SOIL-GAS DATA FOR THE UNDERGROUND HYDROCARBON CONTAMINATION SITE IN THE HIGHLAND AVENUE AREA, FAYETTEVILLE, ARKANSAS

By G.L. Ford and J.V. Brahana

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CONVERSION FACTORS

Multiply	By	To obtain
inch	25.40	millimeter
cubic inch per minute	16.39	cubic centimeter per minute
foot	0.3048	meter
mile	1.609	kilomter

Temperature in degrees Fahrenheit (^{0}F) as follows:

$$^{0}F = 1.8 \times {}^{0}C + 32$$

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ABSTRACT

This report is a preliminary compilation of soil-gas data taken from the underground hydrocarbon contamination site in the Highland Avenue area, Fayetteville, Arkansas. Soil-gas data were collected by using a portable gas chromatograph, with samples collected along three traverses within a 400 foot by 400 foot area on either side of the 300 block of north Highland Avenue south of Lafayette Street in Fayetteville. Sampling traverses were oriented N 4° W, and data-collection sites were spaced at intervals ranging from 2 to 50 feet. Sixty sites were sampled during a 30-day time period from July 15, 1991, to August 15, 1991, with some sites being resampled. This report presents those data, and describes the methodology used to acquire them. No interpretation of the preliminary data is included.

INTRODUCTION

Fayetteville, Arkansas, is located in Washington County, northwestern Arkansas (fig. 1). Since September 1989, public records document that the city has had an ongoing problem with hydrocarbon contamination occurring in the ground water and soil in the 300 block of north Highland Avenue (J. G. Hill, Arkansas Environmental Engineers, Inc., written commun., 1990). Undocumented accounts from residents reporting fumes in their basements suggest the problem may have been present several years before it was officially documented.

