ATSDR Agency for Toxic Substances & Disease Registry Public Health Assessments & Health Consultations

PETITIONED HEALTH CONSULTATION

Public Comment Release

PCB Contamination in Residential Soil

GENERAL ELECTRIC
(a/k/a GENERAL ELECTRIC COMPANY/GENERAL ELECTRIC ROME)
ROME, FLOYD COUNTY, GEORGIA

BACKGROUND AND STATEMENT OF ISSUES

The Agency for Toxic Substances and Disease Registry (ATSDR) was petitioned by Congressman Bob Barr in April 2001 to perform a public health assessment of contamination by polychlorinated biphenyls (PCB) occurring outside the site boundaries of the General Electric (GE) facility [1]. In August 2001, ATSDR conducted a scoping visit to view the site area and to collect available environmental data related to the site. This health consultation focuses on exposure to residential soil contaminated with PCBs that occurred through the application of waste PCB oil, called "Pyranol". ATSDR is focusing on soil contamination because high levels of PCBs were found in residential soils during sampling. Other exposure pathways and environmental data will be evaluated in a separate document that will be released at a later date.

The GE facility in Rome, Georgia, is a former transformer manufacturing facility that closed its manufacturing operations in 1997. GE used polychlorinated biphenyls (PCBs) in its manufacturing process from the time the plant opened, in 1953, until PCBs were banned in 1977. Prior to 1953, the area was the site of the Rome Municipal Airport. The former GE facility encompasses 236 acres and is bounded by Redmond Circle and Lavendar Drive. The area surrounding the plant is a mix of residential and light industrial use.

In the past, some GE workers took home waste PCB oil, or Pyranol from the facility. The workers allegedly used the oil at their homes for several purposes. It was applied as an insecticide for termite control in soils around the foundations of houses and in crawlspaces, on driveways as a dust suppressant, and on fences as a wood preservative. In addition, sludge containing waste PCBs was obtained from the local wastewater treatment plant and used as a fertilizer in yards and gardens.

PCBs are mixtures of up to 209 individual polychlorinated biphenyls compounds (called *congeners*). No natural sources of PCBs are known to exist. PCBs are either oily liquids or solids, colorless to light yellow in color, with no known smell or taste. Some PCBs can be present in the air as a vapor. Many commercial PCB mixtures are known in the United States by the trade name Aroclor. PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they do not burn easily, and they are good insulators. Because of these properties, PCBs were used widely in the electrical transformer manufacturing industry until they were banned in 1977.

Use of PCBs and disposal of PCB wastes lead to uncontrolled releases into the environment, mostly to land (soils) and waterways. The fate of PCBs in the environment depends on the environmental medium (e.g., air, soil, or water) that is contaminated. PCBs usually bind to soil and persist in the soil for many years. This is true for most PCB congeners that contain high amounts of chlorine. PCBs with lower amounts of chlorine can volatilize from contaminated soil into the air [2].

The Georgia Environmental Protection Division (GA EPD), the U.S. Environmental Protection Agency (EPA), Emory University, and the Floyd County Health Department have been involved at the GE Rome facility before ATSDR was petitioned to perform a public health assessment. (See the Public Health Action Plan at the end of this document for past, current, and future public health activities at this site by these agencies.)

RESIDENTIAL SOIL SAMPLING RESULTS

The residential soil sampling being conducted by GE is an on-going effort. ATSDR chose to examine the data currently available since it is unknown when the additional sampling efforts will be completed. This health consultation specifically evaluates residential soil data collected through October 29, 2001. Any related sampling that is completed after October 29, 2001 will be evaluated in a future document.

ppm - parts per million, which correlates with milligrams per kilogram (mg/kg)

Most of the sampling of residential soil associated with use of Pyranol and/or PCB contaminated sludge has been conducted by GE. General Electric performed sampling at 24 residential properties where owners could provide some proof of use of Pyranol or PCB-contaminated sludge at their property. Between September 2000 and October 2001, PCBs were detected at 14 of the 24 residences sampled, at levels ranging up to 24,000 parts per million (ppm) [3]. In addition, GA EPD performed sampling at four properties that GE chose not to sample; none of the these properties had detectable levels of PCBs [4]. See Appendix A for details of GE's soil sampling results.

Laboratory results on PCBs indicate that Aroclor 1260 is the predominant PCB mixture found on the residential properties (data not included). In some samples, Aroclor 1254 was also detected. Because Pyranol is composed of approximately 50% PCBs and 50% combination of trichlorobenzene and tetrachlorobenzene [5], the soil at all residences was analyzed for these chlorobenzene compounds. Neither chlorobenzene compound was detected in any surface or subsurface soil sample; therefore, these compounds will not be considered further in this report [3].

Table 1 on the following page shows a breakdown and the status of the 28 properties that GE and GA EPD sampled.

Table 1. Status of sampled properties

PCB Level	No. of Houses (out of 28)	Status
Non-detectable	14	No further action
< 1 ppm	6	No further action
1 ppm - 10 ppm	0	Not applicable
> 10 ppm	8	3 - remediated to levels less than 1 ppm - No further action
		5 - no remedial action taken - need further evaluation

This document will evaluate the 14 properties where PCBs were detected. The other 14 properties, that have no detectable levels of PCBs, require no further action, and will not be considered further in this document.

EXPOSURE PATHWAY ANALYSIS

Methods

In preparing this analysis, ATSDR staff members have used established methodologies for determining how people might be exposed to PCBs and what harmful effects, if any, might result from such exposure. See Appendix B for a detailed discussion of quality assurance considerations, human exposure pathways analyses, ATSDR's health comparison values, and the methods used to select contaminants of concern.

