AA Technical Memorandum ERL AOML-32

DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA

POLYCHLORINATED BIPHENYLS, CHLORINATED PESTICIDES AND TRACE METALS IN SOILS OF THE EVERGLADES NATIONAL PARK AND ADJACENT AGRICULTURAL AREAS

Adolfo G. Requejo
Richard H. West
George R. Harvey
Patrick G. Hatcher
Philip A. McGillivary

Atlantic Oceanographic and Meteorological Laboratories
Miami, Florida
October 1977

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / Environmental Research Laboratories

NOAA Technical Memorandum ERL AOML-32

POLYCHLORINATED BIPHENYLS, CHLORINATED PESTICIDES AND TRACE METALS IN SOILS OF THE EVERGLADES NATIONAL PARK AND ADJACENT AGRICULTURAL AREAS

Adolfo G. Requejo
Richard H. West
George R. Harvey
Patrick G. Hatcher
Philip A. McGillivary

Ocean Chemistry Laboratory

Atlantic Oceanographic and Meteorological Laboratories
Miami, Florida
October 1977

UNITED STATES
DEPARTMENT OF COMMERCE
Juanita M. Kreps, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Richard A. Frank, Administrator

Environmental Research
Laboratories
Wilmot N. Hess, Director

DISCLAIMER

CONTENTS

ABSTRACT

Soil samples collected in May, 1976, from the eastern Everglades National Park and adjacent farmlands were analyzed for polychlorinated biphenyls (PCB's), certain chlorinated pesticides, and trace metals. The results indicate that although concentrations of PCB's, DDT's, Chlordane, and copper are high at agricultural sites, little horizontal movement of these compounds has occurred. In addition, black plastic is identified as the source of PCB's in the area, but the input of these compounds into the Park is minor.

KEY WORDS: EVERGLADES NATIONAL PARK, SOILS, PCB's, PESTICIDES, TRACE METALS, NATIONAL PARK SERVICE

INTRODUCTION

The U.S. Department of Interior has recently expressed concern over the possible adverse environmental impact of farming in the Everglades National Park. In an effort to determine the severity of this threat, a study was undertaken to analyze soil samples collected from the Everglades National Park and agricultural lands east of the Park for trace metals and certain chlorinated hydrocarbons. The objectives of this study were to 1) determine levels of PCB's, selected pesticides, and trace metals, and 2) determine if horizontal transport of these metals and anthropogenic compounds from adjacent farmlands into the Park is occurring.

EXPERIMENTAL DESIGN

The sampling grid was designed to detect any horizontal gradient of agricultural chemicals present in the area. Sites included locations in Taylor Slough, south and west of Context Road, agricultural lands (active and fallow), and several sites immediately south of the agricultural lands (Figure 1). Sites in Taylor Slough were sampled in the center and to either side of the main flow of water (Figure 2). At station CR6, additional samples (designated CR6S and CR6H, respectively) were taken from a nearby solution sinkhole and hardwood hammock. Cores were also taken at selected locations. Samples of black plastic, identical to that used in agricultural fields, were analyzed for PCB content.

SAMPLE COLLECTION

All sampling was done in May, 1976. Surface soil samples were collected using a Teflon scoop to remove approximately the upper 2 cm of soil. Care was taken to remove any non-representative surface debris (detrital material, etc.). The samples were placed in clean glass jars and sealed with Teflon lined caps. Cores were taken using glass barrels and sealed with Teflon sheeting. Upon return to the laboratory all samples were immediately frozen. They were subsequently freeze-dried then stored frozen for later analysis.

ANALYTICAL METHODS

Chlorinated Hydrocarbons

A weighed portion of the freeze-dried soil was extracted with hexane in a Soxhlet apparatus for 24 hours. Saponification of random samples to determine extraction efficiency showed this procedure to be greater than 80% efficient for chlorinated hydrocarbons. However, this efficiency may vary with the chemical composition of the soil.

An aliquot of the hexane extract was concentrated to near dryness and transferred onto a column of Florisil deactivated with 3% water (this slight deactivation of the adsorbent assured reproducibility). The column was eluted sequentially with hexane, 6% diethyl ether in hexane, and 50% diethyl ether in hexane. The 6% and 50% ether/hexane fractions were concentrated in preparation for analysis by electron capture gas chromatography. In order to separate PCB's from DDT's and DDT metabolites, the hexane fraction was further chromatographed on 3% deactivated silicic acid (Armour and Burke, 1970) and eluted with hexane followed with benzene. These fractions were similarly prepared for gas chromatographic analysis. Average recovery of standard mixtures was greater than 80%. The separation scheme is detailed in Figure 3.

PCB's were extracted from black plastic by treatment with boiling sulfuric acid, followed by partitioning using hexane. The hexane extract was cleaned and analyzed using the procedure described above.

Components were identified and quantitated using a Tracor 550 gas chromatograph equipped with a Ni63 electron capture detector interfaced with a Hewlett-Packard 3380A reporting integrator. Three different column packings were used: glass columns (all columns 2m x 2mm i.d.) packed with 5% OV-210 on 100/120 mesh Supelcoport were used primarily for quantitation of pesticides, while columns packed with 1.5% SP-2250/ 1.95% SP-2401 on 100/120 mesh Supelcoport and 4% SE-30/6% QF-1 on 100/120 mesh Supelcoport were used for PCB analysis and confirmation of pesticide component peaks, respectively. Chromatograms of standard pesticide mixtures and individual Aroclors are shown in Figures 4, 5, 6, 7, 8, 9, and 10.

Pesticide concentrations were calculated using external standard techniques. Total DDT and total Chlordane values were reported as the sum of DDT and DDT metabilites and the gamma and alpha isomers of Chlordane, respectively. Total pesticide concentrations less than one ppb were not reported. PCB concentrations were also calculated using external standards; however, individual contributions of the four Aroclors (PCB grades manufactured by the Monsanto Company), which account for the majority of domestic use (Interdepartmental Task Force on PCB's, 1972), were calculated using a computerized pattern recognition program (Zobel, 1974). Total PCB was reported as the sum total of individual Aroclor concentrations and values below 0.10 ppb were not reported.

Trace Metals

Freeze-dried samples were weighed then digested using triply-distilled nitric acid with heat for 90 minutes. Upon cooling, the solutions were filtered through a combination of a glass fiber filter (Whatman GF/C, effective retention 1.2μm) and Nuclepore filter (Nuclepore, 0.4μm pore size). The filtrate was diluted and analyzed using a Perkin-Elmer 503 atomic absorption spectrophotometer equipped with a heated graphite furnace Model HGA 2100.

RESULTS AND DISCUSSION

Pesticide concentrations are presented in Tables 1 and 2 (Toxaphene, Parathion and Malathion were not detected in any of the samples analyzed). Residues of chlorinated pesticides other than Chlordane, DDT, and DDT metabolites were found at only four sites (CR-6H, 20, A1, and A2). Total Chlordane concentrations range from less than 1.0 ppb to 194.8 ppb, the greater value corresponding to site A2, an active agricultural field. Total DDT concentrations range from less than 1.0 ppb to 760.7 ppb, the latter also at site A2. Chromatograms of pesticides detected at two agricultural sites are shown in Figures 10 and 12. p,p'-DDE accounted for over 50% of total DDT detected, indicating a lack of recent use of DDT in the area. Over half of all the sites sampled contained DDT and Chlordane concentrations less than 2 ppb. No cores were analyzed because of these baseline concentrations found in the surficial sediments. DDT and Chlordane distributions are shown in Figures 15 and 16. These contours show that the high concentrations of pesticides are restricted to the farmlands; and that there is little, if any, horizontal movement of these compounds into the Park.

Table 1. Chlorinated pesticide concentration in soil samples from the Everglades National Park and adjacent areas (ng/g dry weight).

Sample	Lindane	Heptachlor Epoxide	Dieldrin	Aldrin	Endrin	Chlordane	Chlordane	Total Chlordane
CR-0	*	*	*	*	*	*	*	*
CR-1	*	*	*	*	*	1.17	0.45	1.62
CR-2	*	*	*	*	*	*	*	*
CR-3	*	*	*	*	*	*	*	*
CR-4	*	*	*	*	*	2.25	1.12	3.37
CR-5	*	*	*	*	*	*	*	*
CR-6	*	*	*	*	*	*	*	*
CR-6S	*	*	*	*	*	*	*	*
CR-6H	*	*	23.20	*	*	21.31	14.75	36.06
1	*	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*	*
4	*	*	*	*	*	*	*	*
5	*	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*	*
7A	*	*	*	*	*	1.10	1.00	2.10
7B	*	*	*	*	*	*	*	*
7C	*	*	*	*	*	*	*	*
8	*	*	*	*	*	*	*	*
9A	*	*	*	*	*	*	*	*
9B	*	*	*	*	*	0.87	0.72	1.59
9C	*	*	*	*	*	0.86	0.21	1.07
10A	*	*	*	*	*	1.45	0.96	2.41
10B	*	*	*	*	*	0.61	0.51	1.12
10C	*	*	*	*	*	2.23	0.56	2.79
11A	*	*	*	*	*	0.66	0.51	1.17
11B	*	*	*	*	*	1.62	1.09	2.71
11C	*	*	*	*	*	0.60	0.67	1.27
12A	*	*	*	*	*	0.51	0.56	1.07
12B	*	*	*	*	*	*	*	*
12C	*	*	*	*	*	0.50	0.65	1.15
13	*	*	*	*	*	0.61	0.83	1.44
14	*	*	*	*	*	0.87	0.67	1.54
15	*	*	*	*	*	1.91	1.21	3.12
16	*	*	*	*	*	*	*	*
17	*	*	*	*	*	*	*	*
18	*	*	*	*	*	0.73	0.58	1.31
19	*	*	*	*	*	*	*	*
20	*	*	2.01	*	*	3.46	1.29	4.75
21	*	*	*	*	*	*	*	*
22	*	*	*	*	*	1.10	0.94	2.04
A1	*	*	15.60	*	*	40.30	27.60	67.90
A2	*	*	237.50	10.66	*	111.60	83.20	194.80
A3	*	*	*	*	*	1.21	0.23	1.44

* = Below 1.0 ppb.

Table 2. DDT and DDT metabolite concentration in soil samples from the Everglades National Park and adjacent areas (ng/g dry weight).

Sample	op-DDD	pp-DDD	op-DDE	pp-DDE	op-DDT	pp-DDT	Total DDT
CR-0	*	*	*	*	*	*	*
CR-1	*	*	*	*	*	*	*
CR-2	0.52	0.59	*	0.57	*	0.33	2.01
CR-3	*	*	*	*	*	*	*
CR-4	0.83	1.33	*	4.86	*	0.12	7.14
CR-5	*	*	*	*	*	*	*
CR-6	*	*	*	*	*	*	*
CR-6S	*	*	*	*	*	*	*
CR-6H	*	10.39	*	14.82	6.35	11.87	41.55
1	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*
4	*	*	*	*	*	*	*
5	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*
7A	*	0.33	*	0.25	0.46	0.18	1.22
7B	*	*	*	*	*	*	*
7C	*	*	*	*	*	*	*
8	*	*	*	*	*	*	*
9A	*	1.45	*	0.45	*	1.22	3.12
9B	0.82	1.80	*	18.27	0.18	0.45	21.52
9C	*	1.90	*	2.22	*	*	4.12
10A	*	0.75	*	1.69	*	0.78	3.22
10B	*	0.76	*	4.13	*	0.31	5.20
10C	*	0.81	*	5.35	*	0.51	6.67
11A	*	0.31	*	0.76	*	0.18	1.25
11B	1.25	2.87	*	3.10	*	0.39	7.61
11C	0.82	2.34	*	8.81	*	1.04	13.01
12A	0.44	0.44	*	0.61	*	0.19	1.68
12B	0.33	0.21	*	0.59	*	0.19	1.32
12C	*	0.36	*	0.65	*	*	1.01
13	*	0.38	*	1.36	*	*	1.74
14	*	*	*	*	*	*	*
15	*	0.52	*	0.65	*	*	1.17
16	*	*	*	*	*	*	*
17	*	*	*	*	*	*	*
18	*	*	*	*	*	*	*
19	*	*	*	*	*	*	*
20	*	0.68	*	1.69	*	*	2.37
21	0.87	1.03	*	0.75	*	*	2.65
22	1.67	0.83	*	1.32	*	*	3.82
A1	6.74	12.67	*	96.80	37.50	83.80	237.51
A2	*	58.50	*	503.30	136.90	61.98	760.70
A3	0.14	*	*	*	0.23	10.50	10.87

* = Below 1.0 ppb.

The distribution of PCB's in the area is more widely dispersed than the chlorinated pesticides. Values range from less than 0.10 ppb to 42.71 ppb (Table 3). Chromatograms of PCB's from two agricultural sites are shown in Figures 11 and 14. Figure 18 shows that the agricultural sites are the areas of highest PCB concentration. There is, however, a sharp decreasing gradient moving west from the farmlands, encompassing a six-fold decrease in concentration over a distance of 2.5 kilometers. Analysis of the suspected source of PCB's in this area, black plastic sheeting, revealed a total concentration of 263.8 ppb. A typical chromatogram of the PCB extract from black plastic is shown in Figure 15. In addition, the individual Aroclor distribution of the total PCB detected in the sampling area closely resembles the individual Aroclor distributions in black plastic (Table 4). These data strongly suggest that PCB's are being released into the atmosphere during the burning of black plastic. The east-southeast winds which prevail during most of the year are the most likely mechanism for their westerly transport (Figure 18). However, the burning of black plastic appears to account for an extremely low-level contamination into the parklands. The mean PCB values within the Park agree closely with baseline PCB levels of 2-5 ppb found in surface sediments of the North Atlantic abyssal plain (Harvey and Steinhauer, 1976).

The ration of total PCB to total chlorinated hydrocarbons (Figure 19) indicates that PCB's, shown to be a small portion of the total chlorinated compounds detected at the agricultural sites, become the major chlorinated compound a few kilometers to the west.

Table 3. PCB concentrations and Total Organic Carbon in soil samples from the Everglades National Park and adjacent areas (ng/g dry weight).

