

# Health Consultation

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## Exposure Investigation Report

CYPRESS CREEK SUB-AREA III

MEMPHIS, SHELBY COUNTY, TENNESSEE

EPA FACILITY ID: TND981015456

SEPTEMBER 26, 2008

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

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HEALTH CONSULTATION

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EPA FACILITY ID: TND981015456

Prepared by:

Tennessee Department of Health  
Under Cooperative Agreement with the  
U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry

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## EXECUTIVE SUMMARY

In the years before environmental regulation, several chemical companies disposed of wastes in Cypress Creek in north Memphis. Cyclodiene pesticides accumulated in the sediment of the creek. In order to prevent flooding, the City of Memphis dredged the creek and lined it with concrete in the 1960s. The dredged sediment, containing cyclodiene pesticides, was placed beside the creek in the backyards of residents and area businesses.

In March 2005, the Memphis and Shelby County Health Department (MSCHD) and the Tennessee Department of Environment and Conservation (TDEC) jointly requested that Environmental Epidemiology (EEP), under our Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR), publish a health consultation for the Cypress Creek area in Memphis, Shelby County. The purposes of the health consultation were: 1) to examine the possible exposure and hazard to residents living adjacent to and near Cypress Creek whose yards have had soil sampled; and 2) to work with TDEC, the Environmental Protection Agency (EPA), MSCHD and Velsicol to jointly identify remedial action levels that are protective of human health.

Conclusions of the Health Consultation were: 1) for the majority of residential properties, contaminants were not found at levels of concern and 2) past, current, and future public health hazards exist from exposure to soil contaminated with pesticides and associated chemicals on some residential properties in Sub-Area III adjacent to or near Cypress Creek in Memphis, Shelby County, Tennessee.

After presenting the Health Consultation to the community and government agencies, EEP determined that additional data were needed to better evaluate potential human exposure to environmental contamination. In order to fill this data gap, EEP proposed an Exposure Investigation to determine if those community members who have the most potential for exposure have elevated blood levels of the cyclodiene pesticides, aldrin, dieldrin, and endrin. Nineteen homes in Cypress Creek Sub-Area III were targeted for blood serum and indoor dust sampling. Indoor dust concentrations of dieldrin and endrin were determined in the residences of community members chosen for blood sampling. A questionnaire was administered to find out how often these people worked in their yards and ate home-grown produce.

Table A in Appendix A summarizes the locations chosen for blood serum sampling of residents and dust sampling of their homes, with any relevant comments. Households 1 (as numbered in this EI report), 4, 6, 13, 16, 17, and 18 chose to participate in serum sampling, dust sampling, or both.

Outdoor soil concentrations of dieldrin and endrin did not correlate with indoor dust concentrations. Neither aldrin nor endrin was detected in any participants' blood. Soil and dust concentrations of dieldrin did not correlate with lipid-adjusted blood dieldrin levels.

The dieldrin concentration in the people over 20 years of age who participated in the EI were below the 95<sup>th</sup> percentile confidence interval for all persons 20 years and older in National

## Cypress Creek Sub-Area III Exposure Investigation

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Health and Nutrition Examination Survey (NHANES) 2001-2002. The youngest participants had lipid-adjusted serum dieldrin concentrations less than the analytical limit of detection.

For past exposures to dieldrin in household dust, an indeterminate health hazard existed. Currently and in the future, no apparent health hazard exists from exposure to dieldrin in household dust.

We cannot draw any conclusions from the survey responses on the consumption of eating home-grown vegetables because of small sample size. Recommendations include general food and safety guidelines such as washing hands before preparing and eating foods and thoroughly washing and peeling vegetables.

We will continue to work with TDEC to ensure continued cleanup of any remaining pesticide pollution related to Cypress Creek.

We will continue to work with the Memphis-Shelby County Health Department and the Mid-Town North Health Committee to educate the public about environmental public health issues near Cypress Creek and in their endeavors to assist the entire community.

## **Objectives and Rationale**

The primary objective of the Exposure Investigation (EI) is to find out if those community members who have the most potential for exposure to contaminated soil have elevated body burdens of the cyclodiene pesticides: aldrin, dieldrin, and endrin. In addition, indoor dust concentrations of aldrin, dieldrin, and endrin were determined in the residences of community members chosen for blood sampling.

The purpose of these measurements is to answer two questions: 1) do community members with contaminated soil in their yards have increased body burdens of dieldrin and endrin and 2) can contaminated soil lead to contaminated dust in the home resulting in a completed exposure pathway from ingestion and inhalation of indoor dust.

## **Background**

Cypress Creek is located in the Northwest area of Memphis, Shelby County, Tennessee. Prior to 1963, the creek was used to dispose of sanitary sewage and manufacturing wastewater. Velsicol Chemical Corporation (Velsicol), Buckeye Chemical, and Buckman Laboratories were among the industries that discharged industrial wastewater to the creek. In the 1960s, the City of Memphis, while straightening the creek to control flooding, removed sediments from a portion of the creek and deposited them along the banks within backyards of residential and commercial properties. In 1963 the facilities discharging industrial wastewater to Cypress Creek began discharging to the Memphis Sewage Treatment Plant (TDH 2006).

In 2001, as part of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI), Velsicol performed a series of soil investigations along the creek downstream of the Velsicol facility. This off-site investigation was required in response to pesticide exposure to construction workers and employees of area utility companies. For the purpose of that investigation, Cypress Creek was divided into five sub-areas based on the different creek channel conditions and land-use conditions. These sub-areas also reflect different exposure scenarios related to human health risk considerations. Sub-Area III is predominantly residential and runs just downstream of Jackson Avenue to Evergreen Street (See the Protocol for a map).

A committee to determine factors that impact the quality of life in the area has been established by the Memphis-Shelby County Health Department (MSCHD). The Mid-Town North Health Committee is composed of MSCHD staff, Environmental Epidemiology (EEP) staff, members of the Cypress Creek Sub-Area III community, a local physician, the local community group, University of Tennessee-Memphis Faculty, and the Rhodes Hollywood-Springdale Partnership. Committee members are successfully working with the community. EEP worked with this committee to inform the community of the exposure assessment and to find the best ways of obtaining consents.

## **Contaminants of Concern and Environmental Sampling:**

Sampling of backyard soils performed from 2001-2005, by the Tennessee Department of Environment and Conservation (TDEC), U.S. Environmental Protection Agency (EPA), and Velsicol, has shown the presence of cyclodiene pesticides at most of the 129 residential properties sampled. Aldrin, dieldrin, endrin, endrin aldehyde, and endrin ketone were considered chemicals of concern. Dieldrin was used as a surrogate in cleanup, since cleanup of dieldrin to the 2.5 ppm level agreed upon by TDH, TDEC, and EPA Region 4 would assure protection of public health from exposure to aldrin and the endrin compounds (TDH 2006).

Only eleven properties (9%) had levels of dieldrin below the 0.06 parts per million (ppm) average concentration of dieldrin in cities (HSDB)<sup>1</sup>. Seventeen properties (13%) had levels of dieldrin greater than 2.5 ppm. The remaining 101 properties (78%) had levels of dieldrin greater than 0.06 ppm and less than 2.5 ppm.

## **Cypress Creek Sub-Area III**

Approximately 1,245 people live adjacent to or near Cypress Creek, comprising census blocks 1005, 2000, and 4014 in census tract 7 and census blocks 1009, 1021, 1024, 1025, and 2007 in census tract 9. These census blocks account for 471 households and 311 families, with an average household size of 2.58 and an average family size of 3.34. Homes that are not directly adjacent to the creek are also included within these census blocks. Children under the age of 15 years and persons 65 years and older account for 39.8% and 14.5%, respectively, of the population. Approximately 97.5% of the persons in the Cypress Creek community are African American. Also within this area is an elementary school where soil was remediated for elevated lead (>400 ppm residential soil).

## **Methods**

### **Exposure Investigation Design**

Nineteen homes in Cypress Creek Sub-Area III were targeted for blood serum and indoor dust sampling. Table A in Appendix A lists the houses eligible for blood serum sampling of residents and dust sampling of their homes and includes relevant comments.

Seven households, which are labeled in this exposure investigation as 1, 4, 6, 13, 16, 17, and 18, chose to participate in serum sampling, dust sampling, or both.

### **Target Population**

Persons from Cypress Creek Sub-Area III with the potential for greatest exposure to the pesticides were chosen for serum sampling for aldrin, dieldrin, and endrin. They included all

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<sup>1</sup> Dieldrin was detected in soils from 5 US cities at mean concentrations of less than 0.01 to 0.06 parts per million (ppm) (HSDB (Carey AE et al; Pest Monit J 13: 17-22 (1979))).

people 12 years of age and older that were living in a house with dieldrin levels in their yards greater than 2.5 ppm or living in houses near a cluster of houses with dieldrin levels in their yards greater than 2.5 ppm.

To explain the exposure investigation, personnel from MSCHD visited people in homes that were eligible for sampling. In addition, staff from MSCHD, EEP, and the Mid-Town North Health Committee delivered flyers to area homes inviting participation in an informal public forum at which we would further explain the exposure investigation. Personnel from MSCHD telephoned each eligible household to make appointments for sampling during the weeks of May 1 through May 12, 2007. These dates were chosen so that soil samples would arrive at the EPA Athens Laboratory within the holding time specified for cyclodiene pesticide analyses in soil.

Three of the 19 homes were abandoned. Of the 16 remaining eligible households, seven (44%) chose to participate.

## **Environmental Sampling**

### ***Data Collection/Sampling Procedures***

The purposes of the dust sampling were to determine if indoor dust in the Cypress Creek area may have become contaminated from pesticides in outdoor soil and whether contaminated dust presented a completed exposure route to people living in the house. American Society for Testing and Materials (ASTM) method D 5438 – 05, Standard Practice for Collection of Floor Dust for Chemical Analysis, was used. 3I-Chem glass sample bottles (341-1050) were used to collect the samples.

Areas to be vacuumed for collection of dust samples were determined individually at each residence. The areas in front of the television, in the main living area, and in bedrooms were measured and delineated with masking tape so that a known area was sampled. Vacuuming took place within the delineated areas. Pictures of each area were taken, if permitted by the home owner. In addition, the area of the home sampled was recorded in square meters.

When the appointment was scheduled, residents were asked NOT to vacuum or dust for one week before the appointment. All participants agreed to this and did not vacuum or clean for one week prior to their appointment.

Dust samples were sieved by EEP staff to isolate the fine dust (below 15 microns) using ASTM Method D 422-63. A matrix field blank and a matrix spike were submitted for analysis. The field blank sample was prepared by putting a clean sample bottle on the decontaminated dust sampler for a few minutes. The sampler was not turned on. The sample bottle was removed and shipped to the EPA lab. The dust spike samples were taken as a split sample from two residences that provided sufficient dust (about 90 grams) and were clearly labeled. The EPA laboratory added the spike.