Exposure Pathways

Primary pathway. In this document, ATSDR has limited its evaluation to the pathway of PCBs in residential soils, which has been determined to be the most immediate exposure of concern. Incidental ingestion of contaminated surface soil is the predominant PCB exposure pathway at contaminated residences in Rome, GA.

PCBs were detected in the yards, gardens, and crawlspaces of homes (see appendix A). The exposure pathway which might include incidental ingestion of surface soil could take place during several different activities. For adults, these include gardening, yard work, or accessing crawlspace areas. For children, these include playing in the dirt or ingesting outdoor dust tracked into the house.

Children and adults are not expected to come into contact with subsurface soil as often as surface soil. In addition, concentrations of PCBs were generally lower in subsurface soil than surface soil. Therefore, using surface soil concentrations of PCBs for the exposure assessment and exposure doses is a worst-case scenario and protective of public health.

Other exposure pathways. There are several other possible exposure pathways, including dermal contact with contaminated soil and inhalation of PCB vapors. Exposure via inhalation of PCB vapors is not discussed in this document because no air data are available to evaluate the inhalation pathway. Exposure via the dermal contact pathway is a major route of exposure in factory workers that have direct contact with PCB oils; however, when PCBs are bound to the soil, less than 2% is absorbed [6]. Because exposure to soil in a residential area from dermal contact is considered to be such a small contributor of *total* exposure to PCBs, such exposure will not be evaluated in this document.

Another potential exposure pathway is ingestion of home-grown vegetables contaminated with PCBs. Vegetables grown in gardens with PCB-contaminated soil can be contaminated with PCBs from uptake through the roots, or from PCBs that have been volatilized into the air from the soil and then deposited on the leaves [2]. However, the main concern for PCBs and vegetables is the *dirt* found on the vegetables that may be PCB-contaminated. The route of incidental ingestion of soil, examined in this document, accounts for this type of exposure.

Crawlspace soil. In addition to the general exposure activities mentioned above, site-specific exposures for the Rome area are also important. For instance, some homes in the Rome area have crawlspaces underneath their houses. Sampling by GE has shown that PCBs are present in the soil in crawlspaces of some homes. People do not access crawlspaces as often as they do yards and/or gardens; therefore, such exposure would occur less frequently. ATSDR assumes in this document that only adults will have access to the crawlspace soil; therefore, children's exposure to crawlspace soil is not evaluated. As stated previously, other pathways besides incidental ingestion of contaminated soil will be evaluated in a future document.

Pica. Pica is a behavior in young children, usually ages 1 to 3 years, in which they intentionally consume large amounts of soil at one time. The amount of soil a pica child consumes can be on the level of 5 to 10 grams per day. However, pica behavior is not common, and it is usually intermittent and a transient or short-term activity in young children. To be protective of children, ATSDR evaluated pica exposure scenarios as part of the exposure assessment.

Comparison Values
Comparison Values (CVs) are concentrations of contaminants set by ATSDR that are considered to be safe levels of exposure. CVs are used for screening purposes only to determine if the contaminant needs further evaluation. Since maximum concentrations of PCBs at all properties where PCBs were detected exceeded at least one ATSDR CV (see table 2), all 14 properties were evaluated further. See appendix B for more details on comparison values.

Table 2. ATSDR Comparison Values (CVs)

Comparison Value	Type of Comparison Value	# of homes with PCBs above the comparison value
0.06 ppm	EMEG - pica child	14 out of 14
0.40 ppm	oral CREG	9 out of 14
1.0 ppm	EMEG - chronic child	8 out of 14
10.0 ppm	EMEG - chronic adult	8 out of 14

EMEG - Environmental Media Evaluation Guideline
CREG - Cancer Risk Evaluation Guideline

Exposure Doses
Incidental ingestion of soil may occur from hand-to-mouth transfer, direct mouth contact, ingestion of soil on home-grown fruits and vegetables, and ingestion of dust from soil. Exposure activities and the concentration of the contaminant both play an important role in determining the amount of PCBs to which a person is exposed. However, a variety of other factors are involved in using exposure to estimate an exposure dose and to evaluate what adverse health effects, if any, may occur from that dose. These factors include:

- **duration of exposure:** when the contamination occurred and how long residents have lived there.
- **frequency of exposure:** how often the person has contact with the soil.
- **body weight:** the amount the person weighs.
- **area of contamination:** does the person come into contact with the highest level of PCBs all the time?

The earliest reports of the usage of Pyranol on private properties date back to the 1960s [7]. Because the Pyranol was deposited some time ago, and in areas that are used frequently (i.e., yards, gardens), exposures are likely to be frequent and are likely to have occurred over a long period of time. These factors all have a part in determining an exposure dose, or the estimated average amount of PCBs ingested by a person on a daily basis. (For more information on exposure doses and examples of calculations, see Appendix C.)