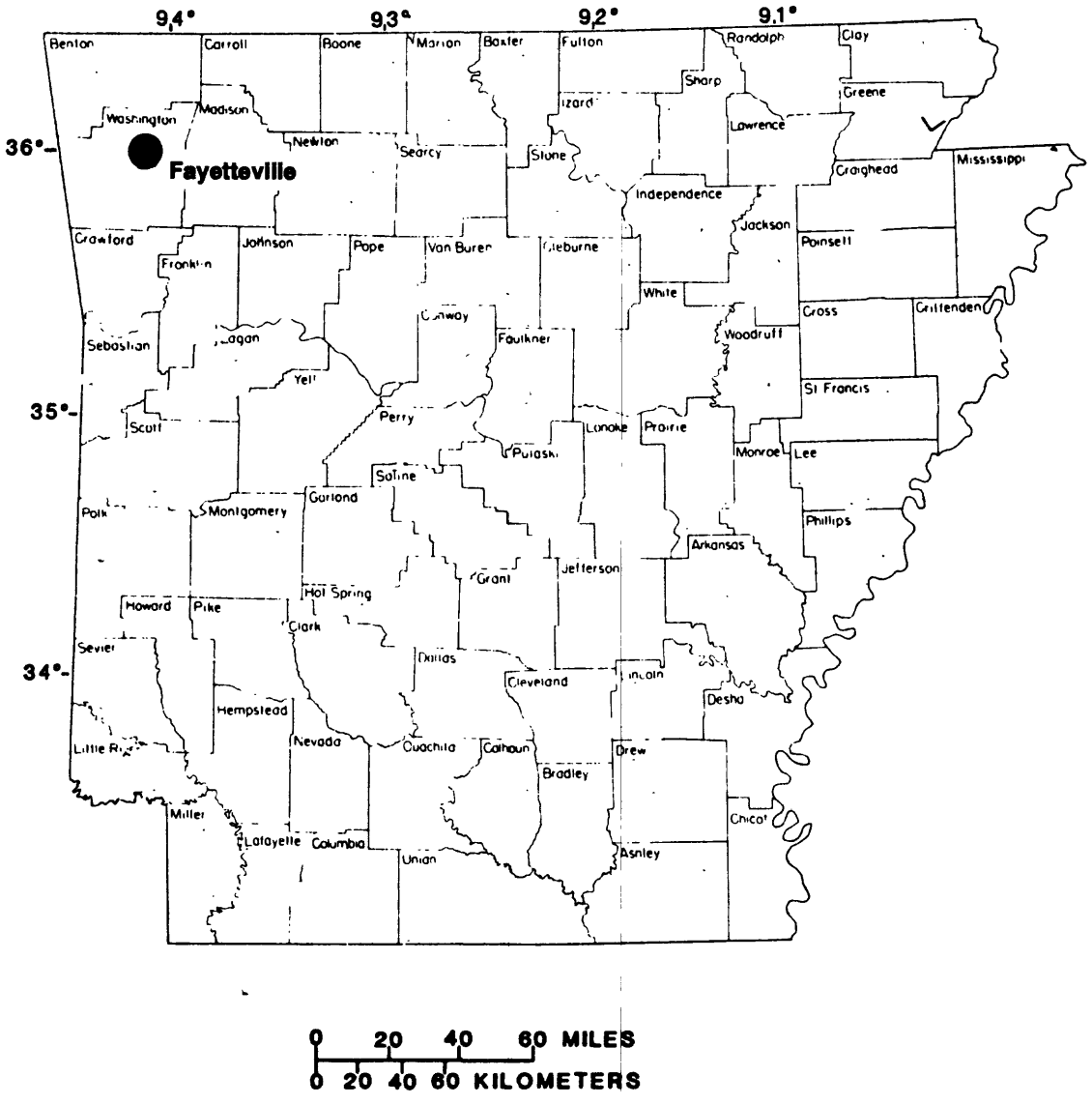

Figure 1.--Location of Fayetteville, Washington County, Arkansas.

The area of this study is restricted to the 300 block of north Highland Avenue, extending from 200 feet on either side of the street in an east-west direction, and from Lafayette Street on the north to 400 feet south of Lafayette Street on the south (fig. 2). This 400 foot by 400 foot area is herein referred to as the Highland Avenue study area. Multiple residential properties in the Highland Avenue study area have documented hydrocarbon contamination of ground water; two specific properties, 345 and 340 Highland Avenue were assessed to be the most environmentally affected (J.G. Hill, Arkansas Environmental Engineers, Inc., written commun., 1990). A fire occurred on the 345 Highland Avenue property (fig. 2) in October 1990, and Arkansas Environmental Engineers, Inc. was contacted. Their project analysis reported that the 345 Highland Avenue property had "heavy petroleum vapors and free petroleum product both in the soil and ground water" (J.G. Hill, Arkansas Environmental Engineers, Inc., written commun., 1990). At present (February 1992), hydrocarbons are still being observed at this site (Martin Maner, Arkansas Department of Pollution Control and Ecology, oral commun., 1992).

PURPOSE AND SCOPE

This report describes the initial phase of an ongoing study in cooperation with the University of Arkansas that will assess the effectiveness of gas chromatography as a tool capable of identifying the extent of contamination by hydrocarbons on ground water for hydrogeologic conditions present in Fayetteville, Arkansas. The purpose of this report is to present a preliminary compilation of soil-gas data collected from July 15, 1991 to August 15, 1991, from 60 sites located in the Highland Avenue study area (fig. 2). This report presents those data, and describes the methodology used to acquire them. No interpretation of the preliminary data is included.

