REPORT OF SOIL GAS INVESTIGATION

FORMER TORRINGTON HEAVY BEARINGS FACILITY
3702 WEST SAMPLE STREET
SOUTH BEND, INDIANA

Submitted to:

CAPSULE ENVIRONMENTAL ENGINEERING, INC.

St. Paul, Minnesota

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St. Louis, Missouri

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Project 1-211-2-0074

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1.0 BACKGROUND

The former Torrington Heavy Bearings Facility is located at 3702 West Sample Street in South Bend, Indiana (Figure 1). The site is approximately 16 acres and includes a 352,000 square foot manufacturing building, foundry building, solvent still building and surface water pond. Four additional surface water ponds (2 through 5) located south of the manufacturing building and west of the foundry previously existed on the property. These ponds were formerly used to collect surface drainage and drainage from processes inside the building. Twenty-five ground-water monitoring wells and one recovery well are located on-site with five of the 25 monitoring wells located in two parking lot areas north of the manufacturing building. Additionally, two production wells (Torrington Wells T-3 and T-4) are located within the east and west portion of the manufacturing building, respectively.

The site subsurface soil generally consists of sand and gravel deposits to an approximate depth of 60 feet below the ground surface. Based on past subsurface data collected at the site, a clay layer (20 feet to 30 feet thick) is present at an approximate depth of 60 feet below the ground surface. The clay layer, which is reportedly continuous beneath the site, is underlain by sand and gravel deposits similar to the overlying soil (Torrington Investigation Report, Capsule 1991).

A previous soil gas investigation was conducted at the site by Tracer Research Corporation (Tracer) in April 1992. Under the supervision of Capsule Environmental Engineering (Capsule), Tracer collected 47 soil gas samples in the general area of monitoring well S-3 and the southwest portion of the manufacturing building. Tracer's report of the April 1992 investigation is included in the Summary Report of Previous Assessment Activities, dated September 10, 1992 and prepared by Law.

2.0 PURPOSE

The purpose of the soil gas survey was to attempt to delineate the horizontal extent and identify potential source areas of volatile organic compounds (VOCs) in the subsurface. To achieve the objectives of the investigation, soil gas samples were collected and analyzed for the following:

- benzene, toluene, ethylbenzene and total xylenes (BTEX),
- total volatile hydrocarbons (TVHC),
- 1,1 - dichloroethene (1,1-DCE),
- 1,1 - dichloroethane (1,1-DCA),
- trichloroethane (TCA),
- trichloroethene (TCE), and,
- tetrachloroethene (PCE).

Although the soil gas survey is useful in delineating the horizontal extent of impact to a site, identifying potential source areas and migration pathways, there are limitations. Soil gas surveys measure vapor concentrations which are present in the unsaturated zone. These vapor concentrations do not necessarily correlate to soil and ground-water analyte concentrations. Soil gas surveys cannot detect semivolatile organic compounds or heavy metal contamination. Shallow ground-water at a soil gas sampling location may also inhibit the collection of a soil gas sample.

3.0 FIELD ACTIVITIES

Field activities commenced on November 11, 1992 and were completed on November 18, 1992. Soil gas samples were collected and analyzed by Tracer using a field gas chromatograph (GC). Identification of the soil gas sample locations commenced with sample number SG-48 and concluded with SG-155. The previous soil vapor investigation, conducted by Tracer in April 1992, completed soil gas sample locations SG-1 through SG-47.

The soil gas survey was initiated inside the north end of the manufacturing building at the SG-48 sample location. A total of 107 soil gas samples were collected from 108 locations (Figure 2). The presence of water in the SG-75 probe hole prevented soil gas sample collection. Based on Tracer's sample point spacing recommendations for data interpretation, Tracer proposed 80 soil gas sampling points to be used for the soil gas survey. Use of the field GC enabled Tracer and Law to interpret incoming data and select locations for up to 40 additional soil gas sampling points to further define the potential source areas. Seven soil gas samples were collected in the southwest portion of the manufacturing building to correlate data from the previous soil gas investigation.

Two attempts were made to collect soil gas samples inside Pond 1 (Figure 2). Water was encountered in each probe hole at a depth of less than one foot below the pond floor. Subsequently, no samples were collected in the Pond 1 area. The probe hole attempts in Pond 1 were not assigned a sample number.

A compressed air driven rock drill was used to advance 1-inch diameter holes through the floor slabs of the manufacturing building, former foundry building and the concrete outside the buildings. Soil gas sample probes were driven at each numbered location using either a van mounted hydraulic unit, a remote compressed air driven hammer or were hand pounded to the desired depth. An attempt was made to drive each sampling probe to a depth of five feet below the ground surface at each sample location. However, probe refusal or water was encountered prior to reaching the depth of five feet at a number of locations. Soil gas sampling locations less than five feet below the ground surface are shown on Table 1. The Tracer report (November 1992) summarizing field activities and findings is provided as Appendix A. Figures 1 through 6 of the Tracer report show the soil gas sampling locations and isoconcentration maps for five of the compounds listed in Section 2.0. Concentrations are reported in micrograms per liter ($\mu g/\ell$). Isoconcentration maps for BTEX and TVHC were not provided by Tracer.

4.0 SOIL GAS SURVEY RESULTS

The following sections (4.1 through 4.6) provide a summary of soil gas data from the November 1992 Tracer report. Isoconcentration maps of 1,1-DCE, 1,1-DCA, TCA, TCE and PCE (Figures 2 through 6 of the Tracer report) were used to identify potential VOC source areas at the site. In the following sections, sample identifications, VOC concentrations, and sample locations are presented in tabular format. The soil gas sample identifications and corresponding VOC concentrations generally consist of the highest VOC concentrations detected in a given area (sample location) of the site. The sample locations identified in Sections 4.1 through 4.6 are shown on Figure 3.

4.1 BTEX and TVHC

BTEX compounds were detected in a total of 13 soil gas samples. Benzene was detected in one sample while toluene and total xylenes were each detected in six samples. Ethylbenzene was not detected. TVHC was detected in 59 soil gas samples. The highest concentration of benzene, toluene, total xylenes and TVHC and the general sample location are as follows:

Soil Probe Number	Analyte Concentration ($\mu g/\ell$)	Approximate Sample Location
SG-72	0.2 benzene	Northwest corner of manufacturing building
SG-70	22 toluene	North of steam cleaning room
SG-124	180 total xylenes	Southeast area of site
SG-95	240 TVHC	Southeast area of site

Isoconcentration maps for BTEX and TVHC were not provided by Tracer.

4.2 1,1-DCE

1,1-DCE was detected in 33 soil gas samples. The two highest concentrations were detected at the SG-55 (1,200 $\mu g/\ell$) and the SG-70 (100 $\mu g/\ell$) locations. Both of these soil gas sample locations are adjacent to what appears to be a former steam cleaning room in the manufacturing building (Figure 2 of the November 1992 Tracer report). 1,1-DCE at or above 20 $\mu g/\ell$ was identified at three other locations. These areas include the northwest corner of the manufacturing building, southeast area of the site and the monitoring well S-3 area along the east side of the manufacturing building. The highest concentrations of 1,1-DCE and approximate sample locations are as follows:

Soil Probe Number	1,1-DCE Concentration ($\mu g/\ell$)	Approximate Sample Location
SG-55	1,200	South of steam cleaning room
SG-70	100	North of steam cleaning room

SG-134	20	Northwest corner of manufacturing building
SG-153	20	Northwest corner of manufacturing building
SG-68	20	Monitoring well S-3 area (east side of manufacturing building)
SG-88	24	Southeast area of site