Sample	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCB	TOC#
CR-0	11.09	7.39	7.39	7.39	33.26	6.00
CR-1	7.64	1.01	0.13	1.89	10.67	4.60
CR-2	0.50	0.73	0.70	0.50	2.40	7.40
CR-3	0.90	3.70	0.40	*	5.00	7.20
CR-4	2.80	2.80	5.20	6.20	17.00	21.70
CR-5	2.70	0.11	2.70	0.15	5.66	5.40
CR-6	2.06	0.93	2.09	*	5.08	7.50
CR-6S	10.00	15.00	*	*	25.00	21.40
CR-6H	2.66	8.97	*	5.98	17.61	22.07
1	0.64	20.42	0.69	0.74	22.50	6.15
2	6.03	8.27	2.12	1.71	18.13	5.91
3	8.01	4.51	4.63	0.84	18.00	4.59
4	3.70	5.98	0.73	0.27	10.68	1.79
5	11.74	10.11	0.82	1.14	23.81	4.43
6	*	*	*	*	*	7.63
7A	*	6.29	3.14	2.09	11.52	8.18
7B	*	*	*	*	*	4.47
7C	*	*	*	*	*	5.42
8	5.98	4.29	0.55	*	10.82	7.20
9A	*	*	0.35	0.52	0.87	16.10
9B	*	*	*	*	*	39.57
9C	*	0.47	0.71	5.40	6.58	26.47
10A	*	*	3.64	6.21	9.85	20.63
10B	*	*	*	*	*	30.26
10C	*	*	*	2.13	2.13	9.23
11A	*	*	1.62	4.30	5.92	6.51
11B	*	*	2.90	7.70	10.60	12.75
11C	*	*	*	2.57	2.57	28.63
12A	*	1.91	3.02	6.45	11.38	5.81
12B	*	*	0.58	*	0.58	4.67
12C	*	*	0.30	0.26	0.56	8.78
13	*	1.28	*	0.45	1.73	6.44
14	9.82	1.04	0.80	*	11.66	3.66
15	1.21	0.97	0.29	0.43	2.90	5.83
16	1.85	2.31	0.82	*	4.98	9.37
17	*	*	*	0.88	0.88	4.43
18	*	*	*	0.40	0.40	4.57
19	*	*	*	*	*	2.76
20	*	*	7.50	4.81	12.31	10.01
21	*	*	*	2.74	2.74	4.03
22	*	*	*	2.65	2.65	0.34
A1	26.20	1.10	3.81	11.60	42.71	2.40
A2	10.97	7.31	10.12	10.12	38.52	2.21
A3	13.70	11.30	11.00	0.20	36.20	7.20
BP	94.31	82.48	45.41	51.62	273.82	

* = Below 0.10 ppb.

= Percent dry sediment weight.

Table 4. Individual Aroclor concentrations for black plastic and the sampling grid.

	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Black plastic	0.34	0.30	0.17	0.19
Sampling grid	0.31	0.29	0.18	0.22

The distribution of the individual Aroclors (Figure 20 and 21) shows that Aroclors 1242 and 1248 are found almost exclusively west-northwest of the farmlands, while Aroclors 1254 and 1260 predominate to the south of the farmlands and in Taylor Slough (Figures 22 and 23). An explanation for these unequal distributions of individual Aroclors could be the differing volatilities of individual chlorobiphenyls. The major chlorobiphenyls in Aroclors 1242 and 1248, having vapor pressures an order of magnitude greater than those in Aroclors 1254 and 1260 (Spencer and Cliath, 1972; Mackay and Wolkoff, 1973), would be more easily volatilized and therefore transported a greater distance from the agricultural sites.

Figures 17 and 18 also show slightly elevated values for total DDT and total PCB in Taylor Slough. The water flow data available for this area (Earle and Hartwell, 1973) point to the agricultural lands east of the Park as the source of these pollutants (i.e., chlorinated compounds are adsorbed on particulate matter suspended in the water column which is deposited in the Slough). The Hole-in-the-Donut, which until recently was heavily farmed, could have had a minor contribution to the elevated levels in this area. It should be emphasized, however, that this input is small and as such does not appear to represent a major source of pollutants to the east of the Hole-in-the-Donut.

The trace metal data are listed in Table 5. The distribution of copper (Figure 24) shows that little movement from the agricultural lands is occurring. Cu is a well known agricultural fungicide and would be expected in agricultural land and watersheds. Its transport mechanism from the agricultural area is probably similar to that of the pesticides and accounts for the slightly elevated values in Taylor Slough.

Table 5. Trace metal concentration in soil samples from the Everglades National Park and adjacent areas (ng/g dry weight).

Sample	Cu	Cd	Fe	Zn
1	46.0	2.4	13000	*
2	14.0	1.8	1700	160
3	14.0	5.2	2000	220
4	4.2	1.9	11000	430
5	0.86	3.1	2300	98
6	4.0	2.4	2900	100
7A	51.0	*	5600	*
7B	1.4	0.13	1400	*
7C	*	*	960	62
8	9.4	5.5	830	9.8
9A	8.3	2.6	4700	160
9B	11.0	0.35	11000	*
9C	37.0	0.35	3900	130
10A	31.0	0.15	8100	*
10B	5.3	17.0	5700	*
10C	19.0	0.81	6500	57
11A	3.2	0.88	1100	34
11B	45.0	*	8200	55
11C	15.0	30.0	8600	140
12A	2.7	0.051	2700	*
12B	3.5	0.56	1700	3.9
12C	3.0	0.41	2400	83
13B	1.7	0.94	1300	40
14	4.1	*	2200	*
15	45.0	*	2000	20
16	#	#	#	#
17	#	#	#	#
18	9.4	7.2	1500	*
19	18.0	5.3	1700	*
20	20.0	3.0	1800	*
21	3.7	2.9	4500	*

Table 5 (cont.)

Sample	Cu	Cd	Fe	Zn
22	4.4	5.5	*	*
A1	270.0	4.9	3300	69
A2	82.0	1.6	2200	92
A3	15.0	0.35	8000	15
CR0	4.9	1.3	5200	*
CR1	6.1	10.0	1500	*
CR2	#	#	#	#
CR3	#	#	#	#
CR4	42.0	0.69	6700	2300
CR5	26.0	0.96	2400	*
CR6	4.6	1.9	4500	9.3
CR6H	130.0	0.55	330	3.9
CR6S	19.0	*	7200	*

samples not analyzed due to contamination.

* Below detectibility limits of individual metal: Cu 1 ng/g, Cd 0.04 ng/g, Fe 0.5 ng/g, Zn 0.02 ng/g (Perkin Elmer Corp.)

It is obvious from the data on Cd, Fe, and Zn set out in Table 5 that these metals were not used in or near the agricultural lands. None of the high values among these metals correspond to the farmland values or the high values found for Cu. Since the range of Cd and Zn values is so great with none of the highs or lows corresponding with any apparent use pattern or topological feature of the terrain, we must assume that these data represent normal geochemical variations between soil types, mineralogy, and localized erosion and accumulation. It was originally intended to use the Fe values as a normalizing factor for the other three elements. However, it is apparent that the same complex processes operating on the trace metals Cd and Zn affect Fe, a major crustal component, in the same way.

CONCLUSIONS

This study indicates that little or no contamination is moving from the agricultural lands into the Park. The highest concentrations of PCB, DDT, Chlordane, and copper are restricted to the agricultural sites. In addition, contours from these various parameters show very short dispersal distances. The major pathway for PCB distribution into the Park appears to be the burning of black plastic sheeting, However, the inputs are extremely low, and generally the concentrations found in the Park are similar to those observed in pristine environments. An exception is the slightly elevated values found in the Taylor Slough area. These levels may be accounted for by water transport and, to a lesser degree, the previously farmed Hole-in-the-Donut area.

ACKNOWLEDGMENTS

The authors wish to thank Brendan Dwyer, Mike Macau, and Mike Mallette for their assistance with the analysis. This study was funded by the National Park Service, Department of Interior under Contract No. 5297-1008-182.

List of Figures

REFERENCES

Armour, J.A. and J.A. Burke (1970), Separating PCB from DDT and analogs, Journ. of the Ass'n. of Official Analytical Chemists, 53, 761-768.

Earle, J.E. and J.M. Hartwell (1973), Hydrologic data for Taylor Slough, Open File Report No. 73012, United States Geological Survey, Tallahassee, Florida.

Harvey, G.R. and W.G. Steinhauer (1976), PCB concentrations in North Atlantic sediments; in Environmental Biogeochemistry, Vol. 1, J.O. Nraigu, ed., (Ann Arbor: Ann Arbor Science, Inc.) pp. 213-214.

Interdepartmental Task Force on PCB's, PCB's and the Environment (Mar. 1972), COM-72-10419, National Technical Information Service, U.S. Department of Commerce, Springfield, VA.

Mackay, D. and A.W. Wolkoff (1973), Rate of evaporation of low solubility contaminants from water bodies to the atmosphere, Environ. Sci. and Tech., 7, 611.

Spencer, W.F. and M.M. Cliath (1972), Volatility of DDT and related compounds, J. Agr. Food Chem., 20, 645.

Zobel, M.G.R. (1974), Quantitative determination of polychlorinated biphenyls - a computer approach, Journ. of the Ass'n. of Official Analytical Chemists, 57, 791-795.

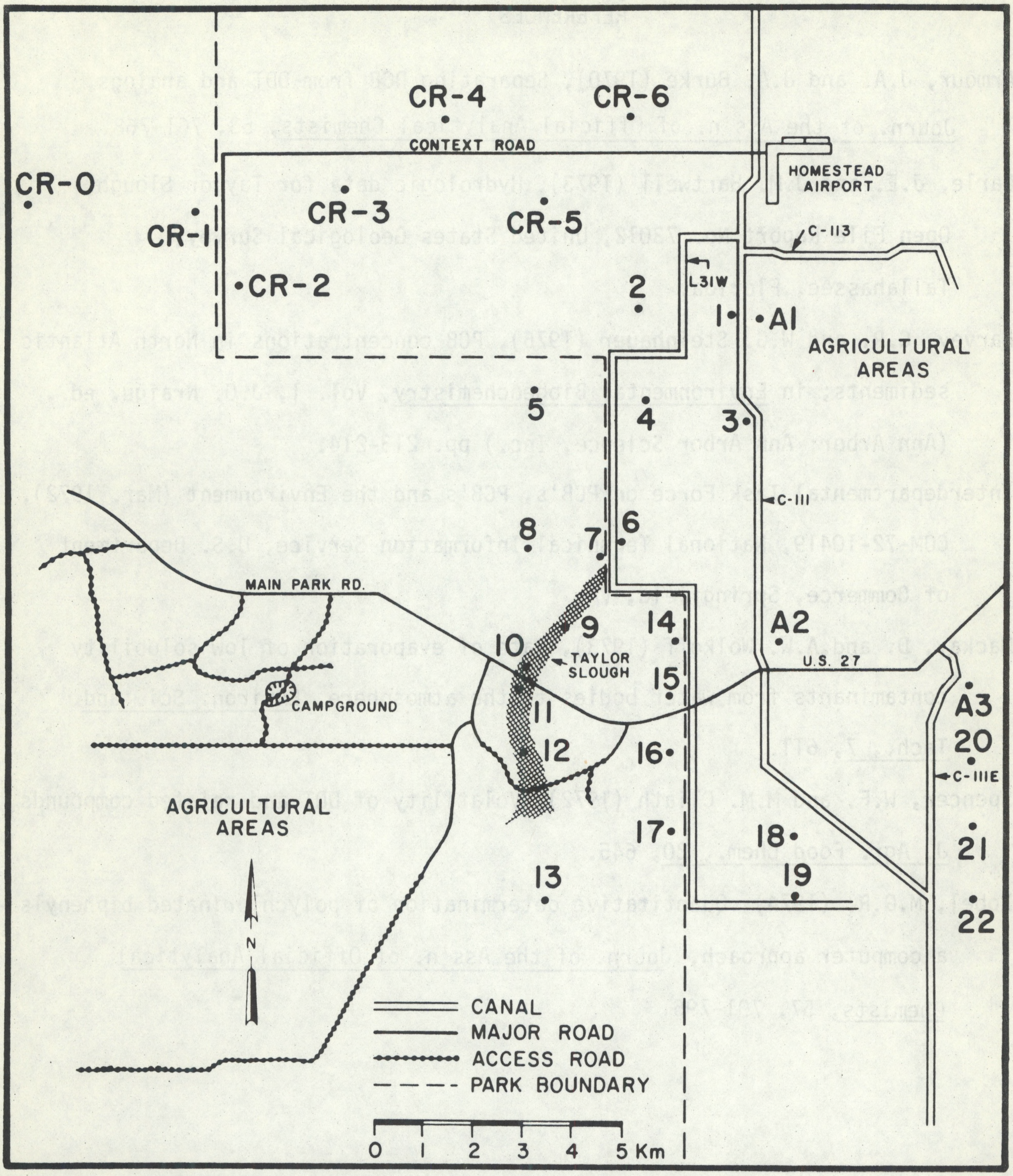

Figure 1. Location of sampling sites.

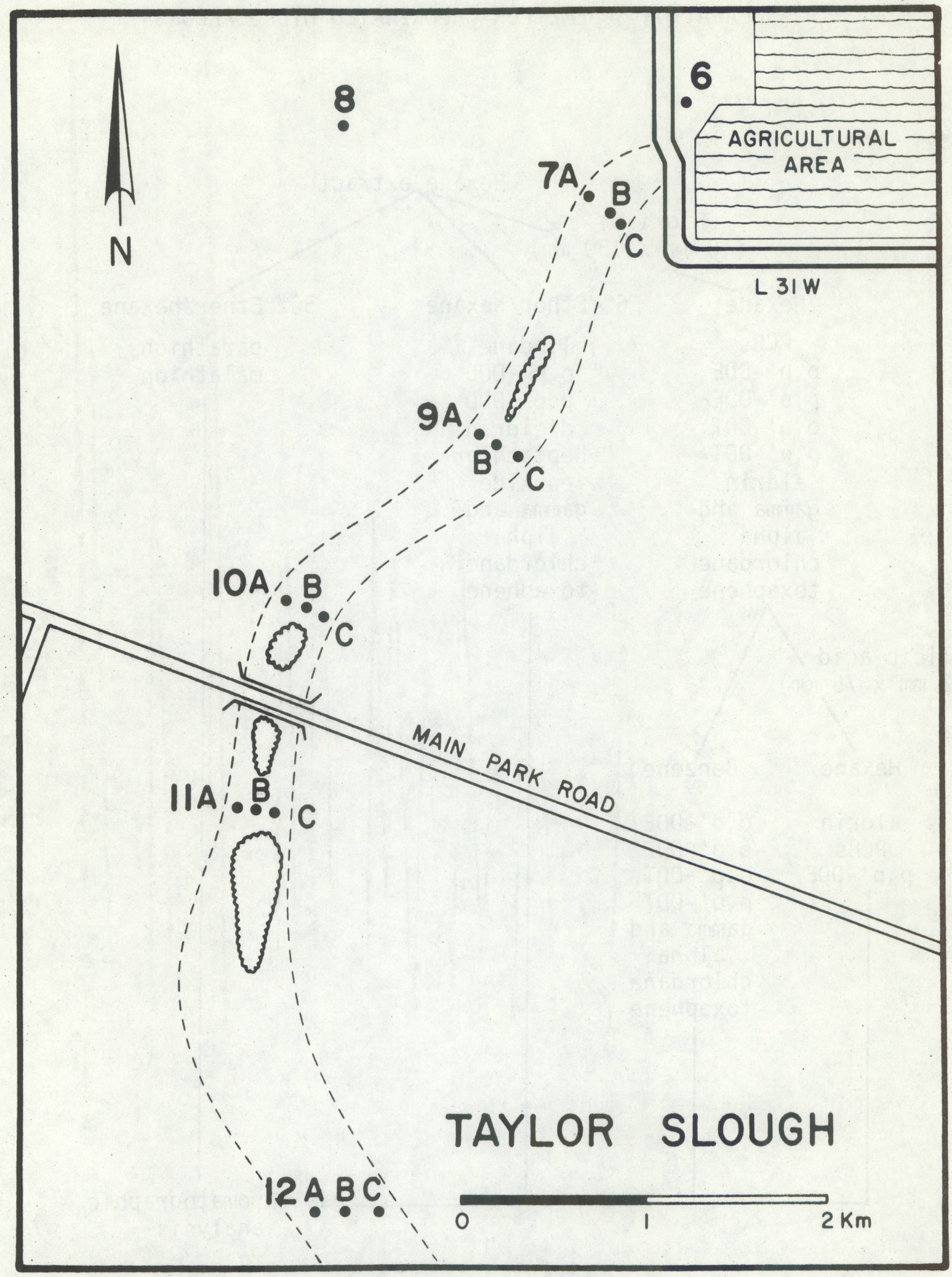

Figure 2. Station location in Taylor Slough.