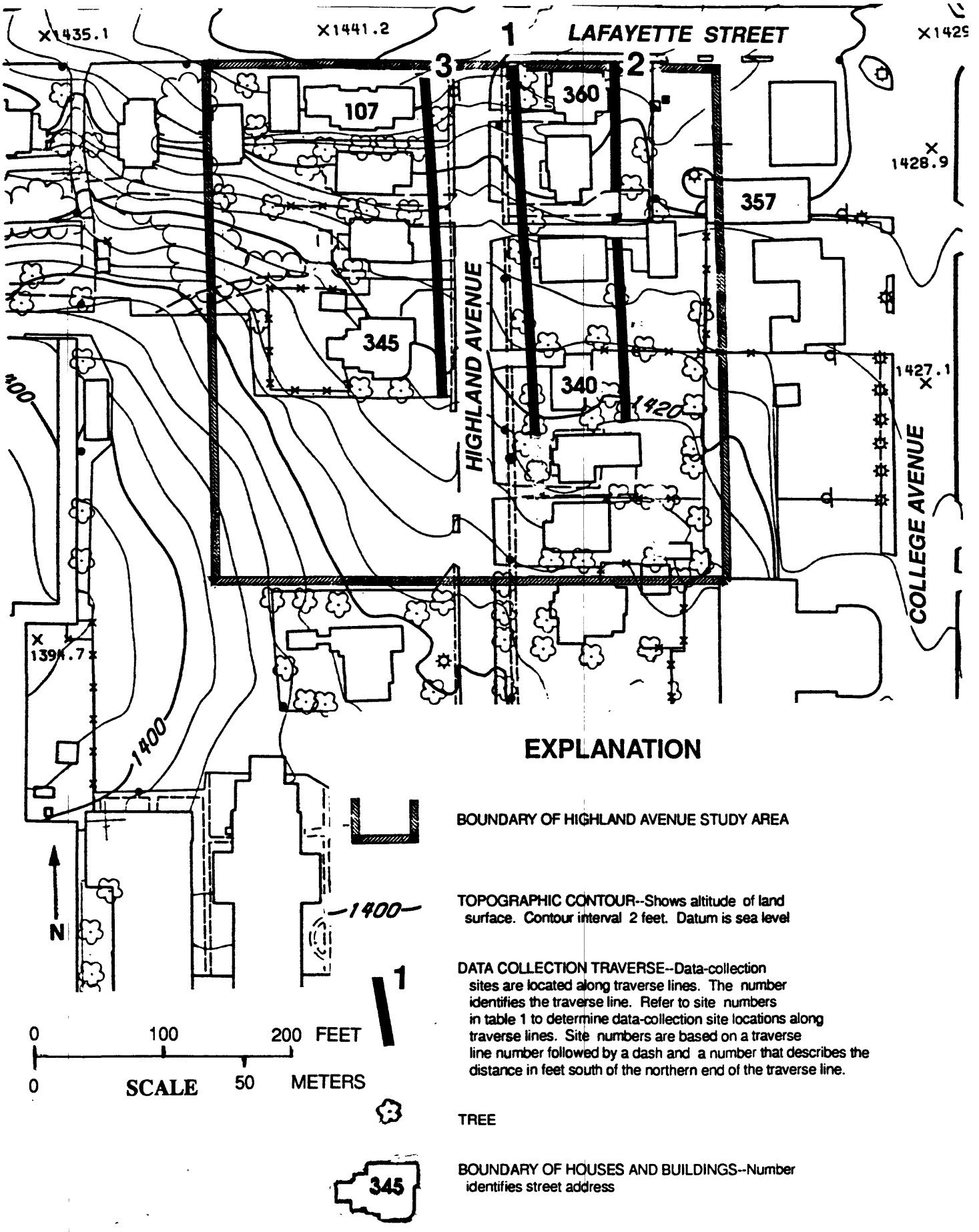

Figure 2.--Location of soil gas data-collection traverses, Highland Avenue study area, Fayetteville, Arkansas (modified from City of Fayetteville street map, City Engineer, 1991).

ACKNOWLEDGEMENTS

The authors would like to thank Mr. Martin Maner of the Arkansas Department of Pollution Control and Ecology, Fayetteville, for his assistance with this project. In addition, the authors are grateful to those property owners in the Highland Avenue area and their representatives who provided access to and allowed soil-gas sampling on their properties.

DATA COLLECTION AND COMPILATION

Data were collected following the general procedure outlined by Brock (1990) and Freiwald (D.A. Freiwald, U.S. Geological Survey, written commun., 1990). The procedure involved monitoring the vadose zone of the Highland Avenue study area to determine the presence and relative areal extent of volatile components in the soil-gas. A plunger bar was used to make 0.5-inch diameter vertical holes approximately 3.5 feet deep into the soil. A 6-inch nonflexible PVC casing, with 0.5 inch outside diameter (O.D.) and with a removable cap, was inserted in each hole to facilitate resampling. The holes, or soil-gas sampling sites, were located along 3 traverses oriented N 4^{o} W (fig. 2). The orientation was selected along paths of approximate ground-water flow, and at the same time, to avoid man-made features (houses, utility lines, sidewalks, roads) within this developed part of Fayetteville. Traverse 1 was set in the front yards of the properties on the east side of the 300 block of north Highland Avenue, traverse 2 was set in the back yards of those same properties, and traverse 3 was set in the front yards of those properties on the west side of the 300 block of north Highland Avenue (fig. 2). Ground-water flow directions, generally toward the south and west, were defined by water levels from 22 test wells that had been drilled in October 1990 in and near the Highland Avenue study area (Martin Maner, Arkansas Department of Pollution Control and Ecology, written commun., 1991).

