Letter Health Consultation

Arsenic in Georgia Wells

PRIVATE WELL WATER SAMPLING ON
CARVER ROAD AND CAMP JOHN HOPE ROAD
PEACH COUNTY, GEORGIA

Prepared by the
Georgia Department of Community Health

APRIL 5, 2010

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

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GEORGIA DEPARTMENT OF
COMMUNITY HEALTH

Rhonda M. Medows, MD, Commissioner *Sonny Perdue, Governor*

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March 24, 2010

Mayor John Stumbo
Woolfolk Alliance
Fort Valley City Hall
P.O. Box 956
Fort Valley, GA 31030

RE: Private well water sampling on Carver Road and Camp John Hope Road

Honorable Mayor Stumbo:

On October 21, 2008, a member of the Woolfolk Alliance expressed concerns about residential water wells located in the Carver Drive and Camp John Hope Road in Peach County, Georgia. The wells-are located approximately four miles down gradient of the Woolfolk Chemical Works Superfund Site. From April through August, 2008, the U.S. Environmental Protection Agency (EPA) found elevated levels of arsenic in soil near these residential areas, and the Alliance member is concerned about the extent of contamination from the Woolfolk site.

In response to these concerns, the Peach County Health Department and North Central Health District (NCHD) developed and distributed a community survey to the residents of Carver Drive and the northern end of Camp John Hope Road [1]. The survey was comprised of ten questions and asked residents about their well construction and maintenance practices. Residents were also asked to describe any concerns they had about their well water quality. Respondents were given the opportunity to sign the survey giving consent for no cost well water sampling. NCHD distributed the survey in neighborhoods where EPA discovered elevated arsenic levels in soil. The well water quality of the area was unknown; however, based on groundwater sampling conducted at the Woolfolk site in 2008, site-related groundwater contamination does not extend to these neighborhoods [2].

In November and December 2009, staff from NCHD, the Peach County Health Department and the Georgia Division of Public Health distributed the needs assessment surveys and well water maintenance surveys to 28 residences. Sixteen homes (37 people) completed surveys. Results of the surveys indicate that none of the residents had their well water previously tested and only one home had disinfected their well in the past. In addition, only one well was fully protected structurally. During the canvassing events, staff observed many of the well houses used as storage for household and vehicle maintenance chemicals, and other potential soil and groundwater contaminants.

Of the 16 homes that returned surveys, eight homeowners (63%) granted consent for well water testing. Residential well sampling was conducted by an EPA contractor on January 22, March 26, and March 31, 2009. Two more wells were sampled without signed consent forms (see Figure 1 for locations of residential wells sampled). Samples were collected at the well head and analyzed for metals, pesticides and volatile organic compounds (VOCs). Analytical results showed elevated levels of lead in three wells, and a pesticide in two wells. No other metals or pesticides, or VOCs, were detected in any of the wells sampled.

Three of the 10 wells contained lead at levels exceeding the Federal Drinking Water Standard of 15 micrograms per liter (ug/L). Results for these wells were: 29.0 ug/L, 74.9 ug/L, and 23.4 ug/L. Two other wells had the banned pesticide dieldrin at concentrations of 0.0095 ug/L and 0.018 ug/L. Both of these wells were resampled on March 31, 2009, and results showed dieldrin concentrations of 0.0097 and 0.018, respectively [3]. The EPA has set a drinking water standard for dieldrin of 2 ug/L[1].

Lead

Lead is a naturally occurring bluish white metal found in small amounts of the earth's crust. People become exposed to lead by eating food or drinking water that contains lead or by other human activities such as burning fossil fuels, mining or manufacturing in which the toxic metal is inhaled. The main target for lead toxicity in both adults and children is the nervous system.

Adults are exposed to lead through their occupations or hobbies, by using health care products, or through non-conventional medicinal use. Lead pipes in older houses are one method of exposure to lead through drinking water. Long-term lead exposure in adults can result in increased blood pressure, and repeated exposure to high lead levels can severely damage the brain and kidneys.

