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PESTICIDE MONITORING SPECIAL STUDY NO. 44-1312-77  
SURVEY OF PESTICIDE ODOR IN QUARTERS  
FORT BELVOIR, VIRGINIA  
NOVEMBER 1976

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ABERDEEN PROVING GROUND, MD 21010

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ABSTRACT

A reported pesticide odor was investigated at a quarters, Ft Belvoir, VA. Soil and air samples were taken from under the building, and air and wipe samples were taken from within the quarters.

Results of sample analyses indicated abnormally high levels of chlordane; this problem is aggravated by standing water underneath the quarters. Recommendations were made to remove the standing water and to prevent future accumulation of standing water under the quarters.

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SURVEY OF PESTICIDE ODOR IN QUARTERS  
FORT BELVOIR, VIRGINIA  
NOVEMBER 1976

1. AUTHORITY.

- a. AR 40-5, Health and Environment, 25 September 1974.
- b. AR 200-1, Environmental Protection and Enhancement, 7 December 1973.

2. REFERENCE. Letter, US Environmental Protection Agency, 21 October 1976, subject: Complaint Regarding Possible Misuse of a Pesticide (Appendix A).

3. PURPOSE. To determine the possible involvement of pesticides in the reported odor problem at Quarters 1556-B Statesman Road, Ft Belvoir, VA.

4. BACKGROUND.

a. Referenced letter, 21 October 1976, stated that the residents of the Quarters 1556-B Statesman Road, Ft Belvoir, VA, had reported to the US Environmental Protection Agency (EPA) that a pesticide odor was causing discomfort. The odor was noticed immediately after a treatment for subterranean termites in March 1975, and has been a persistent problem since that time. EPA requested that the US Army Environmental Hygiene Agency investigate the problem.

b. The quarters building is a two-story duplex with a cinder block foundation and brick exterior. Examination of the crawl space under the building revealed a layer of tar paper covering the entire surface. Standing water, 2 to 5 cm in depth, covered most of the area. The only relatively dry ground was a built-up portion along the perimeter of the foundation. According to the occupant, standing water is present almost year round. The cinder block foundation showed evidence of an injection application of insecticide. Three soil samples, one water sample and three air samples were taken beneath the quarters (Appendix B).

c. The residents stated that the odor was most noticeable in the kitchen and bathroom on the first floor. Two air samples were taken in the kitchen, two in the bathroom and one in the storage room. In addition to the air samples, wipe samples (glass-wool saturated with iso-octane and swabbed across a surface) were taken in the kitchen, bathroom and storage area (Appendix C).

5. RESULTS AND DISCUSSION.

a. Results. The analytical results of the air, soil and water, and wipe samples are listed in Tables 1 thru 3 of Appendix D. Pesticides analyzed for and their limits of detectability are listed in Appendix E.

b. Discussion.

(1) The soil and water taken beneath the house show high levels of chlordane. Normal application rates for chlordane for surface treatments should give about 560 parts per million (ppm) in the soil. The mean values observed under the quarters were 534 ppm. The half-life of chlordane (the amount of time required for one-half of the residue to disappear) is 1 to 2 years.<sup>1</sup> Approximately 1-1/2 to 2 years passed before the samples were taken. Assuming a 2-year half-life, about 280 ppm should have been in the soil. However, these half-life values are for pesticides which have been incorporated into the soil (plowing, etc.) and are subject to normal environmental conditions.

(2) This crawl-space area is unique; there is limited air movement; little light; there is not a true soil surface because of the tar paper; and there is almost a continual water cover. Because of this situation, one might assume a much slower rate of decline of residue levels. If one assumes a 25 percent decrease instead of a 50 percent decrease over the 1-1/2- to 2-year period, theoretically 420 ppm should be present. Thus, the observed value of 534 ppm is 27 percent above the expected values. Sample 1072 is exceptionally high. This sample was taken from the area directly below the bathroom and may account for the odor in this area. This area also appeared to be subject to the least amount of standing water. Sample 1071 was taken underneath the kitchen and appeared to be subject to more water cover. Sample 1073 was taken more toward the center of the house than the other samples. This sample was taken right at the edge of standing water, and the areas had evidently been under water at some time in the past. The water sample taken at the crawl-space entrance reflects the high level of chlordane in the soil. Chlordane is relatively insoluble in water, and as a result, those values obtained probably reflect the amount on the particulate matter in the water.<sup>2</sup> Although little work has been done on the chlordane residues in standing water, levels reported from 109 sites of major rivers in the United States had a mean residue level of 0.001 mg/l.<sup>2</sup> From this value, it is evident that the chlordane levels under the crawl space are excessive.