Soil-gas sampling sites were sampled with soil-gas sampling probes, which were fabricated from 0.25-inch O.D. stainless steel tubing crimped at one end, and perforated with multiple holes within 1 inch of the crimped end to permit the flow of gas into the probe (fig. 3). The open end of the probe, which had a small hole drilled about 1 inch from the upper end, was inserted at least 2 inches into flexible polyvinyl chloride (PVC) tubing, which was in turn connected to a vacuum pump. The vacuum pump was capable of extracting approximately 2 liters of soil-gas per minute. At each soil-gas sampling site, a soil-gas sampling probe was inserted into the hole to a depth of 3 feet below land surface, which was 0.5 foot above the bottom of the hole (fig. 3). Topsoil was packed around the probe to prevent the flow of atmospheric air into the hole during the sampling process.

Soil-gas samples were obtained after about 2 liters of soil-gas had been purged from the sampling system with the vacuum pump. The samples were collected with 100 µL glass syringes. This was accomplished by inserting the needle through the tubing into the hole at the top of the probe, flushing the syringe with the sample three times, and withdrawing a 70 µL sample. The soil-gas sample was injected directly into the portable gas chromatograph (GC).

The GC used was a Photovac model 10S50 portable gas chromatograph[1] with a 10.7 eV photoionization detector [PID] (Photovac, 1987). The instrument was set up using a 6-inch precolumn and a 4-foot analytical column (D.A. Freiwald, U.S. Geological Survey, written commun., 1990). The carrier gas was hydrocarbon-free air with a flow rate of 15 cubic centimeters per minute. The instrument was qualitatively calibrated (retention times only) several times each day using analytical standards of benzene, toluene, and xylene.

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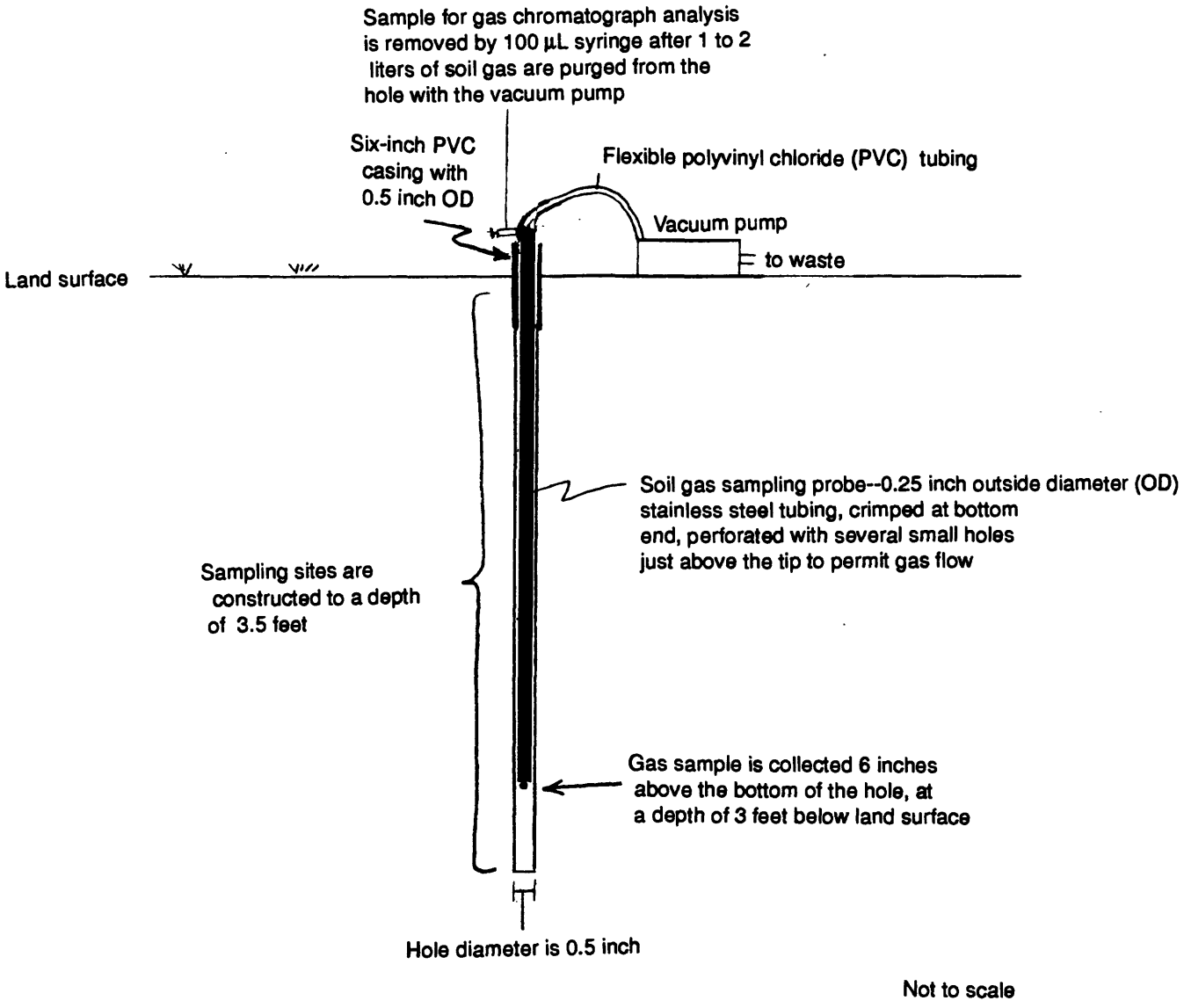
[1]Use of brand names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.