4.3 1,1-DCA

1,1-DCA was detected in 20 soil gas samples. The two highest concentrations of 1,1-DCA were detected near the steam cleaning room in the manufacturing building. The soil gas samples collected from the SG-55 and SG-70 locations exhibited concentrations of 2,500 $\mu g/\ell$ and 110 $\mu g/\ell$, respectively. Four additional areas of detectable 1,1-DCA were identified during the soil gas survey. These included the northwest corner of the manufacturing building, the southeast area of the site, the S-3 area and the east portion of the covered loading dock area on the south side of the manufacturing building (Figure 3 of the November 1992 Tracer report). The highest concentrations of 1,1-DCA and approximate sample locations are as follows:

Soil Probe Number	1,1 DCA Concentration ($\mu g/\ell$)	Approximate Sample Location
SG-55	2,500	South of steam cleaning room
SG-70	110	North of steam cleaning room

SG-132	40	North of steam cleaning room
SG-51	40	North of steam cleaning room
SG-133	13	Northwest corner of manufacturing building
SG-134	15	Northwest corner of manufacturing building
SG-68	16	Monitoring well S-3 area (east side of manufacturing building)
SG-117	40	Loading dock area
SG-147	15	Loading dock area
SG-62	30	Loading dock area
SG-89	18	Southeast area of site
SG-96	10	Southeast area of site

4.4 TCA

TCA was detected in 106 of the 107 samples analyzed. The soil gas samples collected from locations SG-53, SG-55, SG-70, SG-112 and SG-153 exhibited the greatest TCA concentrations at the site. TCA in the these samples ranged from 100 $\mu g/\ell$ at the SG-53 and SG-112 locations to 430 $\mu g/\ell$ at the SG-55 location (Figure 4 of the November 1992 Tracer report). The highest concentrations of TCA and approximate sample locations are described as follows:

Soil Probe Number	TCA Concentration ($\mu g/\ell$)	Approximate Sample Location
SG-55	430	South of steam cleaning room
SG-70	300	North of steam cleaning room
SG-53	100	West of steam cleaning room
SG-153	180	Northwest corner of manufacturing building
SG-112	100	Southeast area of site

4.5 TCE

TCE was detected in 19 soil gas samples. Based on the soil gas survey data, the primary area of TCE impact is in the northwest corner of the manufacturing building. Two smaller areas impacted by TCE were identified in the southeast area of the site and in the general area of the covered loading dock (Figure 5 of the November 1992 Tracer report). The highest concentrations of TCE and approximate sample locations are described as follows:

Soil Probe Number	TCE Concentration ($\mu g/\ell$)	Approximate Sample Location
SG-133	16	Northwest corner of manufacturing building
SG-136	11	Northwest corner of manufacturing building
SG-147	2	Loading dock area
SG-96	2	Southeast area of site

4.6 PCE

PCE was detected in 50 soil gas samples. The highest concentration of PCE was identified at the SG-55 location (290 $\mu g/\ell$). Additional areas of PCE impact included the northwest corner of the manufacturing building, southeast area of the site, the covered loading dock area and an area north of monitoring well S-3 (Figure 6 of the November 1992 Tracer report). The highest concentrations of PCE and approximate sample locations are described as follows:

Soil Probe Number	PCE Concentration ($\mu g/\ell$)	Approximate Sample Location
SG-55	290	South of steam cleaning room
SG-70	2	North of steam cleaning room
SG-132	1	North of steam cleaning room
SG-50	7	Northeast of steam cleaning room
SG-105	5	Northeast of steam cleaning room
SG-153	3	Northwest corner of manufacturing building
SG-152	4	North of S-3 area
SG-147	34	Loading dock area
SG-117	4	Loading dock area
SG-109	1	Southeast area of site

5.0 CONCLUSIONS

The following items represent Law's conclusions based upon the information provided in Tracer's Shallow Soil Gas Investigation report (November 1992):

- VOCs are present beneath the site. During the soil gas investigation, 1,1-DCE, 1,1-DCA, TCA, TCE, PCE, BTEX and TVHC were detected in the vadose zone.

- The highest VOC concentration (2,500 ug/L of 1,1-DCE) was detected near the steam cleaning room.

- The isoconcentration maps for the chlorinated compounds are similar. Upon review of the isoconcentration maps, several potential source areas appear to be present including:

  - The general area of the steam cleaning room in the manufacturing building,

  - The northwest corner of the manufacturing building,

  - The southeast area of the site, and,

  - The S-3 monitoring well area along the east side of the manufacturing building.

  These potential source areas are shown on Figure 3.

- Soil gas data collected from the general area of monitoring well S-3 and the southwest portion of the manufacturing building generally correlates with the data from the previous soil gas investigation.

- The presence or absence of VOCs in Pond 1 was not confirmed. Soil gas samples could not be collected inside of Pond 1 due to the presence of shallow water less than one foot below the pond floor.

6.0 RECOMMENDATIONS

Given the apparent extent of VOC impact to the subsurface, and the locations of the potential source areas, Law recommends the following:

- The installation and sampling (soil and ground water) of approximately 6 ground-water monitoring wells (three groups of two monitoring well clusters each) at the subject site. The proposed locations of the three monitoring well clusters (MW-17, MW-18 and MW-19, Figure 4) will assist in assessing both the horizontal and vertical extent of VOCs in the soil and ground-water on-site. Each well cluster should consist of one shallow ground-water monitoring well screened to intercept the ground-water table beneath the site and one deep ground-water monitoring well screened to monitor the unconsolidated sediment/clay layer interface at an approximate depth of 60 feet below the ground surface for the potential presence of dense non-aqueous phase liquids (DNAPLs).

  Ground-water monitoring well clusters MW-17 and MW-18 will be installed to assess the vertical extent and concentration of VOC impact at potential source areas beneath the manufacturing building. Ground-water monitoring well cluster MW-19 will be installed to assess the presence of VOC impact generally hydraulically downgradient and at the property boundary from the the S-3 area (southwest portion of the site).

  During drilling of each ground-water monitoring well borehole, soil samples will be collected and field screened in general accordance with the procedures and using equipment generally described in the FSP. If field screening of soil samples at proposed well cluster locations near potential source areas (MW-17 and MW-18) indicates readings of less than one part per million, Law will discuss with Capsule, the feasibility of conducting additional soil borings and/or relocating the ground-water monitoring well clusters. Additionally, proposed monitoring well locations may be modified in the field as additional information becomes available.

Upon completion of this phase of the Remedial Investigation (RI), the data will be evaluated and recommendations made for additional assessment (including the installation of additional ground-water monitoring well clusters), if necessary.