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<sup>1</sup>Edwards, C. A., Persistent Pesticides in the Environment, 2d ed., p 16, CRC Press (1973)

<sup>2</sup>Edwards, C. A., Persistent Pesticides in the Environment, 2d ed., p 29 (1973)

(3) The wipe samples also indicate excessively high levels of chlordane. Since there were no data available as to expected levels of chlordane from wipe samples in houses, samples were taken from a personally monitored home for a control basis. This home was treated approximately 3 years ago with chlordane (as the house was being built). Although there are some differences between the buildings (full basement versus crawl space) and application times, there is a significant difference between the chlordane residues observed. These chlordane levels observed in the quarters at Ft Belvoir show a strong correlation with the residues in the soil under the building.

(4) Air Samples. Results of air samples collected from the crawl space under the house and rooms within the house fail to demonstrate a health hazard to occupants from an inhalation exposure to chlordane. Refer to Table 1, Appendix D, for results of atmospheric analyses. Samples from the crawl space indicate trace amounts of chlordane present, and room samples show up to 0.007 milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ) present in the kitchen and bathroom and 0.003  $\text{mg}/\text{m}^3$  present in the storage room. The American Conference of Governmental Industrial Hygienists adopted a time-weighted average Threshold Limit Value (TLV<sup>®</sup>) of 0.5  $\text{mg}/\text{m}^3$  for chlordane. Such a value is a time-weighted average concentration for a normal 8-hour workday or 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. Although TLV are not used in evaluation of long term air pollution exposures, it can be shown that the total exposure in an occupant exposed 24 hours per day, 7 days per week would be of the order of one-twentieth of the allowable worker exposure. Furthermore, the World Health Organization has established an acceptable daily intake (ADI) for chlordane of 0.001 milligram per kilogram per day ( $\text{mg}/\text{kg}/\text{day}$ ). The ADI is defined as the daily intake of a chemical that, during a lifetime, appears to provide the practical certainty that injury will not result (in man) during a lifetime of exposure. Calculation of a worst case exposure, that is the subjects were in the house 24 hours per day, would yield a dose per day of approximately 0.001  $\text{mg}/\text{kg}$  for an average adult. Exposures at the 0.007  $\text{mg}/\text{m}^3$  concentration are just at the lowest level above which toxic effects would be expected and would require the person to be exposed at the level for a lifetime before the possibility of injury from the exposure would exist according to data

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® TLV Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1976

presented by The World Health Organization. The EPA has identified chlordane as a potential carcinogen. The judgment is based on studies showing the development of hepatic tumors in mice and rats exposed to chlordane in their diet. No evidence of carcinogenicity of chlordane in man has been demonstrated. In animal studies of chlordane exposure, the lowest exposure at which there was a significant difference in tumor incidence between exposed mice and controls was at 25 ppm chlordane fed daily in the diet over an 18-month period. This effect was shown to be dose related with no significant differences in tumor incidence at 5 ppm fed daily and a larger incidence of tumors at 50 ppm than at 25 ppm exposure. The exposure of 5 ppm fed daily in the diet equates to a dose of 0.75 mg/kg/day, of chlordane. The worst case exposure in the house described above was calculated to be approximately 0.001 mg/kg/day, obviously far less than the no effect level reported in the literature for tumor production in mice. Exposures at the 0.007 mg/m<sup>3</sup> concentration appear on the basis of the data described above to be unlikely to have any tumorigenic effect. The possibility of a hypersensitivity (allergic) response of household occupants to chlordane can not be predicted from the data presented above as this phenomenon is not dose related and depends on individual idiosyncrasy. This possibility was not investigated as it was outside one scope of this type of survey. Besides a possible hypersensitivity response to chlordane, there does not appear to be, on the basis of the data obtained, a significant health hazard for household occupants from exposure to chlordane.

