# SOIL REMEDIATION PLAN

**Prepared for:**

BLACK & DECKER (U.S.) INC.
Hampstead, Maryland

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## TABLE OF CONTENTS


| Section | Title | Page |
|---|---|---|
| **1** | **INTRODUCTION** | **1-1** |
| | 1.1 Overview | 1-1 |
| | 1.2 Objectives | 1-1 |
| **2** | **PREVIOUS SITE INVESTIGATIONS** | **2-1** |
| | 2.1 Initial Groundwater Investigation | 2-1 |
| | 2.2 Phase I Activities | 2-1 |
| | 2.3 Phase II Activities | 2-2 |
| | 2.4 Remediation System Design Activities | 2-3 |
| | 2.5 Remediation System Operation Activities | 2-3 |
| **3** | **SOIL REMEDIATION TECHNOLOGIES** | **3-1** |
| | 3.1 Remedial Technology Description | 3-1 |
| | 3.1.1 Soil Vapor Extraction (SVE) | 3-1 |
| | 3.1.2 Soil Vapor Extraction (SVE) Combined with Air Sparging | 3-2 |
| | 3.1.3 Bioventing | 3-2 |
| | 3.2 Proposed Remedial Technology for Two Primary Source Areas | 3-3 |
| | 3.2.1 Tank Farm 2 Area | 3-3 |
| | 3.2.1.1 Summary of Previous Findings | 3-3 |
| | 3.2.1.2 Selection of a Remedial Technology | 3-5 |
| | 3.2.2 Soil Beneath the Northeast Corner of Existing Building | 3-6 |
| | 3.2.2.1 Summary of Previous Findings | 3-6 |
| | 3.2.2.2 Selection of a Remedial Technology | 3-6 |
| **4** | **PILOT TESTING** | **4-1** |
| | 4.1 Tank Farm 2 Area | 4-1 |
| | 4.1.1 Extraction Vent and Monitoring Probe Installation | 4-1 |
| | 4.1.2 Soil Sampling During Vent and Monitoring Probe Installation | 4-5 |
| | 4.1.3 Pilot Test Procedures | 4-7 |
| | 4.2 Soil Beneath the Northeast Corner of the Existing Building | 4-8 |

## TABLE OF CONTENTS


| Section | Title | Page |
|---|---|---|
| 4.2.1 | Extraction Vents and Monitoring Probes Installation | 4-8 |
| 4.2.2 | Soil Sampling During Vent and Monitoring Probe Installation | 4-11 |
| 4.2.3 | Vapor Manifold | 4-13 |
| 4.2.4 | Vapor Treatment System | 4-14 |
| 4.2.5 | Pilot Test Procedures | 4-14 |
| 4.2.5.1 | System Startup | 4-14 |
| 4.2.5.2 | Pilot Scale System Test Runs | 4-15 |
| 4.2.5.3 | Sustained Operations | 4-17 |
| 4.2.6 | Data Collection Procedures | 4-17 |
| 4.2.6.1 | Static Pressure | 4-19 |
| 4.2.6.2 | Air Flow Rate | 4-19 |
| 4.2.6.3 | Temperature and Relative Humidity | 4-19 |
| 4.2.6.4 | Subsurface Static Pressure | 4-19 |
| 4.2.6.5 | Soil Vapor Organics Concentration | 4-20 |
| 4.3 | Data Analysis and Reporting | 4-20 |
| **5** | **IMPLEMENTATION OF SOIL REMEDIATION** | **5-1** |
| 5.1 | Design | 5-1 |
| 5.2 | Permitting | 5-1 |
| 5.3 | Construction | 5-2 |
| 5.4 | Operation and Monitoring | 5-2 |
| 5.5 | Report | 5-3 |
| **6** | **SCHEDULE** | **6-1** |


## LIST OF ATTACHMENTS


**ATTACHMENT A SOIL GAS PERMEABILITY TEST PROCEDURES A-1**

## LIST OF FIGURES


| Figure | Title | Page |
|---|---|---|
| 3-1 | Tank Farm 2 Soil Profile Depicting Zones of TPH Concentration 100 ppm and VOC Concentration > 1 ppm | 3-4 |
| 4-1 | Vacuum Vent Construction | 4-2 |
| 4-2 | Soil Vapor Extraction (SVE) Pilot Test System Layout Tank Farm 2 Area and Inside Building Soil Remediation | 4-4 |
| 4-3 | Schematic of Nested Pressure Monitoring Probes | 4-6 |
| 4-4 | Schematic of Nested Extraction Vents | 4-10 |
| 4-5 | Schematic of Nested Soil Pressure Monitoring Probes | 4-12 |

## LIST OF TABLES


| Table | Title | |
|---|---|---|
| 4-1 | Schedule of Measurements To Be Taken During Startup Test Period | 4-16 |
| 4-2 | Schedule of Measurements To Be Taken During Sustained Operations Period | 4-18 |

# SECTION 1
# INTRODUCTION

## 1.1 OVERVIEW

This Soil Remediation Plan has been prepared to meet the requirements of Condition IV.T. of the Administrative Consent Order between the State of Maryland Department of the Environment (MDE) and Black & Decker (U.S.) Inc. (Consent Order) finalized during April, 1995. Specifically, Condition IV.T. of the Consent Order calls for a description of the proposed methods for soil remediation and a statement of schedules and goals for soil remediation. A final version of this document will become part of the administrative record for the site which is to be maintained at a public repository in the town of Hampstead.