### ***Laboratory Analytic Procedures***

Dust samples were stored in the bottles in which they were taken. At the end of each day, EEP returned to the laboratory in the MSCH where they sieved and weighed the samples. Sieved dust was put into small 3I-Chem glass sample bottles; each bottle was capped, sealed with evidence tape, and put into a separate zip-lock bag. All samples were stored in a refrigerator designated specifically for the dust samples. The samples were shipped to the EPA laboratory in one large Styrofoam container. Frozen ice packs were placed in the bottom of the cooler, covered by a layer of packing foam to keep the samples from freezing, and the samples placed in the cooler. The Science and Ecosystem Support Division, EPA Region 4 used EPA methods 3545 (extraction) and 8081 (analysis) for pesticides. The methods used for extraction and analysis of dust were the same as those used for soil, as no specific methods exist for dust. The extraction method specifies a ten-day holding time. Because the EPA Region 4 laboratory scheduled extractions for May 14, 2007, EEP took all samples between May 1 and May 10. Samples arrived at the EPA laboratory on May 11. Extraction of samples began on May 24, and as a result all samples except the one taken on May 10 were outside the holding time. Therefore, all sample concentrations were reported with J designation, signifying that concentrations are estimated. The laboratory believes that the sample concentrations are accurate even though the J designation appears on the laboratory report. It is highly unlikely that exceedance of holding time compromised the integrity of the analyses as dieldrin is chemically stable and the holding time refers to soil, not dust. Samples were in sealed 3I-Chem glass bottles and were refrigerated until extraction. Otherwise, quality assurances were met for the analyses of aldrin, dieldrin, and endrin, endrin aldehyde, and endrin ketone.

### **Biologic Sampling**

#### ***Data Collection/Sampling Procedures***

Blood serum samples were collected at the participants' homes, by appointment, using standard operating procedures, Centers for Disease Control and Prevention (CDC) supplied syringes, vacutainers, and other related equipment. Standard venipuncture procedures of the MSCHD were used for drawing blood. MSCHD centrifuged the samples to obtain the serum fraction before shipping the samples to CDC. Samples were stored and shipped according to CDC instructions.

### ***Laboratory Analytic Procedures***

Blood serum was analyzed for aldrin, dieldrin, and endrin by the CDC National Center for Environmental Health (NCEH) Laboratory using a standardized high resolution mass spectrometric method (Barr et al. 2003). Results were compared to values as measured in the National Report on Human Exposure to Environmental Chemicals 2005 in persons at least 12 years of age (CDC 2005).

The CDC laboratory results were reviewed and approved by a quality assurance officer to assure that they conformed to acceptable quality standards.

## **Questionnaire**

At each home, a representative of the MSCHD entered the home first, explained what was to happen and obtained informed consent from the head of the household for dust sampling and from each person consenting to blood sampling. After informed consent was obtained, EEP staff entered the home to begin dust sampling while the phlebotomist from MSCHD obtained blood samples. Seven households gave consent for dust sampling. Eleven people in five households gave consent for blood sampling.

The head of household or a representative for each residence was asked the demographic and soils portion of the standard Agency for Toxic Substances and Disease Registry (ATSDR) exposure questionnaire. Household questionnaire results and house dust concentrations were correlated with individual serum levels of dieldrin and endrin (aldrin was not detected) in an attempt to identify risk factors for exposure.

## **Data Analysis Procedures**

Data were analyzed using standard descriptive statistics. A correlation procedure (Proc CORR) was used to obtain non-parametric correlation coefficients. The Spearman correlation coefficient was calculated for the non-parametric analyses. See Appendix B for details.

Three persons had lipid-adjusted serum dieldrin concentrations less than the limit of detection. In those cases the limit of detection for each person was divided by the square root of 2 to obtain a concentration to use in calculations (CDC 2005).

## **Agency Roles**

The ATSDR provided guidance and oversight to EEP, TDH for this exposure investigation. In addition, ATSDR performed statistical analyses and funded the laboratory analyses of serum. The EPA Region 4 provided analysis of dust samples. Staff of EEP and the MSCHD carried out the exposure investigation.

## Results

### Target Population Demographic

A total of eleven persons in five households gave consent for blood sampling. The head of the household in seven households gave consent for dust sampling. All participants were non-Hispanic blacks. Household information was obtained on 20 people in the seven households. Table 1 below summarizes the target population demographics.

**Table 1. Target population demographics. Cypress Creek Sub-Area III. Memphis, Shelby County, Tennessee.**

	Sample size (%)	Age range
Total	20 (100)	10 – 81
Male	8 (40.0)	20 – 81
Female	12 (60.0)	10 – 76

### Environmental Sampling Results

Test results for aldrin in dust were less than the detection limit for all houses. Results for endrin in dust will be reported as the sum of endrin, endrin aldehyde, and endrin ketone. Where results were listed as the detection limit with a U designation (the analyte was not detected at or above the reporting limit), one-half the reporting limit was used as the concentration in calculations. Dieldrin concentrations in dust ranged from less than 20 parts per billion (ppb) at house 4 to 400 ppb at house 13. These concentrations are well below the level of concern of 2,500 parts per billion (ppb), equal to 2.5 parts per million (ppm) agreed upon by TDH, TDEC, and EPA Region 4. Total endrin concentrations ranged from 32 ppb to 840 ppb. Endrin is less toxic than dieldrin. TDH, TDEC, and EPA Region 4 determined that if dieldrin in soil were cleaned up to less than the level of concern (2,500 ppb), then any remaining endrin would not be of concern. For this reason, dieldrin is the focus of the report. Table B in Appendix A details the dust sampling results.

### Biological Sampling Results

Laboratory analysis of blood sera from all persons who consented to blood testing detected no aldrin or endrin. Eight of eleven persons who consented to blood testing showed measurable amounts of dieldrin in their serum. In this report, all dieldrin concentrations are in parts per billion (ppb) on a lipid adjusted basis. Table C in Appendix A details the blood serum results. Because no aldrin or endrin was detected in participants' blood, dieldrin is the focus the report.

### Questionnaire Results

Participants in the exposure investigation were asked a variety of questions about their house cleaning and gardening habits. Everyone reported that they clean regularly by vacuuming, sweeping, mopping, and dusting. Different households and persons within households reported different amounts of time they spent working in the soil in the yard and in the amount of garden produce they eat. These results are presented in Table D in Appendix A. Only one household currently grows vegetables at home.

### Previous Soil Sampling Results

TDEC, the U.S. EPA, and Velsicol sampled yards from 2001 through 2005. The results for the households which participated in this EI are summarized in Table E in Appendix A.

### Statistical Analyses

Data from a randomly selected sub-sample of the NHANES, 2001-2002 population were used as comparison for the exposure investigation population (CDC 2005). See Table F in Appendix A for details of NHANES results. The geometric mean concentration of dieldrin, lipid-adjusted, in NHANES, 2001-2002, was not calculated because the proportion of results below the limit of detection was too high to provide a valid result (> 40%). However, percentiles, including 95% lower and upper confidence limits, were calculated for all persons tested, all males, all females, Mexican Americans, non-Hispanic blacks, non-Hispanic whites, and persons between 12 years and 19 years of age. In this EI eight of the eleven participants had measurable amounts of dieldrin in their blood (27.3% of the participants had serum dieldrin levels below the detection limit). Their dieldrin levels ranged from ND to 22.6 ppb.

**Table 2. Summary of lipid-adjusted dieldrin concentrations by survey participant characteristics. Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee.**

	Geometric mean (95% CL)	Range, ppb	Sample size
Total	9.12 (5.70 - 14.59) Not age-adjusted	<LOD - 22.6	11
Sex			
Male	6.96 (4.44 - 10.80) Age-adjusted	<LOD - 16.0	5
Female	11.36 (7.61 - 16.95) Age-adjusted	<LOD - 22.6	6

The descriptive statistics of the survey results on the consumption of home-grown vegetables and working in soil is presented in detail in Table D, Appendix A. Only one household, who gave permission for blood sampling, reported currently eating home-grown vegetables; the dieldrin level in the soil at this home was 890 ppb. Three households had stopped eating their own vegetables two to four years ago. Another household reported eating home-grown vegetables years ago, but they did not consent to blood sampling. It is interesting to note that, at two of these residences, the soil contained less than 2.5 ppm dieldrin.

Spearman’s rank correlation, a non-parametric method, was used to examine the correlation between serum dieldrin, soil dieldrin, and dust dieldrin. The correlations between serum and soil dieldrin and between serum and dust dieldrin were significant but, after adjusting for age, the associations were no longer significant. See Appendix B for details.

Spearman’s rank correlation also was used to examine the association between concentrations of dieldrin and endrin in soil and dust. There was no significant correlation between dieldrin concentrations in soil and dust, between endrin concentrations in soil and dust, or between dieldrin concentrations in dust and dieldrin surface loading in dust (see Appendix B for details). Measurement of the amount of dust collected at household 1 was not accurate, resulting in an artificially high loading. When household 1 was omitted from the analysis, there was a strong correlation between concentration of dieldrin in dust and surface loading of dieldrin in dust. Table 3 below details dieldrin concentrations and dieldrin loadings in dust for each household.

**Table 3. Dieldrin dust loading results reported in micrograms per square meter ( $\mu\text{g}/\text{m}^2$ ). Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee.**

House	Concentration of dieldrin in dust, ppb	Surface loading of dieldrin in dust, $\mu\text{g}/\text{m}^2$
1	59 <sup>1</sup>	NA <sup>1</sup>
4	20 <sup>2</sup>	0.02
6	240	0.10
13	400	0.2
16	130	0.05
17	7.9 <sup>2</sup>	0.02
18	240 <sup>2</sup>	0.14
<sup>1</sup> Measurement of the amount of dust collected at household 1 was not accurate.		
<sup>2</sup> Analyte was designated as U; ½ the reporting limit was used in calculations		

The members of household 1 had lower lipid-adjusted serum dieldrin values than those present in members of other households. The data is summarized in Table 4 below.

**Table 4. Lipid-adjusted dieldrin concentrations in serum by household. Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee.**

House #	Range of serum dieldrin, ppb	Geometric mean, serum dieldrin, ppb	Ages	Number in household
1	<LOD –9.5	4.7	17 – 73	5
4	10.5	10.5	52	1
18	15.8	15.8	70	2 (1 was tested)

6	16.0 – 22.6	19.0	76 – 80	2
13	13.9 – 17.7	15.7	66 – 71	2

## Discussion

Aldrin, dieldrin, and endrin are organochlorine pesticides that are no longer produced or used in the United States. From the 1950s to 1970, these chemicals were widely used as insecticides on agricultural commodities including cotton and corn. These agricultural uses were cancelled in 1970. Aldrin and dieldrin were also registered for use to control termites, but this use was cancelled in 1987.

Aldrin is rapidly converted to dieldrin in the environment. Currently, the most likely source of exposure to aldrin and dieldrin in the general population is the diet.

After aldrin enters the body, it is metabolized to dieldrin. Dieldrin can accumulate in fatty tissues, and its metabolites are excreted in bile and feces. It is also excreted in breast milk. The elimination half-life of dieldrin is approximately 1 year. At high doses, aldrin and dieldrin block inhibitory neurotransmitters in the central nervous system. This blocking action can cause abnormal excitation of the brain, leading to symptoms such as headache, confusion, muscle twitching, nausea, vomiting, and seizures (CDC 2005).