SEPARATION SCHEME FOR CHLORINATED HYDROCARBONS

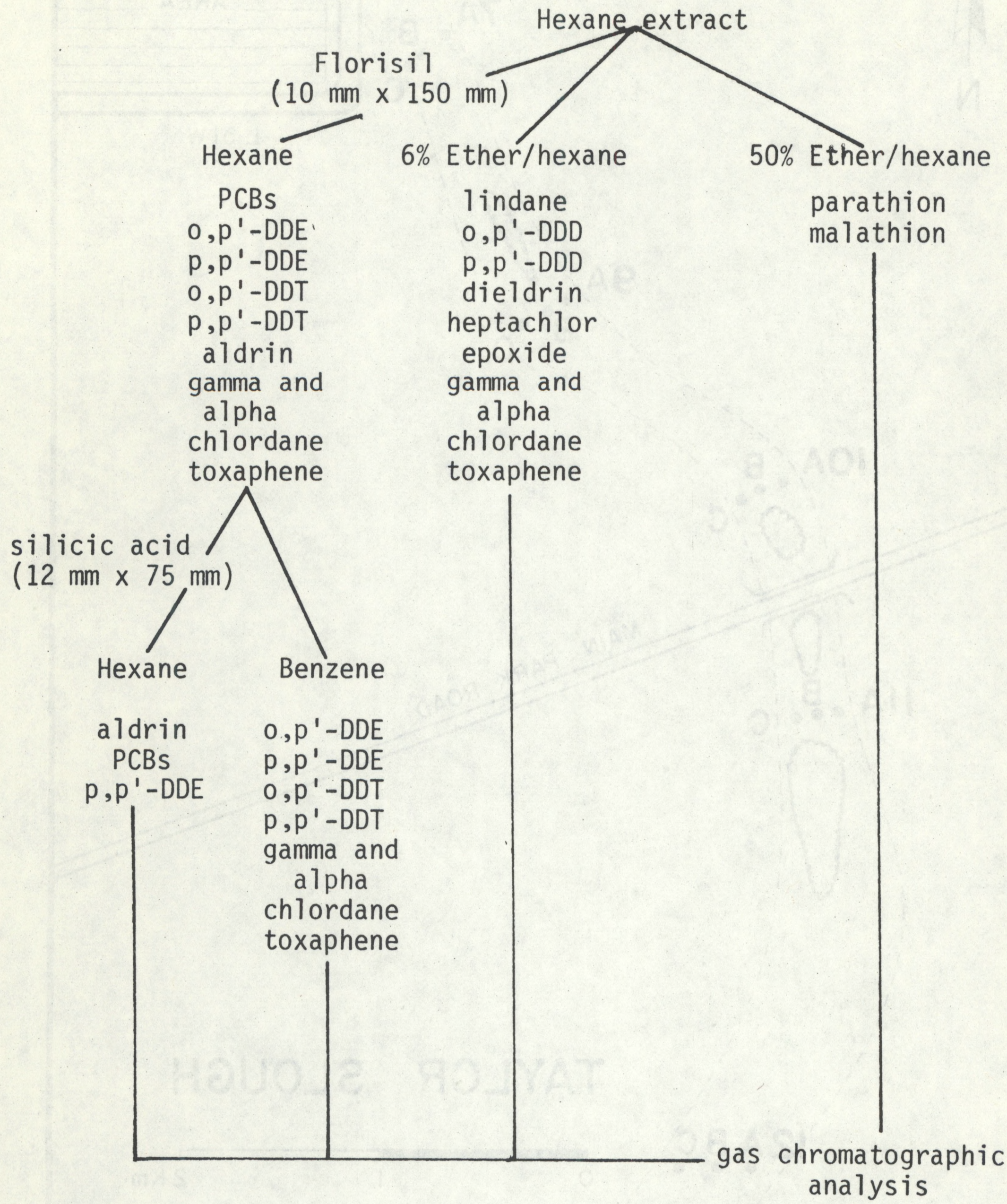

Figure 3. Separation scheme for chlorinated hydrocarbon.

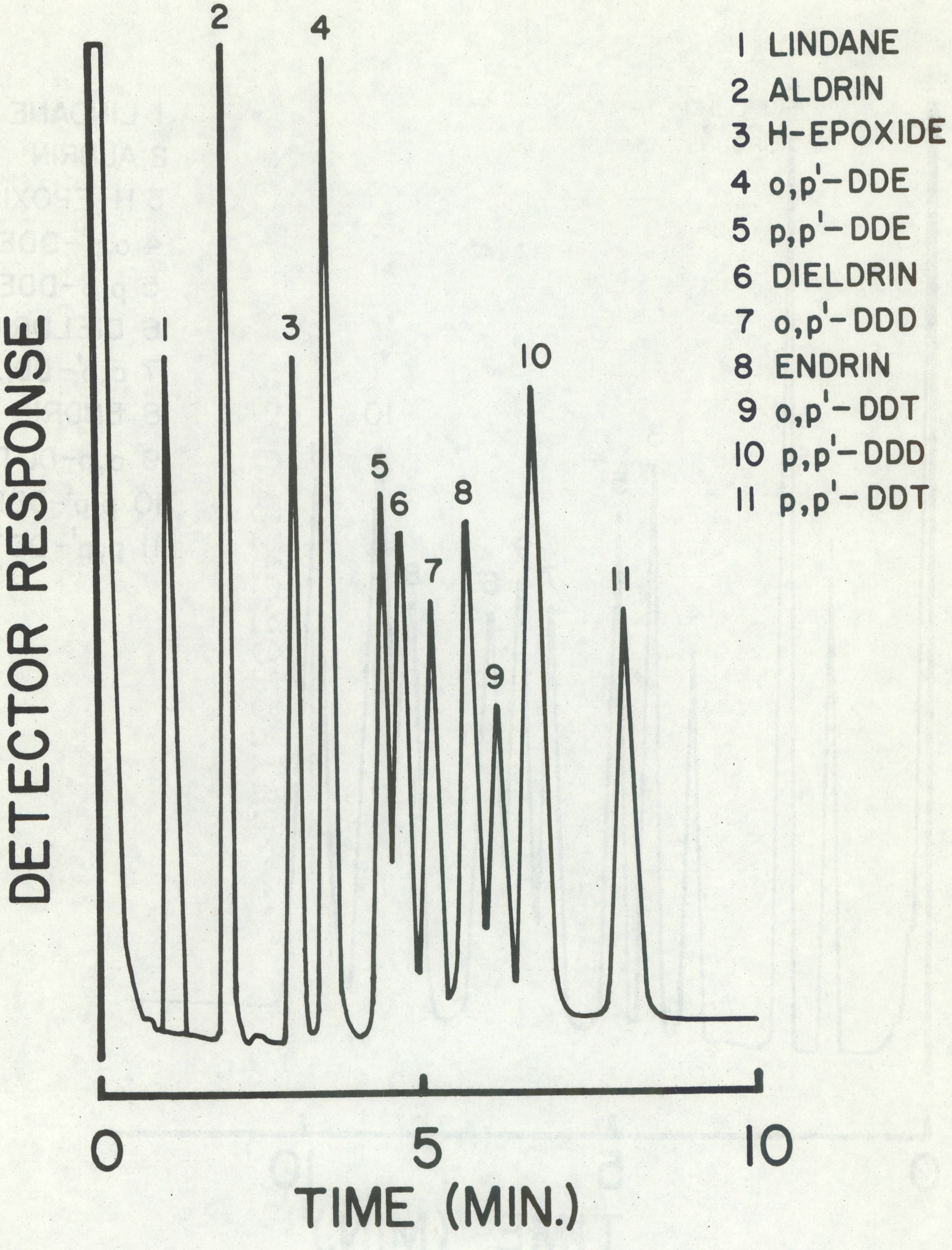

Figure 4. Gas chromatogram of pesticide mixture on a column of 1.5% SP-2250/1.95 SP-2401 100/120 mesh Supelcoport, Column temperature 200^{o}C, carrier flow (N_2) 25 ml/min., Ni^{63} detector.

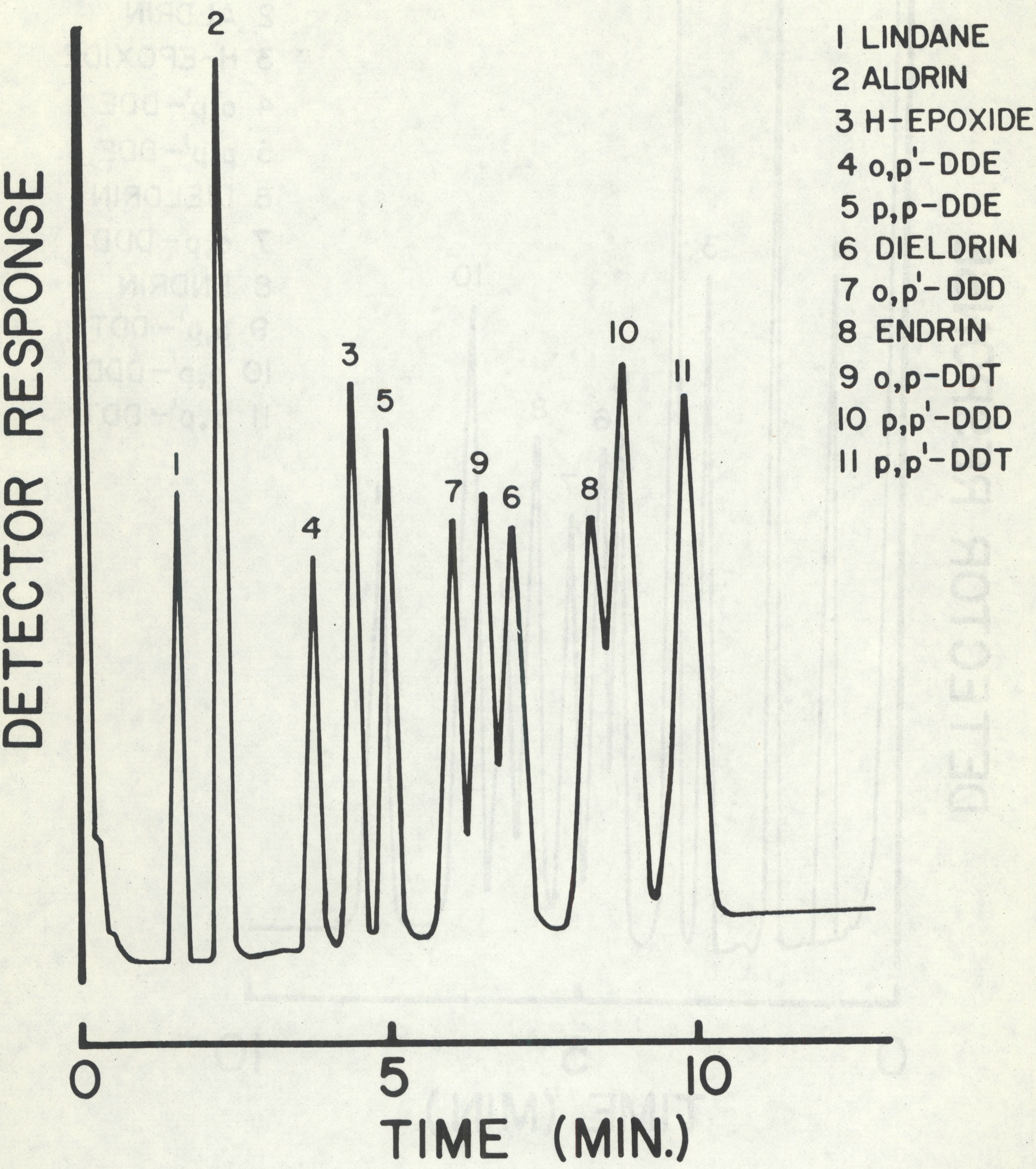

Figure 5. Gas chromatogram of pesticide mixture on a column of 5% OV-210 on 100/120 mesh Supelcoport, Column temperature 170°C carrier flow 25 ml/min. Ni^{63} detector.