## 1.2 OBJECTIVES

The objective of this Soil Remediation Plan is to provide the information required by Condition IV.T. of the Consent Order. Each of the elements of that condition have been addressed in the plan. Specifically, the primary objectives of this Soil Remediation Plan are to provide a summary of previous site investigations (Section 2), a detailed description of the process options available and the rationale for selecting the recommended soil remediation technologies (Section 3), and a plan for conducting pilot testing of the selected remediation technologies (Section 4). A description of the implementation of the selected soil remediation alternative is presented in Section 5. A schedule for implementation of the soil remediation is presented in Section 6.

# SECTION 2
# PREVIOUS SITE INVESTIGATIONS

## 2.1 INITIAL GROUNDWATER INVESTIGATION

In April 1984, as part of an effort to determine the impact of a gasoline spill at the Hampstead Exxon service station, water samples of the supply wells at the Hampstead Black & Decker (U.S.) Inc. facility were collected and analyzed by the State of Maryland for volatile organic compounds (VOCs). As a result of the detection of VOCs, a groundwater investigation was conducted at the site to evaluate potential contaminant source areas in the northwestern corner of the property. The field investigation included geophysics, installation and analytical sampling of monitor wells, and aquifer testing. Based on this initial groundwater investigation, it was concluded that several potential source areas may have contributed to the groundwater contamination.

## 2.2 PHASE I ACTIVITIES

In 1987, the Black & Decker Corporation retained Roy F. Weston, Inc. (WESTON®) to conduct a comprehensive environmental investigation of the facility. Phase I of Weston's environmental investigation, conducted in November and December 1987, utilized soil gas sampling, soil borings, geophysical surveying, test pit excavations, surface water (lagoon) and sediment sampling, and groundwater sampling in an effort to identify potential sources of the constituents found in the groundwater. Data collected during the Phase I investigation were evaluated and the resultant conclusions were incorporated in the design of the Phase II investigation. Results of these investigations were presented in the Environmental Investigation Report (EIR), submitted to MDE during April, 1989.

Specifically in the storage tank area, soil gas analysis was one of the investigative techniques used to determine the presence of soil contamination. Nineteen soil-gas samples were collected and analyzed for TCE and PCE from Tank Farm 1 (eight samples), Tank Farm 2 (three samples), and the aboveground storage tank area (eight samples). Sample locations were concentrated around distribution pipes and the underground and aboveground tanks identified on the site plans.

In addition, soil borings were performed at five locations at the storage tank area based on the soil gas results. Samples were collected from the borings and submitted for TPH and VOC analysis. Sample results indicated that further characterization of the soils in Tank Farms 1 and 2 in Phase II was warranted.

## 2.3 PHASE II ACTIVITIES

Phase II of Weston's environmental investigation, conducted in June, July, and December 1988, involved supplemental monitor well installation, additional soil borings, and groundwater and soil sampling and analysis. These activities aided in further definition of the extent of contamination of the on-site soil and groundwater, characterized routes of migration, and provided preliminary data to be considered in developing remedial alternatives.

During the Phase II investigation, 17 monitor wells were installed across the site (including monitor well RFW-8 at Tank Farm 2). Groundwater samples were collected from the newly installed monitor wells, the previously installed monitor wells, and 3 production wells (wells 5, 6, and 7) and submitted for VOC analysis. The groundwater sample results confirmed that the major contaminants of concern in the groundwater were TCE and PCE and a remediation plan was recommended to recover affected groundwater and prevent its migration off-site. In addition, during Phase II, several sets of water level measurements were collected in order to determine groundwater flow directions at the site.

Specifically in the tank farm area, a total of 13 soil borings were performed at Tank Farm 1 and a total of 14 soil borings were performed at Tank Farm 2 during the Phase II investigation. Soil samples were collected from borings at both areas and analyzed for VOCs and TPH. TCLP analysis was also conducted on selected samples to provide an indication of the mobility of the contaminants in the soil. An overall assessment of Tank Farm 1 suggested that the TPH and VOCs in the soil were present below concentrations which would impact groundwater on-site. However, an overall assessment of Tank Farm 2 suggested that VOCs, particularly TCE and PCE, in the soil were present at concentrations which could potentially impact the groundwater.

## 2.4 REMEDIATION SYSTEM DESIGN ACTIVITIES

Based on the Phase I and II investigations, remediation strategies to recover and treat the contaminated groundwater were proposed in the 1989 EIR. A work plan for soil and groundwater remediation was developed and submitted to MDE in December of 1989. In 1991, after receiving MDE approval of the work plan, Weston initiated a remediation system design investigation. The field investigation for the remedial design of the groundwater recovery and treatment system at the Black & Decker facility involved geophysics, well installation (including monitor well RFW-16 inside the building at the northeast corner), aquifer testing and groundwater sampling.