#### 6. CONCLUSIONS.

a. The presence of chlordane in the air samples, the wipe samples and the unusually high amounts in the soil indicates higher amounts than would be expected following normal application.

b. The standing water under the quarters enhances the vaporization of the chlordane which is present<sup>2</sup> and consequently increases the odor and atmospheric levels of chlordane within the quarters.

7. RECOMMENDATIONS. It is recommended that the standing water under the quarters be removed and that the future accumulation of water be prohibited by better drainage.

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<sup>2</sup>Edwards, C. A., Persistent Pesticides in the Environment, 2d ed., p 29 (1973)

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*Kenneth L. Olds*

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APPENDIX A

ENVIRONMENTAL PROTECTION AGENCY  
PESTICIDES FIELD OFFICE  
40 South Gay Street, Rm. 402-E Custom House  
Baltimore, Maryland 21202

October 21, 1976

Commander  
U.S. Army Environmental Hygiene Agency  
Aberdeen Proving Ground, MD 21010

Dear Sir,

As you are aware, EPA has under its jurisdiction, the enforcement of the Federal Insecticide, Fungicide and Rodenticide Act of 1972 as amended. Under Section 12(a)2(g) it is unlawful for anyone "... to use any registered pesticide in a manner inconsistent with its labeling."

My reason for pointing this out is that EPA, Region III, Hazardous Materials Division, 6th & Walnut Streets, Philadelphia, PA 19106 John W. Smith, supervisor, (215-597-9870) received a complaint from Mrs. Celest Yelker, 1556 Statesman Road, Fort Belvoir, VA 22060 regarding a possible misuse of a pesticide.

On 09-08-76 I visited Mrs. Yelker and she related that sometime in March 1975 their residence was treated by the Army for termites and since that time, especially when the forced hot air heating system is operating there is a "pesticide odor" present that has caused discomfort to Mrs. Yelker and her family.

I have been authorized, by John W. Smith, to request the U.S. Army Environmental Hygiene Agency conduct an investigation since the individuals involved are military personnel and the incident occurred on a military base. A report of the findings should be forwarded to this office and to EPA Region III for their review.

The type of information needed for evaluation would be; methods of application, type and amounts of chemical used, analysis of residue samples from soil, furnishings, air etc. as well as any other information pertinent to the investigation.

Should any additional information or assistance be required, please contact me at my office, 301-962-3454.

Sincerely,



David K. Hannemann  
Consumer Safety Officer



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Pesticide Monitg Sp Study No. 44-1312-77, Nov 76

## USE INVESTIGATION REPORT

1. PERSON INTERVIEWED			
a. NAME <i>Mrs. Celeste Yelker</i>		b. ADDRESS <i>1556 Statesman Rd.</i>	
c. TELEPHONE <i>703-781-9063</i>		d. ADDRESS <i>Ft. Belvoir, Va 22060</i>	
2. APPLICATOR			
a. NAME		b. ADDRESS	
c. TELEPHONE	e. CERTIFICATION NUMBER		
3. SITE OF APPLICATION			
a. NAME		b. ADDRESS <i>1556 Statesman Rd.</i>	
c. TELEPHONE		d. ADDRESS <i>Ft. Belvoir, Va 22060</i>	
d. TYPE OF BUSINESS <i>Home</i>	e. CROP, AREA OR OBJECT TREATED <i>Crawl space, &amp; cracks block/brick injection</i>		
f. TARGET PEST <i>Termites</i>	g. DATE AND TIME OF APPLICATION <i>03-1975</i>		
h. WEATHER AT TIME OF APPLICATION (Wind, temperature, humidity, rain, etc., list source of information) <i>fair, cool light breeze.</i>			
i. PESTICIDE APPLIED			
a. BRAND NAME	b. EPA REG. NO.	c. BATCH NO.	d. CLASSIFICATION
e. TYPE OF FORMULATION <input type="checkbox"/> DUST <input type="checkbox"/> SPRAY <input type="checkbox"/> GRANULAR <input type="checkbox"/> MIST <input type="checkbox"/> FOG <input type="checkbox"/> OTHER (Specify):			
f. RATE OF APPLICATION			
g. METHOD OF APPLICATION <input type="checkbox"/> GROUND <input type="checkbox"/> AERIAL <input type="checkbox"/> OTHER (Specify):			
h. DILUTION RATE			
i. DILUTED MATERIAL APPLIED PER UNIT (Gallons/Acre)		j. ACTUAL ACTIVE PER UNIT (Lbs/Acre)	
k. SAMPLES COLLECTED (List sample numbers)			
a. FORMULATION	b. DILUTED MATERIAL	c. RESIDUE	
7. WERE THE FOLLOWING LABELING INSTRUCTIONS FOLLOWED? <input type="checkbox"/> YES <input type="checkbox"/> NO (If "NO", check and explain.)			
<input type="checkbox"/> TARGET PEST	<input type="checkbox"/> RATE OF APPLICATION	<input type="checkbox"/> REENTRY INTERVAL	
<input type="checkbox"/> METHOD OF APPLICATION	<input type="checkbox"/> CROP, AREA OR OBJECT TREATED	<input type="checkbox"/> APPLICATOR CERTIFIED	
<input type="checkbox"/> DILUTION USED	<input type="checkbox"/> CAUTIONARY LABELING	<input type="checkbox"/> PREHARVEST INTERVAL	
<input type="checkbox"/> OTHER:			
8. CONSEQUENCES OF USE (List any unusual results or adverse effects from treatment) <i>My husband had bronchial spasms &amp; Mrs. Yelker stays home - very throat - difficulty had headaches, nausea - noticeable when heat is on (heat is forced hot air)</i>			
9. REMARKS <i>Crawl space is constantly damp. - condensation is aggravated when forced hot air is working - ducts are in crawl space.</i>			
10. DATE OF INVESTIGATION <i>03-06-76</i>	11. DATE <i>11/24</i>	12. INVESTIGATOR (Signature) <i>[Signature]</i>	13. TITLE <i>CSO</i>