Children are more vulnerable to lead poisoning and when exposed to lead under the age of six can suffer irreversible mental and physical damage. Small children are exposed to lead by eating lead-based paint chips, chewing on objects covered with lead-based paint, through contaminated drinking water, and by swallowing house dust or soil that contains lead. A child who consumes large amounts of lead may develop anemia, severe stomach aches, muscle weakness, and brain damage.

Dieldrin

Dieldrin, a white powder with a mild chemical odor, was widely used as a pesticide for crops like corn and cotton until banned by the EPA in 1974, except to control termites. In 1987, EPA banned all uses of dieldrin. The pesticide does not occur naturally in the environment and is often found in the environment at very low levels. Health effects may occur after long periods of exposure to low levels because the chemical builds up in the body. Dieldrin usually affects the nervous system and symptoms include headaches, dizziness, irritability, vomiting, and uncontrolled muscle movements. Workers removed from the source of exposure rapidly recovered from most of these effects. Children can be exposed in the same ways as adults and suffer the same health effects as adults.

One might be exposed to dieldrin by consuming contaminated fish and seafood or root crops, dairy products or meats. Living in an older home that may have been termite treated with dieldrin could be another exposure pathway. Dieldrin can be passed through a mother's milk.

[1] This level is a lifetime exposure concentration protective of adverse, non-cancer health effects that assumes all of the exposure to dieldrin is from a drinking water source.

TOXICOLOGICAL EVALUATION

Non-Cancer Health Effects

For each environmental medium (e.g.; air, soil, groundwater), GDPH examines the types and concentrations of contaminants of concern. In preparing this document, GDPH used ATSDR comparison values, to screen contaminants that may warrant further evaluation. Comparison values (CVs) are concentrations of contaminants that can reasonably (and conservatively) be regarded as harmless, assuming default conditions of exposure. The CVs include ample safety factors to ensure protection of sensitive populations. Because CVs do not represent thresholds of toxicity, exposure to contaminant concentrations above CVs will not necessarily lead to adverse health effects. CVs and the evaluation process used in this document are described in more detail in Appendix A. GDPH then considers how people may come into contact with the contaminants. Because the level of exposure depends on the route and frequency of exposure and the concentration of the contaminants, this exposure information is essential to determine if a public health hazard exists [4].

<u>Lead</u>

Because of the varied nature of lead-containing compounds, ATSDR has not developed a health-based CV for lead. However, ATSDR has developed a mathematical model designed to estimate blood lead levels in the body based upon the actual concentrations in drinking water, along with using estimated default values of environmental lead levels for outdoor air, indoor air, food, soil, and dust [6] (Appendix B).

Three of the 10 wells contained lead at levels exceeding the Federal Drinking Water Standard of 15 micrograms per liter (ug/L). The Centers for Disease Control and Prevention (CDC) considers children to have an elevated blood lead level if the amount of lead in blood is 10 micrograms per deciliter of whole blood (ug/dL) or greater [5].

Estimated blood lead levels from drinking water contaminated with lead

Residential Well	Lead Concentration in Drinking Water (ug/L)	Estimated Blood Lead Level* (ug/dL)
PW 105	29.0	Low: 6.28 High: 6.54
PW 109	74.9	Low: 13.63 High: 14.03
PW 110	23.4	Low: 5.39 High: 5.79

ug/L: micrograms per liter
ug/dL: micrograms of lead per deciliter of blood
* results calculated using the ATSDR Lead Model (Appendix B)

The estimated blood lead levels (using conservative default values) from exposure to environmental and dietary lead for persons exposed to contaminated drinking water from PW109 are 13.63 ug/dL (low) and 14.03 ug/dL (high). These blood lead levels are above CDC's level of concern. We cannot know for sure how long exposure to lead from PW 109 has been occurring, but GDPH can conclude that children drinking water from PW 109 do have the potential for adverse health risks from exposure to lead from this drinking water source.