Table 1: Soil Gas Sample Depths

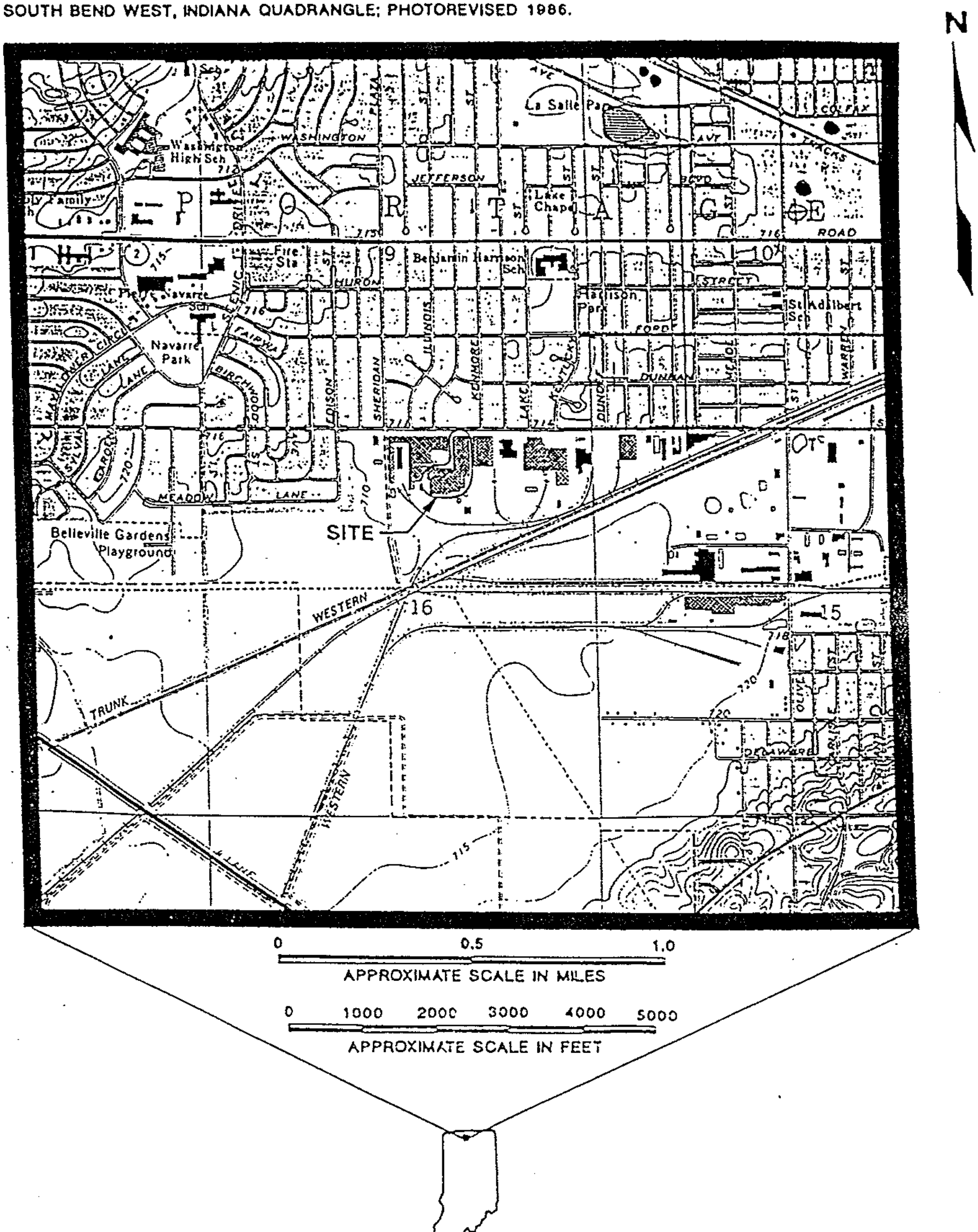
Soil Gas Sample Location	Sample Depth (feet below ground surface)	Result
SG-62	3.5	Refusal
SG-67	4.5	Refusal
SG-68	4.0	Refusal
SG-72	2.0	Refusal
SG-75	NS	Water in probe hole
SG-104	2.0	Poor vacuum below 2 feet
SG-115	3.5	Refusal
SG-116	3.5	Refusal
SG-119	4.0	Refusal
SG-125	3.5	Refusal
SG-128	3.5	Refusal
SG-139	3.0	Water below 3 feet
SG-140	3.0	Water below 3 feet
SG-141	3.0	Water below 3 feet
SG-142	4.0	Water below 4 feet
SG-143	3.0	Water below 3 feet
SG-144	3.0	Water below 3 feet
SG-146	1.0	Water below 1 foot
SG-149	3.0	Refusal

Notes:

NS - No sample
SG- Soil gas
Remaining soil gas samples (SG-48 through SG-155 excluding those listed above), collected from a depth of five feet below ground surface.
Soil gas samples collected by Tracer Research Corporation between November 11, 1992 and November 18, 1992.

Prepared By/Date RAQ / 1/22/93
Checked By/Date CJD / 1/22/93

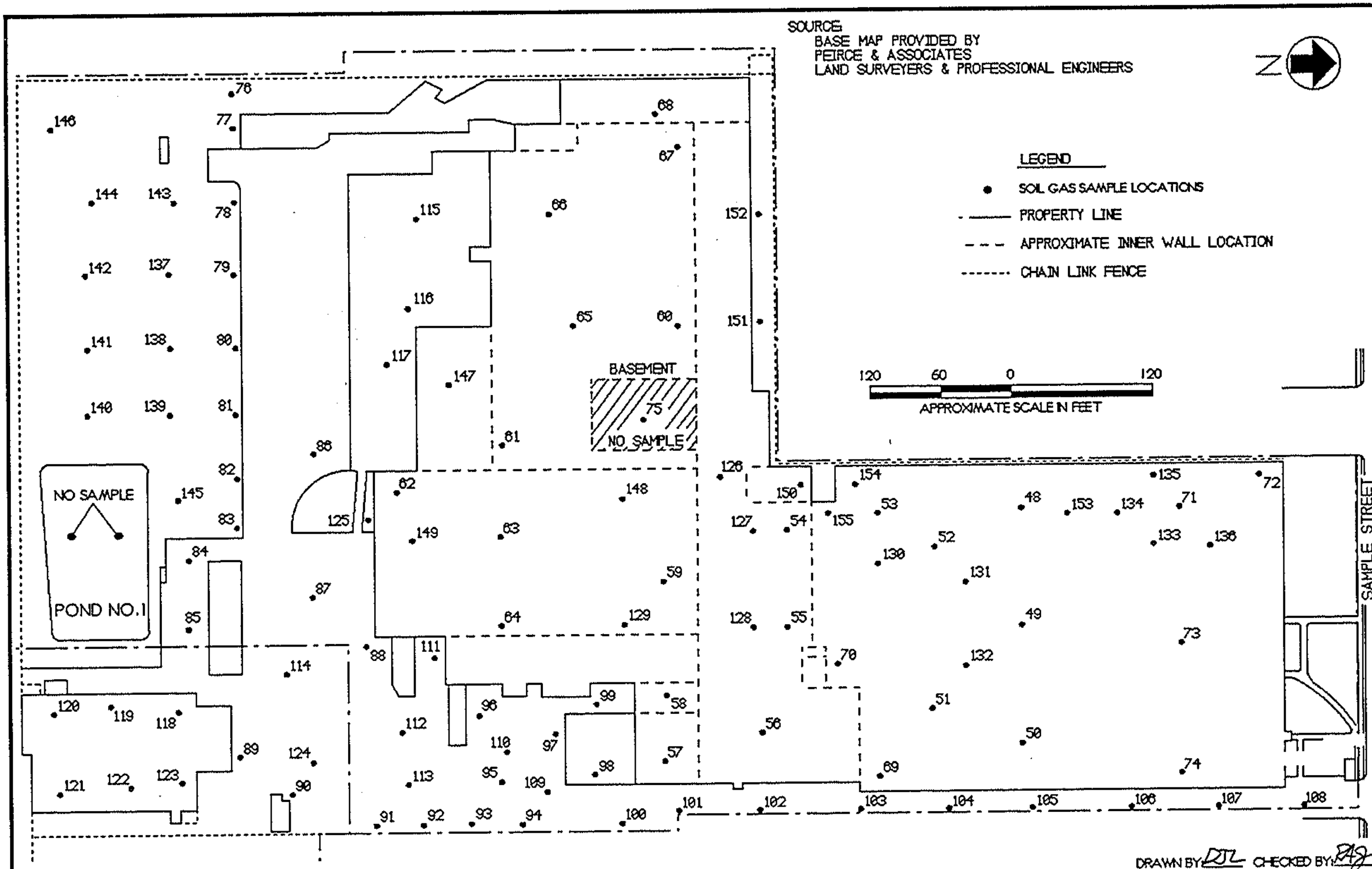
SOURCE: U.S. GEOLOGICAL SURVEY; 7.5 MINUTE SERIES (TOPOGRAPHIC)
SOUTH BEND WEST, INDIANA QUADRANGLE; PHOTOREVISED 1986.