Water table is reported to occur at depths ranging from 3 to 18 feet below bottom of sampling sites (Martin Maner, Arkansas Department of Pollution Control and Ecology, written commun., 1991)

Figure 3.--Idealized cross section showing important features of data collection at soil-gas sampling sites, Highland Avenue study area, Fayetteville, Arkansas.

Soil-gas samples were taken from 60 sampling sites at intervals ranging from 2 to 50 feet (table 1). Some sites were sampled more than once. Site numbering nomenclature is based on the following scheme: the first digit indicates the traverse on which the sample was taken (fig. 2), and the numbers after the dash indicate the distance in feet south of the northern end of the traverse. An example of the site numbering nomenclature is given by site number 1-147 (table 1). This site is on traverse 1 (fig. 2), 147 feet S 4^{0} E from the northern extent of the traverse.

The data site that is furthest north on each traverse is numbered 1 (1-1; 2-1; 3-1). The location of site 1-1 is 30 feet 10 inches N 77^{0} W of the northwest corner of the house at 360 Highland Avenue; The location of site 2-1 is 4 feet 2 inches N 39^{0} E of the northeast corner of the house at 360 Highland Avenue; and the location of site 3-1 is 8 feet 7 inches N 85^{0} E of the northeast corner of the house at 107 Lafayette Street (fig. 2).

REFERENCES

Brock, R.D., 1990, The protocol for onsite screening of volatile organic compounds using a portable gas chromatograph: U.S. Geological Survey Open-File Report 90-379, 15 p.

Photovac, 1987, Instruction manual for Photovac 10S50: Photovac, Inc., Huntington, New York, 85 p.

Table 1.--*Field data from portable gas chromatography sampling, Highland Avenue study area, Fayetteville, Arkansas*

[Gain, gain dial setting on portable gas chromatograph and is 10 unless otherwise noted; °C, degrees Celsius; sec, seconds; mvs, millivolts; --, no peak detected; Do., ditto]