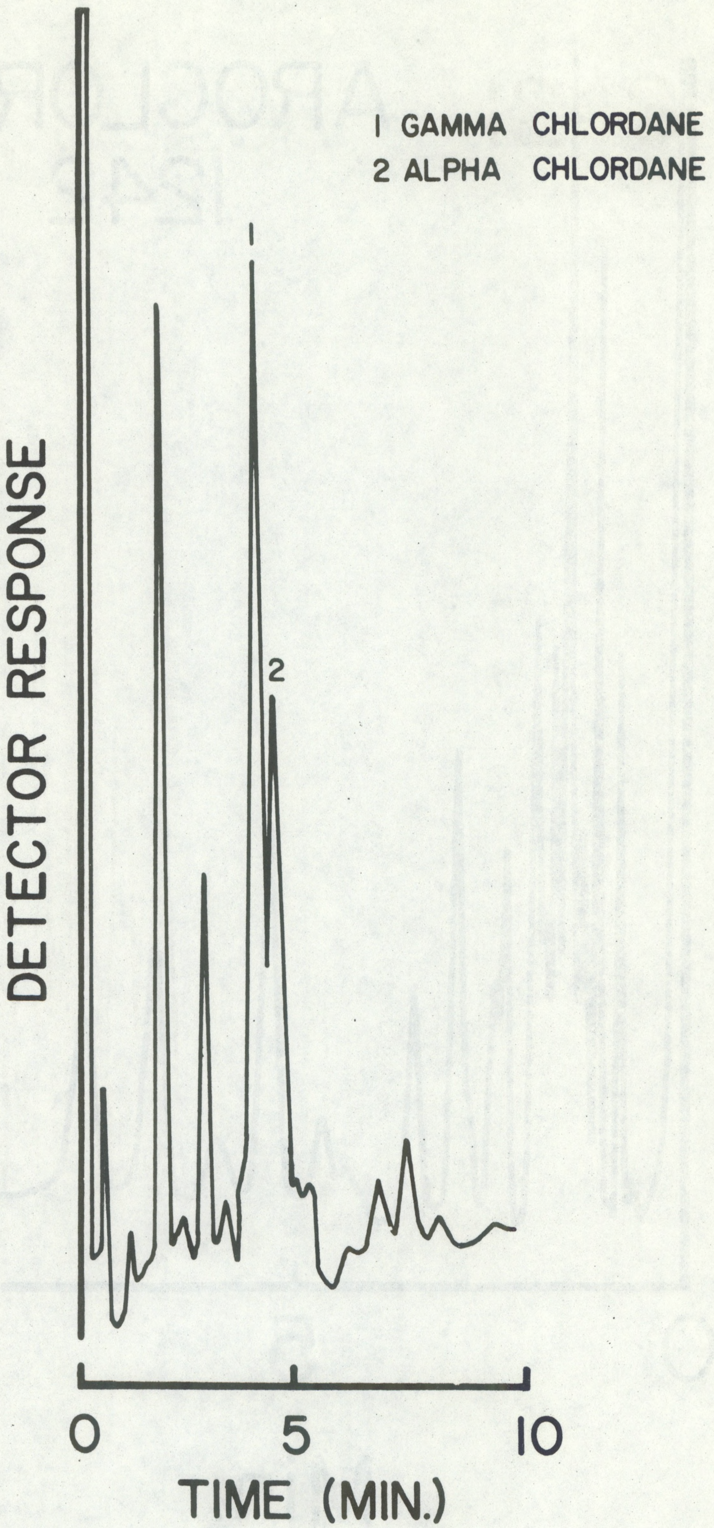

Figure 6. Gas chromatogram of technical grade Chlordane on a column of 5% OV-210.

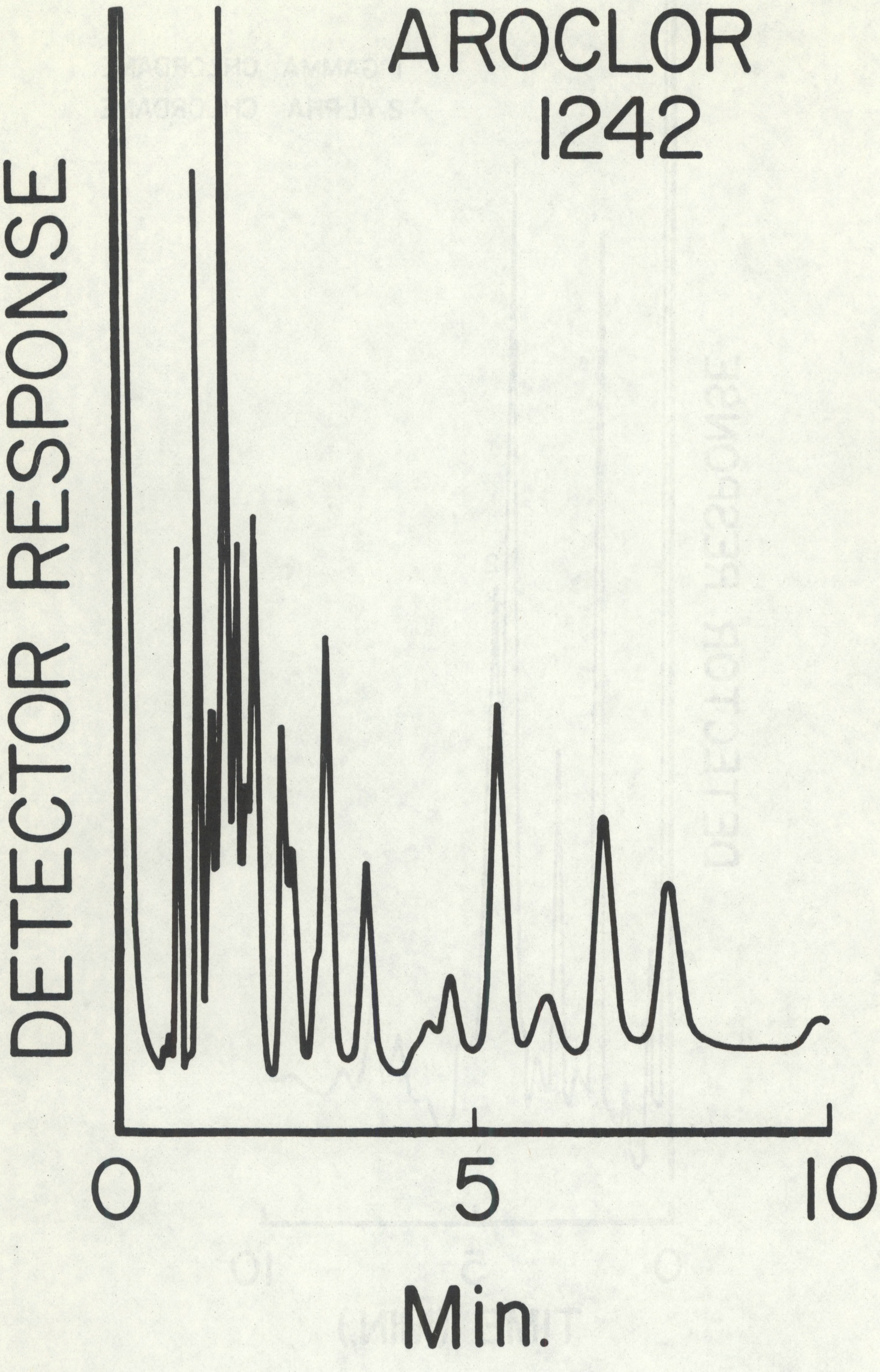

Figure 7. Gas chromatogram of Aroclor 1242 on a column of 1.5% SP-2250/1.95% SP-2401.

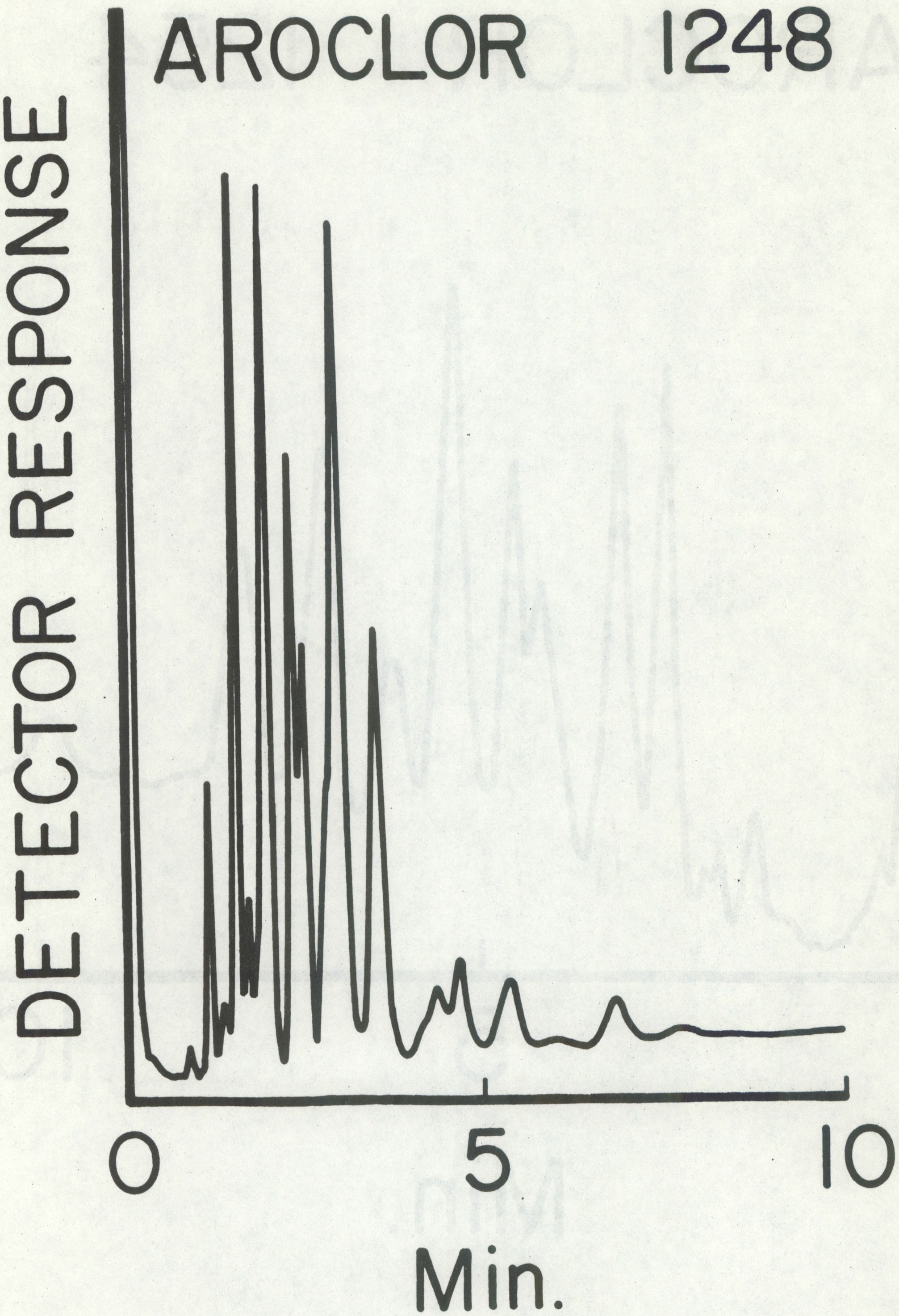

Figure 8. Gas chromatogram of Aroclor 1248 on a column of 1.5% SP-2250/1.95% SP-2401.

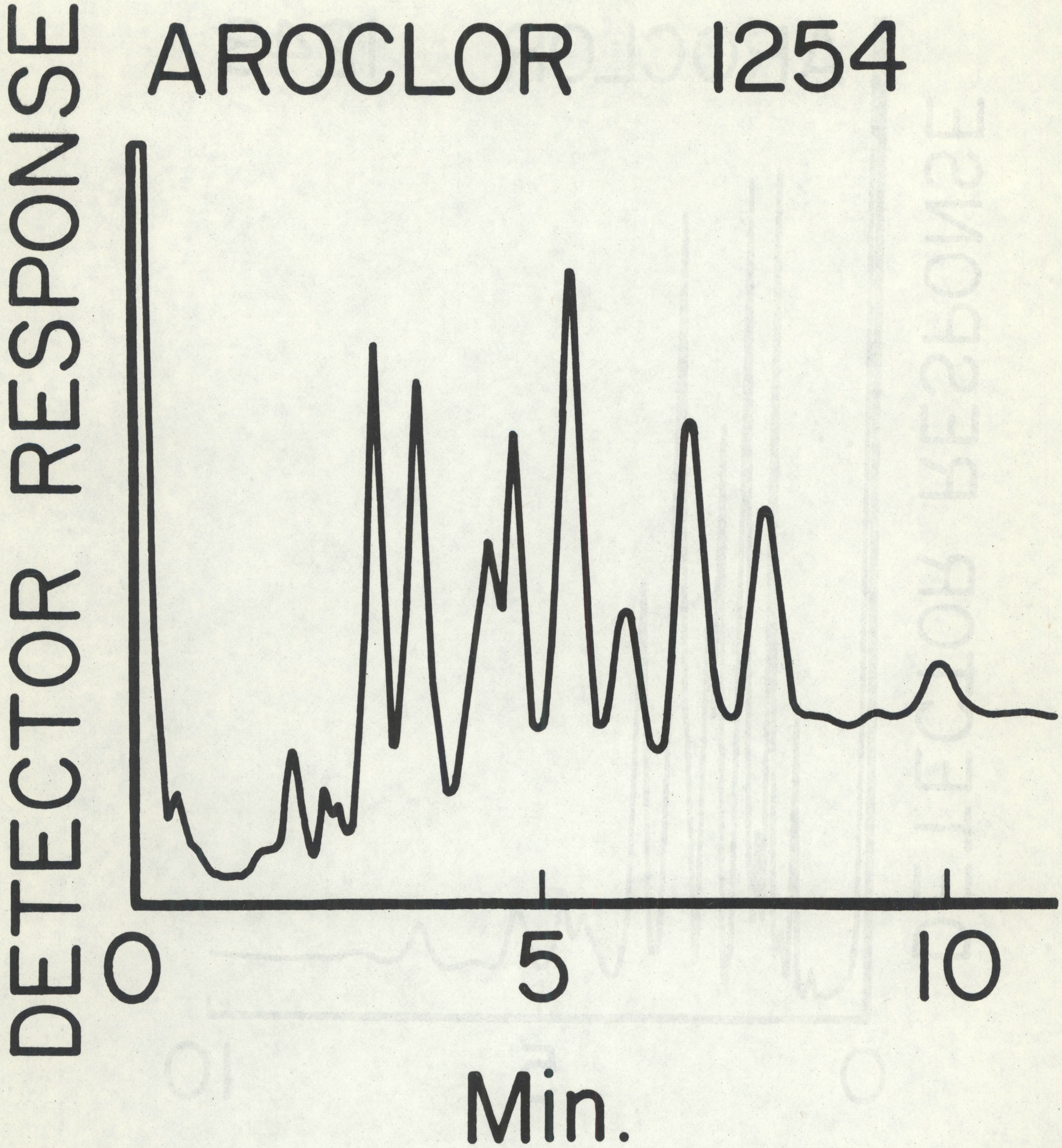

Figure 9. Gas chromatogram of Aroclor 1254 on a column of 1.5% SP-2250/1.95% SP-2401.