Total Exposure
The evaluations in this document are subject to limitations because of the complex PCB exposure pathways that arise from site-specific conditions. ATSDR's evaluation, limited to incidental ingestion of PCB-contaminated soil, is unable to

account for *total exposure* to PCBs. With the exception of dermal contact exposures, it is unknown how other potential exposures not evaluated in this document might contribute to total exposure; however, if the exposure exists, the exposure doses calculated in this document are likely to result in underestimation of true dose from total exposure. The factors contributing to total exposure include:

- *Other exposure pathways*. The exposure doses which were calculated only account for ingestion of PCB-contaminated soil. These exposure doses do not account for other possible exposure pathways (e.g., dermal (skin) contact with PCBs in soil or inhalation of PCB-vapors), nor do these doses account for possible exposure to PCBs from other sources (e.g., eating contaminated fish or occupational exposures). Exposures from any or all of these exposure routes will increase the exposure dose estimates provided in this document.
- *PCB vapors*. There is uncertainty as to whether vapors from PCBs in crawlspace soil would migrate into the living areas of the house. If PCB vapors do migrate into the house, this pathway also will increase the estimated daily dose.
- *Past PCB levels*. The levels of PCBs examined in this document represent current contamination levels. Past levels of PCBs are unknown. Because PCBs are persistent in the environment, the current levels are used in this document to represent past exposures. However, some degradation (including vaporization, migration with underground water and/or with eroded soil) is expected to have occurred; therefore, it is possible that PCB levels might have been higher in the past. This would increase the exposure dose estimates provided in this document.

DISCUSSION

PCBs were detected at 14 properties. For the purpose of this evaluation, the properties are divided into two groups according to the maximum amount of PCBs detected. The first group consists of properties with maximum levels that are less than 1 part per million (ppm), and the second group consists of properties with maximum levels that are greater than 10 ppm. There are no properties with maximum levels between 1 ppm and 10 ppm. Individual properties are identified by number (assigned by GE) rather than address to preserve the confidentiality of the residents. Properties that had no PCBs detected or that have not been sampled yet are not included in this discussion.

Properties with maximum levels of PCBs less than 1ppm

There are 6 properties (property numbers 2, 3, 9, 23, 51, and 63) where the highest levels of PCBs detected were less than 1 ppm [3]. The maximum concentrations at these properties range from 0.067 ppm to 0.55 ppm in surface soil (see appendix A). The maximum concentrations at each property exceed ATSDR's soil comparison value for a pica child, but not for children with normal exposure scenarios or adults (see table 2). Since the concentrations exceed the CV, exposure doses were calculated using maximum concentrations and compared to ATSDR's MRL of 0.03 Âµg/kg/day for intermediate exposure.

Pica child - a child that frequently and purposely consumes large amounts of dirt.

The range of doses estimated for the 6 properties is 0.01 - 0.12 Âµg/kg/day for pica children. Three of the properties (numbers 2, 51, and 63) have estimated doses above ATSDR's Minimal Risk Level (MRL) of 0.03 Âµg/kg/day. The highest dose out of the three, 0.12 Âµg/kg/day, is 4 times greater than the MRL, and represents a worst-case scenario. A worst-case scenario uses conservative assumptions in the calculations; it assumes a more chronic and constant exposure. These assumptions may not be appropriate for pica behavior because pica behavior is transient, intermittent, and short-term in nature. In addition, the doses are 10 to 100 times lower than the level at which there is an observable adverse health effect in animals for intermediate exposure (7.5 Âµg/kg/day). Considering all of these factors, the PCB levels at these 6 properties are generally not expected to cause an increased risk of adverse health effects in pica children. However, if parents believe a child exhibits pica behavior, steps can be taken to reduce the behavior as part of good public health practice; see the section entitled "Best Public Health Practice" at the end of this document.

Minimal Risk Level (MRL) - Estimates of daily human exposure to a chemical that are unlikely to be associated with any appreciable risk of adverse non-cancerous effects. MRLs are used to compare estimated daily exposure doses to doses in the toxicological literature.

Chronic MRL = 0.02 µg/kg/day
Intermediate MRL = 0.03 µg/kg/day

Properties with soil PCB levels less than 1 ppm pose no apparent public health hazard.

Properties with maximum levels of PCBs greater than 10 ppm

There are 8 properties (property numbers 4, 13, 16, 18, 21, 47, 50, and 59) at which the highest levels of PCBs detected were greater than 10 ppm [3]. The maximum concentrations in either the crawlspace or the yard area of these properties range from 12 - 24,000 ppm (see appendix A).

GE has completed remedial activities at property numbers 4, 16, and 21, reducing PCB levels to 1 ppm or less [3]. Since the affected soils have been removed, exposures at these properties reflect only past exposure. However, past exposure could have been significant, because the duration of exposure is estimated to be up to 40 years.

Property numbers 13, 18, 47, 50, and 59 have not yet had any remedial action. GE is negotiating clean up with the property owners [3]. Exposure at these properties reflects past, current, and future exposure. The exposure duration is up to 40 years for past exposure, and 70 years (a lifetime standard) for future exposure.

The maximum PCB concentrations measured at these 8 properties exceed ATSDR's CVs for adults and children (see table 2); therefore, exposure doses were calculated using maximum concentrations and compared to ATSDR's MRL of 0.02 Âµg/kg/day for chronic exposure.

(Appendix C provides detail on exposure doses and how they are calculated.) For each property, one of the estimated exposure doses, whether for an adult or child, exceeds ATSDR's MRL of 0.02 Âµg/kg/day (see doses to the right and in table C1). These doses exceed the MRL by 15 to 1,000 times. The doses calculated for pica children exceed ATSDR's MRL by 60 to 28,000 times. In this case, the exposure factors used are appropriate; assuming a chronic and frequent exposure should represent residents' actual exposures on their properties. Considering the exposure and toxicity data, there is a potential for increased risk of adverse health effects for residents on these properties.