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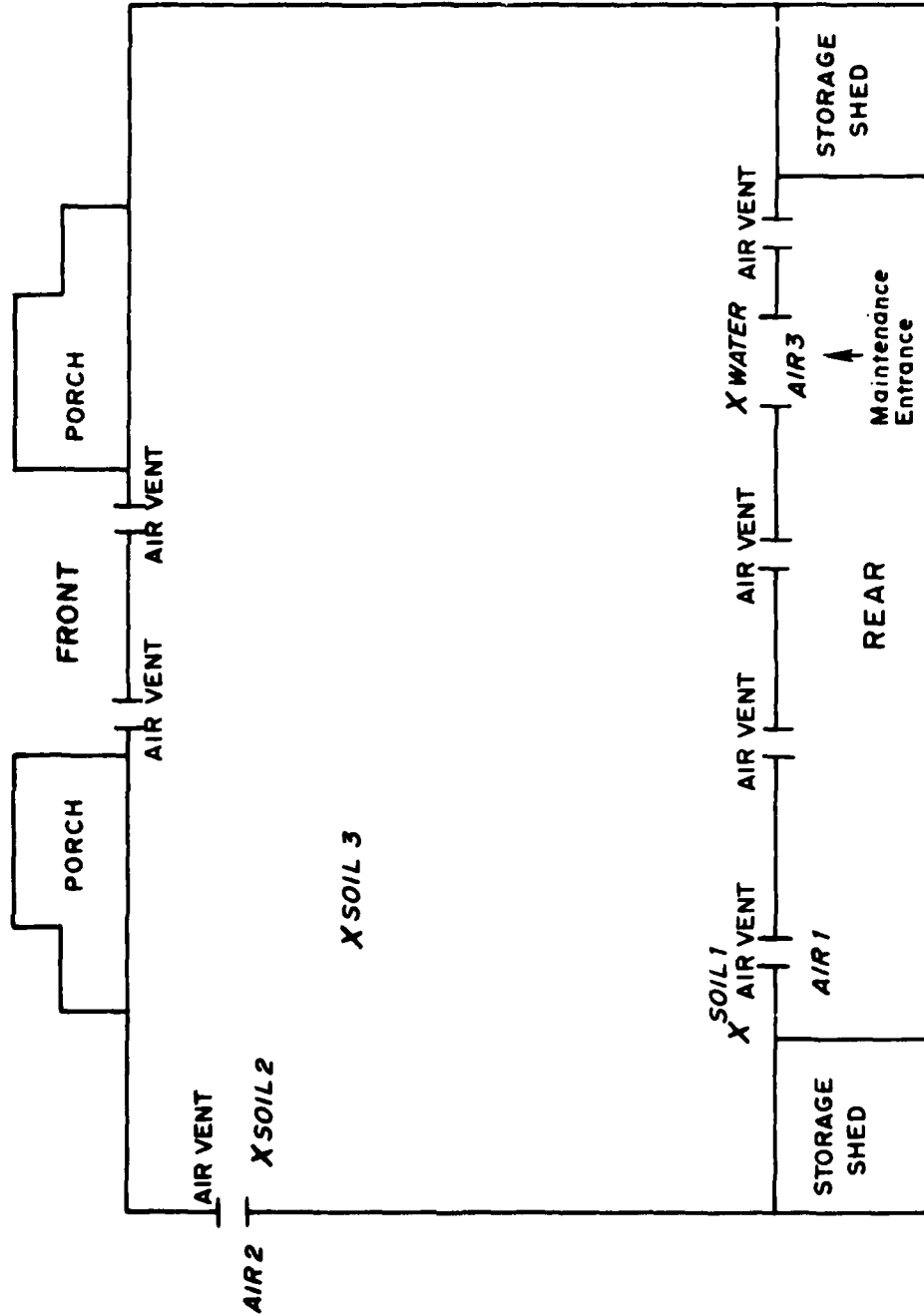
APPENDIX B