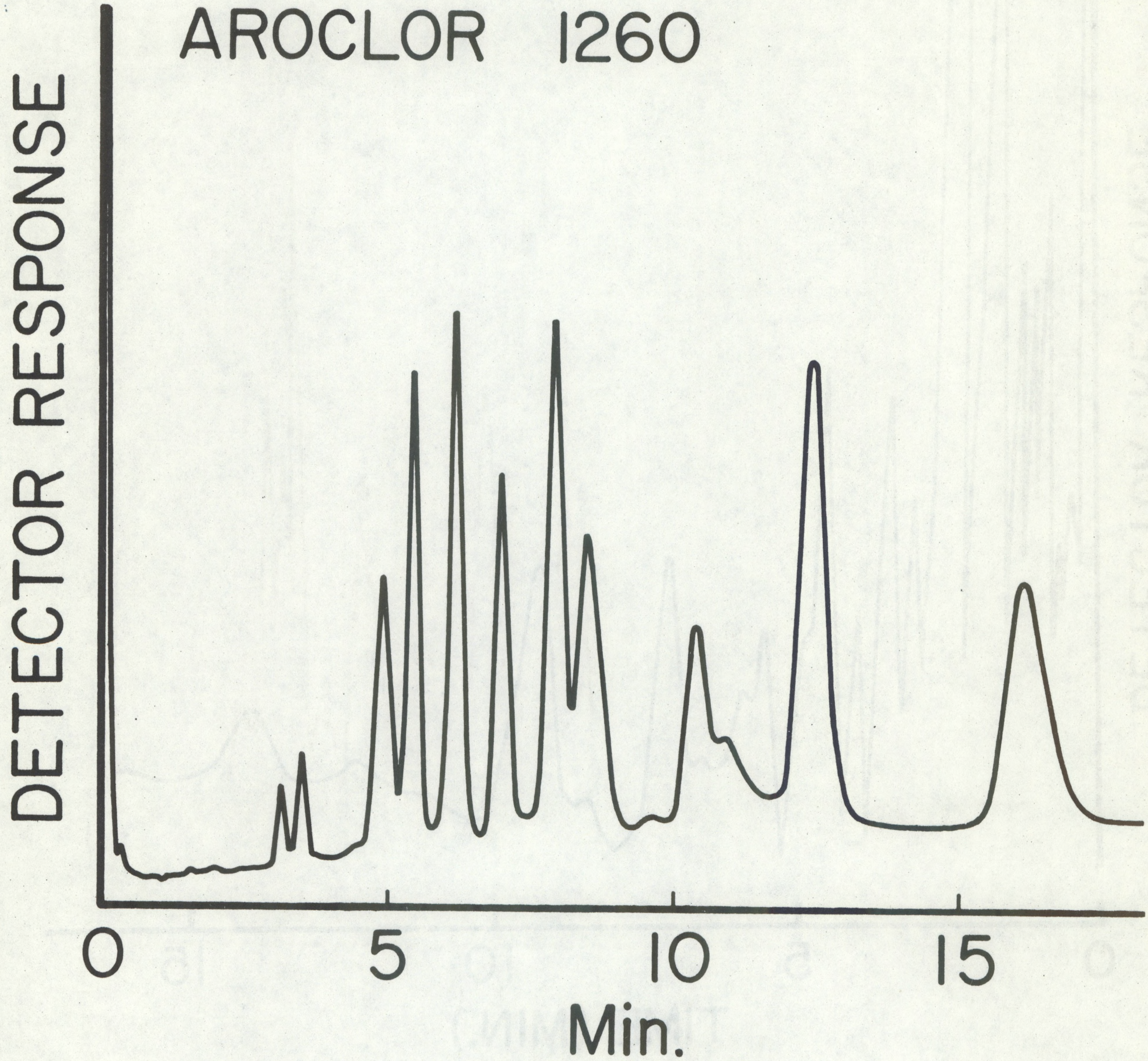

Figure 10. Gas chromatogram of Aroclor 1260 on a column of 1.5% SP-2250/1.95% SP-2401.

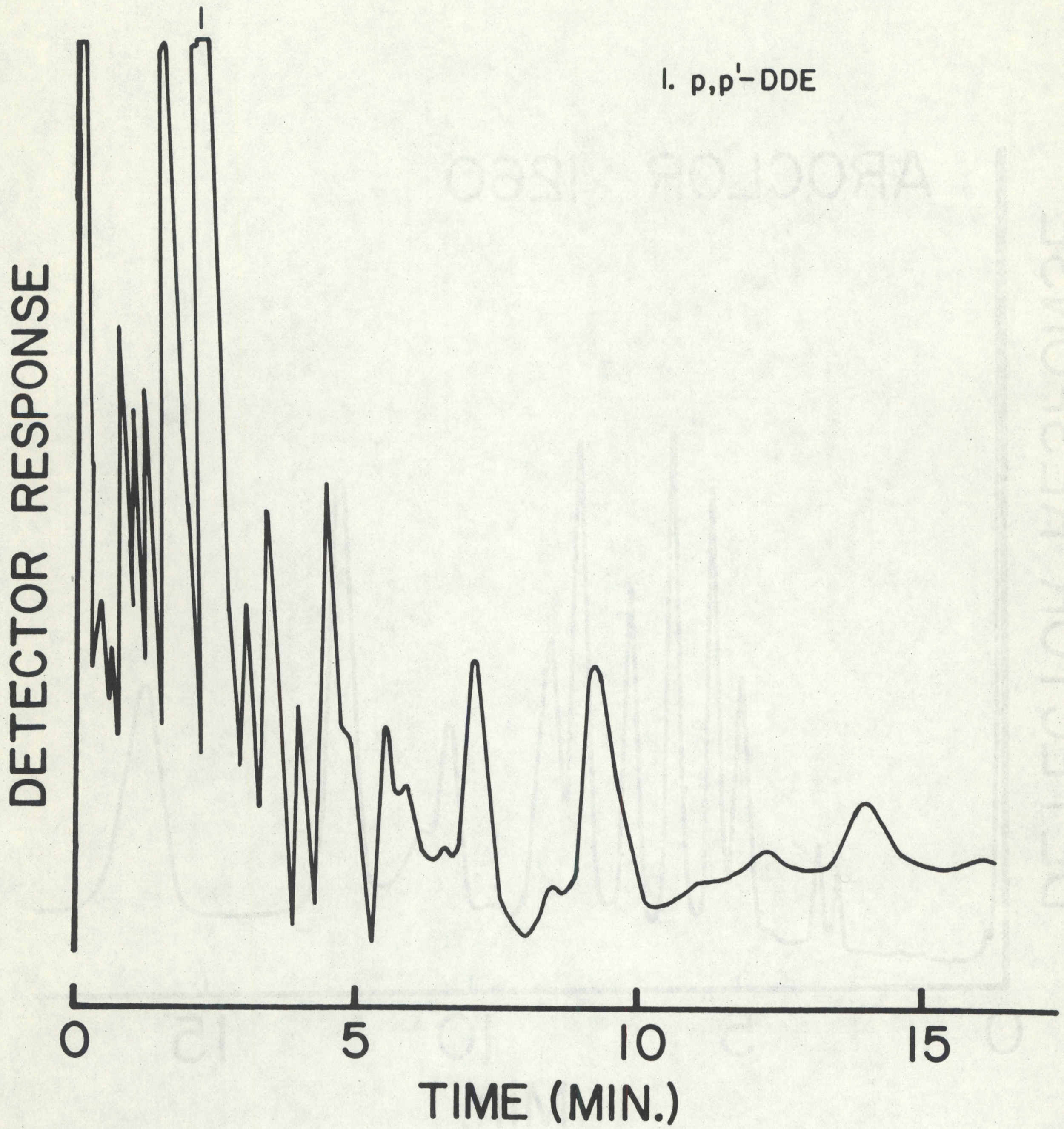

Figure 11. Gas chromatogram of PCBs at site A1.

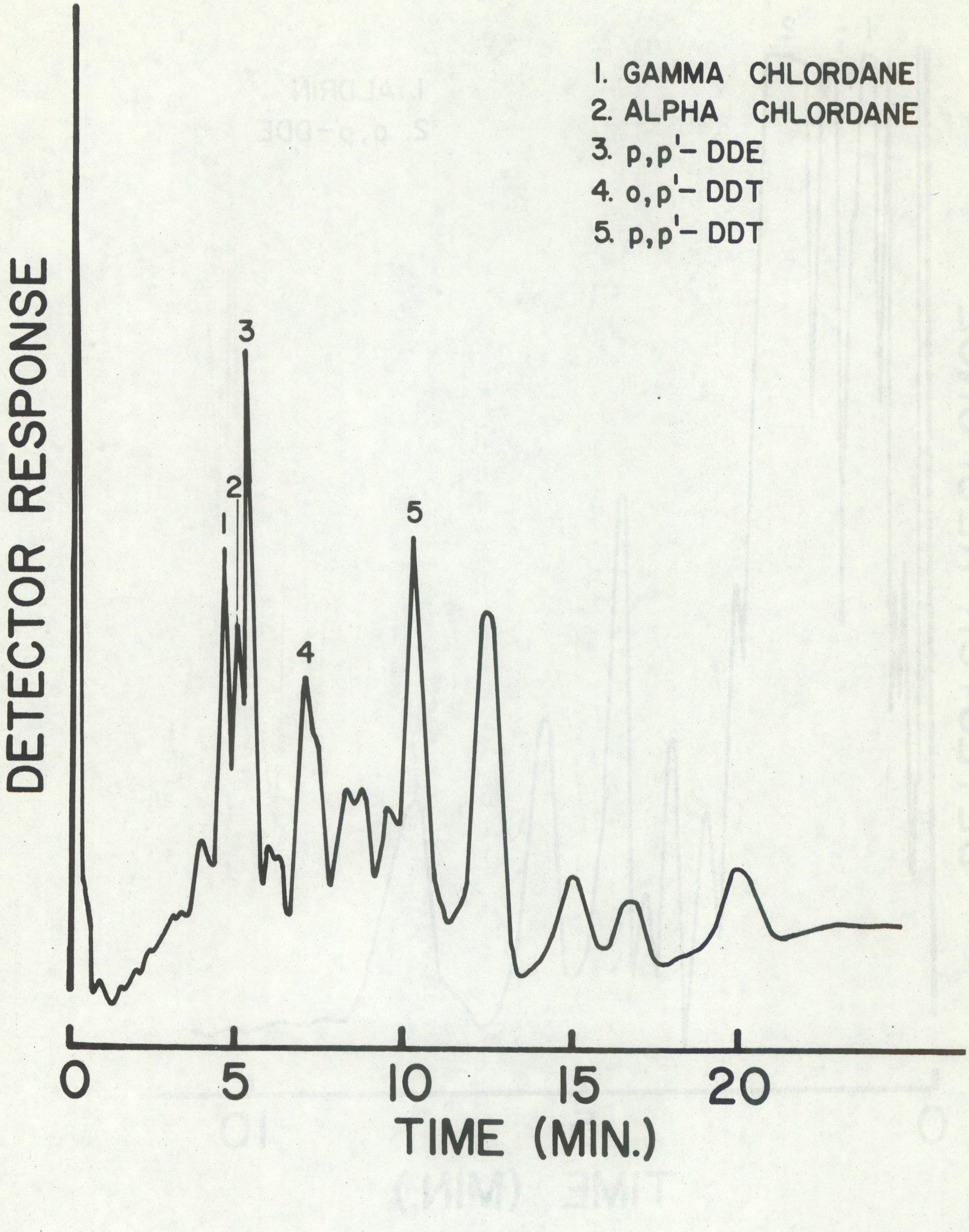

Figure 12. Gas chromatogram of pesticides at site A1.

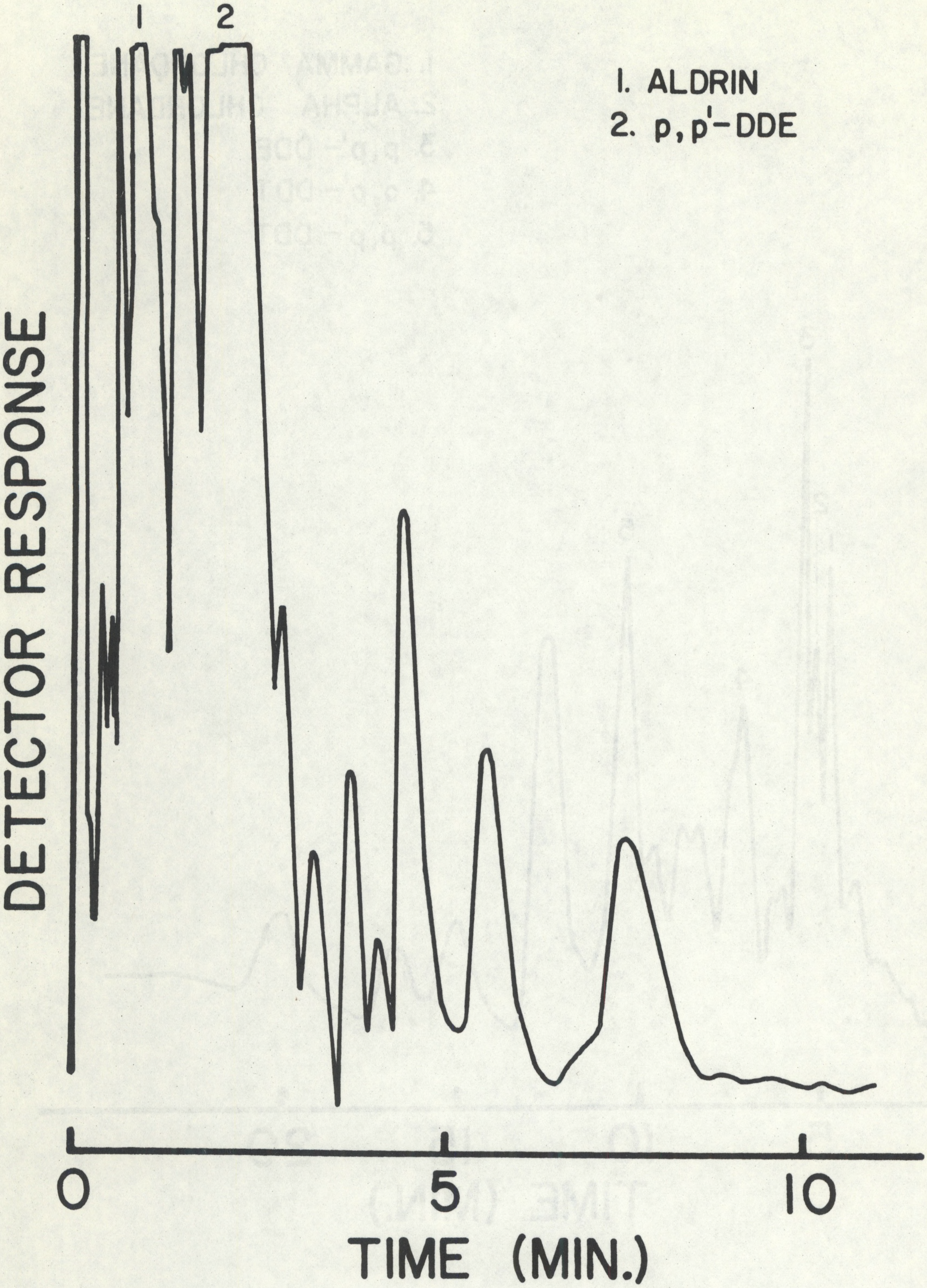

Figure 13. Gas chromatogram of PCBs at site A2.