DRAWN BY JCM CHECKED BY GJD

THE TORRINGTON COMPANY 3702 WEST SAMPLE STREET SOUTH BEND, INDIANA PROJECT NO. 1-211-2-0074	LAW ENGINEERING, INC. 12977 NORTH FORTY DRIVE SUITE 300 ST. LOUIS, MISSOURI (314) 469-2900	SITE LOCATION MAP FIGURE 1

N71744



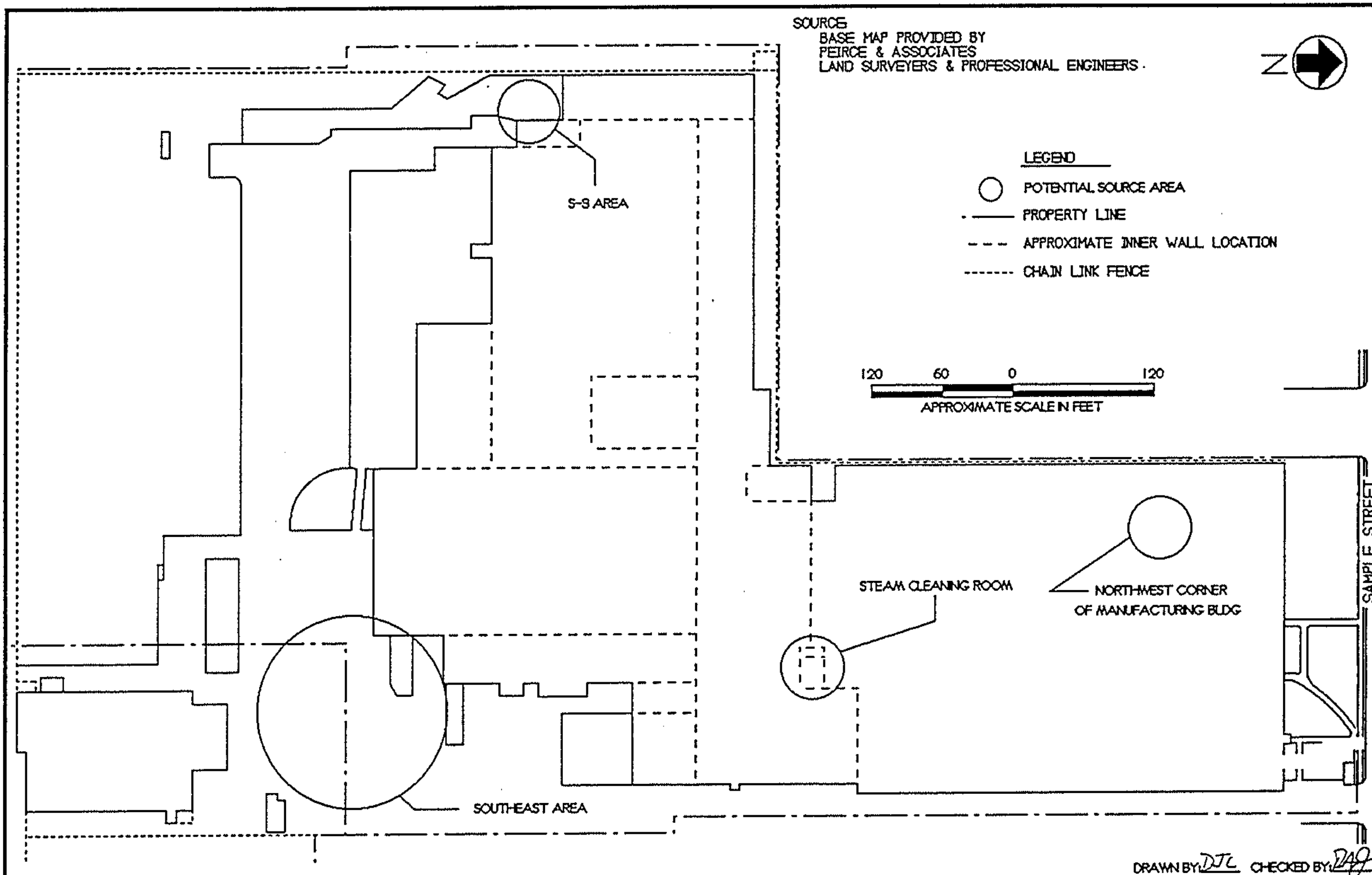
THE TORRINGTON COMPANY
3702 WEST SAMPLE STREET
SOUTH BEND, INDIANA

PROJECT NUMBER: 1-211-2-0074

LAW ENGINEERING, INC.
12977 NORTH FORTY DRIVE
SUITE 300
ST. LOUIS, MISSOURI
(314) 469-2900

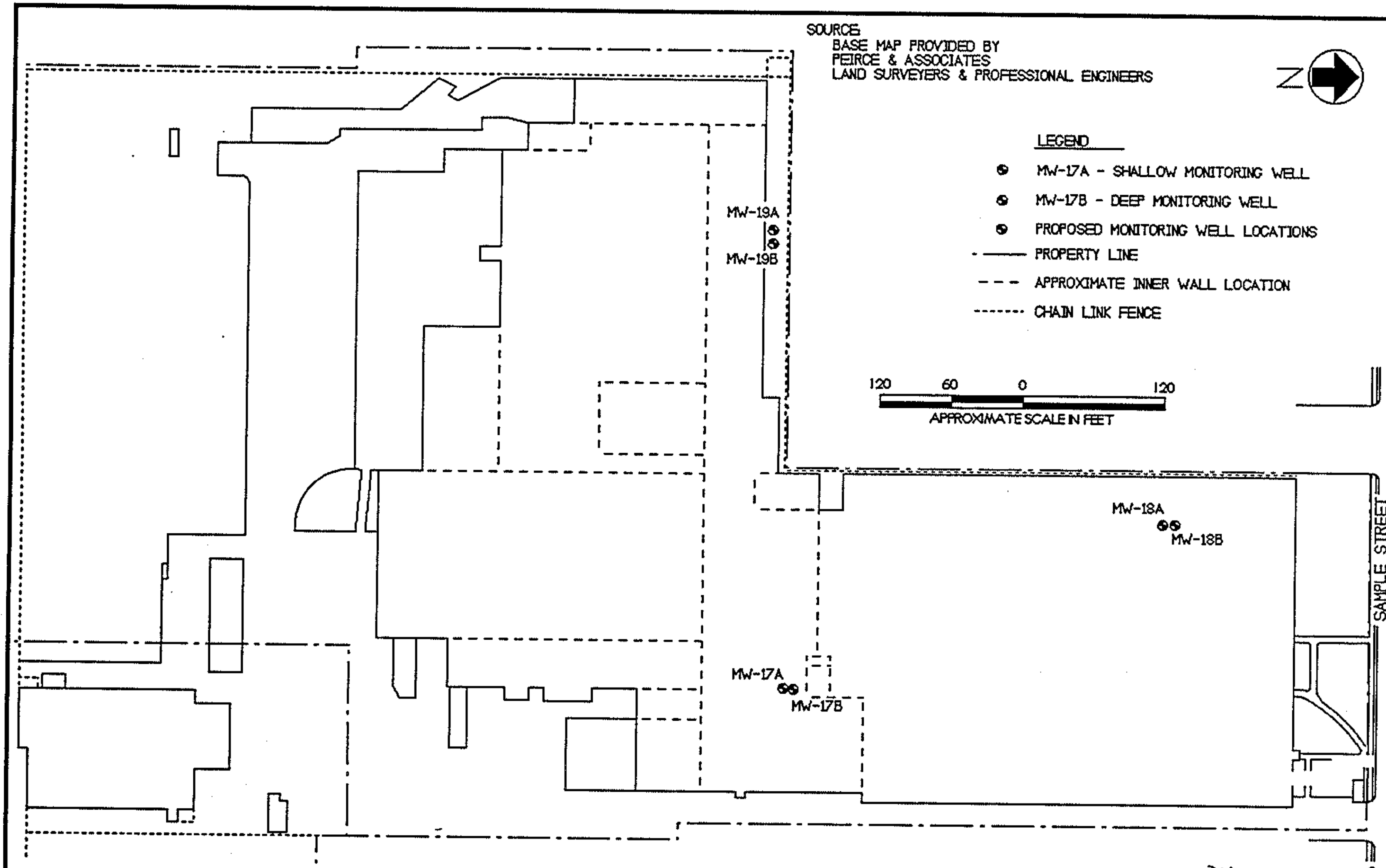
SITE PLAN SHOWING
SOIL GAS SAMPLE LOCATIONS