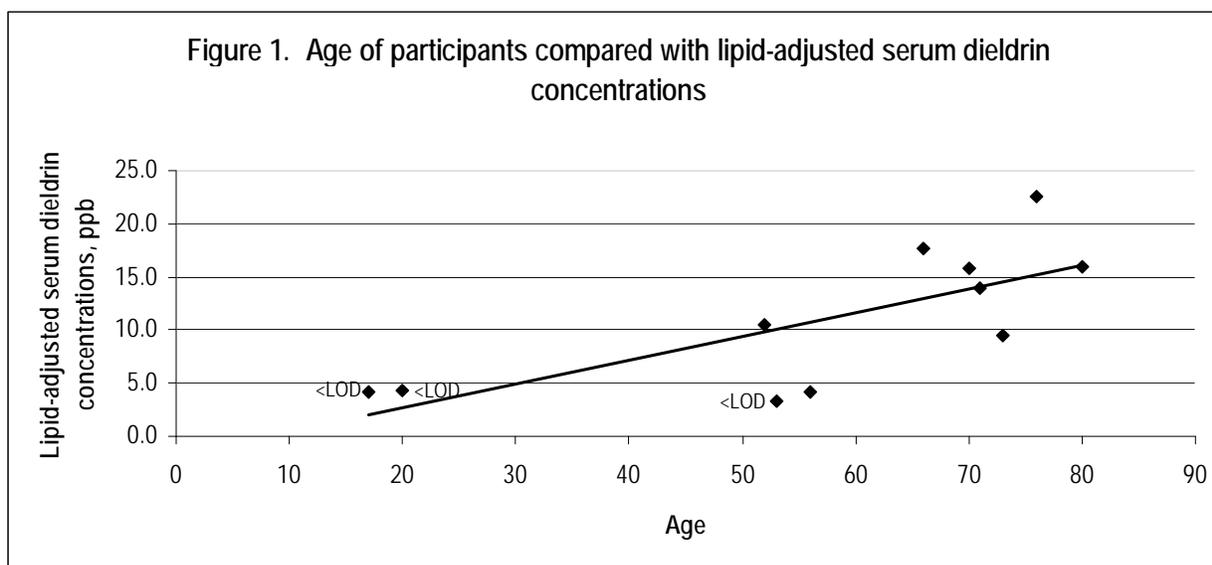
In experiments conducted in the 1960s, researchers found that, when dieldrin administration was stopped, the concentration in blood decreased exponentially (with first order kinetics) with a half-life of 369 days (ATSDR 2002). Dieldrin has not been used in the U.S. since 1987, so it is expected that serum dieldrin concentrations would be lower now than in the past. In the NHANES 2001-2002 subsample, the 95th percentile is approximately ten times lower than levels measured in a subsample from NHANES II (1976-1980). However, if past exposures were high, it may still be possible to measure dieldrin in blood even if there are no current exposures.

In the serum testing in the community near Cypress Creek, 27.3% of persons who gave consent for blood sampling had serum dieldrin levels below the detection limit, while in the NHANES 2001-2002 population more than 40% of participants had serum dieldrin levels below the limit of detection. This difference may be due to the high proportion of older adults included in this EI (only two participants were less than 50 years old) compared to the NHANES population. The dieldrin concentration in the people over 20 years of age who participated in the EI were below the 95<sup>th</sup> percentile confidence interval for all persons 20 years and older in NHANES 2001-2002. (see Table F, Appendix A and Appendix B). The person who was 17 years old at the time of the EI had a blood dieldrin concentration less than the detection limit.

The concentration of dieldrin in blood was significantly associated with age as can be seen in Figure 1, below. Older participants had the highest blood dieldrin concentrations, and the youngest participants had concentrations less than the detection limit (see Table C, Appendix A). Those values less than the detection limit were graphed as the detection limit divided by the square root of 2. This is an indication that the younger members of the test population have not

had significant recent exposures to dieldrin. It is not known if this conclusion applies to all younger members of the community. The backyards of houses 4 and 16 had been remediated before this exposure investigation.

The NHANES data suggest that age is related to blood dieldrin concentrations in the U.S. population. Although specific data for age and blood dieldrin concentrations exists at the National Center for Health Statistics, EEP was unable to obtain that data. Therefore, we do not know if the relationship between age and blood dieldrin concentrations is totally consistent with that in the NHANES population.



No statistically significant correlations were detected between dieldrin concentrations in the soil or the dust and age-adjusted dieldrin concentrations in blood sera. This means that, for this population, we cannot predict biological levels from environmental levels of dieldrin. The source of dieldrin exposure in the EI participants is not known, although the most likely source of exposure to dieldrin in the general population is the diet.

Some food products in the U.S. currently contain measurable amounts of dieldrin. The Food and Drug Administration (FDA) Total Diet Study in 2003 found dieldrin in 6% of foods tested, ranging in concentration from 0.1 to 14.1 parts per billion (FDA 2003). Dieldrin has been found in milk, cheese, beef, pork, lamb, chicken, tuna, eggs, beans, peas, peanuts, corn, fruits, vegetables, and commercial products made from these commodities (FDA 2006). Because of the small sample size, we cannot draw any conclusions about the relationship of eating home-grown vegetables and dieldrin concentrations in blood sera.

Most of participants had not eaten home grown vegetables for two years or more, except for one participant. A few samples of vegetables grown in one yard (not a participant in this EI) were analyzed for dieldrin during the soil sampling phase of environmental regulatory investigations. Some samples showed no detectable levels of dieldrin, while kale, turnip greens, and sweet potatoes showed 3.42 ppb, 8.53 ppb, and 4.65 ppb, respectively; these concentrations are

considered trace amounts by the FDA (FDA 2006). These vegetables were grown on soil containing 171 ppb dieldrin (MEC 2005). This is a lower soil concentration than that in the homes in this investigation. No dieldrin residues were found in kale, turnip greens, or sweet potatoes in the 2003 FDA pesticide monitoring program (FDA 2003). The FDA action level for dieldrin in kale and turnip tops is 0.05 ppm (50 ppb), and for sweet potatoes is 0.1 ppm (100 ppb) (FDA 2000).

### **Limitations**

The small number of participants in the EI decreased the ability to detect statistically significant associations, if they existed. Age was significantly associated with blood sera dieldrin concentrations in this investigation. The NHANES data suggests that age is also related to blood sera dieldrin concentrations in the U.S. population, although the age ranges reported are for 12 years and older, 12 - 19 years, and 20 years and older (CDC 2005). Although specific data for age and blood dieldrin concentrations exist at the National Center for Health Statistics, EEP was unable to obtain that data. Obtaining the age-specific data for the U.S. population would have allowed EEP to determine if our results are similar to those from other locations in the United States.

People were surveyed about the consumption of home-grown vegetables. Only five households reported ever eating home-grown vegetables; only four households gave consent for at least one person to have blood testing. Of those persons who gave us permission to test their blood, only one household reported never having eaten home-grown vegetables. Two other households reported never eating home-grown vegetables, but they did not give consent for blood testing.

### **Child Health Considerations**

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

In this EI, serum concentrations of dieldrin, aldrin, and endrin were not obtained for children under 12 years of age because there are no comparison values in the general population as there are for adults in NHANES. One teenage, and her grandparent, gave consent for blood sampling. This teenager had a blood sera dieldrin concentration less than the analytical detection limit, indicating no identifiable exposure to dieldrin.

## Conclusions

1. The dieldrin concentration in the people over 20 years of age who participated in the EI were below the 95<sup>th</sup> percentile confidence interval for all persons 20 years and older in NHANES 2001-2002. Finding a measurable amount of dieldrin in serum does not mean that the level will result in an adverse health effect.
2. There were no statistically significant correlations between dieldrin concentrations in the soil or dust and age-adjusted dieldrin concentrations in blood sera.
3. Age is significantly associated with serum dieldrin levels. This association is expected because dieldrin can bioaccumulate in fatty tissues over time. Older people were exposed to dieldrin in the food and the environment from the 1950s until 1987, when its use was totally banned. Since dieldrin does not break down quickly in the environment, significant exposures could have continued after 1987. Dieldrin is stored in fatty tissue and is in equilibrium with dieldrin in blood. Therefore, blood dieldrin levels reflect past exposure to dieldrin, as well as recent exposures.
4. The youngest participants had lipid-adjusted serum dieldrin concentrations less than the analytical limit of detection. This indicates that the youngest participants have not had recent measurable exposure to dieldrin.
5. In this EI, it is not possible to evaluate past exposures to environmental contamination. Therefore, EEP concludes that past exposures to site-related contamination posed an indeterminate public health hazard.
6. There is no apparent current or future health hazard from exposure to household dust. All remaining yards with soil dieldrin concentrations greater than 2.5 ppm were remediated after the sampling for this Exposure Investigation.
7. This EI did not have enough data to determine whether eating home-grown vegetables poses a public health hazard.
8. These conclusions are site specific and cannot be extrapolated to other communities.

## **Recommendations**

1. When eating home-grown vegetables, EEP recommends that individuals follow general food safety guidelines such as washing hands before preparing and eating foods and thoroughly washing and peeling vegetables. These procedures would reduce the amount of *surface* dieldrin and endrin contamination.
2. EEP will continue to work with TDEC to ensure the continued cleanup of any remaining pesticide pollution related to Cypress Creek.

## **Public Health Action Plan**

1. EEP will work with the MSCHD and the Mid-Town North Health Committee to educate the community about environmental public health issues near Cypress Creek and about healthy lifestyle choices.
2. EEP, along with MSCHD, will continue to work with the Mid-Town North Health Committee in their endeavors to assist the entire community, including the Cypress Creek area, with health and quality of life issues.

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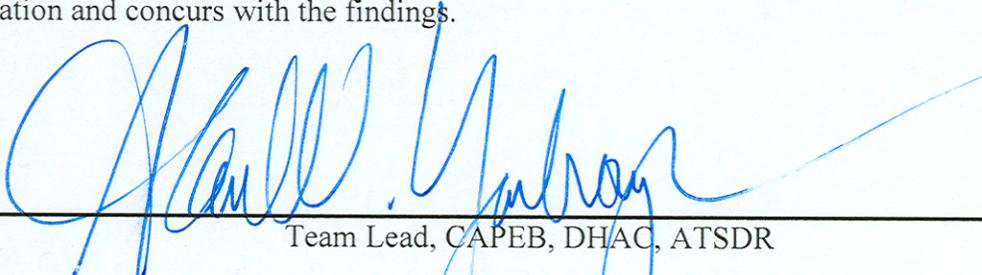
The Tennessee Department of Health prepared this Exposure Investigation, Cypress Creek, Sub-Area III, , under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). At the time this Health Consultation was written, it was in accordance with the approved methodologies and procedures. Editorial review was completed by the Cooperative Agreement partner.



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Technical Project Officer, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.



