MS for the following samples/elements:

_____

_____

MSA was used to quantitate analytical results when contractually required

Correlation coefficients ≥ 0.995, accept results.

Correlation coefficients <0.995 for sample numbers/elements:

Method of Standard Addition (MSA) was not performed as required for samples/elements:

_____

ACTIONS:

1. Qualify associated positive sample results as estimated (J) if duplicate injections are outside ± 20% RSD or CV.

2. If the sample absorbance is <50% of post digestion spike absorbance the following actions should be applied:

	% Recovery		
	<10%	11% - 84%	>115%
Positive Sample Results	R	J	J
Non-detected Results	R	UJ	A

3. Qualify sample results as estimated (J) if MSA was required and not performed. Qualify sample results as estimated (J) if correlation coefficient was <0.995.

K. DETECTION LIMIT RESULTS

1. Instrument Detection Limits

Instrument Detection Limit (IDL) results were present and found to be less than the Contract Required Detection Limits.

IDLs were not included in the data package on Form XI.

IDLs were present, but the criteria was not met for the following elements:

_____

2. Reporting Requirements

Were sample results on Form I reported down to the IDL, not the CRDL, for all analytes?
Yes or No

Were sample results that were analyzed by ICP for Se, Tl, As, or Pb at least 5 x IDL?
Yes or No

Were sample weights, volumes, and dilutions taken into account when reporting detection limits on Form I? Yes or No

If No,

The reported results may be inaccurate. Make the necessary changes on the data summary tables and request that the laboratory resubmit the corrected data.

Region ____

ORGANIC REGIONAL DATA ASSESSMENT

CASE NO._____ SITE _____

LABORATORY_____ NO. OF SAMPLES/
MATRIX _____

SDG # _____ REVIEWER _____

SOW # _____ REVIEWER'S NAME _____

DPO: ACTION ___ FYI _____ COMPLETION DATE _____

DATA ASSESSMENT SUMMARY

	VOA	BNA	PEST	OTHER
1. HOLDING TIMES	___	___	___	___
2. GC/MS TUNE/INSTR. PERFORM.	___	___	___	___
3. CALIBRATIONS	___	___	___	___
4. BLANKS	___	___	___	___
5. SURROGATES	___	___	___	___
6. MATRIX SPIKE/DUP	___	___	___	___
7. OTHER QC	___	___	___	___
8. INTERNAL STANDARDS	___	___	___	___
9. COMPOUND IDENTIFICATION	___	___	___	___
10. SYSTEM PERFORMANCE	___	___	___	___
11. OVERALL ASSESSMENT	___	___	___	___

O = Data had no problems/ or qualified due to minor problems.
M = Data qualified due to major problems.
Z = Data unacceptable
X = Problems, but do not affect data.

ACTION ITEMS: _____

_____

_____

_____

AREAS OF CONCERN: _____

_____

_____

NOTABLE PERFORMANCE:

Region ____

INORGANIC REGIONAL DATA ASSESSMENT

CASE NO._____ SITE _____

LABORATORY_____ NO. OF SAMPLES/

MATRIX _____

SDG # _____ REVIEWER (IF NOT ESD)_____

SOW # _____ REVIEWER'S NAME _____

DPO: ACTION ____ FYI _____ COMPLETION DATE _____

DATA ASSESSMENT SUMMARY

	ICP	AA	Hg	CYANIDE
1. HOLDING TIMES	___	___	___	___
2. CALIBRATIONS	___	___	___	___
3. BLANKS	___	___	___	___
4. ICS	___	___	___	___
5. LCS	___	___	___	___
6. DUPLICATE ANALYSIS	___	___	___	___
7. MATRIX SPIKE	___	___	___	___
8. MSA	___	___	___	___
9. SERIAL DILUTION	___	___	___	___
10. SAMPLE VERIFICATION	___	___	___	___
11. OTHER QC	___	___	___	___
12. OVERALL ASSESSMENT	___	___	___	___

O = Data had no problems/ or qualified due to minor problems.
M = Data qualified due to major problems.
Z = Data unacceptable
X = Problems, but do not affect data.

ACTION ITEMS: _____

_____

_____

AREAS OF CONCERN: _____

_____

_____

NOTABLE PERFORMANCE: _____

_____