Specifically at monitor well RFW-16, the field screening results of the soil during drilling and groundwater analytical results indicated that TCE was present at concentrations that suggested the presence of a TCE source area at the northeast corner of the building that would require soil remediation

## 2.5 REMEDIATION SYSTEM OPERATION ACTIVITIES

During 1994, Black & Decker completed construction of the groundwater remediation system and, in August 1994, after MDE and DNR approval of the air, water appropriation and NPDES permit applications, the groundwater remediation system began operation. The on-going field activities that are conducted as a part of Weston's remedial system operation include quarterly groundwater sampling from the ten recovery wells and 18 monitor wells and monthly water level measurements collected in wells specified in the Water Appropriation Permit, issued by the Water Rights Division of the Maryland Department of Natural Resources.

# SECTION 3
# SOIL REMEDIATION TECHNOLOGIES

Black and Decker had originally considered two major options for soil remediation at Tank Farm 2 and the surrounding area. These were (1) excavation and on-site treatment, and (2) soil vapor extraction. Based principally on occurrence of soil contamination underneath the building near RFW-16, which could not be reasonably addressed by an excavation approach, and on other site specific factors, soil vapor extraction (SVE) has been selected as the best technology to address the Tank Farm 2 area and soil beneath the northeast corner of the existing building. This section describes the available variations of the SVE technology and identifies which process options are most suitable. The process options potentially applicable for soil remediation at these two source areas are SVE alone, SVE combined with air sparging, and SVE aided biodegradation (or bioventing). Descriptions of these remedial technologies are provided in subsection 3.1. A summary of previous findings and the rationale for choosing a specific process option for each of these areas are included in subsection 3.2.

## 3.1 REMEDIAL TECHNOLOGY DESCRIPTION

### 3.1.1 Soil Vapor Extraction (SVE)

Soil vapor extraction (SVE) is an effective in-situ technology that has many advantages over the conventional excavation, treatment and disposal approach. The SVE system removes VOCs from the soil by mechanically drawing air through the soil pore spaces. VOCs volatilize into the air as the air moves through the soil. This is accomplished by installing a series of vents in the vadose (unsaturated) zone of the soil and applying a vacuum to the vents by using a blower. The VOC-laden air stream is then collected and discharged or treated, depending upon the concentrations and types of VOCs present. This technology has also been used to remove VOCs from bedrock fractures using vents installed into the bedrock, where there is unsaturated bedrock. The application of SVE is limited only in cases where the permeability of the soil is too low to establish a sufficient air flow and radius of influence. The radius of influence and final design parameters can be determined by field pilot testing. SVE can achieve remediation with a minimum of site disturbance and can be installed under buildings to address inaccessible soils.

### 3.1.2 SVE Combined with Air Sparging

Because SVE draws air through the unsaturated zone only, SVE does not effectively remediate contamination below the water table. Using air sparging in conjunction with SVE is an emerging hybrid technology which has been shown to extend the effectiveness of the SVE process by providing an effective means for remediating VOCs in the saturated zone. Air sparging involves the injection of clean air below the water table. As the injected air flows up through the saturated soil, adsorbed and aqueous VOCs are volatilized. The injected air is subsequently removed above the water table with SVE. In order to be effective, a sufficient aquifer thickness and hydraulic conductivity are necessary. By forcing air through the saturated zone, air sparging can also significantly increase the concentration of dissolved oxygen (DO) in the groundwater. The increased DO concentrations can potentially increase the rate of aerobic biodegradation of organic contaminants within the saturated zone. This latter mechanism is generally effective only for readily biodegradable organics.

### 3.1.3 Bioventing

Bioventing is an emerging technology for in-situ bioremediation of unsaturated soils. Application of bioventing relies upon the following concepts: 1) the contaminants in the soils are aerobically biodegradable, 2) the soils contain microbial populations capable of biodegrading the target constituents, 3) biological degradation of the target constituents is limited by oxygen supply, and 4) venting of the soils by SVE or air injection can be used to supplement the oxygen supply and support bioremediation.

Mechanically, bioventing is implemented in a manner analogous to SVE alone. One or more ventilation wells are installed and air is injected or withdrawn by mechanical blowers, inducing air flow within soil pore spaces. Bioventing differs from SVE alone in that the latter technology induces a high air flow rate to maximize stripping of VOCs from soils, while bioventing uses lower air flow rates in an effort to minimize stripping and supply only sufficient oxygen to meet the biological oxygen demand of the contaminants. In addition, nutrient addition may be provided to enhance growth, depending upon an assay of soil nutrient levels.

To evaluate the feasibility of performing in-situ bioventing in the vadose zone, bioassessments of targeted area soil samples are conducted in the laboratory. Site bioassessments provide general information about site specific conditions which impact bioremediation. Parameters examined during a bioassessment for vadose zone soil include soil solution pH, nutrient analysis, microbial population density and microbial stimulation testing. In addition, field pilot testing is conducted to confirm sufficient air flow and radius of influence and to provide final design information.