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Team Lead, CAPEB, DHAC, ATSDR

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## **Appendix A, Tables A-F**

**Table A: Houses eligible for resident blood sampling and dust sampling, with list of soil sampling address codes for the Health Consultation, July 2006. Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee.**

Address	Yard with dieldrin level above 2.5 ppm	Cleaned Up	Comments
1 (not the same as house 1 in this EI; did not participate)	Yes	No	Highest soil concentrations; vacant; boarded up; no one available for serum sampling.
2 (did not participate)	No	No	New house; next door to house with highest soil concentrations; 2 adults, several young children
3 (house 1 in this EI)	Yes	No	Coded as house #1 in this exposure investigation
4 (house 4 in this EI)	Yes	Yes	
5 (did not participate)	Yes	Yes	
6 (house 6 in this EI)	No	No	Near yards with a health hazard that had been remediated at the time of the EI
7 (did not participate)	Yes	No	
8 (did not participate)	Yes	No	Abandoned; no one available for serum sampling
9 (did not participate)	Yes	No	
10 (did not participate)	Yes	No	
11 (did not participate)	Yes	No	
12 (did not participate)	Yes	No	Belongs to city; vacant; no one available for serum sampling
13 (house 13 in this EI)	Yes	No	
14 (did not participate)	Yes	No	
15 (did not participate)	Yes	No	
16 (house 16 in this EI)	Yes	Yes	
17 (house 17 in this EI)	Yes	No	
18 (house 18 in this EI)	No	No	Near yards with a health hazard that had not been remediated at the time of the EI
19 (did not participate)	Yes	No	

**Table B. Dust sampling results reported in parts per billion (ppb). Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee.**

House	Aldrin, ppb	Dieldrin, ppb	Endrin, ppb	Endrin aldehyde, ppb	Endrin ketone, ppb	Total Endrin, ppb
1	20 U	59	290	50 U <sup>1</sup>	190	505
4	20 U	20 U <sup>1</sup>	58	76 U <sup>1</sup>	61	157
6	41 U	240	80 U <sup>1</sup>	100 U <sup>1</sup>	100 U <sup>1</sup>	140
13	110 U	400	48	56 U <sup>1</sup>	100	176
16	25 U	130	82	64 U <sup>1</sup>	120	234
17	7.9 U	7.9 U <sup>1</sup>	24 U <sup>1</sup>	20 U <sup>1</sup>	20 U <sup>1</sup>	32
18	240 U	240 U <sup>1</sup>	460 U <sup>1</sup>	610 U <sup>1</sup>	610 U <sup>1</sup>	840
U = The analyte was not detected at or above the reporting limit						
<sup>1</sup> Analyte was designated as U; ½ the reporting limit was used in calculations						

**Table C. Lipid-adjusted dieldrin concentrations, parts per billion (ppb). Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee. May 2007.**

House	Person	Age	Sex	Lipid-Adjusted Serum Dieldrin, ppb
1	1	73	F	9.5
1	2	17	F	<LOD
1	3	56	M	4.2
1	4	20	M	<LOD
1	5	53	M	<LOD
4	6	52	F	10.5
6	9	76	F	22.6
6	10	80	M	16.0
13	16	71	M	13.9
13	18	66	F	17.7
16	11	44	F	NA
16	12	68	F	NA
16	13	72	M	NA
16	14	10	F	NA
16	15	10	F	NA
17	19	52	F	NA
17	20	20	F	NA
17	21	21	M	NA
18	7	70	F	15.8
18	8	81	M	NA
NA means that the person did not have blood drawn.				
<LOD means less than the limit of detection				

**Table D. Questionnaire responses about gardening. Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee, May 2007.**

House	Person	Age	Work in soil	Garden vegetables eaten	Lipid-Adjusted Serum Dieldrin, ppb	Average dieldrin concentration in soil, ppb <sup>1</sup>
1	1	73	Monthly	None	9.5	3,530
1	2	17	Never	None	<LOD	3,530
1	3	56	Weekly	None	4.2	3,530
1	4	20	Never	None	<LOD	3,530
1	5	53	Daily	None	<LOD	3,530
4	6	52	Daily	<sup>2</sup> peppers, cucumber, tomatoes, okra, beets, corn, radishes, watermelon	10.5	12,300
6	9	76	Weekly	<sup>3</sup> squash, tomatoes, greens, plums, okra, beans, watermelon, sweet potatoes, cucumbers	22.6	180
6	10	80	Weekly	<sup>3</sup> squash, tomatoes, greens, plums, okra, beans, watermelon, sweet potatoes, cucumbers	16.0	180
13	16	71	Daily	<sup>4</sup> sweet potatoes, potatoes, peppers, tomatoes, cucumbers, cabbage, green beans, onions, turnips, squash, collard greens, English peas, butter beans, okra, corn	13.9	2,560
13	18	66	Daily	<sup>4</sup> sweet potatoes, potatoes, peppers, tomatoes, cucumbers, cabbage, green beans, onions, turnips, squash, collard greens, English peas, butter beans, okra, corn	17.7	2,560
16	11	44	Never	Vegetables years ago	NA	4,860
16	12	68	Never	Vegetables years ago	NA	4,860
16	13	72	Never	Vegetables years ago	NA	4,860
16	14	10	Never	None	NA	4,860
16	15	10	Never	None	NA	4,860
17	19	52	Never	None	NA	2,560
17	20	20	Never	None	NA	2,560
17	21	21	Mows lawn	None	NA	2,560
18	7	70	Never	greens, okra, tomatoes, sweet potatoes, apples	15.8	890
18	8	81	Daily	greens, okra, tomatoes, sweet potatoes, apples	NA	890
<sup>1</sup> greater than 2,500 ppb (2.5 ppm) dieldrin in soil is considered a health hazard and requires remediation.						
<sup>2</sup> last time was 4 years ago, <sup>3</sup> last time was 3 years ago, <sup>4</sup> last time was 2 years ago						
NA means that the person did not have blood drawn.						
<LOD means less than the limit of detection.						

**Table E. Average soil concentrations of dieldrin and total endrin in parts per billion (ppb), Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee, 2001-2005.**

House	Average soil dieldrin, ppb	Average soil total endrin <sup>1</sup> , ppb
1	3,530	83,280
4	12,300	307,020
6	180	920
13	2,560	52,570
16	4,860	146,030
17	6,260	194,190
18	890	18,630

<sup>1</sup> Total endrin = endrin + endrin aldehyde + endrin ketone

**Table F. Geometric mean and selected percentiles of serum dieldrin concentration (in ng/g of lipid or parts per billion on a lipid-weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 2001-2002.**

	Survey years	Geometric mean	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 12 and older	01-02	*	<LOD	<LOD	15.2 (14.3-17.0)	20.3 (18.7-22.4)	2159
Age group							
12 – 19 years	01-02	*	<LOD	<LOD	<LOD	<LOD	716
20 years and older	01-02	*	<LOD	10.5 (<LOD-11.6)	16.4 (15.1-18.2)	21.3 (19.1-24.0)	1443
Gender							
Males	01-02	*	<LOD	<LOD	15.7 (14.4-18.7)	20.2 (18.5-23.6)	1007
Females	01-02	*	<LOD	<LOD	15.2 (13.4-17.0)	19.8 (18.0-21.6)	1152
Race/Ethnicity							
Mexican Americans	01-02	*	<LOD	<LOD	11.6 (<LOD-15.1)	15.4 (12.6-17.6)	539
Non-Hispanic blacks	01-02	*	<LOD	<LOD	15.0 (11.8-19.1)	20.2 (15.8-25.2)	484
Non-Hispanic whites	01-02	*	<LOD	<LOD	15.5 (14.8-17.7)	20.7 (18.9-23.6)	980
<LOD means less than the limit of detection, which varies for these chemicals by individual sample.							
*Not calculated. Proportion of results below limit of detection was too high to provide a valid result.							

## **Appendix B, Statistical Analyses**

**Table 1. Correlation between serum dieldrin, soil dieldrin, and dust dieldrin. Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee**

	Serum dieldrin vs <b>soil</b> dieldrin r (p-value)		Serum dieldrin vs <b>dust</b> dieldrin r (p-value)	
	Unadjusted	Adjusted for age	Unadjusted	Adjusted for age
Spearman correlation coefficient (r)	-0.76356 (0.0062)*	-0.51371 (0.1288)	0.71554 (0.0133)*	0.50428 (0.1372)

\*statistically significant.

**Table 2. Household dieldrin and endrin concentrations in soil and dust. Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee.**

	Dieldrin concentration (ppb)		Endrin concentration (ppb)	
	Soil	Dust	Soil	Dust
House #1	3530	59	83000	505
House #4	12300	10	307000	157
House #6	180	240	920	140
House #13	2560	400	53000	176
House #18	890	120	18000	840
House #16	4860	130	146000	234
House #17	6260	4	194000	32
	Soil vs dust dieldrin r (p-value)		Soil vs dust endrin r (p-value)	
Spearman correlation coefficient for all 7 households	-0.71429 (0.0713)		-0.28571 (0.5345)	
Spearman correlation coefficient for 5 households where has blood dieldrin level obtained	-0.70000 (0.1881)		0.10000 (0.8729)	

**Table 3. Percentiles of lipid-adjusted serum dieldrin concentrations. Cypress Creek Sub-Area III, Memphis, Shelby County, Tennessee.**

For sample size=10 (the one 17 year old was not included. These percentiles can be compared with older adult result in NHANES)

The UNIVARIATE Procedure  
Variable: dieldrin

Quantiles (Definition 5)

Quantile	Estimate	95% Confidence Limits Assuming Normality	
100% Max	22.6		
99%	22.6	20.8129	39.22065
95%	22.6	17.3079	31.72713
90%	17.7	15.3226	27.83956
75% Q3	16.0	11.6481	21.64387
50% Median	10.5	6.6602	15.52164
25% Q1	4.2	0.5379	10.53372
10%	4.2	-5.6577	6.85921
5%	3.3	-9.5453	4.87389
1%	3.3	-17.0388	1.36897
0% Min	3.3		

The SAS System 12:12 Wednesday, April 16, 2008 2

For sample size=11 (These percentiles can be compared with total in NHANES)

The UNIVARIATE Procedure  
Variable: dieldrin

Quantiles (Definition 5)

Quantile	Estimate	95% Confidence Limits Assuming Normality	
100% Max	22.60		
99%	22.60	21.1851	40.73284
95%	22.60	17.7485	33.03286
90%	20.15	15.7928	29.04120
75% Q3	16.00	12.1432	22.68978
50% Median	12.20	7.1150	16.44499
25% Q1	4.30	0.8702	11.41679
10%	3.75	-5.4812	7.76723
5%	3.30	-9.4729	5.81153
1%	3.30	-17.1728	2.37495
0% Min	3.30		

**Exposure Investigation Protocol** for  
Cypress Creek Sub-Area III  
Memphis, Shelby County, Tennessee

January 2007

(Cost recovery # 40FV )

Prepared by

Bonnie S. Bashor, Tennessee Department of Health

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## **I. PROJECT OVERVIEW**

### *i. Summary*

The purpose of this Exposure Investigation (EI) is to determine if selected residents of the Cypress Creek area are exposed to dieldrin and endrin at levels above the general US population as defined by CDC's National Report on Human Exposure to Environmental Chemicals, 2005. Through a collaborative effort with the Tennessee Department of Health (TDH), Tennessee Department of Environment and Conservation (TDEC), the U.S. Environmental Protection Agency (EPA), and Memphis-Shelby County Health Department (MSCHD), blood serum and indoor dust sampling will be conducted in an attempt to correlate the body burden with the pesticide concentrations in indoor dust and outdoor soil. Results of the exposure investigation will be shared with residents, and local and state agencies. Depending on the findings, other follow-up activities may include recommendations for additional sampling, recommendations for cleanup or expedited cleanup, physician health education, and a community health effects study.