Doses

Adults and Children
0.10 µg/kg/day – 22.1 µg/kg/day

Pica Children
1.17 µg/kg/day – 552.5 µg/kg/day

Properties that have not been remediated represent a current public health hazard, and properties that have been remediated represent a past public health hazard. These determinations are made on the basis of exposure and toxicity data that indicate a potential for increased risk of adverse health effects. A general discussion on potential health effects of PCB exposure is provided in the following section.

Potential Health Effects

Noncancerous health effects

PCBs have been associated with several adverse noncancerous health effects in humans and animals, including liver, thyroid, dermal and ocular changes, immunological alterations, neurodevelopmental changes, reduced birth weight, and reproductive effects. Some of the exposure doses estimated, for the properties with PCBs greater than 10 ppm in soil, are in the range of doses that have caused adverse health effects in animals [1,8-16].

Studies attempting to show the same health effects in humans that have been observed in animals have generally been inconclusive [2]. In general, some human studies have found associations between PCBs and

- neurobehavioral effects in children, particularly from pre-natal exposure or exposure during breast-feeding,
- hepatic (liver) effects in occupationally exposed adults,
- dermal and ocular effects in occupationally exposed adults and in a population that consumed PCB-contaminated rice oil,
- immunological susceptibility, particularly in infants exposed during gestation or breast-feeding,
- reproductive effects, particularly in infants born to mothers who ate contaminated fish [2].

However, one study showed that humans potentially exposed to a dose of 70 - 140 Âµg/kg/day of PCBs for months to years showed no evidence of impaired health [17].

Biological monitoring (e.g., blood sampling) may help to further characterize exposure to PCBs and the risk for adverse health effects for residents living on properties with PCB levels greater than 10 ppm. ATSDR is aware that blood sampling for this population is currently being conducted by GA EPD (see Public Health Action Plan); ATSDR will comment on the results when they become available.

Cancer

PCBs are known to cause cancer in animals [2]; however, the evidence that PCBs cause cancer in humans is not as clear. The potential for PCBs to cause cancer has been investigated through human studies that have examined both occupational exposures and environmental exposures. Most of the studies that examined environmental exposures used biological levels of PCBs rather than environmental levels (i.e., blood samples instead of soil samples). Therefore, it is difficult to evaluate the PCB levels discussed in this document for its potential to cause cancer.However, *occupational* exposures to PCBs (usually at much higher levels than what is found in the environment) have been associated with liver, biliary tract, intestinal, and skin cancer [18-25].

In contrast to human studies, there is stronger evidence that PCBs cause liver and thyroid cancer in animals [26-29], particularly from exposure to PCBs with 60% chlorine (e.g., Aroclor 1260) [30].In addition, a more recent study showed that all 4 mixtures of Aroclors (Aroclors 1016, 1242, 1254, and 1260) induced liver tumors [31,32]. Based on sufficient evidence of carcinogenicity in animals, PCBs have been classified as a probable human carcinogen by the U.S. Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC), and reasonably anticipated to be a human carcinogen by the National Toxicology Program (NTP).

Cancer risks were calculated using maximum and average PCB concentrations. Average concentrations may represent a more likely scenario for long-term cancer risk exposure, especially when concentrations vary spatially [33], which was the case for most of the properties evaluated in this document.

Short-term exposure to carcinogens is an area of considerable debate and research; however, it is generally believed that any exposure factors that are less than what was used for the calculations will significantly decrease the calculated risk (e.g., exposed for a shorter time period; exposed to lower concentrations; exposed less frequently during the time period, etc.).

Cancer risk estimates (and their calculations) from exposure to PCBs can be found in Appendix C. However, there are several important limitations of using cancer risks that the reader needs to keep in mind:

- Cancer risks do not determine or predict if you will develop cancer. They only determine if you may be at a higher risk.
- Cancer risks are population risks, not individual risks.
- The cancer risks calculated assume a worst-case exposure scenario for incidental ingestion.

ATSDR CHILD HEALTH INITIATIVE

During the evaluation of PCBs in residential soil, ATSDR used health guidelines specifically for children. Without evidence of the contrary, children's exposures were considered in past situations for all properties. In addition, future potential exposures to children were also considered if the property had not undergone remedial action. ATSDR also considered a pica scenario for children, which is considered to be a conservative assumption.

The 6 properties with PCB levels less than 1 ppm in soil generally do not pose an apparent public health hazard to children. However, if a child exhibits pica behavior, parents should take steps to reduce the behavior as a part of good public health practice.

The 8 properties with PCB levels greater than 10 ppm in soil represent a public health hazard to children and pica children either 1) in the past, if the property was cleaned up, or 2) in the past, currently, and in the future, if the property has not yet been cleaned up. If the property has not been cleaned up, parents should take the steps outlined in the Recommendations and Best Public Health Practice sections to reduce children's exposure to contaminated soil.

CONCLUSIONS

1. Properties that currently have maximum PCB levels greater than 10 ppm in soil (numbers 13, 18, 47, 50, and 59) *represent a public health hazard.*
2. Properties that have been remediated to PCB levels of less than 1 ppm in soil, but had maximum past PCB levels greater than 10 ppm (numbers 4, 16, and 21) *posed a public health hazard in the past.*
3. Properties with maximum PCB levels of less than 1 ppm in soil (numbers 2, 3, 9, 23, 51, and 53) pose *no apparent public health hazard* for incidental ingestion of soil.