## 3.2 PROPOSED REMEDIAL TECHNOLOGY FOR THE TWO PRIMARY SOURCE AREAS

### 3.2.1 Tank Farm 2 Area

#### 3.2.1.1 Summary of Previous Findings

A source characterization study confirmed that the contaminants of concern in the soils at Tank Farm 2 are petroleum hydrocarbons and the chlorinated hydrocarbons tetrachloroethene (PCE) and trichloroethene (TCE). Total petroleum hydrocarbons (TPH) concentrations in the soils sampled ranged from below detection (ND) to 93,000 ppm; chlorinated hydrocarbons concentrations ranged from ND to 7 ppm. Soils with high chlorinated hydrocarbon concentrations were generally also characterized by high TPH concentrations (see Figure 3-1).

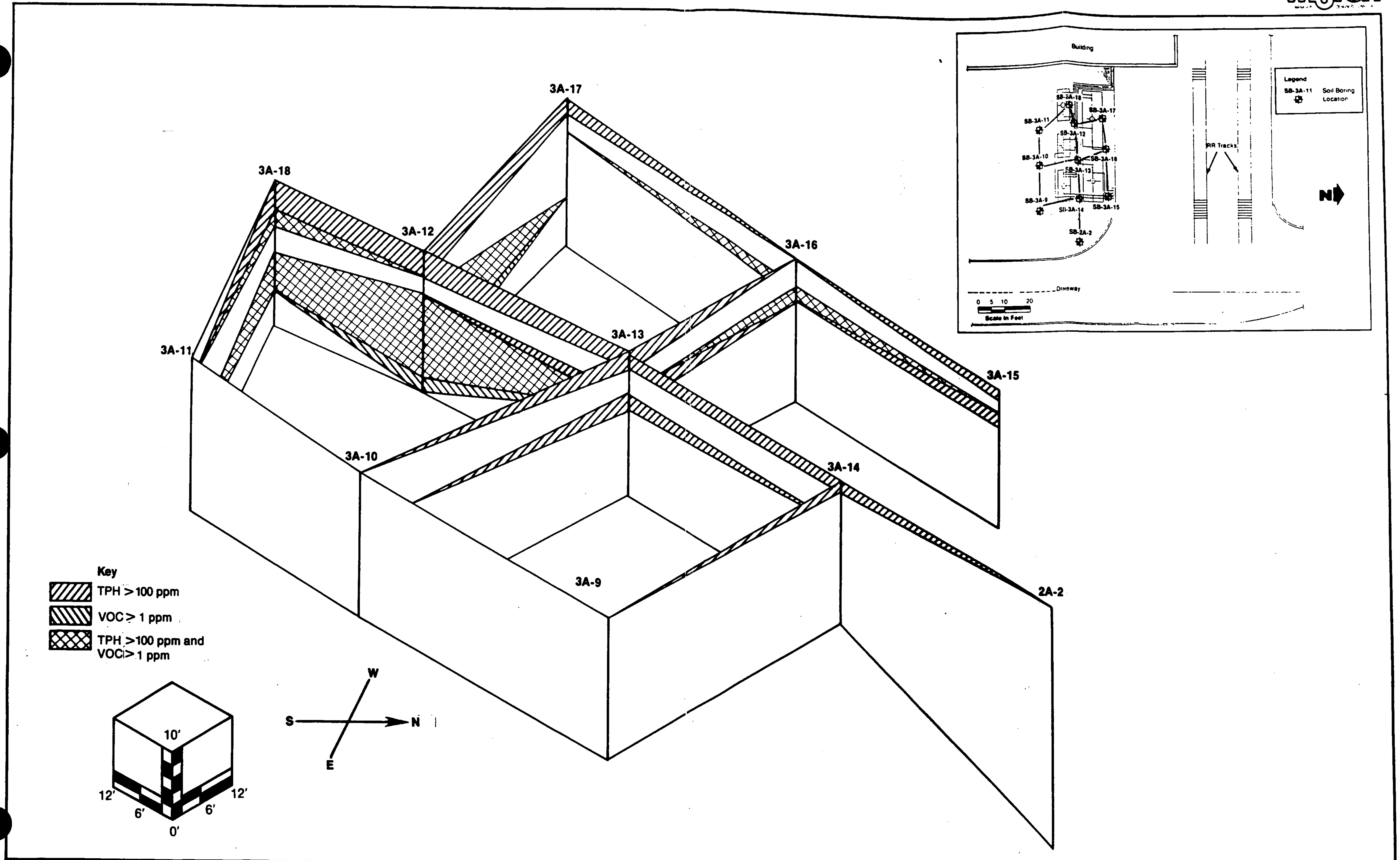


**FIGURE 3-1 TANK FARM 2 SOIL PROFILE DEPICTING ZONES OF TPH CONCENTRATION 100 PPM AND VOC CONCENTRATION > 1 PPM**

Samples from 11 closely spaced borings around Tank Farm 2 were collected and analyzed for VOCs and TPH to define the horizontal and vertical extent of the soil contamination. The data indicated, as depicted in Figure 3-1, that TPH concentrations >100 ppm and VOC concentrations >1 ppm are distributed in the soils:

- Throughout the tank area above 853 feet MSL (top 6 feet of soil), in an approximately 1,800-square foot area.
- In the central part of Tank Farm 2, closest to the building wall from the surface to 839 feet MSL (20 feet below ground surface).