FIGURE 2



DRAWN BY: DJL CHECKED BY: DAO

THE TORRINGTON COMPANY 3702 WEST SAMPLE STREET SOUTH BEND, INDIANA PROJECT NUMBER: 1-211-2-0074	LAW ENGINEERING, INC. 12977 NORTH FORTY DRIVE SUITE 300 ST. LOUIS, MISSOURI (314) 469-2900	SITE PLAN SHOWING POTENTIAL SOURCE AREAS FIGURE 3



DRAWN BY: DJL CHECKED BY: RAG

THE TORRINGTON COMPANY
3702 WEST SAMPLE STREET
SOUTH BEND, INDIANA

PROJECT NUMBER: 1-211-2-0074

LAW ENGINEERING, INC.
12977 NORTH FORTY DRIVE
SUITE 300
ST. LOUIS, MISSOURI
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SITE PLAN SHOWING
PROPOSED MONITORING
WELL LOCATIONS

FIGURE 4

APPENDIX A
TRACER RESEARCH CORPORATION
SHALLOW SOIL GAS INVESTIGATION REPORT

Tracer Research Corporation

Shallow Soil Gas
Investigation

TORRINGTON COMPANY
3702 W. Sample Street
South Bend, Indiana

November 11 - 18, 1992

Tracer Research Corporation

Shallow Soil Gas Investigation

TORRINGTON COMPANY
3702 W. Sample Street
South Bend, Indiana

November 11 - 18, 1992

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1-92-875-S

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1.0 TORRINGTON COMPANY SITE INVESTIGATION

Tracer Research Corporation (Tracer Research) performed a shallow soil gas investigation at an abandoned manufacturing site, 3702 W. Sample Street, South Bend Indiana. The investigation was conducted November 11 through 18, 1992, for Law Environmental of St. Louis, Missouri.

1.1 Objective

The purpose of the investigation was to evaluate the site for possible soil and/or groundwater contamination by screening shallow soil gas for the presence of volatile organic chemicals (VOCs). Soil gas samples were collected and analyzed for the following hydrocarbons and halocarbons.

benzene, toluene, ethylbenzene, and xylenes (BTEX)
total volatile hydrocarbons (TVHC)
1,1 dichloroethene (1,1 DCE)
1,1 dichloroethane (1,1 DCA)
trichloroethane (TCA)
trichloroethene (TCE)
tetrachloroethene (PCE)

1.2 Overview of Results

For this investigation, 107 soil gas samples were collected at depths of 1 to 5 feet below grade from 108 locations. A soil gas sample could not be collected from sampling location SG-75 due to groundwater. A summary of the soil gas investigation is presented in the table on the following page.

Table 1. Soil Gas Sample Summary

Compound	# of samples in which compound was detected	Low conc. µg/L	High conc. µg/L	Sample(s) with high conc.
Benzene	1	NA	0.2	SG-72-2'
Toluene	6	0.3	22	SG-70-5'
Ethylbenzene	0	NA	NA	NA
Xylenes	6	2	180	SG-124-5'
TVHC	59	0.5	240	SG-95-5'
1,1 DCE	33	0.05	1,200	SG-55-5'
1,1 DCA	20	0.8	2,500	SG-55-5'
TCA	106	0.004	430	SG-55-5'
TCE	19	0.001	16	SG-133-5'
PCE	50	0.002	290	SG-55-5'

NA = Not Applicable

2.0 SITE DESCRIPTION

The site of this investigation is an abandoned manufacturing plant. Samples were collected from beneath the concrete surface of much of the site. Samples were also collected from inside the abandoned manufacturing plant building.

Law Environmental representatives reported the subsurface was made up of sands and gravels. The depth to groundwater was reported to occur at 8 feet below grade.

3.0 SAMPLING PARAMETERS

Soil gas sampling probes consisted of 7-foot lengths of 3/4-inch diameter hollow steel pipe. The probes were fitted with detachable drive tips and advanced to depths of 1 to 5 feet below ground surface (bgs). A rock drill was used to drill through the concrete. The probe at sample location SG-128 met with refusal at 1 foot bgs on the first several attempts. However, a soil gas sample was able to be collected at this location on the following day. In areas where there was no van access, several of the probes were hand pounded and/or hammered using a remote compressed air hammer to the desired depths. Otherwise the hydraulic push/pound mechanism on the van was used.

The aboveground end of each probe was fitted with an aluminum reducer (manifold) and a length of polyethylene tubing leading to a vacuum pump. Soil gas was pulled by the vacuum pump into the probe. Samples were collected in a glass syringe by inserting a syringe needle through a silicone rubber segment in the evacuation line and down into the steel probe. The vacuum was monitored by a vacuum gauge to ensure an adequate gas flow from the vadose zone was maintained.

The volume of air within the probe was purged by evacuating 2 to 5 probe volumes of gas. The evacuation time in minutes versus the vacuum in inches of mercury (Hg) was used to calculate the necessary evacuation time. The vacuum in inches Hg was recorded at each sampling location.

High vacuums were recorded at depths greater than 5 feet bgs. Most sample probe vacuums ranged from 3 to 17 inches Hg. The vacuum capacity of the pump was approximately 22 inches Hg.

4.0 ANALYTICAL PARAMETERS

During this investigation, 6 to 10 milliliters (mL) of soil gas were collected for each sample and immediately analyzed in the Tracer Research analytical van. Subsamples (replicates) from these samples were injected into the gas chromatograph (GC) in volumes of 1 to 1000 microliters (µL). Dilutions of soil gas samples SG-55, SG-56, SG-61 were made to injection volumes of 0.25, 0.8, and 0.5 µL, respectively.

4.1 Analyte Class

The soil gas samples were analyzed for the following analyte classes and compounds:

Analyte Class: Hydrocarbon
BTEX
TVHC

Analyte Class: Halocarbon
1,1 DCE
1,1 DCA
TCA
TCE
PCE

4.2 Chromatographic System

A Hewlett Packard Series II chromatograph, equipped with an electron capture detector (ECD), a flame ionization detector (FID), and two computing integrators, was used for the soil gas analyses. Compounds were separated in the GC on two 6 foot by 1/8 inch outer diameter (OD) packed analytical columns (1% SP1000 stationary phase bonded to 60/80 mesh Carbopack B support) in a temperature controlled oven. Hydrocarbons were detected on the FID and the halocarbons were detected on the ECD. Nitrogen was used as the carrier gas.

The instrument calibrations were checked periodically throughout each day to monitor the response factor and retention time. The following paragraphs explain the GC, ECD, and FID processes.

GC Process

The soil gas vapor is injected into the GC where it is swept through the analytical column by the carrier gas. The detector senses the presence of a component different from the carrier gas and converts that information to an electrical signal. The components of the sample pass through the column at different rates, according to their individual properties, and are detected by the detector. Compounds are identified by the time it takes them to pass through the column (retention time).

ECD Process

The ECD captures low energy thermal electrons that have been ionized by beta particles. The flow of these captured electrons into an electrode produces a small current, which is collected and measured. When the halogen atoms (halocarbons) are introduced into the detector, electrons that would otherwise be collected at the electrode are captured by the sample, resulting in decreased current. The current causes the computing integrator to record a peak on a chromatogram. The area of the peak is compared to the peak generated by a known standard to determine the concentration of the analyte.

FID Process

The FID utilizes a flame produced by the combustion of hydrogen and air. When a component, which has been separated on the GC analytical column, is introduced into the flame, a large increase in ions occurs. A collector with a polarizing voltage is applied near the flame and the ions are attracted and produce a current, which is proportional to the amount of the sample compound in the flame. The electrical current causes the computing integrator to record a peak on a chromatogram. By measuring the area of the peak and comparing that area to the integrator response of a known aqueous standard, the concentration of the analyte in the sample is determined.