### *ii. Investigators and collaborators*

#### *Agency for Toxic Substances and Disease Registry*

Division of Health Assessment and Consultation, Exposure Investigation Team

**Lourdes Rosales-Guevara** will provide consultation to state investigators as needed.

Division of Health Assessment and Consultation, State Programs Section

**Trent LeCoultre** will facilitate communication between state and federal investigators.

#### *Tennessee Department of Health*

*Environmental Epidemiology Program (EEP)*

**Bonnie S. Bashor**, M.S., will be the principal investigator, writing the protocol and the final report.

**Ellen Omohundro**, Ph.D., will provide epidemiological support for the EI and will assist in communications with the community.

**Susan M. Miller**, M.S., CHES, will conduct community outreach efforts during protocol development and in dissemination of results and recommendations.

**David M. Borowski**, M.S., will provide technical support throughout the EI.

*Memphis-Shelby County Health Department  
Bureau of Environmental Health Services*

**Norman Lachapelle**, M.S.P.H., R.P.H., Administrator, Bureau of Environmental Health Services, will provide local oversight to project activities and coordinate between the local government entities and the project committee.

**Helen G. Morrow**, M.D., M.P.A., Acting Health Officer, will be the chair of the committee of experts and community members convened to find ways to answer concerns about the health of the community along Cypress Creek Sub-Area III.

**Calondra Tibbs**, MPH, Environmental Epidemiologist, will provide epidemiological support, assistance with community outreach efforts, and will coordinate drawing of blood and collection of epidemiological data.

**Chuck Millstein**, M.B.A., M.T. (ASCP), Laboratory Manager, will provide oversight of laboratory and fieldwork regarding drawing of blood, as well as shipping of samples to CDC.

*U.S. EPA Region 4*

Science and Ecosystem Support Division

**Gary Bennett**, , will provide oversight of laboratory analysis for dieldrin and endrin in indoor dust samples.

Resource Conservation and Recovery Act (RCRA) Division

**Leo Romanowski**, Senior Corrective Action Specialist, will provide liaison between EPA Region 4 SESD, EEP, and ATSDR.

*Cypress Creek Health Committee*

Will provide advice on interacting with the community and obtaining permission from selected households for sampling efforts.

## **II. INTRODUCTION**

### ***i. Background***

Cypress Creek is located in the North West area of Memphis, Shelby County, Tennessee. Prior to 1963, the creek was used to dispose of sanitary sewage and manufacturing wastewater. Velsicol Chemical Corporation (Velsicol), Buckeye Chemical, and Buckman Laboratories were among the industries which discharged industrial wastewater to the creek. In the 1960s, the City of Memphis, while straightening the creek to control flooding, removed sediments from a portion of the creek, and deposited them along the banks within backyards of residential and commercial properties.

In 1963 the facilities discharging industrial wastewater to Cypress Creek began discharging to the Memphis Sewage Treatment Plant.

In 2001, Velsicol performed a series of soil investigations along the creek downstream of the Velsicol facility, as part of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). This off-site investigation was required in response to pesticide exposure to construction workers and employees of area utility companies. For the purpose of this investigation, Cypress Creek was divided into five sub-areas based on the different creek channel conditions and land use conditions. These sub-areas also reflect different exposure scenarios related to human health risk considerations. Sub-Area III is predominantly residential and runs just downstream of Jackson Avenue all the way to Evergreen Street.

A Cypress Creek Health Committee has been established by the Memphis-Shelby County Health Department (MSCHD). This committee is composed of MSCHD staff, Environmental Epidemiology (EEP) staff; members of the Cypress Creek Sub-Area III community, a local physician, the local community group, University of Tennessee-Memphis Faculty, and the Rhodes Hollywood-Springdale Partnership. The purpose of the committee is to determine how to answer health questions that the community has about long-term exposure to cyclodiene pesticides.

### **Contaminants of Concern and Environmental Sampling:**

Sampling of backyard soils done from 2001-2005, conducted by TDEC and Velsicol, has shown the presence of cyclodiene pesticides at most of the 129 residential properties sampled. Only eleven properties (9%) had levels of dieldrin below the average concentration of dieldrin in cities of 0.06 ppm (HSDB)<sup>2</sup>. Seventeen properties (13%) had levels of dieldrin greater than 2.5 ppm (the agreed upon remedial action level). The remaining 101 properties (78%) had levels of dieldrin greater than 0.06 ppm and less than 2.5 ppm. In addition to dieldrin, most properties showed high concentrations of endrin and endrin-like chemicals (TDH). While many (87%) of the properties had concentrations of these pesticides at levels below remedial action levels, some properties (13%) showed levels that were higher.

### **Cypress Creek Sub-Area III:**

Approximately 1,245 people live adjacent to or near Cypress Creek, comprising census blocks 1005, 2000, and 4014 in census tract 7 and census blocks 1009, 1021, 1024, 1025, and 2007 in census tract 9. These census blocks account for 471 households and 311 families, with an average household size of 2.58 and an average family size of 3.34. Homes that are not directly adjacent to the creek are also included within these census blocks (see Appendix A for a map of the community). Children under the age of 15 years and persons 65 years and older account for 39.8% and 14.5%, respectively, of the population. Approximately 97.5% of the persons in the Cypress Creek community are African American. Also within this area is an elementary school, where soil was remediated for elevated lead (>400 ppm residential soil), however, it continues to

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<sup>2</sup> Dieldrin was detected in soils from 5 US cities at means concentrations of less than 0.01 to 0.06 parts per million (ppm).

present a potential environmental public health threat due to the vicinity of other contaminated properties.

### **Community Health Concerns:**

At the public meeting on August 8, 2006, to present the Health Consultation results, the community explicitly asked about cancer, increased infant mortality, and increased number of babies who are small for gestational age (SGA). One community member stated that he has been diagnosed with “Chronic Nervous Syndrome”.

### **Potential exposure routes:**

Potential routes of exposure include incidental ingestion of contaminated soil or dust (especially by children), inhalation of indoor/outdoors dust or vapors, dermal exposure to soil (portions of many yards have bare dirt), and ingestion of vegetables grown in contaminated soil. We do not know the past levels of contamination or the dose of the pesticides that community members may have experienced then or now.

### ***ii. Justification for the exposure investigation***

(1) Can an exposed population be identified?

Yes. Many people in the Cypress Creek community were born there and have lived in the same house their entire lives. Because the yards are small, children tend to play together across yards. A child living across the street from a highly contaminated property can be exposed as much as someone living in the house on the highly contaminated property.

Routes of exposure may include incidental ingestion of household dust originating in the yards, ingestion of contaminated dirt on pets and toys (children), and possibly inhalation of dust and small particulate matter and vapors from dieldrin and endrin emanating from the soil. Some people in the community grow vegetables; this route of exposure cannot be completely ruled out.

Although the community would want everyone tested, it would be more feasible to monitor those people who have contaminated yards and are a higher risk for exposure and those people who live near them (especially children who are old enough to play around the neighborhood). The community wants health studies done.

(2) Does a data gap exist that affects the ability to determine if a public health hazard exists?

Yes. EEP does not know if the possible routes of exposure have resulted in actual exposure. Nor does EEP know if the possible routes of exposure have resulted in body burdens of the cyclodiene pesticides aldrin, dieldrin, and endrin. Because signs and symptoms of exposure are not clear cut, it is important to know if people have excess body burdens of these pesticides before any health studies or public health decisions are made (except for cleanup of those properties that may pose a health hazard). EEP does not know the extent of past exposures; concentrations in the past may have been higher than current concentrations. If an exposure

investigation confirms excess levels of these pesticides in blood serum, then further actions may follow.

Possible completed pathways of exposure are: Incidental ingestion of soil from the backyard; ingestion of household contaminated dust from carpets, plush toys, upholstery, dogs, and cats; ingestion of contaminated garden produce; inhalation of dust particulate matter; inhalation from off-gassing of carbon tetrachloride used as a solvent in the synthesis of the pesticides.

(3) Can an exposure investigation address data gaps?

Yes: An exposure investigation will show whether people living along or near the creek have excess body burdens of the pesticides. If an exposure investigation showed that people living along or near the creek have excess body burdens of these pesticides, EEP would then look at the feasibility of a health effects study to determine if people have been harmed by those exposures. If the exposure investigation shows that people living along or near the creek do not have excess body burdens of these pesticides, no further public health actions would be needed. An exposure investigation may indicate if an epidemiological study might be feasible or needed.

A health consultation has been completed and reported for Cypress Creek Sub-Area III. More EPA sampling would not answer community wide public health questions, although it would answer specific questions about individual yards.

(4) How would the exposure investigation impact public health decisions?

If excess exposure were confirmed, this would lend impetus to quicker cleanup. In addition, the following actions would be taken: 1) local health care provider education regarding health outcomes of concern and 2) determination of the feasibility of implementing a health effects study.

### ***iii. Objectives***

The primary objective of the EI is to find out if those community members who have the most potential for exposure have elevated body burdens of the cyclodiene pesticides, dieldrin and endrin. In addition, indoor dust concentrations of dieldrin and endrin will be determined in the residences of community members chosen for blood sampling.

These activities will answer two questions: 1) do community members with contaminated soil in their yards have increased body burdens of dieldrin and endrin and 2) can contaminated soil in their yards enter dust in their homes, leading to completed exposure pathways from ingestion and inhalation of indoor dust.

### III. METHODS

#### *i. Exposure investigation eligibility*

Persons from Cypress Creek Sub-Area III with the potential for greatest exposure to the pesticides will be chosen for serum sampling for dieldrin and endrin. They include all people 12 years of age and older that are living in a house with pesticides levels in their yards above 2.5 ppm or living in houses near a cluster of houses with pesticides levels in their yards above 2.5 ppm.

#### **ii. Exposure investigation population**

Eighteen homes in the Cypress Creek Sub-Area III will be targeted for blood serum and indoor dust sampling. Table 1 summarizes the locations chosen for blood serum sampling of residents and dust sampling of their homes, with any relevant comments.

Address	Yards with pesticides levels above 2.5 ppm	Cleaned Up	Comments
1	Yes	No	Highest soil concentrations; vacant; boarded up; no one available for serum sampling.
2	No	No	New house; next door to house with highest soil concentrations; 2 adults, several young children
3	Yes	No	
4	Yes	Yes	
5	Yes	Yes	
6	No	No	Near yards with a health hazard that has been remediated
7	Yes	No	
8	Yes	No	Abandoned; no one available for serum sampling
9	Yes	No	
10	Yes	No	
11	Yes	No	
12	Yes	No	Belongs to city; vacant; no one available for serum sampling
13	Yes	No	
14	Yes	No	
15	Yes	No	
16	Yes	Yes	
17	Yes	No	
18	No	No	Near yards with a health hazard that have not been cleaned up

Since three of the houses are vacant, the 15 remaining houses will be chosen for blood serum sampling and analysis for dieldrin and endrin in residents and dust sampling for dieldrin and endrin in household dust.

### ***iii. Data collection/sampling procedures***

Cyclodiene pesticides do not quickly or easily degrade and can remain attached to soil or sediment for decades. In the environment and in the body, aldrin quickly changes into dieldrin. Therefore, all sampling will be for dieldrin (as a surrogate for aldrin and dieldrin) and endrin. The serum dieldrin and endrin samples will be lipid adjusted for better correlation with the National Report on Human Exposure to Environmental Chemicals, 2005.

Blood serum samples will be collected at the participant's home, by appointment, using standard operating procedures, CDC-supplied syringes, vacutainers, and other related equipment. Venopuncture procedures of the MSCHD will be used for drawing blood (Appendix B). MSCHD will centrifuge the samples to obtain the serum fraction before shipping the samples to CDC.