A TCLP leachate analysis of select samples indicated that chlorinated hydrocarbons were sufficiently mobile in the soils to represent an ongoing potential source of groundwater contaminants.

#### 3.2.1.2 Selection of a Remedial Technology

SVE alone is not likely to be sufficiently effective for remediation of contaminated soil in the Tank Farm 2 area because of the presence of nonvolatile petroleum hydrocarbons from the cutting oils in addition to the volatile compounds, PCE and TCE. The VOCs may be dissolved in the oils which results in a much lower vapor pressure than for VOCs alone. Therefore, the volatilization rate may be too low. The non-volatile oils would not be extracted due to their low vapor pressure. SVE with air sparging is not applicable to this area because the soil contamination ends above the water table. SVE/bioventing is the most effective option, because it can stimulate in-situ biological activity and bioremediate the cutting oils. Once the cutting oils are degraded, the VOCs may be removed by a combination of bioremediation and soil vapor extraction. The bioventing process is, therefore, selected for soil remediation in the Tank Farm 2 area.

### 3.2.2 Soil beneath the Northeast Corner of Existing Building

#### 3.2.2.1 Summary of Previous Findings

One of the primary source areas for VOC contamination of site groundwater is suspected to be the soil below the northeast corner of building floor, adjacent to the aboveground storage tank (AST) area that included a TCE tank. Relatively minor spills have been hypothesized as having potentially occurred in association with loading of TCE from tank trucks to the TCE storage tank, although none were observed or reported by plant personnel. Groundwater samples from monitoring well RFW-16 (located inside the building in this area) consistently showed high levels of TCE (>100 ppm). Chemical data for soils in this area of the building are not available. Because of high concentrations of TCE in groundwater (as indicated by RFW-16), the presence of soil contamination in this area is anticipated.

#### 3.2.2.2 Selection of a Remedial Technology

The soils in the vadose zone underneath the building in the immediate area of the former TCE tank likely represent an on-going source of groundwater contamination. Remediation of these soils would significantly accelerate the on-going groundwater remediation effort at the site. SVE with air sparging was previously considered potentially applicable for groundwater and soil remediation in this source area. After the groundwater remediation system was started-up, however, the water table in this area was significantly depressed (>44 ft bgs). RFW-16 is currently dry and the water table is believed to be close to the bedrock in this area. Due to the low hydraulic conductivity in the upper bedrock, the feasibility of air sparging below water table is questionable. Therefore, application of air sparging below the water table in this source area was eliminated from further consideration. If the VOCs in this area are the result of unloading hose releases and there are no high concentrations of cutting oil hydrocarbons under the building, this area will respond more rapidly to SVE than to bioventing. Therefore, a SVE system is recommended for soil remediation in the northeast corner of the existing building. This selection can be verified by sampling soil during the SVE pilot test needed to design the SVE soil remediation system.

# SECTION 4
# PILOT TESTING

Pilot tests are needed to verify the effectiveness of SVE for treatment of VOC contaminated soil beneath the northeast corner of the building and SVE aided biodegradation (bioventing) for treatment of soil containing nonvolatile petroleum hydrocarbons together with volatile compounds in the Tank Farm 2 area, and to gather site-specific data to allow for full-scale system design. During pilot system operation, full scale design criteria will be obtained via monitoring of vadose zone air pressures and extracted vapor. The tasks associated with installation and operation of the pilot systems are presented in the following subsections.

## 4.1 TANK FARM 2 AREA

The pilot test for bioventing of hydrocarbons in Tank Farm 2 area soils will be based upon principles and methods outlined in "Test Plan and Technical Protocol for a Field Treatability Test for Bioventing", Air Force Center for Environmental Excellence (AFCEE) May 1992 (the protocol) (Attachment A). The following sections outline the approach to the bioventing pilot test.

### 4.1.1 Extraction Vent and Monitoring Probe Installation

One extraction vent will be installed approximately at the center of the Tank Farm 2 area. This location corresponds to the soil zone with high concentrations of TPH (>100 ppm) and VOC (>1 ppm) as shown in Figure 3-1, Tank Farm 2 Soil Profile.

The general configuration of the vent is illustrated in Figure 4-1. Considering the shallow depth of contamination in the Tank Farm 2 area (extends to approximately 20 ft bgs), a 3-in. diameter vent is expected to provide adequate airflow for air permeability/radius of influence testing. The soil extraction vent will be installed using hollow-stem auger drilling techniques. The vent will be constructed of schedule 40 PVC, and will be