RECOMMENDATIONS

On the basis of the above conclusions, ATSDR recommends the following:

1. Removal of PCBs at property numbers 13, 18, 47, 50 and 59 should be completed as soon as possible. Until remedial actions have been completed, residents should:
   a. Prevent exposure by avoiding areas of known contamination.
   b. Not consume vegetables or fruit grown on the property, unless the garden soil has been sampled and found to have PCB levels that are less than 10 ppm [34].
   c. Follow the "Best Public Health Practice" recommendations below.
2. Residents who believe that Pyranol or PCB-contaminated sludge is present on their property should call GA EPD (tollfree: 1-888-869-1191) to have their property evaluated for sampling.

BEST PUBLIC HEALTH PRACTICE

Any reduction in exposure to PCBs, no matter how small, will reduce the overall total exposure to PCBs and will be protective of public health. The following recommendations are made for residents interested in using good public health practices that will reduce human exposure to PCBs in soil:

1. Wear long sleeved shirts, long pants, gloves, socks, and shoes when gardening or doing yard work.
2. Change and launder clothes and wash hands following outdoor activities, such as gardening and yard work.
3. Wash children's hands and change and launder children's clothes immediately following outdoor activities, such as playing in the yard.
4. Discourage children from eating soil and putting their dirty hands or fingers in their mouths.
5. Rinse homegrown vegetables thoroughly with water or a 5% vinegar solution before eating or cooking.
6. Do not store food in crawlspaces where PCBs have been detected.
7. Do not use rainwater drained from the property for any domestic purpose.
8. Use the following pica guidelines for parents to reduce their child's pica behavior when possible, as well as the guidelines above:
    a. Supervise children closely to prevent ingestion of dirt and other materials when playing outdoors.
    b. Feed children a well-balanced diet.
    c. Have children with frequent pica behavior checked by a physician for nutritional deficiencies.
9. For more information on PCBs, see the following ATSDR resources:
    a. ToxFAQ on PCBs - http://www.atsdr.cdc.gov/tfacts17.html
    b. Public Health Statement on PCBs - http://www.atsdr.cdc.gov/toxprofiles/phs17.html

PUBLIC HEALTH ACTION PLAN

ATSDR has been petitioned by Congressman Bob Barr to perform a public health assessment of the PCB contamination at the General Electric site and surrounding areas in Rome, Georgia. Several agencies or entities are involved in public health activities at this site and interagency meetings are periodically held to coordinate these activities. ATSDR is working with the Georgia Environmental Protection Division (GA EPD), the lead agency for the site, to ensure that the public health needs in Rome are met in response to the petition. Therefore, ATSDR has prepared this Public Health Action Plan to outline the completed and planned public health activities by ATSDR and other agencies.

ATSDR Activities

Completed Activities

- ATSDR evaluated hazard associated with the residential soil data collected by GE and GA EPD and reported the findings of the evaluation in this health consultation

- ATSDR supports GA EPD's efforts (in conjunction with Emory University and Floyd County Health Department) for collecting blood data on residents living on properties with PCB levels greater than 10 ppm in soil.

Future Activities

- ATSDR will review the blood data when it becomes available.

- ATSDR will review the other available environmental data (on fish, sediment, surface water, and soil not linked to Pyranol contamination) and evaluate these environmental exposure pathways in a future document(s).

- ATSDR will determine the need for further public health activities as more information and data are reviewed.

Other Agency's Activities

Completed Activities

Residential soil sampling

- GE sampled the soil at residences that had credible evidence of Pyranol (PCB waste oil) contamination. By October

29, 2001, GE had interviewed residents of 62 houses to determine suitability for soil sampling, and 24 residences had been sampled; the remaining 38 houses will not be sampled by GE. PCB levels from this sampling event ranged from non-detectable to 24,000 ppm.

- GA EPD sampled the soil at residences that had credible evidence of Pyranol contamination; however, less stringent criteria were applied. By October 29, 2001, GA EPD had sampled 4 residences and 6 residences were pending sampling. PCBs were not detected at levels > 1ppm at any residence during this sampling event.

EPA investigations

- EPA completed a RCRA Phase II investigation for GE in February 2001.
- EPA completed sampling for a Superfund Expanded Site Investigation on GE in June and September, 2000, for surface water, soil, and sediment. The report was completed in December 2001. This investigation concluded that further evaluation under Superfund was warranted.
- EPA completed an Emergency Response and Removal Investigation in November 2000, for soil and sediment. This investigation found that emergency removal of soils was not necessary for the parks and schools.

Other off-site sampling

- The City of Rome completed a surface-water investigation in 1999.
- GA EPD conducted sampling of sediment and soil in the Rome area in 1996/1997.
- GE conducted soil sampling at West End Elementary, West Central Elementary, and Tolbert Park between 1997 and 2001.
- GE conducted isolated sampling events of sediment and surface water in 1976 and 1994.

Community involvement and health education

- GA EPD has a community involvement specialist that has been working with members of the community and their concerns.
- GA EPD has contracted Dr. Howard Frumkin of Emory University to provide physician and community health education.

Future Activities

- GA EPD and GE will continue to sample soils at residences that have credible evidence of Pyranol usage.
- GE and/or GA EPD should consider sampling indoor air at residences known to have high levels of PCBs in their crawlspaces and which have not undergone remedial action, to determine if a significant inhalation pathway exists.
- Blood testing for PCBs in residents of houses at which high levels of PCBs were found in the soil is being conducted. GA EPD and Dr. Frumkin of Emory University will coordinate the blood testing that will be performed by the Floyd County Health Department facilities.