The purpose of the dust sampling is to determine if indoor dust in the Cypress Creek area can become contaminated from pesticides in outdoor soil and if contaminated dust presents a completed exposure route to people living in the house. Because aldrin converts to dieldrin in the environment and soil measurements for cyclodiene pesticides showed very low levels of aldrin, measurements for dieldrin will serve as a surrogate for aldrin and dieldrin. ASTM method D 5438 – 05, Standard Practice for Collection of Floor Dust for Chemical Analysis, will be used. 3I-Chem glass samples bottles (341-1050) will be used to collect the samples.

Areas to be vacuumed for collection of dust samples will be determined individually at each residence. The areas in front of the television, in the main living area, in bedrooms, and on upholstered furniture will be measured and delineated with masking tape. Vacuuming will take place within the delineated areas. Pictures of each area will be taken, and the height and width of each area will be recorded.

At the time the appointment is made, residents will be asked to NOT vacuum or dust for one week before the appointment.

The demographic and soils portion of the standard Agency for Toxic Substances and Disease Registry (ATSDR) exposure questionnaire will be asked of the head of household or representative for each residence (Appendix C). The person doing the dust sampling will fill out a form delineating construction aspects of the residence (Appendix D).

We will discuss the best ways to get permission from residents with the Cypress Creek Health Committee. Each person chosen for blood sampling will be asked to sign a consent form or an assent form for persons less than 18 years of age. Appointments will be made so that people's lives are disrupted as little as possible.

### **iv. Data Analyses & Interpretation**

Blood serum will be analyzed for dieldrin and endrin by the CDC National Center for Environmental Health (NCEH) Laboratory using a high resolution mass spectrometric method

(Barr et al. 2003). Results will be compared to the 95th percentile values as measured in the National Report on Human Exposure to Environmental Chemicals 2005 in persons at least 12 years of age.

Dust samples will be sieved by EEP staff using ASTM Method D 422-63 and analyzed by the Science and Ecosystem Support Division, EPA Region 4. EPA methods 3545 (extraction) and 8081 (analysis) will be used. Recorded results will include the weight of fine dust below 150 microns, mass of dieldrin and endrin detected, and concentration of dieldrin and endrin detected in units of  $\mu\text{g}$  dieldrin or endrin per kilogram of dust. In addition, the area of the home sampled will be recorded in square meters so that a loading in terms of  $\mu\text{g}$  per  $\text{m}^2$  can be determined.

During the Health Consultation process, EEP, TDEC, EPA, and Velsicol agreed upon a remedial action level of 2.5 ppm dieldrin in soil. If the concentrations of dieldrin in soil at a residence had a concentration of dieldrin greater than or equal to 2.5 ppm, the property was considered to present a public health hazard. If dieldrin dust concentrations are found in elevated concentrations, EEP will work with TDEC, EPA, and ATSDR to decide upon the best course of action. The course of action will be influenced by the results of the blood sampling.

Household questionnaire results and house dust concentrations will be correlated with individual serum levels of dieldrin and endrin in an attempt to identify risk factors for exposure. Analysis of variance will be used, with serum results treated as the dependent variable and survey results household dust results treated as the independent variables.

No other testing will be conducted on the remaining blood samples; they will be discarded according to the protocol for universal precautions one year from the date of sampling. The EPA laboratory will also be instructed to dispose of any remaining dust samples.

#### ***v. Records management***

All results will remain confidential and locked in a file cabinet/safe in EEP's office. Data files will be password protected on the TDH secure intranet.

#### ***vi. Fieldwork coordination***

Fieldwork will be coordinated by the MSCHD. They will schedule appointments for sampling in participants' homes, obtain signed consent forms for the blood serum samples and dust samples, take the blood samples according to MSCHD's protocols, follow chain-of-custody procedures, and ship the samples to the CDC NCEH laboratory. Also, during the collection of blood and dust samples, MSCHD staff will collect epidemiological data using the demographic and soils portion of the standard ATSDR exposure questionnaire (Appendix C). MSCHD staff making the appointments will ask residents NOT to vacuum for one week before the appointment.

At the same appointment, EEP and TDEC personnel will collect the dust samples, store the samples according to the EPA protocol, follow chain-of-custody procedures, and ship the samples to the EPA Athens, Georgia, laboratory.

All staff will follow standard TDEC/EPA chain of custody procedures (Appendix E).

***vii. Quality Assurance/Quality Control***

The purpose of the QA/QC procedures is to produce data of known high quality that meet or exceed the requirements of standard analytical methods. Quality assurance/quality control samples of a matrix field blank and a matrix spike will be submitted for analysis for every 20 samples submitted. The field blank sample will be prepared by putting a clean sample bottle on the decontaminated dust sampler for a few minutes. The sampler will not be turned on. The sample bottle will be removed and shipped to the EPA lab. The dust spike sample will be taken as a split sample from a residence that provided sufficient dust (about 90 grams). The split samples will be labeled as “a” and “b”. Sample b will be labeled as duplicate b and marked as “matrix sample matrix spike duplicate” (MSMSD). The EPA laboratory will add the spike.

Evaluation of analytical data, in terms of usability will be conducted using the following criteria, based on USEPA guidance:

Reports – confirmations that report(s) relied upon are complete and appropriate for use in the EI;

Documentation – confirmation that each analytical result is associated with a specific sample location and that appropriate sampling procedure is documented;

Data Sources – confirmation that the quality of analytical methods used are appropriate to identify the chemicals of potential concern for the media of interest;

Analytical Methods and Detection Limits – confirmation that the analytical methods will appropriately identify the chemicals form or species and that the sample detection limit is at or below a concentration appropriate for this EI;

Data Review – confirmation that the quality of analytical results is assessed by a professional knowledgeable in field collection procedures and analytical chemistry and that the data quality are adequate, and;

Data Quality Indicators – documentation that the sampling and analysis data quality indicators (including precision, accuracy, holding times) are evaluated.

**IV. COMMUNITY INVOLVEMENT**

EEP and MSCHD worked with the Cypress Creek Health Committee and ATSDR to make sure the final protocol meet the needs of the community. After the exposure investigation is completed, EEP and MSCHD will hold a public meeting to explain the results and begin discussions for any further work that may need to be done.

During the entire exposure investigation process, EEP and MSCHD will be meeting with the Cypress Creek Health Committee to ensure that there is constant communication between the groups.

## **V. RISK/BENEFIT INFORMATION**

There is on-going concern about exposure to cyclodiene pesticides in the Cypress Creek community. There has been no sampling of dust in homes where yards may present a health hazard. There has been no investigation into the extent that people living in the community may have had actual exposure, resulting in an abnormal body burden of these pesticides. This EI will provide the necessary information that will aid in responding to concerns about exposure to cyclodiene pesticides in dust and resultant health effects. In the absence of this information, anxiety and stress in the community will continue.

There is little risk with giving a blood sample. Collecting blood can cause some discomfort, and sometimes it can cause a bruise where the needle punctures the skin. The kits to draw blood are for one-time use, are sterile, and are disposable. There is little to no risk from vacuuming in a house. Persons participating in the EI will serve the community by allowing us to better understand how people are exposed to dieldrin and endrin in the Cypress Creek area.

## **VI. INFORMED CONSENT PROCEDURES**

The MSCHD and EEP will hold a public meeting explaining the exposure investigation. After the public meeting MSCHD will telephone likely participants to again explain the exposure investigation. If the householder is agreeable an appointment will be made for blood sampling. At the time of the appointment, the consent forms will be explained. After the participant has read the forms, asked questions, and understands, he/she will be asked to sign the forms. See Appendix E for the consent/assent forms.

## **VII. PROCEDURES FOR NOTIFYING PARTICIPANTS OF INDIVIDUAL AND OVERALL RESULTS**

Participants will be notified of results by mail and in person, if the results need clarification. A public meeting will be held to inform the entire community of the results, summarized in such a way that no one person or house is identifiable. If test results are elevated, EEP will work with ATSDR to decide upon the best course of action.

## **VIII. ASSURANCES OF CONFIDENTIALITY AND PRIVACY**

We will protect the privacy of the community members as much as the law allows. All paper files will be stored in a file cabinet safe with a key lock and a number lock on each drawer. Data files will be stored and password protected on one computer in the Tennessee Department of Health, Communicable and Environmental Disease Services office. After analyses are completed, the data will be transferred to a CD that will be stored in the file cabinet safe.

## **VIII. ESTIMATED TIME FRAME**

Once the EI protocol is approved by ATSDR, MSCHD and EEP staff will begin making appointments with selected households for blood sampling. Sampling efforts can be completed within two weeks. The blood analysis will be completed within three months of receipt of samples by the CDC, NCEH laboratory in Atlanta, Georgia, and the dust analysis within 3 months of receipt of samples by the EPA Region 4, Science and Ecosystem Support Division in Athens, Georgia.

Individual letters will go out to participants within one month of receipt of the blood analysis and within 2 weeks of the dust analysis. A draft report will be written and submitted to ATSDR within 2 months of receipt of all sample results. A public meeting will be held within 6 weeks of approval of the final report.

**IX. PROJECTED BUDGET AND SOURCE OF FUNDING (Estimated)**

Blood Sampling Costs = \$8,550 (57 blood samples X \$150.00/sample = \$8,550)

Sampling Supplies = \$726

    Blood sampling = \$300

    Dust sampling = \$250

        Methanol for decontamination = \$80

<sup>3</sup>I-Chem glass sample bottles = \$70

        Kim Wipes = \$76

        100-mesh sieve, cover, separator pan, receiver = \$200

Sample Shipping = \$500

Project Management Costs (PSC) = \$150

Misc. Expenses = \$ 1,248

Total = \$11,174

**X. REFERENCES**

ASTM Designation: D 5438 – 05. Standard Practice for Collection of Floor Dust for Chemical Analysis. March 2005.

Barr J.B., Maggio V.L., Barr D.B., Turner W.E., Sjodin A., Sandau C.D., Pirkle J.L., Needham L.L., and Patterson D.G. Jr. New High-Resolution Mass Spectrometric Approach for the Measurement of Polychlorinated Biphenyls and Organochlorine Pesticides in Human Serum. *J. Chromatography B*, 794: 137-148 (2003).

HSDB. Hazardous Substances Data Bank (HSDB) [Available from URL: <http://toxnet.nlm.nih.gov/>]. Washington DC: US National Library of Medicine.

Tennessee Department of Health. Health Consultation: Cypress Creek Sub-Area III. Prepared by the Tennessee Department of Health under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry. July 31, 2006.

**XI. APPENDICES**

Appendix A: Map of Cypress Creek Sub-Area III showing areas of pesticide concentration above the remedial action level of 2.5 ppm dieldrin.

Appendix B: MSCHD protocol for collection and dispatch of patient samples.

Appendix C: Exposure questionnaire

Appendix D: TDEC/EPA protocol for chain-of-custody

Appendix E: Consent/Assent forms

Appendix A: Map of Cypress Creek Sub-Area III showing areas of pesticide concentration above the remedial action level of 2.5 ppm dieldrin.



Appendix B: MSCHD protocol for collection and dispatch of patient samples.