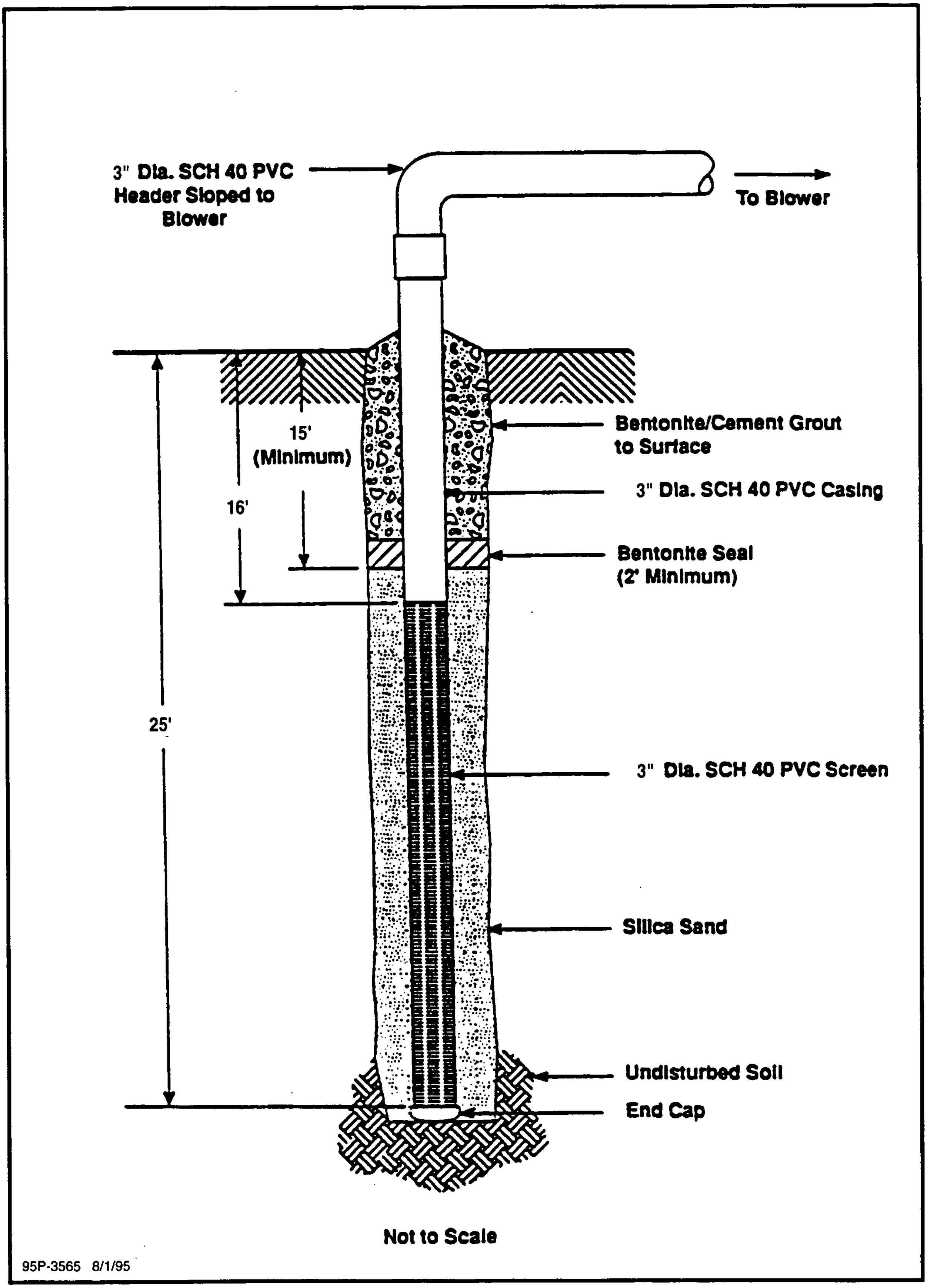


**FIGURE 4-1 VACUUM VENT CONSTRUCTION**

screened with a slot size that maximizes airflow through the soil. The screened interval will extend from 15 ft bgs to 25 ft bgs. The annular space corresponding to the screened interval will be filled with silica sand or equivalent. The annular space above the screened interval will be sealed with wet bentonite and grout to prevent short-circuiting of air from the surface.

Figure 4-2 shows the layout of the SVE pilot scale system. A trailer-mounted SVE blower system will be used for the pilot test. The trailer-mounted pilot plant consists of the following equipment:

- One knockout tank (moisture separator tank)
- One particulate air filter
- One vacuum relief valve
- One 7.5 HP positive displacement vacuum blower and motor
- Air/Air heat exchanger
- Piping, valves, and instrumentation

Other equipment to be used during the pilot test include above ground piping for extracted vapor and instrumentation.

The vent will have a sampling port for operational measurements, such as static pressure, temperature, and air flow rate. Vapor extracted from the vent will be drawn through the aboveground piping under vacuum to the vacuum blower system. The vapor will pass through the knockout tank (for removing entrained liquids), through the vacuum blower, through the heat exchanger, through two vapor-phase GAC units connected in series, and will then be discharged to the atmosphere. The SVE blower system will have sampling ports for operational measurements at SVE system inlet (velocity and static pressure, temperature, relative humidity) and at heat exchanger inlet and outlet (temperature).

Three (3) pressure monitoring (PM) probes (one on the east and two on the west of the soil vent), each screened to two (2) depths will be installed in a straight line radially from the soil vent. The proposed locations of the nested PM probes are shown in Figure 4-2.