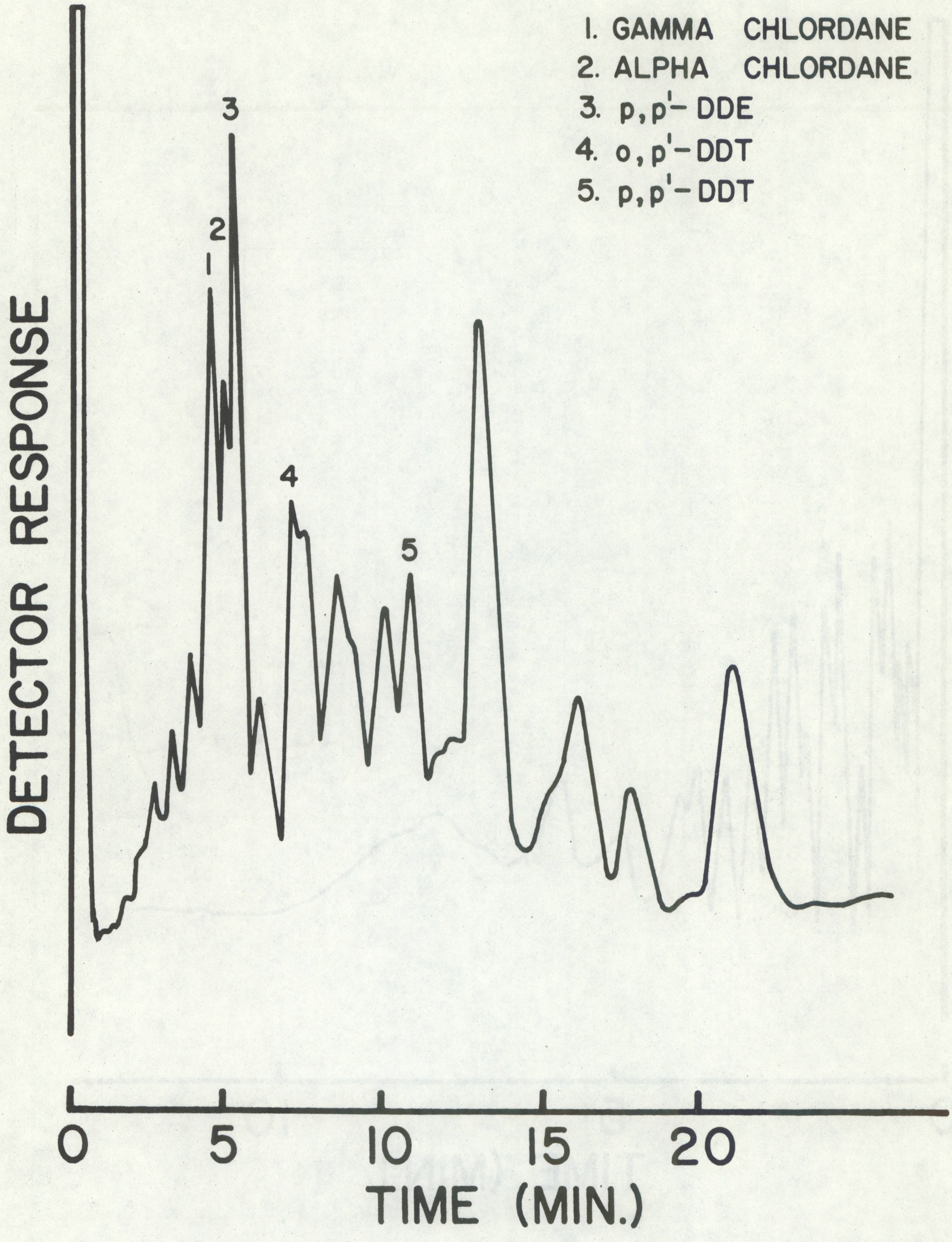

Figure 14. Gas chromatogram of pesticides at site A2.

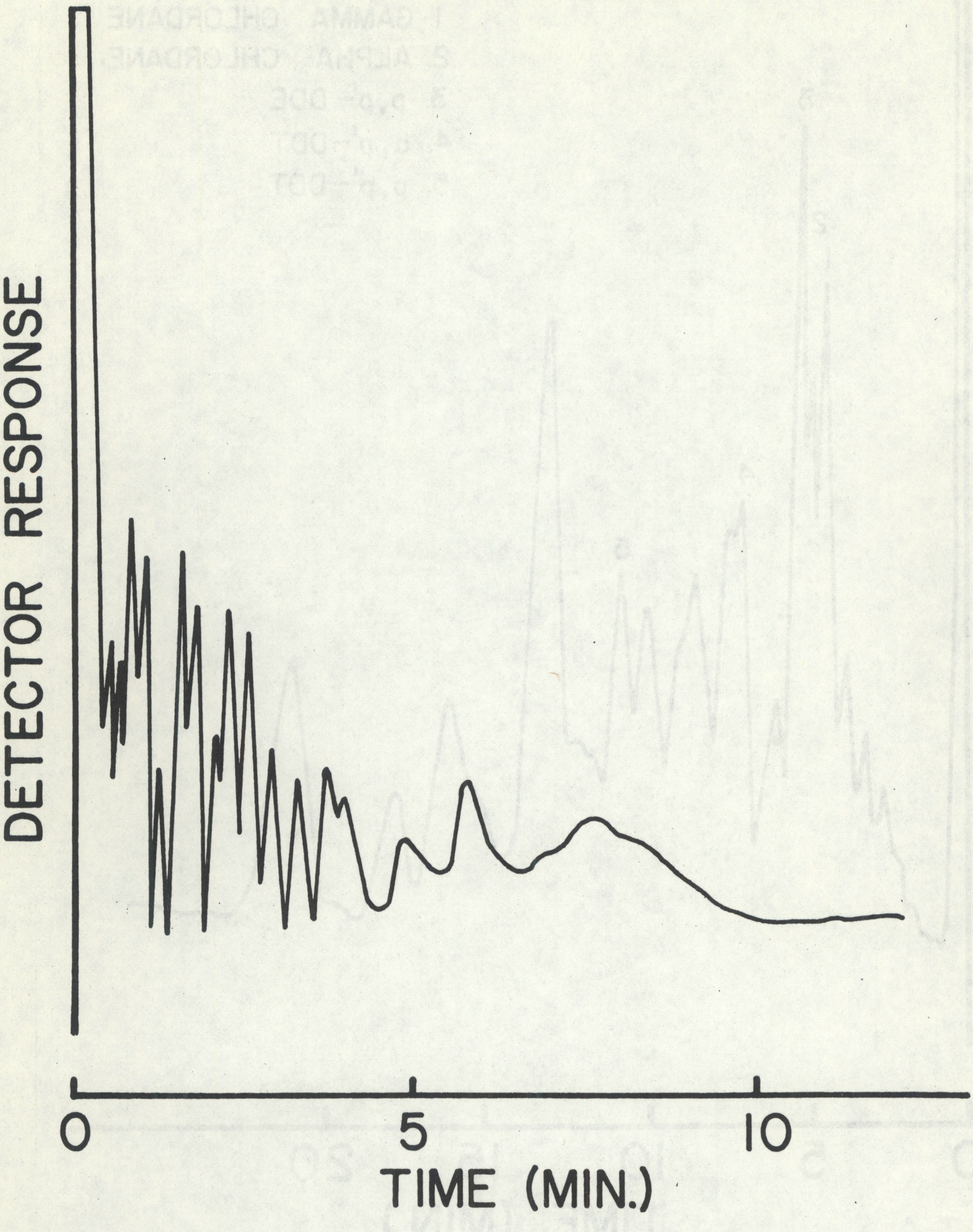

Figure 15. Gas chromatogram of PCBs in black plastic.

TOTAL CHLORDANE
ng/g dry weight

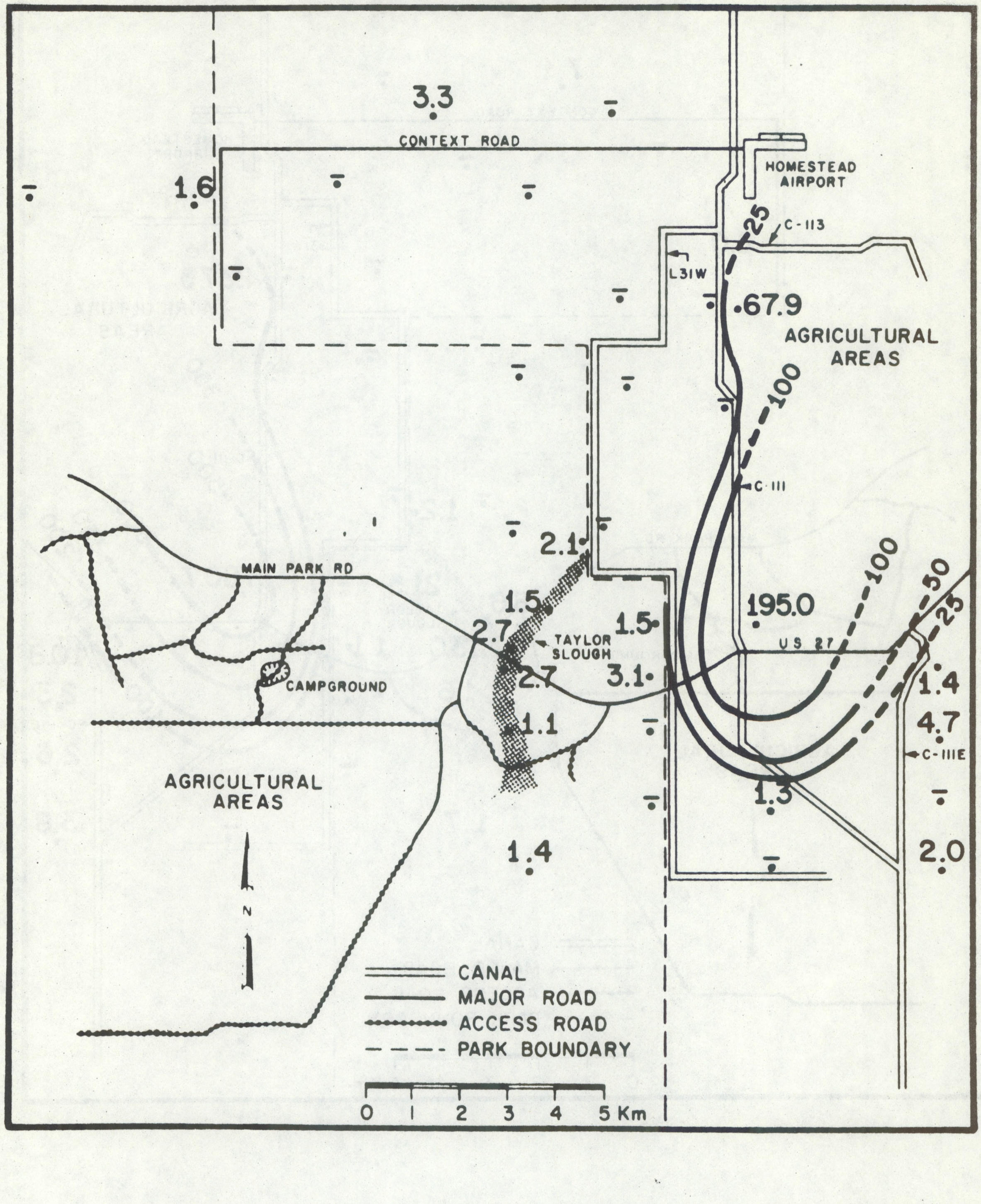

Figure 16. Distribution of total Chlordane.

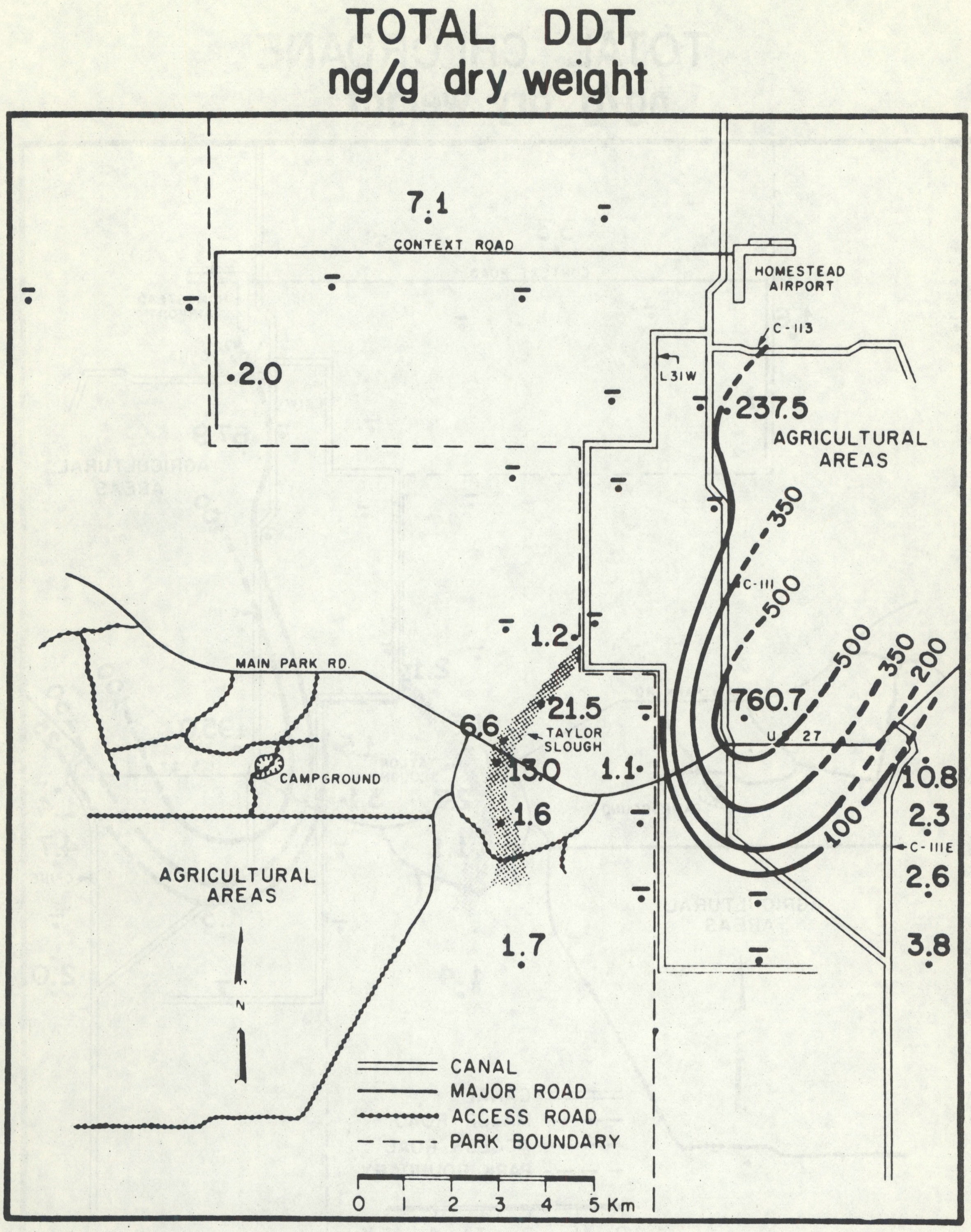

Figure 17. Distribution of total DDT.