MEMPHIS & SHELBY COUNTY HEALTH DEPARTMENT  
DEPARTMENTAL COMMUNICATION

TO: Norman LaChapelle

FROM: Charles Millstein  
Assistant Laboratory Manager

DATE: December 11, 2006

RE: DRAFT PROTOCOL FOR COLLECTION AND DISPATCH OF  
PATIENT SAMPLES

Per our conversation this date concerning the collection of blood samples from residents of the Cypress Creek area:

1. Standard blood specimen collection protocols will be followed in accordance with Clinical and Laboratory Standards Institute guidelines for collection of Venous or Capillary Samples, CLSI (formerly NCCLS) standards H03-A5 and/or H04-A5. Samples will be collected using standard “vacutainer”-type methods or syringes as per the contract protocol. All blood-borne pathogen/universal precautions will be observed.
2. Samples for serum (aliquots) will be separated using appropriate techniques. If aliquots are to be frozen, they should be decanted to appropriate plastic screw-cap tubes. Whole blood clot tubes or serum-separator tubes will be spun as soon as practicable. Original samples will be immediately labeled with required minimum information; serum aliquots will be labeled so as to be traceable to the original specimen and in accordance with contract requirements.
3. Whole blood samples (EDTA, Citrate, heparin, etc.) will be handled according to standard techniques (CLSI Standard H18-A3). Samples will be labeled immediately upon collection.
4. Specimens/aliquots will be packed, labeled, and dispatched according to 49 CFR parts 171-180 (US DOT Hazardous Materials Regulations) and as per contract directives.

For additional information you may contact me at :

901-544-7555/ [cmillstein@co.shelby.tn.us](mailto:cmillstein@co.shelby.tn.us)

## Appendix C: Exposure questionnaire

Form Approved

OMB NO.: 0923-0040

EXPIRATION DATE: 07/31/2009

Public reporting burden for this collection of information is estimated to average thirty minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to: CDC/ATSDR Reports Clearance Officer; 1600 Clifton Road, MS D-74, Atlanta, GA 30333, ATTN: PRA (0923-xxxx).

### Example Script for Environmental and/or Biologic Sampling Events

Hello, my name is **SAY NAME**. We are doing an Exposure Investigation for ATSDR. ATSDR is a sister agency to the Centers for Disease Control and Prevention. As part of the investigation, we will be asking you some common questions like your name and address. We will also ask questions about your contact with chemicals. We are asking these questions to better understand all the data we collect.

The questions should take less than thirty minutes. After that, we will be offering free dust sampling in your home. We will also be offering free blood sampling to measure the amount of dieldrin in your blood. Once we are done with this investigation, you will be given a copy and details of the dust results and your and your children's test results. Generally, we are able to get results to you within (**FILL IN ADJUSTED TIME FRAME OR INSERT 4 – 8 WEEKS**).

### General Information Questions

Example Script: Now I want to ask you questions about how I can contact you. I may also be asking how long you have lived here. This is needed to find out how long you may have had contact with chemicals and how long it may have lasted.

(Name of Survey Taker)	
(Investigation ID)	TND981015456 - 01
(Participant ID Number)	(Numerical from 01, to be determined before interviewing)
(Relationship/Household ID)	Street and #
(Laboratory ID)	(Given by lab. May be multiple if sample is split or divided into aliquots)

NOTE TO SURVEYOR: The following abbreviations and acronyms are used throughout.

DK-Don't know  
 NA-Not applicable  
 Mm/dd/year-2 digit month, 2 digit day, 4 digit year  
 Ft-feet  
 In-inches

(First name of person answering questions for minor child)			
(Last name of person answering questions for minor child)			
<b>General Information</b>			
Please spell your first name: (if minor child, put child's name here)			
Please spell your last name:			
Middle Initial:			
What is your Street Address?			
If this is an apartment, or the address has another defining number or letter, please provide that now:			
City:	Memphis		
County:	Shelby		
State:	TN		
Zip Code:	3810__		
Do you (or household head) rent or own this property?	Own	Rent	NA
If your mailing address is different from your street address, what is your mailing address?			
City:			
State:			
Zip Code:			
How long have you lived at this address?	<6months	6mos-1yr	2-5 yrs
	6-10 yrs	>10 yrs	
How long have you lived at this address? (Note: use this question if you need a more exact date)	mm/year		
Please provide a phone number where we can reach you.	Home:	Work:	Cell: Other:
What is the primary language spoken in your home? (ONE ANSWER ONLY)	English	FILL IN OTHERS	

What is the occupation of the adults in the household?  
 (Note to surveyor: You may want to ask this question here or with the list of jobs in the confounder section but probably not in both sections. List of occupations is on a separate laminated sheet.)

**Demographic Questions**

Script: The next questions are about you and will help us compare your test results.

Surveyor, please indicate whether the person is a male or female. If this questionnaire is for a minor child, be sure to ask their gender.

Gender:	M	F		
Date of Birth: dd/mm/yr(yyyy)				
What is your ethnicity?	Hispanic or Latino	Non Hispanic or Latino	Don't Know (DK)	Refused
Choose the race that best characterizes you (or your minor child)	White	Black or African American	Asian	
	Native Hawaiian or Other Pacific Islander	American Indian or Alaskan Native		

**Soils**

Script: If chemicals are in the soils, you can get them on your skin by gardening, playing, touching your pets, walking barefoot on exposed dirt (no grass, mulch, etc). These questions will help determine your chances of coming into contact with chemicals in soils.

	Never Do This	Seldom Do This	Sometimes Do This	Always Do This
Do you work in soil (e.g., gardening, digging, building, repairing)?	1	2	3	4
b. if so, how often?	Never	Daily	Weekly	Monthly
Do you use glove and protective clothing when you work in soil?	1	2	3	4
Do you wash hands, face, and other exposed skin immediately after outdoor activity (e.g., working, playing, gardening, yard work)?	1	2	3	4
Do you change clothes immediately after outdoor activity (e.g. working, playing, gardening, yard work)	1	2	3	4

Do you wash dirty clothes immediately after wear (e.g., work clothes, yard work clothes)?	1	2	3	4
Do you remove shoes before entering home?	1	2	3	4
Do your pets go outdoors and track dirt into the house?	1	2	3	4
Do you cover bare soils with turf or mulch?	1	2	3	4
Wet-down disturbed soils (e.g. gardening, digging, building)	1	2	3	4
Do you frequently go outside and have contact with the dirt without shoes?	1	2	3	4
For children: Do you play or ride bikes in the dirt or areas with little grass covering?	1	2	3	4
Do you use pesticides on your lawn or garden or do you pay a lawn service to care for your lawn (use a proprietary lawn service)?	1	2	3	4

Questions on cleaning and the frequency

In your home, do you use a vacuum with a bag?	1	2	3	4
Do you vacuum your home?	1	2	3	4
Do you have a HEPA filter on your vacuum?	No		Yes	Don't know
Do you damp dust your home?	1	2	3	4
Do you wet mop your home?	1	2	3	4
Do you dry dust your home?	1	2	3	4
Do you sweep your home?	1	2	3	4
In the last week was any cleaning done in the rooms that we will vacuum?	No		Yes	
If yes, what type of cleaning?	Vacuum		Damp mop	Wet mop
	Dry mop or dust		Sweep	Other:

If you currently have children in your home, please respond to the following statements. If not, please skip to the next section.

	Never Do This	Seldom Do This	Sometimes Do This	Always Do This
Keep children from playing, biking, or doing other activities in areas with possible soil contamination.	1	2	3	4
Keep children from eating dirt	1	2	3	4
Keep children from putting their fingers and hands in their mouths	1	2	3	4

Garden

Script: these questions will help to determine if eating fruits and vegetables grown in your garden may increase your chances of being exposed to pollutants.

What vegetables/fruits do you grow and eat from your or your neighbor's garden? (Record the neighbor's address, if applicable.)			
When was the last time you ate that vegetable and/ or fruit?	Days	Weeks	Months
How often do you or your family eat the vegetables and/or fruit grown in you or your neighbor's garden?	Daily	Weekly	Monthly
Do you wash the vegetables and /or fruit before you eat them?	Never	Sometimes	Always
Do you process your fruit and vegetables or your neighbor's? (Note to surveyor: Process can include pressure cooking (can or bag, hot water (can or bag), freezing, or drying)	No	Yes	DK= Don't Know
Do you wash the vegetables and /or fruit before you cook them?	Never	Sometimes	Always
When was the last time you ate your processed fruit or vegetables?	Days	Weeks	Months
How often do you or your family eat the vegetables and/or fruit you processed from your garden?	Daily	Weekly	Monthly
How often do you or your family eat the vegetables and/or fruit you processed from your neighbor's garden?	Daily	Weekly	Monthly
Do you use pesticides on your lawn or garden and/or do you use a service?	No	Yes	DK

## List of Occupations

Animal Control Worker, Animal Scientist,  
Veterinarian  
Airport or Aircraft Worker  
Arts & Media  
Assemblers & Fabricator  
Car Repair, Mechanic  
Chemical Industry Worker (mixer,  
processor, researcher)  
Child Care Worker  
Cleaning homes or offices  
Construction  
Crop & Livestock Production  
Dentist, Dental Hygienist  
Detective and Criminal Investigator  
Disabled & stay at home  
Dry Cleaning Worker  
Fire Fighter  
Electrician, Electrical worker  
Engineering, Sciences & Education  
Equipment Operator  
Etcher or Engraver  
Extractive (e.g., mine machines, drills)  
Explosives Worker  
Farm Worker  
Fishing & Hunting  
Floor Finisher  
Food Processor  
Food Service  
Furniture Finisher  
Grounds Maintenance Worker  
Hairdresser, Hair Stylist &/or Cosmetologist  
Health Care Worker  
Home Care Taker  
Installation, Maintenance & Repair Worker  
Jeweler  
Logging, Forest & Conservation Worker  
Machinist  
Material Moving  
Metalworking & Plastic working  
Miner  
Miscellaneous Production Worker  
Manicurist  
Mortician and Embalmer  
Office Worker  
Painter  
Pest Control Worker  
Petroleum worker  
Photo processing, photographer  
Physician, Anesthesiologists  
Pilot  
Police or Sheriff Patrol Officer  
Printing Worker  
Retired  
Roofer  
Textile, Apparel & Furnishing Worker  
Utilities & Transportation Worker  
Welder including soldering & brazing  
Woodworker

Other: \_\_\_\_\_



**FIGURE 3-2  
MEDIA CODES**

① **Station ID - Station ID is required if positional data is recorded for the sample.**  
Any combination of letters, numbers, or other characters. Maximum of 20 characters. Use this column to identify a sampling station where one or more samples or field measurements are taken. A few examples are well numbers, NPDES permit numbers, Air permit numbers, AOC numbers, Grid numbers, Site designations, etc., or combinations of these as appropriate.