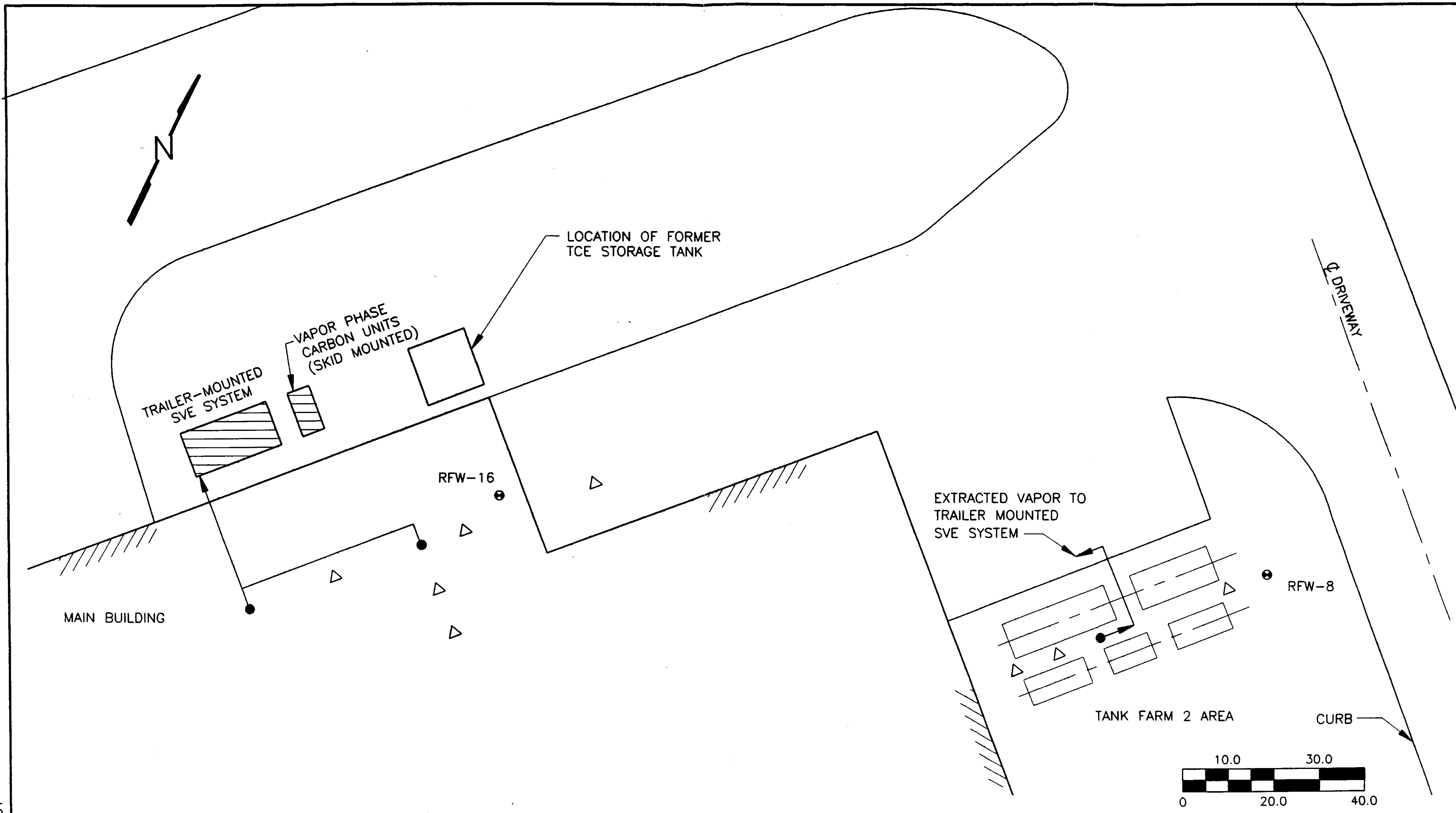


FIG. 4-2
SOIL VAPOR EXTRACTION (SVE) PILOT TEST SYSTEM LAYOUT TANK FARM 2 AREA AND INSIDE BUILDING SOIL REMEDIATION
BLACK & DECKER, INCORPORATED
HAMPSTEAD MARYLAND

ROY F. WESTON, INC.
WESTON
MANAGERS DESIGNERS/CONSULTANTS

| DRAWN JTT | DATE 7/20/95 | DES. ENG. | DATE | W. O. NO. 2501004001 |
|---|---|---|---|---|
| CHECKED | DATE | APPROVED | DATE | DWG. NO. FIG 4-2 |

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The nested PM probes on the west side will be positioned at 10 ft intervals and the PM probe on the east side will be located approximately 30 ft from the extraction vent. The deepest probe of the nested PM probe assembly will be installed to a depth of about 23 ft bgs. The shallowest probe will be installed to a depth of about 12 ft bgs. Each probe will consist of a 2.5-ft section of 0.01-inch slotted schedule 40 PVC, and 1.25-inch O.D Schedule 40 PVC riser pipe. A 5-ft sand pack will be placed around the 2.5 ft slotted PVC pipe section for the shallow and deeper probes. The screened intervals for the probes will be located at 11 to 13.5 ft bgs and 21 to 23.5 ft bgs. A layer of hydrated bentonite will be placed on top of the two sand packs. A cement/bentonite grout seal will be used between the shallowest sand pack and the bentonite seal above the bottom interval. The 6-inch borehole for the nested probes will be completed with a cement/bentonite grout seal. The top of the nested probes will be covered with PVC caps, which will have a port for attaching a pressure monitoring gauge. A schematic of the nested soil PM probe assembly is shown in Figure 4-3.