4.3 Analyses

The detection limits for target compounds depend on the sensitivity of the detector to the individual compound as well as the volume of the injection. The detection limits of the target compounds were calculated from the response factor, the sample size, and the calculated minimum peak size (area) observed under the conditions of the analyses. If any compound was not detected in an analysis, the detection limit is given as a "less than" value, e.g., <0.1 µg/L. The approximate detection limits for the target compounds are presented in the table below.

Table 2. Detection Limits for Soil Gas Compounds

Compound	Detection Limits (µg/L)
Benzene	0.03
Toluene	0.1
Ethylbenzene	0.2
Xylenes	0.6
TVHC	0.6
1,1 DCE	0.2
1,1 DCA	1
TCA	0.005
TCE	0.01
PCE	0.01

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

Tracer Research's Quality Assurance (QA) and Quality Control (QC) program was followed to maintain data that was reproducible through the investigation. An overview presenting the significant aspects of this program is presented below.

Soil Gas Sampling Quality Assurance

To ensure consistent collection of soil gas samples, the following procedures are performed:

- Sampling Manifolds

Tracer Research's custom designed sampling manifold connects the sample probe to the vacuum line and pump. The manifold is designed to eliminate sample exposure to the polymeric (plastic) materials that connect the probe to the vacuum pump.

The sampling manifold is attached to the end of the probe, forming an air tight union between the probe and the silicone tubing septum. The septum connects the manifold to the pump vacuum line and permits syringe sampling.

This sampling system allows the sample to be taken upstream of the sampling pump, manifold, and septum. Since cross contamination of sampling equipment can be a major problem, Tracer Research replaces the materials (probe and syringe), between sampling points, that contact the soil gas before or during sampling.

-Sampling Probes

Steel probes are used only once each day. To eliminate the possibility of cross contamination, they are washed with high pressure soap and hot water spray, or steam-cleaned. Enough sampling probes are carried on each van to avoid the need to re-use any during the day.

-Glass Syringes

Glass syringes are used for only one sample a day and are washed and baked out at night. If they must be used twice, they are purged with carrier gas (nitrogen) and baked out between probe samplings.

-Sampling Efficiency

Soil gas pumping is monitored by a vacuum gauge to ensure that an adequate flow of gas from the soil is maintained. A reliable gas sample can be obtained if the sample vacuum gauge reading is at least 2 inches Hg less than the maximum measured vacuum of the vacuum pump.

Analytical Quality Assurance Samples

Quality assurance samples are performed at the below listed, or greater, frequencies. The frequency depends on the number of soil gas samples analyzed and the length of time of the survey:

Table 3. Quality Assurance Samples

Sample type	Frequency
Ambient Air Samples	2 per day or per site
Analytical Method Blanks	5% (1 per 20 samples or 1 a day)
Continuing Calibration Check	20% (1 every 5 samples)
Field System Blank	10% (1 every 10 samples or 1 a day)
Reagent Blank	1 per set of working standards
Replicate Samples	10% to 100% of all soil gas samples

The ambient air samples are obtained on site by sampling the air immediately outside the mobile analytical van and directly injecting it into the GC. Analytical method blanks are taken to demonstrate that the analytical instrumentation is not contaminated. These are performed by injecting carrier gas (nitrogen) into the GC with the sampling syringe. Subsampling syringes are also checked in this fashion.

The injector port septa through which soil gas samples are injected into the GC are replaced daily to prevent possible gas leaks from the chromatographic column. All sampling and subsampling syringes are decontaminated after use and are not used again until they have been decontaminated by washing in anionic detergent and baking at 90°C.

Field system blanks are analyzed to check for contamination of the sampling apparatus, e.g., probe and sampling syringe. A sample is collected using standard soil gas sampling procedures, but without putting the probe into the ground. The results are compared to those obtained from a concurrently sampled ambient air analysis.

If the blanks detect compounds of interest at concentrations that indicate equipment contamination or concentrations that exceed normal background levels (ambient air analysis), corrective actions are performed. If the problem cannot be corrected, an out-of-control event is documented and reported.

A reagent blank is performed to ensure the solvent used to dilute the stock standards is not contaminated. Analytical instruments are calibrated daily using fresh working standards made from National Institute of Sciences and Technology traceable standards and reagent blanked solvents.

Quantitative precision is assured by replicating analysis of 10 to 100 percent of the soil gas samples. Replicate analyses are performed by subsampling vapors from the original sampling syringe.

6.0 RESULTS

The analytical results from this soil gas investigation are condensed in Appendix A. The data are presented by location and by analyte concentration. When the compound was not detected, the detection limit is presented as a "less than" value, e.g., <0.0001 µg/L. A map of the sampling locations and isoconcentration contours for the halocarbon compounds are included in Appendix B.

Soil gas samples are identified by sample location and sampling depth. For example, SG-48-5' represents soil gas sample number forty-eight, collected at a depth of 5 feet below the ground surface.

There are three main areas of 1,1 DCE contamination. Contamination in the north end of the building is anchored by sampling location SG-55 and extends to the north through sample location SG-71. Location SG-68 on the west side of the building contains 20 µg/L of 1,1 DCE. The area of contamination extends from this point to the south through sample locations SG-117 and SG-62. Contamination is also found outside the building near the southeast corner and extends to the south and to the north.

1,1 DCA contours are closely related to the 1,1 DCE contours. Again sample location SG-55 forms the anchor of contamination in the north end of the building. However, the areal extent of the contamination is not as great. Smaller pockets of contamination are prevalent to the south and east of the building. Sample location SG-68 which is found on the west side of the building also contained 1,1 DCA (16 µg/L).

TCA was found in 106 samples analyzed at this site. Samples SG-53, 55, 70, 112, and 153 contained the greatest amount of TCA detected at the site. TCA in these samples ranged from 100 to 430 µg/L.

In contrast to TCA, TCE was found in only 19 samples. The main concentration of TCE was found in the northwest corner of the building. Two small areas of TCE were also found at sample locations SG-96 and SG-147 (2 µg/L).

PCE is scattered throughout the site. The main area of contamination is again anchored by sample SG-55 (290 µg/L). Other small areas of contamination are found on each side of the building.

APPENDIX A Condensed Data

TRACER RESEARCH CORPORATION - ANALYTICAL RESULTS
Law Environmental/ Former Torrington Co./ Syracuse, New York/ 2-92-875-S
11/11/92

SAMPLE	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC µg/L	1,1 DCE µg/L	1,1 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
AIR	<0.08	<0.1	<0.1	<0.1	<3	<0.07	<0.2	<0.003	<0.002	<0.002
SG-48-5'	<0.2	<0.2	<0.3	<0.3	21	1	2	30	<0.01	0.1
SG-49-5'	<0.2	<0.2	<0.3	<0.3	5	<17	<45	6	<0.5	<0.4
SG-50-5'	<0.2	<0.2	<0.3	2	10	<1	4	1	<0.04	7
SG-51-5'	<0.2	<0.2	<0.3	<0.3	13	<14	40	0.4	<0.4	0.3
SG-52-5'	<0.2	<0.2	<0.3	<0.3	25	3	9	OLR	<0.02	0.1
SG-53-5'	<0.2	<0.2	<0.3	<0.3	55	<70	<180	100	<2	<2

OLR = Out of Linear Range

Analyzed by: D. Bonner
Proofed by: M. Stivers

TRACER RESEARCH CORPORATION - ANALYTICAL RESULTS
Law Environmental/ Former Torrington Co./ Syracuse, New York/ 2-92-875-S
11/12/92