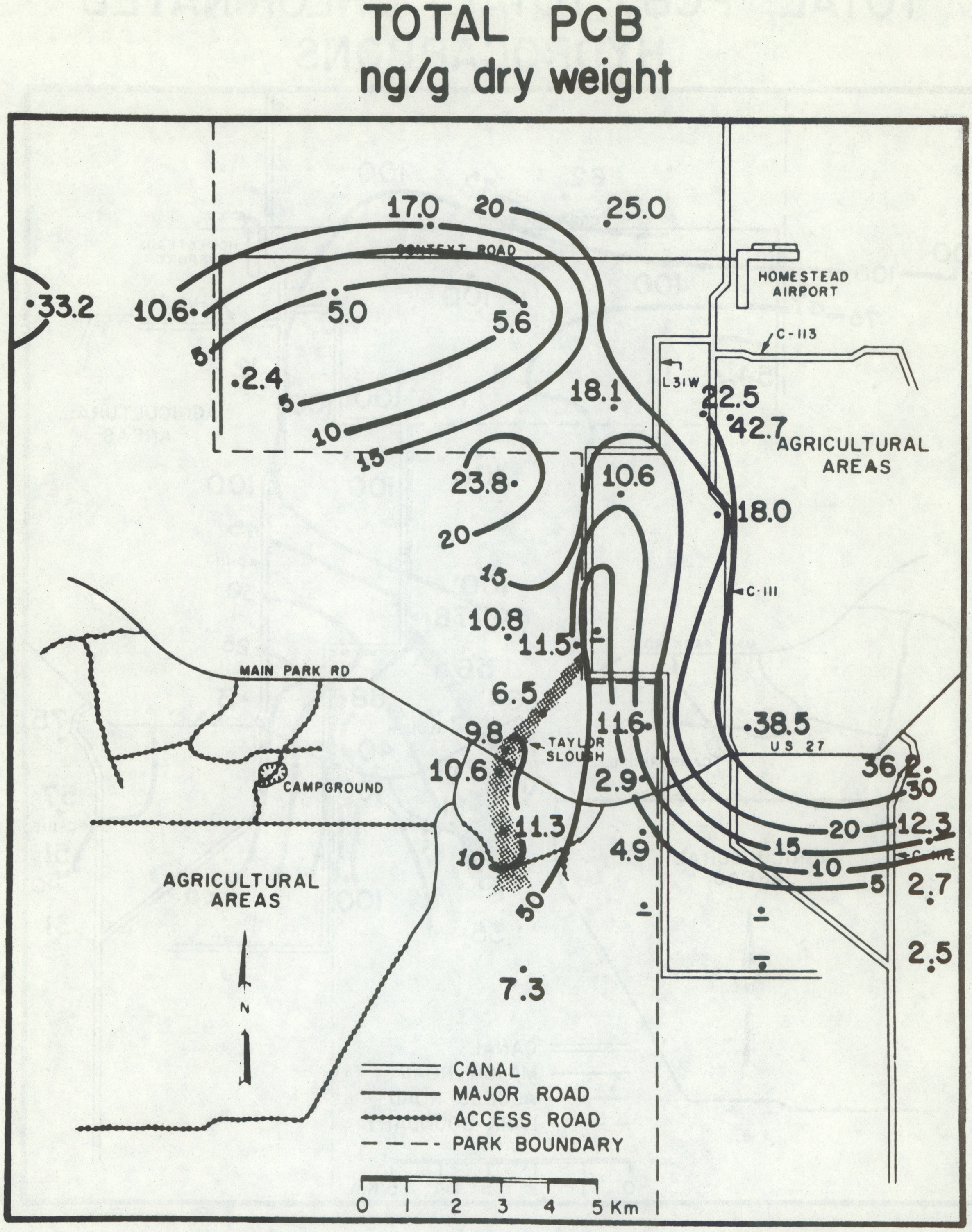

Figure 18. Distribution of total PCB.

TOTAL PCB/TOTAL CHLORINATED HYDROCARBONS

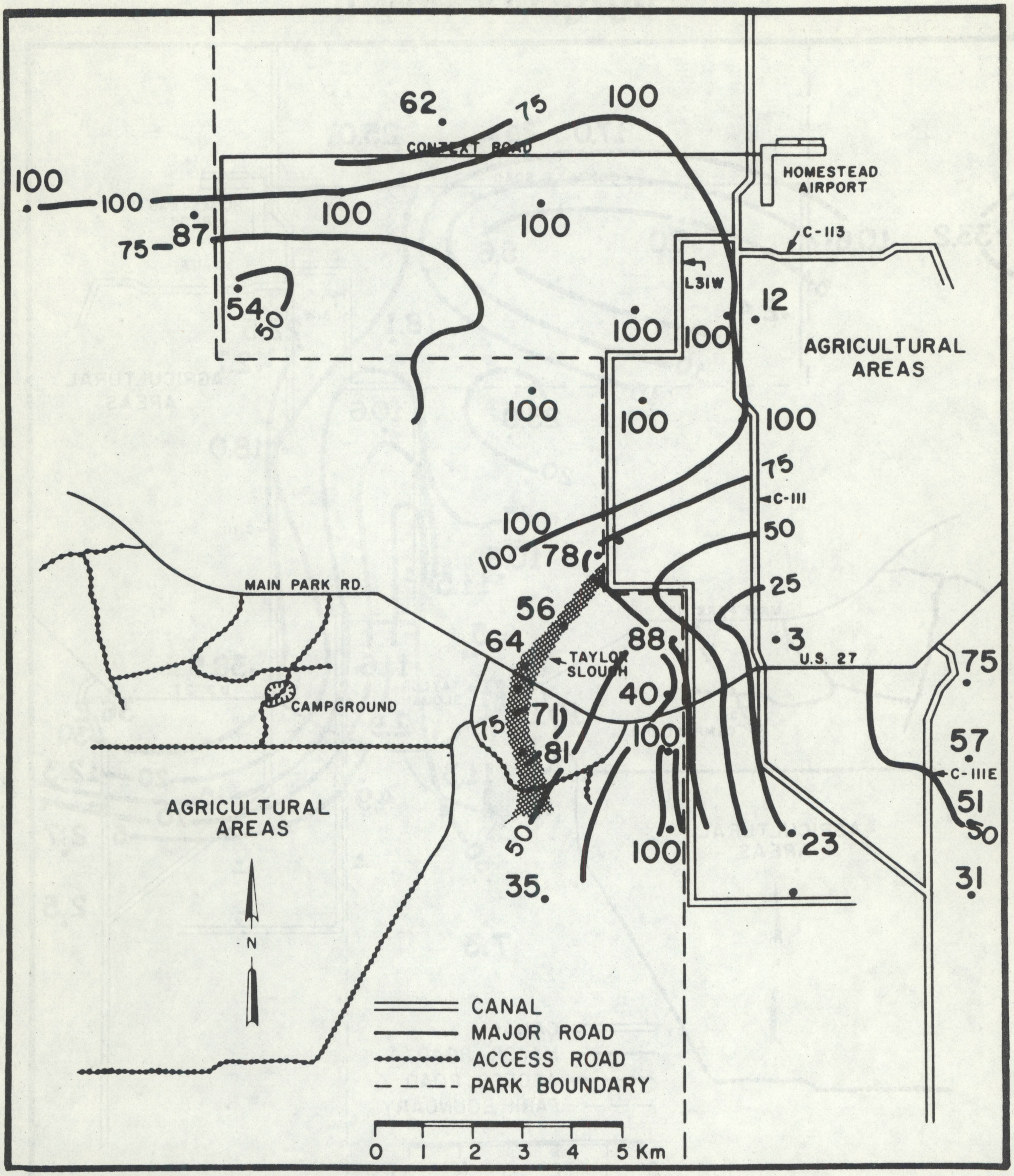

Figure 19. Percent Total PCB/Total chlorinated Hydrocarbons.

AROCLOR 1242 + AROCLOR 1248

TOTAL PCB

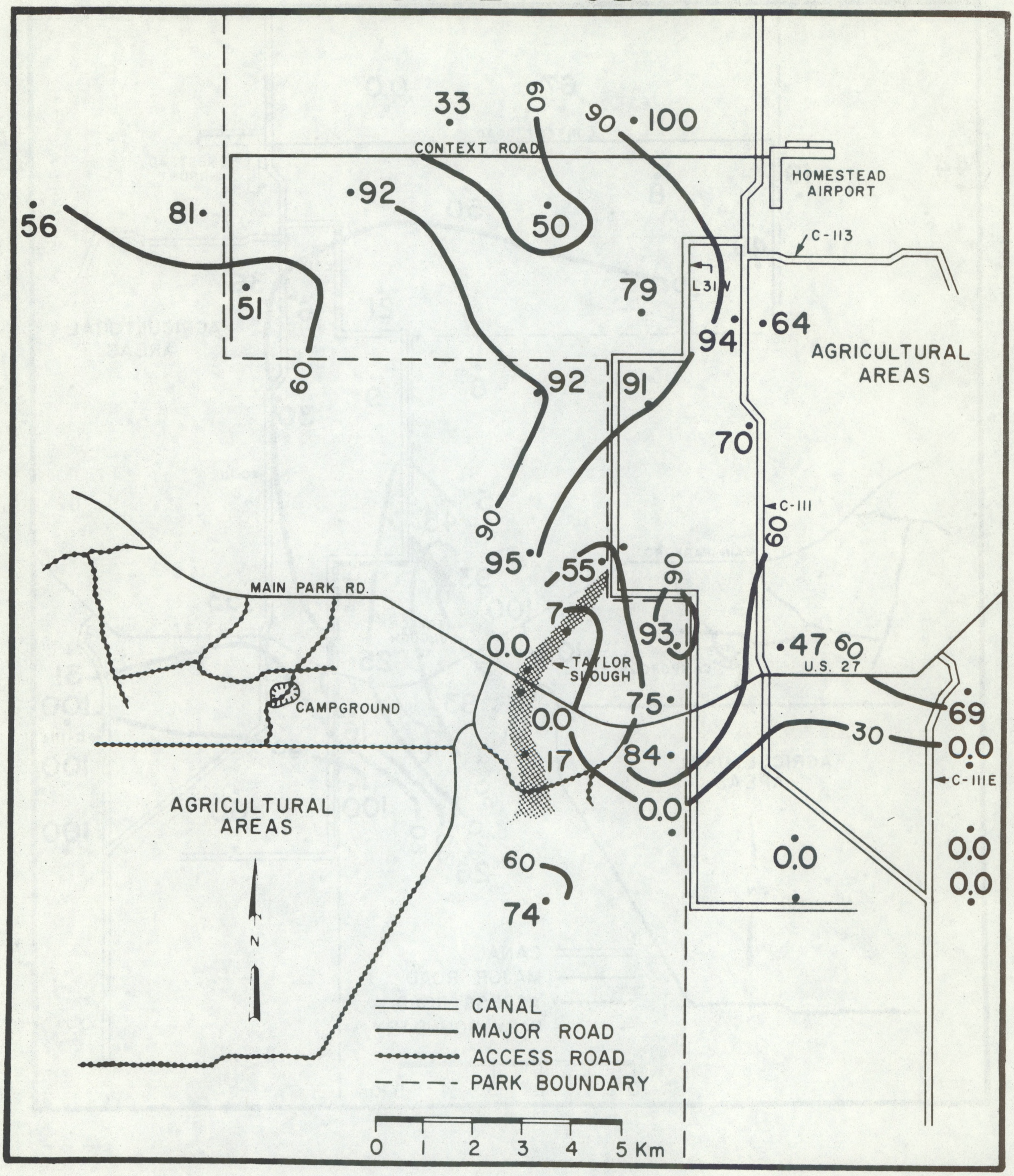

Figure 20. Aroclor 1242 + Aroclor 1248/Total PCB.