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APPENDIX A: RESIDENTIAL SOIL SAMPLING RESULTS

GE Residential Soil Sampling Results [1] [2]

Property #	Location sampled	Frequency detected/ # of samples	Range of detected samples (mg/kg or ppm)[3]	Average concentration (mg/kg or ppm) [4]

2	Yard - surface soil	7/12	0.051 - 0.18	0.089
	Yard - subsurface soil	0/8	N/A	N/A
3	Yard - surface soil	3/11	0.047 - 0.088	0.065
	Yard - subsurface soil	2/8	0.048 - 0.079	0.064
4	Crawlspace - surface soil	5/5	5.8 - 48.0	21.0
	Yard - surface soil	11/11	0.82 - 35.0	8.7
	Yard - subsurface soil	4/9	0.063 - 0.47	0.11
9	Surface soil	1/3	0.067	N/A
	Subsurface soil	1/3	0.16	N/A
13	Yard - surface soil	13/13	0.21 - 66.0	12.4
	Yard - subsurface soil	7/13	0.046 - 1.15	0.31
16	Crawlspace - surface soil	0/1	N/A	N/A
	Yard - surface soil	22/23	0.14 - 100.0	30.5
	Yard - subsurface soil	7/11	0.048 - 12.0	3.9
18	Crawlspace - surface soil	8/8	340 - 24000	5965.0
	Yard - surface soil	1/1	390	N/A
	Yard - subsurface soil	1/1	9.4	N/A
21	Crawlspace - surface soil	8/8 [5]	5.7 - 2300	890.7
	Yard - surface soil	18/20	0.14 - 5.5	1.2
	Yard - subsurface soil	3/3	0.18 - 0.89	0.49
23	Yard - surface soil	5/11	0.046 - 0.14	0.08
	Yard - subsurface soil	0/11	N/A	N/A
47	Crawlspace - surface soil	6/6	73.0 - 1700.0	972.2

	Yard - surface soil	3/3	10.0 - 2600.0	946.7
	Yard - subsurface soil	2/2	0.63 - 0.66	0.6
50	Yard - surface soil	5/8	1.4 - 12.0	6.1
	Yard - subsurface soil	0/8	N/A	N/A
51	Yard - surface soil	4/7	0.065 - 0.24	0.14
	Yard - subsurface soil	7/7	0.045 - 0.48	0.25
59	Yard - surface soil	18/21	0.077 - 17.0	3.4
	Yard - subsurface soil	1/2	0.29	N/A
63	Yard - surface soil	7/8	0.067 - 0.55	0.2
	Yard - subsurface soil	0/4	N/A	N/A

[1] Data was compiled from individual property reports and summary tables provided from GE to ATSDR.
[2] Only properties where PCBs were detected are included in the table.
[3] The method detection limit varied with the sample; however, it was generally <0.05 mg/kg ppm.
[4] Non-detects were not included in calculating averages.
[5] Four more samples were collected by GE and analyzed using rapid assay field test kits. Results showed the four samples had > 6.4 ppm PCBs.

APPENDIX B: EVALUATION OF ENVIRONMENTAL CONTAMINATION AND POTENTIAL EXPOSURE PATHWAYS METHODOLOGY

Quality Assurance

In preparing this report, ATSDR staff relied on the information provided in the referenced documents. ATSDR reviewed the available quality assurance and control data and determined that it was adequate for the purpose of this document.

Human Exposure Pathway Evaluation and the Use of ATSDR Comparison Values

ATSDR assesses a site by evaluating the level of exposure in potential or completed exposure pathways. An exposure pathway is the way chemicals may enter a person's body to cause a health effect. An exposure pathway must include all the steps between the release of a chemical and the population exposed: (1) a chemical release source, (2) chemical movement, (3) a place at which people can come into contact with the chemical, (4) a route of human exposure, and (5) a population that could be exposed. In this consultation, ATSDR evaluates incidental ingestion of PCBs from contaminated soil.

Comparison values are used as screening tools to evaluate environmental data relevant to exposure pathways. Comparison values are concentrations of contaminants that are considered to be not likely to cause health effects. Comparison values used in this document include ATSDR's environmental media evaluation guide (EMEG), and ATSDR's cancer risk evaluation guide (CREG). Comparison values are derived from available health guidelines, such as ATSDR's Minimal Risk Levels (MRLs) and EPA's Reference Doses (RfDs).

The derivation of a comparison value uses conservative exposure assumptions, resulting in values that are much lower than exposure concentrations that have been observed to cause adverse health effects. These comparison values are therefore protective of public health in essentially all exposure situations. That is, if the concentrations in the exposure medium are less than the comparison values, the exposures are not of health concern and no further analysis of the pathway is required. While concentrations below the comparison value are not expected to lead to any observable health effect, it should not be inferred that a concentration greater than the comparison value will necessarily lead to adverse effects. Depending on site-specific environmental exposure factors (for example, duration of exposure) and human activities that result in exposure (time spent in area of contamination), exposure to levels above the comparison value may or may not lead to a health effect. ATSDR's comparison values, therefore, are not used to predict the occurrence of adverse health effects.

The CREG is a concentration at which excess cancer risk is not likely to exceed one case of cancer in a million persons exposed over a lifetime. The CREG is a very conservative comparison value that is used as a screening value for cancer. Exposure to a concentration equal to or less than the CREG is defined as an insignificant risk and is an acceptable level of exposure over a lifetime.

Aroclor 1260 was the predominant PCB mixture that was detected in the soil samples. However, there are no comparison values specific for Aroclor 1260. ATSDR's comparison values are derived from studies using Aroclor 1254. In the absence of other information, the comparison values for Aroclor 1254 are used for screening purposes in this document. ATSDR typically uses Aroclor 1254 screening values for health documents that evaluate any type of PCBs or PCB mixtures.