SAMPLE	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC µg/L	1,1 DCE µg/L	1,1 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
AIR	<0.08	<0.1	<0.1	<0.1	<3	<0.07	<0.2	0.03	<0.002	<0.002
SG-54-5'	<0.06	<0.2	<0.5	<1	13	3	3	70	<0.01	0.8
SG-55-5'	<0.03	<0.1	<0.3	<0.5	55	1200	2500	430	<0.6	290
SG-56-5'	<0.06	<0.2	<0.5	<1	<1	<60	<360	20	<3	<1
SG-61-5'	<0.06	<0.2	<0.5	<1	38	<25	<140	70	<1	<2
SG-59-5'	<0.06	<0.2	<0.5	<1	<1	<2	<14	2	<0.1	<0.2
SG-63-5'	<0.03	<0.1	<0.2	<0.5	0.5	<0.2	<1	0.4	<0.01	0.1
SG-62-5'	<0.03	<0.1	<0.2	<0.5	20	7	30	20	<0.006	0.4
SG-60-5'	<0.03	<0.1	<0.2	<0.5	7	<10	<60	18	<5	<0.7
SG-65-5'	<0.03	<0.1	<0.2	<0.5	14	4	<14	40	<0.1	<0.2
SG-68-4'	<0.03	<0.1	<0.2	<0.5	54	20	16	70	<0.1	<0.2
AIR	<0.03	<0.1	<0.2	<0.5	<0.5	<0.06	<0.4	0.006	<0.003	<0.004
SG-64-4'	<0.03	<0.1	<0.2	<0.5	19	<12	<70	17	<0.6	<0.9
SG-58-5'	<0.03	<0.1	<0.2	<0.5	11	<6	<40	30	<0.3	<0.4
SG-57-5'	<0.03	<0.1	<0.2	<0.5	4	<6	<40	6	<0.3	<0.4
SG-69-5'	<0.03	<0.1	<0.2	<0.5	4	1	3	9	<0.01	<0.02
SG-70-5'	<0.03	22	<0.2	<0.5	130	100	110	300	<0.6	2
SG-71-5'	<0.03	0.3	<0.2	<0.5	33	11	<14	70	4	<0.2
SG-72-2'	0.2	0.6	<0.2	<0.5	14	<2	<14	10	<0.1	<0.2
SG-73-5'	<0.03	0.4	<0.2	<0.5	2	<0.2	<1	2	3	<0.02
SG-74-5'	<0.03	<0.1	<0.2	<0.5	1	<6	<40	2	<0.3	<0.4

Analyzed by: D. Bonner
Proofed by: M. Stiveed

TRACER RESEARCH CORPORATION - ANALYTICAL RESULTS
Law Environmental/ Former Torrington Co./ Syracuse, New York/ 2-92-875-S
11/13/92

SAMPLE	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC µg/L	1,1 DCE µg/L	1,1 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
AIR	<0.04	<0.1	<0.3	<0.6	<0.5	<0.02	<0.1	<0.0005	<0.001	<0.001
SG-76-5'	<0.07	<0.3	<0.6	<1	<1	<0.2	<1	<0.005	<0.01	<0.01
SG-77-5'	<0.07	<0.3	<0.6	<1	<1	0.05	<0.01	0.06	0.005	0.1
SG-78-5'	<0.07	<0.3	<0.6	<1	<1	<0.02	<0.1	1	<0.001	0.01
SG-79-5'	<0.07	<0.3	<0.6	<1	<1	<0.1	<0.7	0.05	<0.006	<0.006
SG-80-5'	<0.07	<0.3	<0.6	<1	<1	<0.02	<0.1	OLR	<0.001	<0.001
SG-81-5'	<0.04	<0.1	<0.3	<0.6	4	0.6	<0.3	8	<0.002	0.02
SG-82-5'	<0.04	<0.1	<0.3	<0.6	2	0.2	<1	5	<0.01	<0.01
SG-83-5'	<0.04	<0.1	<0.3	<0.6	4	2	<1	OLR	<0.01	<0.01
SG-67-5'	<0.04	<0.1	<0.3	<0.6	10	7	<1	34	<0.01	0.2
SG-66-5'	<0.04	<0.1	<0.3	<0.6	4	<2	<18	9	<0.2	<0.2
AIR	<0.04	<0.1	<0.3	<0.6	<0.5	<0.06	<0.4	<0.001	<0.003	<0.003
SG-88-5'	<0.04	<0.1	<0.3	<0.6	15	24	<92	35	<0.6	<0.6
SG-87-5'	<0.04	<0.1	<0.3	<0.6	<0.5	<0.2	<0.9	0.01	<0.006	<0.006
SG-86-5'	<0.04	<0.1	<0.3	<0.6	4	<3	<18	6	<0.1	<0.1
SG-84-5'	<0.04	<0.1	<0.3	<0.6	<0.5	<0.03	<0.2	0.1	0.001	<0.002
SG-85-5'	<0.04	<0.1	<0.3	<0.6	<0.5	<0.03	<0.2	OLR	<0.001	0.002
AIR	<0.04	<0.1	<0.3	<0.6	<0.5	<0.02	<0.07	<0.0003	<0.0006	<0.0007

OLR = Out of Linear Range

Analyzed by: D. Bonner
Proofed by: M. Stivers

Tracer Research Corporation

TRACER RESEARCH CORPORATION - ANALYTICAL RESULTS
Law Environmental/ Former Torrington Co./ Syracuse, New York/ 2-92-875-S
11/16/92

SAMPLE	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC µg/L	1,1 DCE µg/L	1,1 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
AIR	<0.03	<0.1	<0.2	<0.6	<0.6	<0.01	<0.07	<0.0003	<0.0008	<0.001
SG-89-5'	<0.03	<0.1	<0.2	13	67	2	18	20	0.02	<0.01
SG-90-5'	<0.03	<0.1	<0.2	<0.6	3	<3	<15	5	<0.2	<0.02
SG-91-5'	<0.03	<0.1	<0.2	<0.6	<0.6	<0.3	<2	0.7	<0.02	<0.02
SG-92-5'	<0.03	<0.1	<0.2	<0.6	<0.6	<0.3	<2	6	<0.02	0.7
SG-93-5'	<0.03	<0.1	<0.2	<0.6	<0.6	<0.3	<2	1	<0.02	<0.02
SG-94-5'	<0.03	<0.1	<0.2	<0.6	<0.6	<0.3	<2	0.5	<0.02	0.6
SG-95-5'	<0.06	<2	<4	110	240	<0.3	7	0.2	0.02	0.09
SG-96-5'	<0.3	<1	<2	<6	<22	9	10	60	2	0.08
SG-97-5'	<0.06	<0.2	<0.5	<1	<4	<3	<15	9	<0.2	<0.2
SG-98-5'	<0.06	<0.2	<0.5	<1	3	<3	<15	8	0.2	<0.2
AIR	<0.03	<0.1	<0.2	<0.6	<0.6	<0.01	<0.08	<0.0003	<0.0008	<0.001
SG-99-5'	<0.06	<0.2	<0.5	<1	5	0.5	<0.8	12	<0.008	<0.01
SG-100-5'	<0.06	<0.2	<0.5	<1	<1	<0.3	<2	0.3	<0.02	0.02
SG-101-5'	<0.06	<0.2	<0.5	<1	<1	<0.5	<3	5	<0.03	<0.01
SG-102-5'	<0.06	<0.2	<0.5	<1	<1	<0.3	<2	1	<0.02	0.4
SG-103-5'	<0.06	<0.2	<0.5	<1	<1	<0.1	<0.8	0.3	<0.007	<0.01
SG-104-5'	<0.06	<0.2	<0.5	<1	<1	<0.03	<0.2	OLR	<0.002	<0.002
SG-105-5'	<0.06	<0.2	<0.5	<1	1	<0.03	<0.2	0.5	0.06	5
SG-106-5'	<0.06	<0.2	<0.5	<1	<1	<0.3	<2	0.3	<0.02	0.2
SG-107-5'	<0.06	<0.2	<0.5	<1	<1	<0.1	<0.8	0.04	<0.008	0.02
SG-108-5'	<0.06	<0.2	<0.5	<1	<1	<0.1	<0.8	0.09	<0.008	<0.01
AIR	<0.03	<0.1	<0.2	<0.6	<0.6	<0.01	<0.08	<0.0003	<0.0008	<0.001