② **Sample ID - Required.** Any combination of letters or numbers. Maximum of 8 characters. **NOTE: For QA/QC samples, the Sample ID must begin with the letters "QA for the sample to be properly identified.**

③ **Media Code - Required.** Choose the code that most closely describes the sample:

**Environmental Samples**

<b>SF</b> -Surface Soil (0"-12")	<b>WP</b> -Wipe Sample
<b>SB</b> -Subsurface Soil (>12")	<b>FI</b> -Fish Sample
<b>PW</b> -Potable Water	<b>VG</b> -Vegetation
<b>MS</b> -Municipal Water Supply	<b>MI</b> -Macroinvertebrates
<b>IW</b> -Industrial Well	<b>WW</b> -Wastewater
<b>WA</b> -Waste	<b>SL</b> -Sludge (non-RCRA)
<b>SW</b> -Surface Water	<b>UI</b> -UIC Injection Wells
<b>SD</b> -Sediment	<b>US</b> -Underground Storage Tanks
<b>GW</b> -Groundwater	<b>PT</b> -Petroleum Tanks
<b>PC</b> -Precipitation	<b>AA</b> -Ambient Air
<b>OT</b> -Other (Unknown)	<b>IA</b> -Indoor Air
<b>OB</b> -Other Biota	<b>ME</b> -Municipal Eff. Wastewater
<b>MP</b> -Municipal Proc. Wastewater	<b>IE</b> -Industrial Eff. Wastewater
<b>IP</b> -Industrial Proc. Wastewater	<b>PE</b> -Periphyton
	<b>TI</b> -Tissue

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**Field QA/QC Samples**

<b>TS</b> -Trip Blank-Soil	<b>FB</b> -Filter Sand Blank
<b>TW</b> -Trip Blank-Water	<b>OW</b> -Organic Free Water Blank
<b>TP</b> -Trip Blank-Wipe	<b>PB</b> -Preservative Blank
<b>EB</b> -Equipment Rinse Blank	<b>GB</b> -Glove Blank
<b>GR</b> -Grout Blank	<b>BO</b> -Bottle Blank
<b>MB</b> -Drilling Mud Blank	<b>FL</b> -Field Blank
<b>DB</b> -Potable Decon Blank	<b>IB</b> -Dry Ice Blank
<b>BB</b> -Bentonite Blank	<b>BK</b> -Other Blank
<b>FA</b> -Field Blank Air	

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## Appendix E: Consent and Assent forms

**MEMPHIS and SHELBY COUNTY HEALTH DEPARTMENT  
TENNESSEE DEPARTMENT OF HEALTH  
CONSENT FOR BLOOD SAMPLING and DUST SAMPLING**

We invite you to take part in an exposure investigation (EI). The purpose of the EI is to see if the pesticides in your yard got into the dust in your house and if the pesticides then got into your body. This form will tell you about the EI and about what you will need to do if you want to be a part of it. Please read this Consent Form carefully. We will answer any questions you have about this EI. Later, if you have more questions, please call Bonnie Bashor at 615-532-2212 or Calondra Tibbs at 901-544-7743.

**The purpose of the EI**

The Memphis and Shelby County Health Department and the State of Tennessee Department of Health are doing an EI in Cypress Creek Sub-Area III. We will look at the amount of dieldrin and endrin in the blood of community members and at the amount of dieldrin and endrin in house dust. If you decide to take part in this EI, you will give a blood sample so that the amount of dieldrin and endrin in your blood can be measured and your house will be vacuumed with a special vacuum cleaner to collect dust. After testing your blood for these two chemicals, no other blood test will be done on the leftover blood and it will be discarded safely. The extra dust samples will also be thrown away.

**What you will be asked to do**

Three people from the Health Departments and Tennessee Department of Environment and Conservation (TDEC) will come to your home. You will have to give about 3 tablespoons of blood. A nurse will take the blood from a vein in your arm using a clean, disposable needle. Two of the people will vacuum portions of your home with a special vacuum cleaner. The samples will tell us if dieldrin and endrin in the soil has gotten into the dust in your home. This take about 30 minutes.

The persons taking your blood sample will ask you some questions about your outdoor activities. This will take about 15 minutes.

**Risks and benefits**

You will have little risk giving the blood sample. You may have some discomfort. Sometimes giving blood can cause a bruise where the needle goes into the skin. You will benefit your community by allowing us to find out if the dieldrin and endrin has gotten into your body.

You will have no risk from allowing us to vacuum your house. You will benefit your community by allowing us to find out if dieldrin and endrin have gotten into the dust in houses.

**Results**

You will receive the results of your blood test and of the dust sampling within four months. The results will be mailed to you. Also, someone from the Health Departments will talk with you about your results.

## **Privacy of Records**

Individual test results will not be made available to the public and confidentiality will be protected to the fullest extent possible by law. Individual test results may be released only to other federal, state and local public health and environmental agencies. These agencies must also protect this confidential information. All records and computer files related to this EI will be locked and password protected, respectively.

The report about the EI will not contain information that can be used to identify you.

The results of this EI may be published in peer-reviewed journals, but no one will be able to tell who you are.

## **Your rights**

You can choose to participate in this EI or not. If you decide not to be in this EI nothing will happen to you. If you decide to be in this EI, you can change your mind later and drop out. Again, nothing will happen to you if you do this. If you join this EI, you do not have to answer any questions you do not want to. You can also choose not to do some parts of the EI.

## **Are there any costs?**

No, there are no costs to you. You do not have to pay to be in this EI, nor will we pay you for being in this EI. If you discuss the results of this EI with your own doctor and he or she wants to do more tests on you, you or your insurance will be responsible for the costs of those tests.

If you do not understand the form, please ask questions. Please mark one of the choices below.

**Consent for EI – Blood Sampling**

\_\_\_\_\_ I will take part in the EI.

\_\_\_\_\_ I DO NOT want to take part in the EI.

**I have read this form. All my questions have been answered. If I will take part in the EI, I understand that I may stop at any time and that my rights to privacy (as explained above) will be respected.**

\_\_\_\_\_  
\_\_\_\_\_  
**Date** **Signature**

\_\_\_\_\_  
**Printed Name**

\_\_\_\_\_  
\_\_\_\_\_  
**Address**

\_\_\_\_\_  
**Witness**

**I have read the consent form to the person named above. He/she has asked questions about the investigation and had the questions answered.**

\_\_\_\_\_  
**Signature of person giving oral consent**

\_\_\_\_\_  
**Signature of person NOT giving oral consent**

If you do not understand the form, please ask questions. Please mark one of the choices below.

**Consent for EI – Dust Sampling**

\_\_\_\_\_ I will take part in the EI.

\_\_\_\_\_ I DO NOT want to take part in the EI.

**I have read this form. All my questions have been answered. If I will take part in the EI, I understand that I may stop at any time and that my rights to privacy (as explained above) will be respected.**

\_\_\_\_\_  
\_\_\_\_\_  
**Date** **Signature**

\_\_\_\_\_  
**Printed Name**

\_\_\_\_\_  
\_\_\_\_\_  
**Address**

\_\_\_\_\_  
**Witness**

**I have read the consent form to the person named above. He/she has asked questions about the investigation and had the questions answered.**

\_\_\_\_\_  
**Signature of person giving oral consent**

\_\_\_\_\_  
**Signature of person NOT giving oral consent**

**MEMPHIS and SHELBY COUNTY HEALTH DEPARTMENT  
TENNESSEE DEPARTMENT OF HEALTH**

**PARENTAL CONSENT FOR CHILD'S BLOOD SAMPLING**

We invite your child to take part in an exposure investigation (EI). The purpose of the EI is to see if the pesticides in your yard or house dust got into their bodies. Your child has to be 12 years old or older. This form will tell you about the EI and about what your child will need to do if you want him/her to be a part of it. Please read this Consent Form carefully. We will answer any questions you have about this EI. Later, if you have more questions, please call Bonnie Bashor at 615-532-2212 or Calondra Tibbs at 901-544-7743.

**The purpose of the EI**

The Memphis and Shelby County Health Department and the State of Tennessee Department of Health are doing an EI in Cypress Creek Sub-Area III. We will look at the amount of dieldrin and endrin in the blood of community members and at the amount of dieldrin and endrin in house dust. If you allow your child to take part in this EI, your child will give a blood sample so that the amount of dieldrin and endrin in your blood can be measured.

**What your child will be asked to do**

Two people from the Health Departments will come to your home. Your child will have to give about 3 tablespoons of blood. A nurse from the Memphis and Shelby County Health Department will take the blood from a vein in your child's arm using a clean, disposable needle.

**Risks and benefits**

Your child will have little risk giving the blood sample. Your child may have some discomfort. Sometimes giving blood can cause a bruise where the needle goes into the skin. Your child will benefit your community by allowing us to find out if the dieldrin and endrin has gotten into his/her body.

**Results**

You will receive the results of the blood test within three months. The results of the blood test will be mailed to you. Also, someone from the Health Departments will talk with you about the results.

**Privacy of Records**

Anything we learn about your child during this EI will be confidential. Individual test results will not be made available to the public and confidentiality will be protected to the fullest extent possible by law. Individual test results may be released only to other federal, state, and local

public health and environmental agencies. These agencies must also protect this confidential information.

The report about the blood sampling results will not contain information that can be used to identify your child.

The results of this EI may be published in peer-reviewed journals. Again, no one will be able to tell who your child is.

### **Your rights**

You can choose to allow your child to participate in this EI or not. If you decide that your child cannot be in this EI, nothing will happen to you or your child. If you allow your child to be in this EI, you can change your mind later and have your child drop out. Again, nothing will happen to you or your child if you do this. If your child joins this EI, your child does not have to answer any questions he/she does not want to.

### **Are there any costs?**

No, there are no costs to you. You do not have to pay for your child to be in this EI, nor will we pay you or your child for being in this EI. If you discuss the results of this EI with your own doctor and he or she wants to do more tests on your child, then you or your insurance will be responsible for the costs of those tests.

**Consent for Your Child to be in the EI – Blood Sampling**

**If you do not understand the form, please ask questions. Please mark one of the choices below.**

**Consent for Child’s Participation in the Exposure EI – Blood Sampling**

\_\_\_\_\_ **I will allow my child to take part in the EI.**

\_\_\_\_\_ **I WILL NOT allow my child to take part in the EI.**

**I have read this form. All my questions have been answered. If I will allow my child to take part in the EI, I understand that he/she may stop at any time and that his/her rights to privacy (as explained above) will be respected.**

\_\_\_\_\_ **Date**

\_\_\_\_\_ **Parent Signature**

\_\_\_\_\_ **Printed Name**

\_\_\_\_\_ **Address**

\_\_\_\_\_ **Witness**

I have read the consent form to the person named above. He/she has asked questions about the investigation and had the questions answered.

\_\_\_\_\_ **Signature of person giving oral consent**

\_\_\_\_\_ **Signature of person NOT giving oral consent**

**MEMPHIS and SHELBY COUNTY HEALTH DEPARTMENT  
TENNESSEE DEPARTMENT OF HEALTH**

**CHILDREN'S ASSENT FORM**

**Read the statement below to each child in the presence of their parent(s) before collecting the child's blood:**

Dieldrin and endrin are chemicals that were used to kill insects. The chemicals got in some of the dirt in this neighborhood. We need a sample of your blood to find out if the chemicals got into your body. We will use a needle to get blood from a vein in your arm. When the needle goes into your arm, you might feel a little pain that lasts a few seconds. You might get a little bruise where the needle goes into the skin. It is safe to do this.

Your mother or father said it was OK for you to do this. But you do not have to if you do not want to. If you say it is OK, please write your name and your age in the space below.

Do you have any questions?

**Name of child:** \_\_\_\_\_

**Signature of child:** \_\_\_\_\_ **Age:** \_\_\_\_\_

**Witness:** \_\_\_\_\_  
**Printed Name** **Signature**

\_\_\_\_\_  
**Address**