Selecting Contaminants of Concern

Contaminants of concern (COCs) are the site-specific chemical substances that the health assessor selects for further evaluation of potential health effects. Identifying contaminants of concern is a process that requires the assessor to examine contaminant concentrations at the site, the quality of environmental sampling data, and the potential for human exposure. A thorough review of each of these issues is required to accurately select COCs in the site-specific human exposure pathway. The following text describes the selection process.

In the first step of the COC selection process, the maximum contaminant concentrations are compared directly to health comparison values. ATSDR considers site-specific exposure factors to ensure selection of appropriate health comparison values. If the maximum concentration for a chemical was less than the health comparison value, ATSDR would conclude that exposure to that chemical was not of public health concern; therefore, no further data review would be required for that chemical. However, if the maximum concentration was greater than the health comparison value, the chemical would be selected for additional data review, as a contaminant of concern (COC). In addition, any chemicals detected that did not have relevant health comparison values would also be selected as a COC.

ATSDR comparison values have not been developed for some contaminants, and, based on new scientific information, other comparison values may be used that are appropriate for the specific type of exposure (e.g., EPA's Maximum Contaminant Levels (MCLs) for drinking water).

The next step of the process requires a more in-depth review of data for each of the contaminants selected. Factors used in the selection of the COCs include the number of samples with levels above the minimum detection limit, the number of samples with detections above an acute or chronic health comparison value, and the potential for exposure at the sampling location.

APPENDIX C: EXPOSURE DOSE AND CANCER RISK ESTIMATES

Exposure Doses (for noncancerous health effects)

The levels of PCBs detected were above at least one of ATSDR's comparison values for non-cancerous health effects at all of the properties. These comparison values (CVs) are very conservative levels, at which ATSDR believes is safe for exposure. Evaluating the potential for health effects involves using a more realistic exposure scenario with site-specific conditions, if known. Doses were calculated to estimate the average daily dose for an adult, child, and pica child exposed to the maximum concentration of PCBs. Exposure doses can be found in Table C1 of this appendix. The following are the assumptions used in the calculations:

Concentration (C):	Maximum concentrations at each property were used
Ingestion rate (IR):	Adult - 50 mg/day (From EPA's Exposure Factors Handbook [2]) Child - 200 mg/day Pica child - 5,000 mg/day

Body weight (BW): Adult - 70 kg (From EPA's Exposure Factors Handbook [2])
Child - 16 kg

Exposure frequency (EF):

Surface soil in yard = {(5 days/week) x (50 weeks/year) x (40 years)* / (365 days/year) x (40 years)*}= 0.68

Crawlspace soil = {(1 day/week) x (50 weeks/year) x (40 years)*/ (365 days/year) x (40 years)*}= 0.14

* 70 years is used if the property is not remediated

Equation:

$$ED(mg/kg/day) = \frac{C(mg/kg) \ x \ IR(mg/day) \ x \ EF \ x \ CF(1E-6)}{BW(kg)} \ x \ 1000(ug/kg)$$

Where:

ED= exposure dose
C = contaminant concentration
IR = ingestion rate
EF = exposure frequency
CF = conversion factor (A conversion factor of 10^{-6} kg/mg is required to convert the soil contaminant concentration (C) from mg/kg soil to mg/mg soil.
BW = body weight

Example for Property number 4:

A. Adult - crawlspace soil

$$ED(ug/kg/day) = \frac{48.0(mg/kg) \ x \ 50(mg/day) \ x \ 0.14 \ x \ 1E-6(kg/mg)}{70(kg)} \ x \ 1000(ug/kg) = 0.0048 ug/kg/day$$

B. Adult - soil in yard

$$ED(ug/kg/day) = \frac{35.0(mg/kg) \ x \ 50(mg/day) \ x \ 0.68 \ x \ 1E-6(kg/mg)}{70(kg)} \ x \ 1000(ug/kg) = 0.017 ug/kg/day$$

C. Child - soil in yard

$$ED(ug/kg/day) = \frac{35.0(mg/kg) \ x \ 200(mg/day) \ x \ 0.68 \ x \ 1E-6(kg/mg)}{16(kg)} \ x \ 1000(ug/kg) = 0.30 ug/kg/day$$

D. Pica child - soil in yard

$$ED(ug/kg/day) = \frac{35.0(mg/kg) \ x \ 5000(mg/day) \ x \ 0.68 \ x \ 1E-6(kg/mg)}{16(kg)} \ x \ 1000(ug/kg) = 7.4 ug/kg/day$$

Cancer Risk Estimates (for cancerous health effects)

Most of the levels of PCBs detected were above ATSDR's comparison value for cancer (CREG) which is 0.4 mg/kg or ppm. This is a very conservative level at which ATSDR believes is safe for exposure. Initial screening with CREGs are based on continuous exposure for a lifetime (70 years). Evaluating cancer risk involves using a more realistic exposure scenario that considers site-specific conditions, if known. Cancer Risk Estimates can be found in Table C1 of this appendix. The following assumptions were used:

1. Exposure duration - If the property has been remediated, exposure duration was 40 years. If the property has not yet been remediated, a lifetime was used (70 years).
2. Ingestion rates, body weights, and frequency of exposure are the same for exposure doses.
3. The Cancer Slope Factor for ingestion determined to be the most applicable for this situation is 2.0 $mg/k/day^{-1}$. Please see the following:

> The upper reference point (2 per mg/kg-d) is appropriate for food chain exposure, sediment or soil ingestion, and dust or aerosol inhalation; these are exposure pathways for which environmental processes are likely to increase risk. Due to potential for higher sensitivity early in life, the upper reference point is also used for all early-life exposure. The middle reference point (0.4 per mg/kg-d) is appropriate for drinking water ingestion and vapor inhalation; these are

exposure pathways for which environmental processes are likely to decrease risk. The lowest reference point (0.07 per mg/kg-d) should not be used without specific information on the congener composition of the mixture. The second tier is invoked when there are congener or isomer analyses for the mixture of interest. The lowest reference point (0.07 per mg/kg-d) can be used if these analyses verify that congeners with more than four chlorines comprise less than one-half percent of total PCBs, as well as the absence of dioxin-like, tumor-promoting, and persistent congeners. When congener concentrations are available, the slope-factor approach can be supplemented by analysis of dioxin TEQs to evaluate dioxin-like toxicity. [2].

Equations:

$$\text{Lifetime Average Daily Dose (LADD)} = \frac{\text{Exposure Dose}(\mu g/kg/day) \times \text{Exposure Duration}(years)}{70\,years}$$

$$\text{Cancer Risk Estimate (CRE)} = \text{LADD}(\mu g/kg/day) \times \text{Cancer Slope Factor (CSF)}(mg/kg/day^{-1})$$

Example for Property Number 4:

Crawlspace Soil Lifetime Average Daily Dose (LADD)

$$LADD = \frac{0.0048(\mu g/kg/day) \times 40\,(years)}{70\,years} = 0.0027\,\mu g/kg/day$$

Yard Surface Soil Lifetime Average Daily Dose (LADD)

$$LADD = \frac{0.017(\mu g/kg/day) \times 40\,(years)}{70\,years} = 0.0097\,\mu g/kg/day$$

1. Add the Crawlspace LADD and the Yard Surface Soil LADD to get total LADD:
Total LADD = 0.0027 Âµg/kg/day + 0.0097 Âµg/kg/day = 0.0124 Âµg/kg/day =1.24E-5 mg/kg/day

2. Cancer Risk Estimate = 1.24E-5 mg/kg/day x 2.0 mg/kg/day-1 = 2.48E-5

A Cancer Risk Estimate of 2.48E-5 is rounded to 2.0E-5 and represents *No apparent increased cancer risk*. (See Table C2 for cancer risk categories).

Table C1. Exposure doses and cancer risk estimates for properties with maximum PCB levels greater than 10 ppm.[1]

Property #	Maximum concentration (ppm or mg/kg)	Estimated high-end exposure dose (Âµg/kg/day) MRL= 0.02 Âµg/kg/day			Cancer Risk Estimate (EPA's Cancer Slope factor = 2.0 mg/kg/day)					
		Adult	Child	Pica child	Maximum Concentrations (at left)			Average Concentrations (from table A1)		
					LADD[2]	Cancer Risk (of sum of LADDs)[3]		LADD[2]	Cancer Risk (of sum of LADDs)[3]	
4	48 (crawlspace)	0.0048	-	-	2.74E-6	2.0E-5	No apparent increased risk	1.20E-6	7.0E-6	No increased risk
	35 (yard)	0.017	0.30	7.4	9.71E-6			2.41E-6		

13	66 (garden area)	0.032	0.56	14.0	3.20E-5	6.0E-5	Low increased risk	6.02E-6	1.0E-5	No apparent increased risk
16	100 (garden area)	0.049	0.85	21.3	2.80E-5	6.0E-5	Low increased risk	8.47E-6	2.0E-5	No apparent increased risk
18	24000 (crawlspace)	2.4	-	--	2.40E-3	5.0E-3	Moderate/High increased risk	5.97E-4	2.0E-3	Moderate increased risk
	390 (yard)	0.2	3.3	82.9	2.00E-4			1.89E-4		
21	3000 (crawlspace)	0.3	--	--	1.71E-4	3.0E-4	Low increased risk	5.09E-5	1.0E-4	Low increased risk
	5.5 (yard/garden)	0.003	0.047	1.17	1.71E-6			3.33E-7		
47	1700 (crawlspace)	0.2	--	--	2.00E-4	3.0E-3	Moderate increased risk	9.72E-5	1.0E-3	Moderate increased risk
	2600 (yard)	1.3	22.1	552.5	1.30E-3			4.60E-4		
50	12 ppm (yard)	0.0058	0.10	2.55	5.80E-6	1.0E-5	No apparent increased risk	2.96E-6	6.0E-6	No increased risk
59	17 ppm (yard)	0.0083	0.14	3.61	8.26E-6	1.0E-5	No apparent increased risk	1.65E-6	3.0E-6	No increased risk

[1] Shaded areas indicate a remediated property and represent past exposures.
[2] LADD = Lifetime Average Daily Dose. Based on adult exposure doses because it represents lifetime exposure more accurately than child doses.
[3] Cancer Risks are rounded to the nearest whole number in order to assign a risk category.

Table C2. Risk Categories Used by ATSDR [3]

Category	Fraction	Exponential equivalent
No increased risk	< 1/100,000	< 1E-05
No apparent increased risk	1/100,000	1E-05
Low increased risk	1/10,000	1E-04
Moderate increased risk	1/1,000	1E-03
High increased risk	1/100	1E-02
Very high increased risk	> 1/100	> 1E-02

References for Appendix C

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