LOCATION OF SOIL, WATER AND  
AIR SAMPLES FROM UNDER QUARTERS

B-1

APPENDIX B

LOCATION OF SOIL, WATER AND  
AIR SAMPLES FROM UNDER  
QUARTERS 1556, STATESMAN RD  
FORT BELVOIR, VA



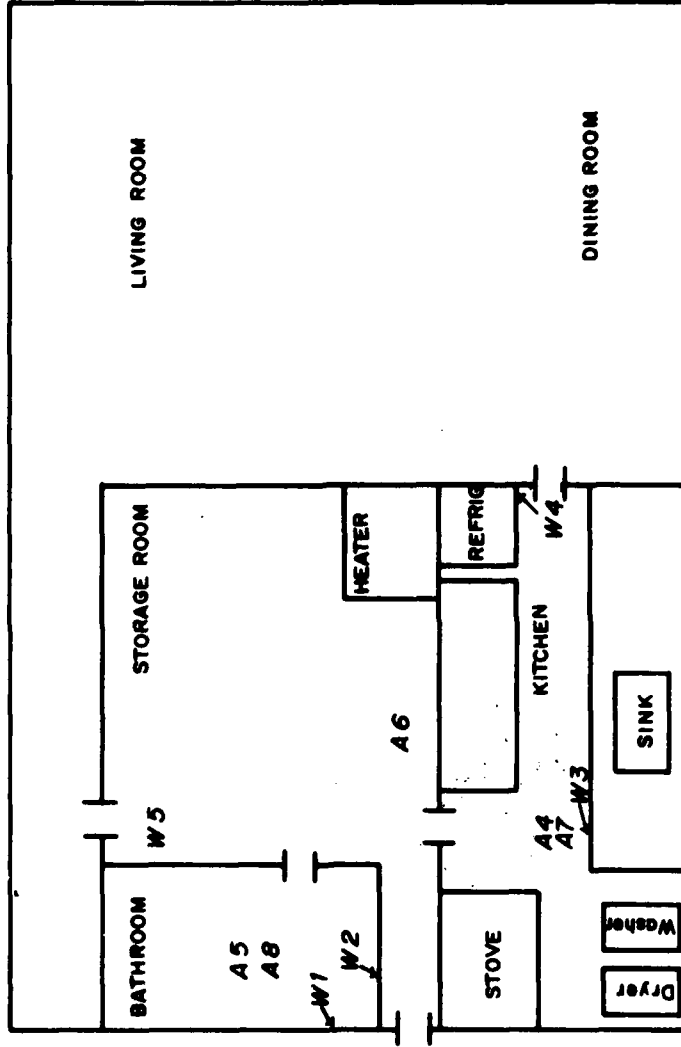
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APPENDIX C