AROCLOR 1254 + AROCLOR 1260
TOTAL PCB

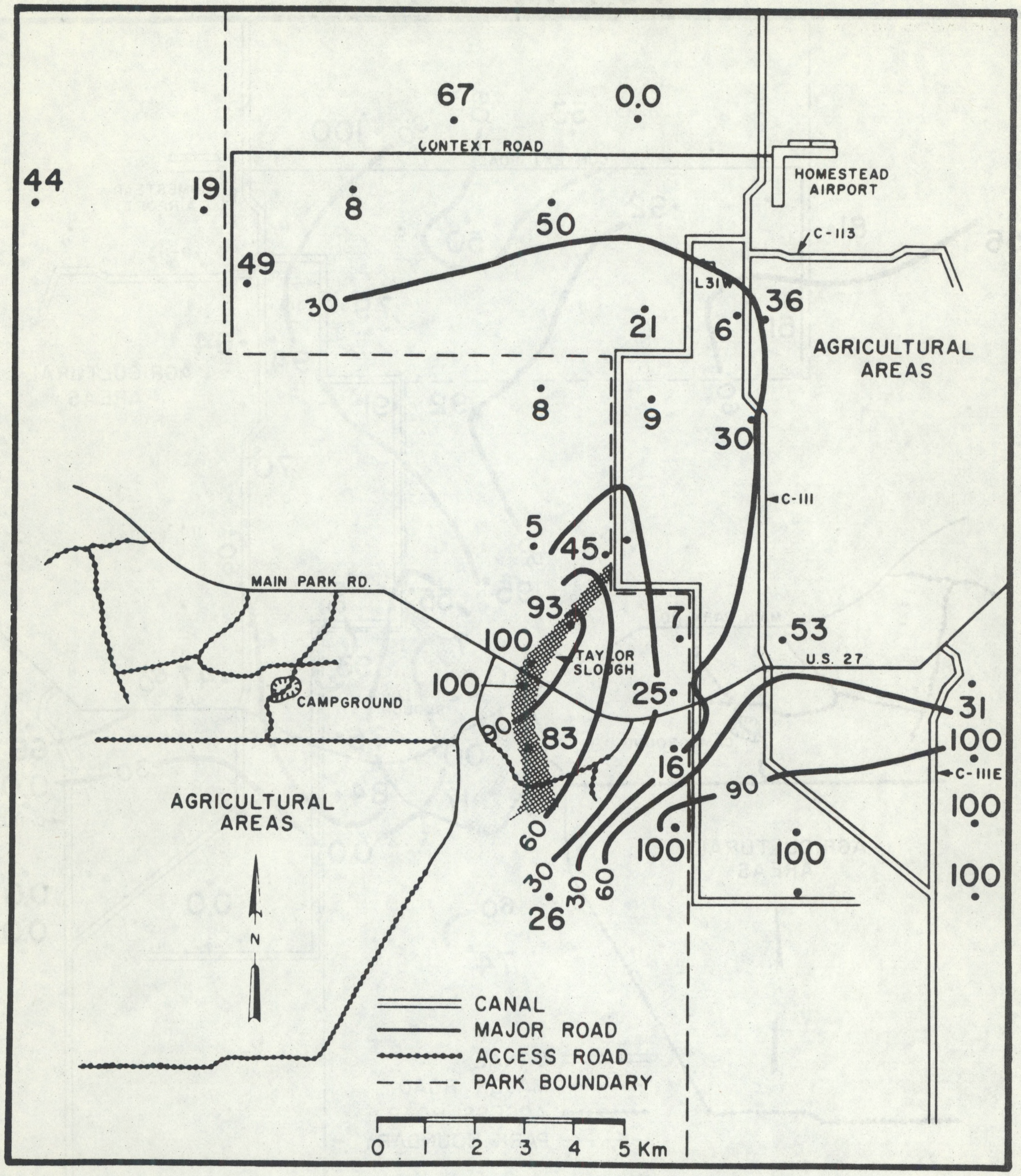

Figure 21. Aroclor 1254 + Aroclor 1260/Total PCB.

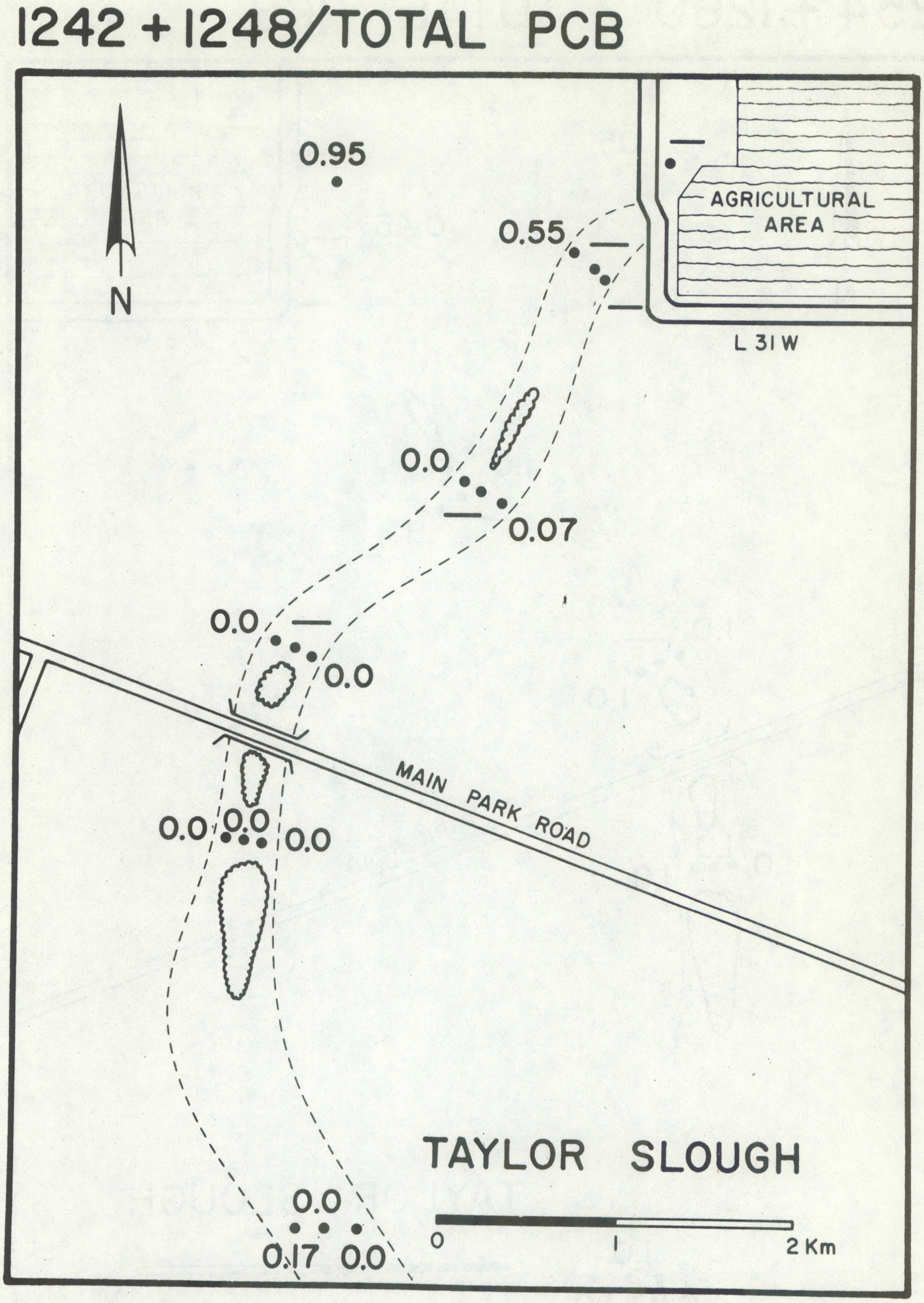

Figure 22. Aroclor 1242 + Aroclor 1248/Total PCB in Taylor Slough.

1254 + 1260 / TOTAL PCB

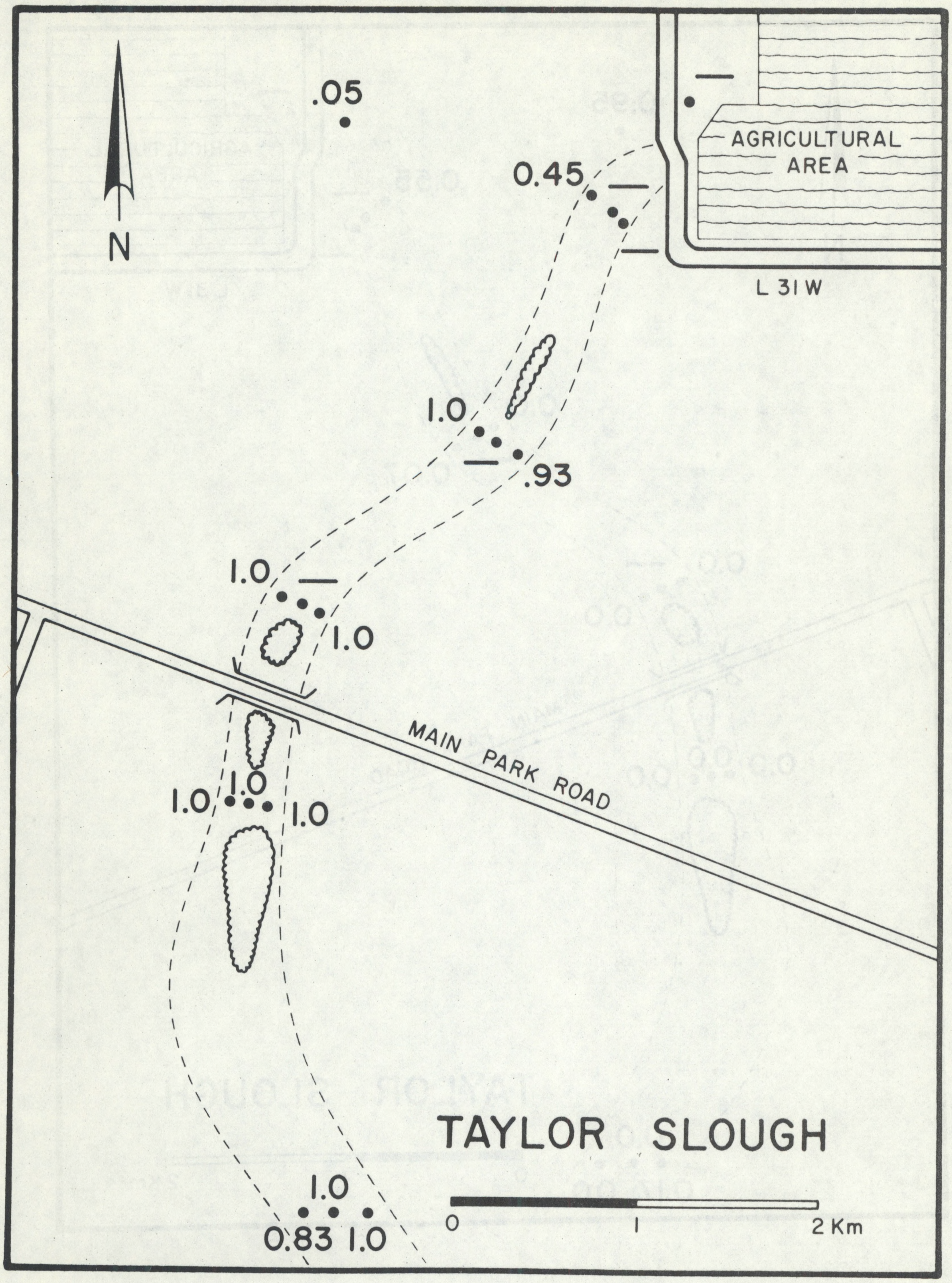

Figure 23. Aroclor 1254 + Aroclor 1260/Total PCB in Taylor Slough.

COPPER
ng/g dry weight

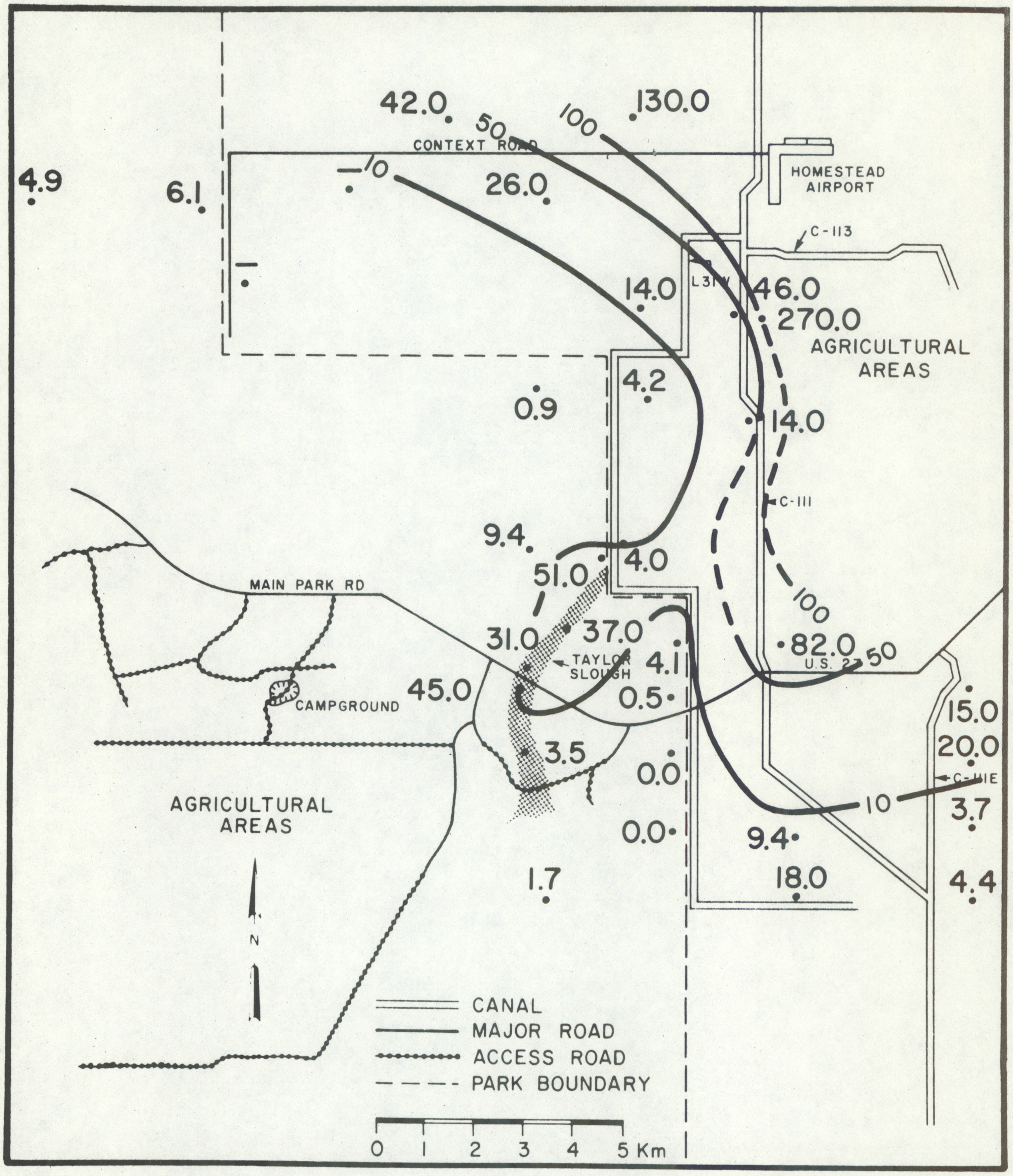

Figure 24. Distribution of copper.