Site number (refer to figure 2)	Sampling date	Sampling time	Temperature (°C)	Peak 1		Peak 2		Peak 3		Peak 4		Peak 5		Comments
				sec	mvs	sec	mvs	sec	mvs	sec	mvs	sec	mvs	
1-1	7-15-91	1258	30	--	--	--	--	--	--	--	--	--	--	No discernable peaks. Gain=2
1-48.5	7-15-91	1310	30	--	--	--	--	--	--	--	--	--	--	Do.
1-97	7-16-91	1137	30	53.9	71.6	--	--	--	--	--	--	--	--	Gain=20
1-107	7-16-91	1227	32	146.9	15.4	--	--	--	--	--	--	--	--	Do.
1-147	7-16-91	1216	31	146.9	8.7	--	--	--	--	--	--	--	--	Do.
1-197	7-16-91	1303	32	--	--	--	--	--	--	--	--	--	--	No discernable peaks. Gain=20
1-207	7-16-91	1359	34	--	--	--	--	--	--	--	--	--	--	Do.
1-217	7-16-91	1320	32	60.9	53.4	73.7	216.8	84.7	60.3	146.9	6.5	221.8	1,400	Gain=20
1-219	7-16-91	1414	33	58.9	45.8	71.1	181.6	127.4	98.7	--	--	210.3	1,800	Peak #4 did not record. Gain=20
1-239	7-18-91	1020	29	46.1	121.9	67.7	171.1	260.9	586.8	--	--	--	--	Gain=20
1-244	7-18-91	1100	30	66.1	174.6	--	--	--	--	--	--	--	--	Do.
1-269	7-18-91	0945	28	258.5	139.6	--	--	--	--	--	--	--	--	Gain=2
1-1	8-09-91	1757	30	61.3	289.9	98.0	27.5	--	--	--	--	--	--	Previously sampled 7-15-91
1-48.5	8-09-91	1742	30	54.7	66.2	--	--	--	--	--	--	--	--	Do.
1-97	8-09-91	1727	31	54.7	47.5	95.9	17.8	--	--	--	--	--	--	Previously sampled 7-16-91
1-107	8-09-91	1712	31	58.7	105.3	98.0	35.4	--	--	--	--	--	--	Do.
1-147	8-09-91	1650	30	39.3	70.0	--	--	--	--	--	--	--	--	Do.
1-197	8-09-91	1637	30	--	--	--	--	--	--	--	--	--	--	No discernable peaks
1-207	8-09-91	1621	30	45.6	22.1	54.3	45.1	--	--	--	--	--	--	Previously sampled 7-16-91
1-215	8-09-91	1559	30	--	--	--	--	--	--	--	--	--	--	No discernable peaks
1-217	8-09-91	1527	30	38.2	487.7	42.5	1,400	54.5	2,900	67.8	14.7	77.4	10.3	Previously sampled 7-16-91
1-219	8-09-91	1511	30	50.7	31.8	--	--	--	--	--	--	--	--	Do.
1-239	8-09-91	1456	30	53.9	20.0	59.3	94.0	99.2	37.5	--	--	--	--	Do.
1-215	8-15-91	1310	29	97.7	14.1	--	--	--	--	--	--	--	--	Previously sampled 8-9-91
1-217	8-15-91	1255	29	49.7	131.6	61.3	249.1	79.5	1,100	--	--	--	--	Do.
2-1	7-19-91	1158	31	62.5	15.7	98.6	64.9	--	--	--	--	--	--	
2-20	7-19-91	1334	34	53.5	18.7	96.8	87.8	--	--	--	--	--	--	
2-40	7-19-91	1353	35	51.7	44.7	96.5	82.9	--	--	--	--	--	--	
2-50	7-19-91	1433	36	96.5	109.0	--	--	--	--	--	--	--	--	
2-60	7-19-91	1443	36	54.7	169.5	96.5	114.5	--	--	--	--	--	--	
2-70	7-19-91	1504	36	54.3	171.9	96.8	123.6	--	--	--	--	--	--	
2-80	7-19-91	1523	38	52.1	16.8	100.7	278.4	--	--	--	--	--	--	
2-90	7-19-91	1611	40	54.5	130.8	97.7	206.8	--	--	--	--	--	--	
2-98	7-19-91	1643	41	96.2	172.7	--	--	--	--	--	--	--	--	

Table 1.--*Field data from portable gas chromatography sampling, Highland Avenue study area, Fayetteville, Arkansas*--Continued