### 4.1.2 Soil Sampling During Vent and Monitoring Probe Installation

The extent of VOC and TPH contamination in the Tank Farm 2 area soils has been well documented. During boring installation for the soil vent, split spoon soil samples will be collected from three different depths (target depth intervals being 0 and 7 ft bgs, 7 and 15 ft bgs, and 15 and 25 ft bgs). Sample locations will be determined in the field based on PID readings. Each sample will be analyzed for TPH, TCE and PCE. In addition, three samples will be analyzed for total kjeldahl nitrogen (TKN), total phosphorous, alkalinity, total iron, moisture, hydraulic conductivity, porosity, pH, and total heterotrophic plate count. Samples will also be collected during boring installation for monitoring probes. From zero to three samples will be selected in the field for the same analysis based upon PID readings.

VOC and TPH data will be used to confirm the level and spatial distribution of TCE, PCE and TPH in the Tank Farm 2 soils.

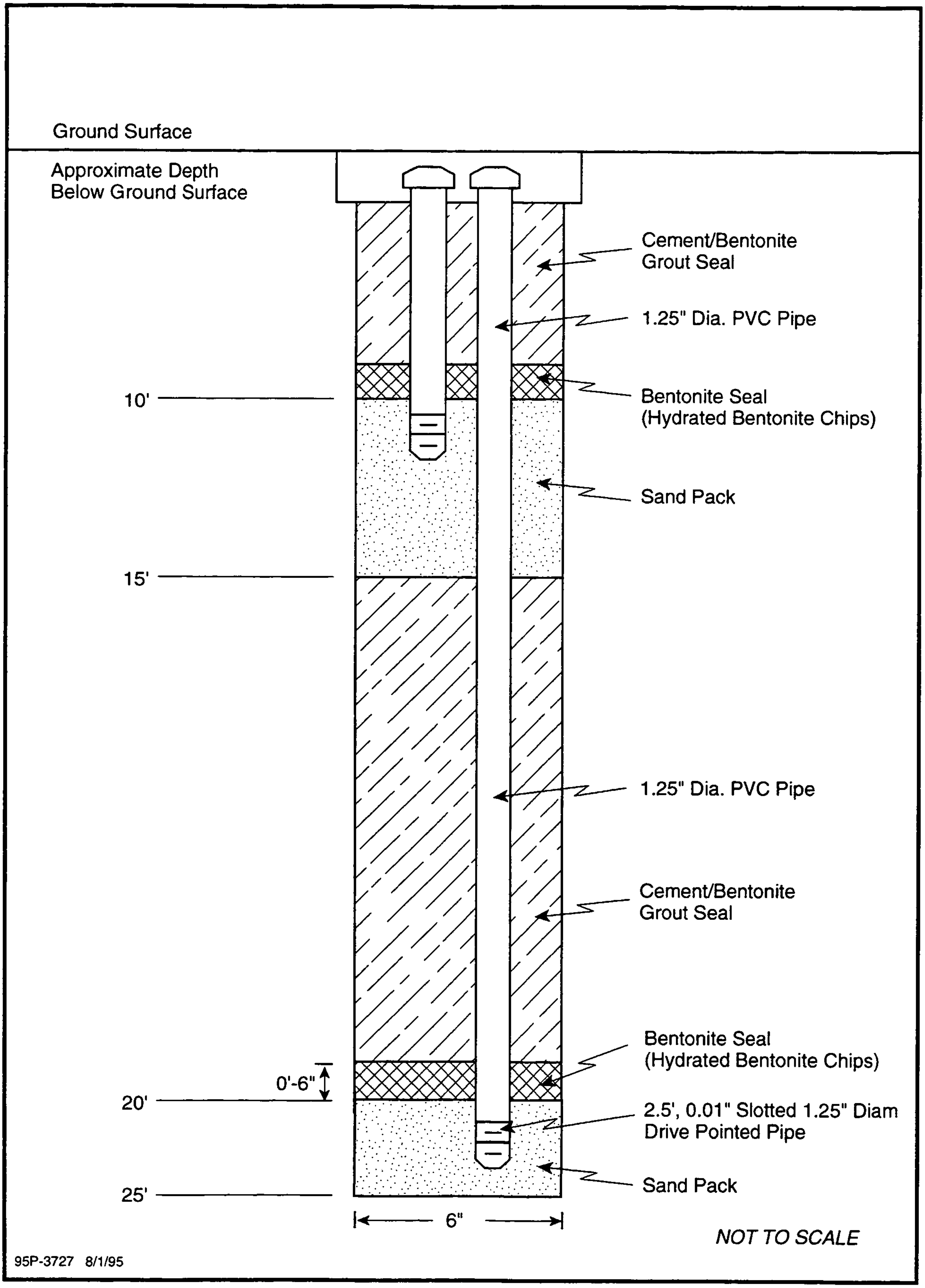


**FIGURE 4-3 SCHEMATIC OF NESTED SOIL PRESSURE MONITORING PROBES**