LOCATION OF AIR AND WIPE  
SAMPLES FROM INSIDE QUARTERS

APPENDIX C

LOCATION OF AIR AND WIPE  
SAMPLES FROM INSIDE QUARTERS



A - AIR SAMPLES  
W - WIPE SAMPLES

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APPENDIX D

TABLE 1. RESULTS OF AIR SAMPLE ANALYSIS

Sample No.	Site	Air Volume (liters)	Pesticide	Results Amount mg/m <sup>3</sup>
SP-1105	Vent, Rear of House, No. 1	83.1	Chlordane	NR*
SP-1106	Vent, Side of House, No. 2	80.9	Chlordane	NR*
SP-1107	Vent, Rear of House, No. 3	82.5	Chlordane	NR*
SP-1108	Kitchen, Heating Vent by Washing Machine, No. 4	60.8	Chlordane	0.003
SP-1109	Bathroom, No. 5	58.8	Chlordane	0.007
SP-1110	Storage Room - Near Heating Unit, No. 6	60.0	Chlordane	0.003
SP-1111†	Kitchen, Heating Vent by Washing Machine, No. 7	69.5	Chlordane	0.007
SP-1112†	Bathroom, No. 8	81.9	Chlordane	0.005

\*NR - Pesticide qualitatively identified but insufficient quantities for quantitative determination.

†Samples SP-1111 and 1112 were collected in ethylene glycol. All other samples collected in iso-octane.

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TABLE 2. RESULTS OF WIPE SAMPLE ANALYSIS

Sample No.	Site	Approximate Area cm <sup>2</sup>	Results Pesticide	µg/cm <sup>2</sup>
SP-1075	Bathroom Heat Vent, No. 1	465	ND*†	
SP-1076	Bathroom Baseboard, No. 2	22	Chlordane	1.90
SP-1077	Kitchen Heat Vent, No. 3	105	ND*†	
SP-1078	Kitchen Baseboard, No. 4	155	Chlordane	0.20
SP-1079	Storage Room Baseboard, No. 5	232	Chlordane	0.07
C-1	Kitchen Baseboard‡	225	ND*	
C-2	Bathroom Baseboard‡	225	ND*	
C-3	Storage Room Baseboard‡	225	ND*	

\*ND - No pesticides detected.

†Unidentified peaks present.

‡Control samples taken from personal home, Edgewood, Maryland.

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TABLE 3. RESULTS OF SOIL AND WATER SAMPLE ANALYSIS

Sample No.	Sample Type	Results	
		Pesticide	µg/g
SP-1071	Soil No. 1	Chlordane	495.24
		Malathion	NR*
SP-1072	Soil No. 2	Chlordane	1000.16
		Malathion	NR*
SP-1073	Soil No. 3	Chlordane	106.40
SP-1074	Water-Maintenance Entrance	Chlordane	0.224 mg/l

\*NR - Pesticide qualitatively identified but insufficient quantities for quantitative determination.

APPENDIX E

PESTICIDES ANALYZED FOR AND LIMITS OF DETECTABILITY

Pesticide	Soil (ppm)	Limits of Detectability	
		Water (ppm)	Air (mg/m <sup>3</sup> )*
α BHC	0.003	0.00003	0.00002
β BHC	0.010	0.00010	0.00008
aldrin	0.008	0.00008	0.00007
chlordane	0.060	0.00060	0.00050
o,p'-DDD	0.020	0.00020	0.00020
p,p'-DDD	0.016	0.00016	0.00013
o,p'-DDE	0.020	0.00020	0.00020
p,p'-DDE	0.016	0.00016	0.00013
o,p'-DDT	0.020	0.00020	0.00020
p,p'-DDT	0.030	0.00030	0.00025
dieldrin	0.012	0.00012	0.00010
endrin	0.021	0.00021	0.00018
heptachlor	0.003	0.00003	0.00003
heptachlor epoxide	0.008	0.00008	0.00007
lindane	0.004	0.00004	0.00003
methoxychlor	0.080	0.00080	0.00070
mirex	0.020	0.00020	0.00020
toxaphene	0.800	0.00800	0.00700
chlorpyrifos	0.012	0.00012	0.00010
diazinon	0.052	0.00052	0.00040
malathion	0.010	0.00080	0.00070
methyl parathion	0.030	0.00030	0.00025
parathion	0.020	0.00020	0.00007
cis-chlordane	0.008	0.00008	0.00007
trans-chlordane	0.008	0.00008	0.00007
oxychlordane	0.008	0.00008	0.00007

\*mg/m<sup>3</sup> based upon a 60 liter air sample.