OLR = Out of Linear Range

Analyzed by: D. Bonner
Proofed by: M. Shivers

TRACER RESEARCH CORPORATION - ANALYTICAL RESULTS
Law Environmental/ Former Torrington Co./ Syracuse, New York/ 2-92-875-S
11/17/92

SAMPLE	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC µg/L	1,1 DCE µg/L	1,1 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
AIR	0.7	1	<0.6	<1	3	<0.05	<0.3	<0.001	<0.003	<0.004
SG-119-4'	<0.7	<1	<0.6	<1	<2	<0.5	<3	3	<0.03	0.4
SG-118-5'	<0.7	<1	<0.6	<1	<2	2	<3	22	<0.03	<0.04
SG-120-5'	<0.7	<1	<0.6	<1	<2	<3	<13	1	<0.1	<0.2
SG-122-5'	<0.7	<1	<0.6	<1	15	3	<1	40	<0.01	0.4
SG-121-5'	<0.7	<1	<0.6	<1	6	<3	<13	16	<0.1	<0.2
SG-123-5'	<0.7	<1	<0.6	<1	17	<3	<13	40	<0.1	<0.2
SG-113-5'	<0.7	<1	<0.6	<1	5	<3	<13	12	<0.1	<0.2
SG-109-5'	<0.7	<1	<0.6	<1	<2	<3	<13	2	<0.1	1
SG-110-5'	<0.08	<0.3	<0.6	24	89	<0.05	0.8	0.08	0.06	0.02
SG-112-5'	<0.08	<0.3	<0.6	<1	34	7	<13	100	<0.1	0.8
AIR	<0.08	<0.3	<0.6	<1	<1	<0.05	<0.3	0.004	<0.001	<0.002
SG-111-5'	<0.08	<0.3	<0.6	<1	7	<5	<26	20	<0.3	0.7
SG-124-5'	<0.08	<0.3	<0.6	180	210	<3	<13	8	<0.1	<0.2
SG-114-5'	<0.2	<0.6	<1	<3	7	0.2	7	0.8	0.04	0.03
SG-117-5'	<0.2	<0.6	<1	<3	18	3	40	5	0.4	4
SG-116-3.5'	<0.2	<0.6	<1	<3	6	<3	<13	13	0.1	0.3
SG-115-5'	<0.2	<0.6	<0.6	<1	<3	<3	<13	3	<0.1	<0.2
SG-125-3.5'	<0.08	<0.6	<0.6	<1	<1	<0.1	<0.6	0.2	<0.007	0.01
SG-126-5'	<0.08	<0.6	<0.6	<1	<1	<3	<13	2	<0.1	<0.2

OLR = Out of Linear Range

Analyzed by: D. Bonner
Proofed by: M. Stivers

TRACER RESEARCH CORPORATION - ANALYTICAL RESULTS
Law Environmental/ Former Torrington Co./ Syracuse, New York/ 2-92-875-S
11/17/92

SAMPLE	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC µg/L	1,1 DCE µg/L	1,1 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
SG-127-5'	<0.08	<0.6	<0.6	<1	4	<3	<13	11	<0.1	0.3
SG-129-5'	<0.08	<0.6	<0.6	<1	2	<3	<13	5	<0.1	<0.2
SG-130-5'	<0.08	<0.6	<0.6	<1	19	3	<13	62	<0.1	<0.2
SG-131-5'	<0.08	<0.6	<0.6	<1	8	<10	<52	19	<0.1	<0.2
SG-132-5'	<0.08	<0.6	<0.6	8	13	3	40	0.3	0.1	1
SG-133-5'	<0.08	<0.6	<0.6	<1	31	5	13	50	16	<0.2
SG-134-5'	<0.08	<0.6	<0.6	<1	61	20	15	OLR	2	0.3
SG-135-5'	<0.08	<0.6	<0.6	<1	16	6	<32	50	1	<0.4
SG-136-5'	<0.08	<0.6	<0.6	<1	33	<6	<32	45	11	<0.4
AIR	<0.08	<0.3	<0.6	<1	<1	<0.03	<0.1	<0.0006	<0.001	<0.002

OLR = Out of Linear Range

Analyzed by: D. Bonner
Proofed by: M. Shivers

TRACER RESEARCH CORPORATION - ANALYTICAL RESULTS
Law Environmental/ Former Torrington Co./ Syracuse, New York/ 2-92-875-S
11/18/92

SAMPLE	BENZENE µg/L	TOLUENE µg/L	ETHYL BENZENE µg/L	XYLENES µg/L	TVHC µg/L	1,1 DCE µg/L	1,1 DCA µg/L	TCA µg/L	TCE µg/L	PCE µg/L
AIR	<0.3	<0.6	<0.3	<0.6	<1	<0.02	<0.09	<0.0003	<0.0009	<0.001
SG-137-5'	<0.1	<0.3	<0.6	<1	<1	<0.02	<0.9	0.4	<0.009	0.02
SG-138-5'	<0.1	<0.3	<0.6	<1	<1	<0.02	<0.9	1	<0.009	0.02
SG-139-5'	<0.1	<0.3	<0.6	<1	<1	<0.02	<0.9	0.2	<0.009	0.01
SG-140-3'	<0.3	2	<0.3	<0.6	2	<0.03	<0.2	0.004	<0.002	<0.002
SG-141-3.5'	<0.3	<0.1	<0.3	<0.6	<3	0.07	<0.2	0.03	<0.002	0.002
SG-142-4'	<0.04	<0.1	<0.3	<0.6	<0.6	<0.03	<0.2	0.007	<0.002	0.002
SG-145-5'	<0.04	<0.1	<0.3	<0.6	<0.6	<0.03	<0.2	0.5	<0.002	0.004
SG-143-3'	<0.04	<0.1	<0.3	<0.6	<0.6	<0.08	<0.4	0.1	<0.004	<0.005
SG-144-3'	<0.04	<0.1	<0.3	<0.6	<0.6	<0.03	<0.2	0.02	<0.002	<0.002
SG-146-1'	<0.04	<0.1	<0.3	<0.6	<0.6	<0.03	<0.2	0.05	<0.002	0.003
AIR	<0.04	<0.1	<0.3	<0.6	<0.6	<0.1	<0.7	0.006	<0.0009	<0.001
SG-147-5'	<0.6	<0.3	<0.6	<1	45	8	15	30	2	34
SG-148-5'	<0.04	<0.1	<0.3	<0.6	4	<8	<44	5	<0.4	<0.5
SG-149-3'	<0.04	2	<0.3	<0.6	5	<3	<18	1	<0.2	<0.2
SG-150-5'	<0.04	<0.1	<0.3	<0.6	<0.6	<0.06	<0.4	0.6	<0.004	0.2
SG-151-5'	<0.04	<0.1	<0.3	<0.6	<0.6	<0.3	<2	2	<0.02	<0.02
SG-152-5'	<0.04	<0.1	<0.3	<0.6	2	<0.3	<2	5	<0.02	4
SG-153-5'	<0.04	<0.1	<0.3	<0.6	71	20	<350	180	<4	3
SG-128-3.5'	<0.04	<0.1	<0.3	<0.6	17	<3	<18	40	<0.2	0.8
SG-154-5'	<0.04	<0.1	<0.3	<0.6	43	7	<18	OLR	<0.2	0.3
SG-155-5'	<0.04	<0.1	<0.3	<0.6	12	<8	<44	30	<0.4	0.5
AIR	<0.04	<0.1	<0.3	<0.6	<0.6	<0.02	<0.09	<0.001	<0.0009	<0.001

OLR = Out of Linear Range

Analyzed by: D. Bonner
Proofed by: [illegible]

APPENDIX B Figures