Site number (refer to figure 2)	Sampling date	Sampling time	Temperature (°C)	Peak 1		Peak 2		Peak 3		Peak 4		Peak 5		Comments
				sec	mvs	sec	mvs	sec	mvs	sec	mvs	sec	mvs	
2-1	8-05-91	1159	32	54.5	61.3	96.8	15.6	--	--	--	--	--	--	Previously sampled 7-19-91
2-20	8-05-91	1246	33	42.3	245.9	56.5	7.9	97.7	76.7	--	--	--	--	Do.
2-40	8-05-91	1305	34	64.7	476.2	101.0	81.9	--	--	--	--	--	--	Do.
2-50	8-05-91	1338	35	60.7	2,600	97.4	108.8	--	--	--	--	--	--	Do.
2-50	8-05-91	1434	36	54.1	953.6	99.5	77.9	--	--	--	--	--	--	Do.
2-60	8-05-91	1453	36	55.7	1,000	99.8	97.9	--	--	--	--	--	--	Do.
2-70	8-05-91	1552	36	42.0	88.6	--	--	--	--	--	--	--	--	Do.
2-80	8-05-91	1708	36	40.9	42.1	--	--	--	--	--	--	--	--	Do.
2-90	8-05-91	1618	36	41.2	83.5	--	--	--	--	--	--	--	--	Do.
2-98	8-05-91	1654	35	41.1	74.5	--	--	--	--	--	--	--	--	Do.
2-130	8-05-91	1635	36	41.1	59.2	--	--	--	--	--	--	--	--	
2-155	8-07-91	0920	27	42.3	56.3	49.7	27.3	--	--	--	--	--	--	
2-165	8-07-91	0954	29	43.5	29.8	--	--	--	--	--	--	--	--	
2-185	8-07-91	1101	31	--	--	--	--	--	--	--	--	--	--	No discernable peaks
2-195	8-07-91	1045	31	44.4	38.7	--	--	--	--	--	--	--	--	
2-205	8-07-91	1111	32	--	--	--	--	--	--	--	--	--	--	No discernable peaks
2-215	8-07-91	1130	32	--	--	--	--	--	--	--	--	--	--	Do.
2-225	8-07-91	1140	33	--	--	--	--	--	--	--	--	--	--	Do.
2-235	8-07-91	1219	34	96.5	9.2	--	--	--	--	--	--	--	--	
2-245	8-07-91	1247	34	48.1	28.4	99.5	17.7	--	--	--	--	--	--	
2-255	8-07-91	1332	34	99.5	20.2	--	--	--	--	--	--	--	--	
2-265	8-07-91	1411	35	101.0	25.2	--	--	--	--	--	--	--	--	
2-275	8-07-9 1	1435	34	37.3	13.0	105.5	49.4	--	--	--	--	--	--	
2-1	8-15-91	1620	30	50.1	695.8	--	--	--	--	--	--	--	--	Previously sampled 8-5-91
2-20	8-15-91	1611	30	55.1	108.0	97.1	33.9	--	--	--	--	--	--	Do.
2-40	8-15-81	1604	30	49.7	29.4	--	--	--	--	--	--	--	--	Do.
2-50	8-15-91	1556	30	--	--	--	--	--	--	--	--	--	--	Do. No discernable peaks.
2-60	8-15-91	1549	30	56.5	154.1	97.7	32.9	--	--	--	--	--	--	Previously sampled 8-5-91
2-70	8-15-91	1542	30	57.5	97.7	99.5	31.8	--	--	--	--	--	--	Do.
2-80	8-15-91	1527	30	41.3	86.5	56.3	66.7	97.7	20.5	--	--	--	--	Do.
2-90	8-15-91	1518	30	55.3	65.3	98.0	21.9	--	--	--	--	--	--	Do.
2-98	8-15-91	1510	30	42.3	120.7	57.7	212.0	97.1	13.7	--	--	--	--	Do.
2-130	8-15-91	1457	29	41.2	334.2	56.7	188.3	97.4	40.5	--	--	--	--	Do.
2-155	8-15-91	1445	29	40.3	171.0	55.7	76.6	96.8	12.7	191.8	124.6	247.7	2,500	Previously sampled 8-7-91
2-165	8-15-91	1428	29	53.9	30.4	--	--	--	--	--	--	--	--	Do.
2-185	8-15-91	1435	30	55.1	54.8	95.9	48.5	--	--	--	--	--	--	Do.
2-195	8-15-91	1420	29	55.5	29.2	96.5	10.6	--	--	--	--	--	--	Do.
2-205	8-15-91	1410	30	52.9	29.5	--	--	--	--	--	--	--	--	Do.
2-215	8-15-91	1403	30	--	--	--	--	--	--	--	--	--	--	Previously sampled 8-7-91. No discernable peaks.

Table 1.--*Field data from portable gas chromatography sampling, Highland Avenue study area, Fayetteville, Arkansas*--Continued

Site number (refer to figure 2)	Sampling date	Sampling time	Temperature (°C)	Peak 1 sec	Peak 1 mvs	Peak 2 sec	Peak 2 mvs	Peak 3 sec	Peak 3 mvs	Peak 4 sec	Peak 4 mvs	Peak 5 sec	Peak 5 mvs	Comments
2-225	8-15-91	1354	29	55.7	31.1	96.5	13.4	--	--	--	--	--	--	Previously sampled 8-7-91
2-235	8-15-91	1347	29	56.71	19.7	99.2	29.6	--	--	--	--	--	--	Do.
2-245	8-15-91	1340	29	57.9	113.0	99.2	42.0	148.9	167.7	--	--	--	--	Do.
2-255	8-15-91	1333	29	57.1	137.8	97.4	17.9	--	--	--	--	--	--	Do.
2-265	8-15-91	1326	29	57.1	570	97.7	24.0	--	--	--	--	--	--	Do.
2-275	8-15-91	1319	29	58.3	180.4	99.8	31.9	--	--	--	--	--	--	Do.
3-1	8-10-91	1437	28	37.0	29.9	51.5	56.8	--	--	--	--	--	--	
3-20	8-10-91	1500	29	44.0	35.4	--	--	--	--	--	--	--	--	
3-40	8-10-91	1522	29	45.7	27.5	51.7	65.9	--	--	--	--	--	--	
3-50	8-10-91	1550	30	--	--	--	--	--	--	--	--	--	--	No discernable peaks
3-60	8-10-91	1606	30	36.1	38.4	--	--	--	--	--	--	--	--	
3-70	8-10-91	1654	31	--	--	--	--	--	--	--	--	--	--	No discernable peaks
3-80	8-10-91	1702	32	--	--	--	--	--	--	--	--	--	--	Do.
3-90	8-10-91	1710	31	--	--	--	--	--	--	--	--	--	--	Do.
3-105	8-10-91	1728	30	--	--	--	--	--	--	--	--	--	--	Do.
3-126	8-10-91	1738	30	--	--	--	--	--	--	--	--	--	--	Do.
3-132	8-10-91	1749	30	--	--	--	--	--	--	--	--	--	--	Do.
3-138	8-10-91	1759	30	--	--	--	--	--	--	--	--	--	--	Do.
3-145	8-10-91	1808	30	--	--	--	--	--	--	--	--	--	--	Do.
3-155	8-10-91	1816	30	--	--	--	--	--	--	--	--	--	--	Do.
3-165	8-11-91	1535	28	37.7	21.9	--	--	--	--	--	--	--	--	
3-175	8-11-91	1550	29	51.9	12.0	--	--	--	--	--	--	--	--	
3-185	8-11-91	1604	29	37.7	232.1	--	--	--	--	--	--	--	--	
3-195	8-11-91	1627	30	54.2	350×10^3	78.5	13.8×10^3	122.6	1,300	--	--	--	--	#1 = 350,000 mvs #2 = 13,800 mvs
3-200	8-11-91	1802	31	57.1	81.3	97.4	46.5	--	--	--	--	--	--	
3-205	8-11-91	1659	30	51.3	17.9	134.3	218.8	--	--	--	--	--	--	
3-215	8-11-91	1712	31	52.3	22.4	134.9	193.7	--	--	--	--	--	--	
3-225	8-11-91	1726	31	44.2	17.6	95.6	10.3	134.0	298.4	--	--	--	--	
3-235	8-11-91	1740	31	--	--	--	--	--	--	--	--	--	--	No discernable peaks
3-245	8-11-91	1748	30	96.5	6.8	140.9	267.3	--	--	--	--	--	--	
3-195	8-15-91	1237	29	42.9	528.2	48.3	1,200	59.3	42.4	77.1	582	--	--	Previously sampled 8-11-91