Dieldrin

The dieldrin concentrations present in residential wells PW 107 and PW 118 are lower than ATSDR's CVs of 2 ug/L for adults and 0.5 ug/L for children. When calculating exposure doses from consumption of drinking water using the most conservative assumptions, and comparing these exposure doses to ATSDR's minimal risk levels (MRLs), adults drinking from PW 107 are exposed to dieldrin at levels that are 365 times less than the MRL. Children drinking from PW 107 are exposed to dieldrin at levels that are 130 times less than the MRL. Adults drinking from PW 118 are exposed to dieldrin at levels that are 19 times less than the MRL. Children drinking from PW 107 are exposed to dieldrin at levels that are 7 times less than the MRL [7]. See Appendix A for details on how the exposure doses were calculated. Based on exposure levels that are occurring in residential wells PW 107 and PW 118, GDPH concludes that adverse health effects from exposure to dieldrin are not likely.

Cancer Health Effects

Lead

The International Agency for Research on Cancer classifies lead as possibly carcinogenic to humans (limited human evidence; less than sufficient evidence in animals), and the EPA classifies lead as a probable human carcinogen (inadequate human, sufficient animal studies). In 2004, the U.S. Department of Health and Human Services, National Toxicology Program classified lead as reasonably anticipated to be a human carcinogen because lead exposure has been associated with increased risk of lung, stomach and bladder cancer in diverse human populations [8]. However, EPA has not determined a slope factor for lead from which any kind of numeric cancer risk can be assessed (refer to Appendix A).

Dieldrin

The EPA classifies dieldrin as a probable human carcinogen based on animal studies. Human studies have been inadequate in determining whether dieldrin is carcinogenic to humans. However, EPA has established a cancer slope factor based on animal studies from which a cancer risk based on level of exposure can be established. The risk for cancer in an adult from a lifetime exposure to the level of dieldrin in PW 107 is 1.7×10^{-8} (1 in 170 million). The risk for cancer in an adult from a lifetime exposure to the dieldrin concentration present in PW 118 is 3.2×10^{-7} (1 in 32 million). Therefore, GDPH concludes the persons exposed to the levels of dieldrin present in PW 107 and PW 118 have a negligible risk for developing cancer over a lifetime of consuming this drinking water.

Conclusions

Based on the available environmental sampling data, GDPH has made the following conclusions:

1. Lead and dieldrin contamination found in residential wells approximately four miles south of the Woolfolk Chemical Works Superfund Site are not related to the groundwater plume connected to the superfund site.
2. Children who consume water from residential well PW 109 could be harmed. This is a public health hazard.
3. Consuming water contaminated with very small amounts of dieldrin in residential wells PW 107 and PW 118 is not expected to harm people's health.
4. There are no elevated cancer risks from consumption of drinking water from any of the residential wells tested.

Recommendations

- If residents who consume water from residential wells PW 105, PW 109 and PW 110 are concerned about lead exposure, they can consult with a health care professional for medical testing to determine if elevated blood lead levels exist. Parents can get their child (six years of age and under) tested for their blood lead level by a health care professional or by contacting the Peach County Health Department at (478) 825-6939 for free or at a reduced rate.
- Residents concerned with exposure to lead and/or dieldrin should install an appropriate water filter system to mitigate exposure to lead and/or dieldrin at their own expense. Lead can be removed from drinking water by reverse osmosis filtration systems. Dieldrin can be removed from drinking water by filtration systems using activated carbon. Water sampling after installation of the water filtration system is recommended. Also, routine water sampling, such as annual sampling, is strongly suggested.

- Residents concerned with exposure to lead and/or dieldrin also have the option of drinking bottled water at their own expense. The University of Georgia has published several educational brochures regarding water quality at home. These brochures may be found under Water Quality at:
  http://www.fcs.uga.edu/ext/pubs/housing.php?category=Water,%20Energy,%20Waste.
  Specific brochures that may be helpful include: Home Water Quality and Treatment, Your Household Water Quality (Lead and Copper), Your Household Water Quality (Pesticides, Solvents and Petroleum Products), and Disinfecting Your Well Water (Shock Chlorination).

If additional data become available, GDPH will consider a separate request for evaluation. If you have any questions regarding this health consultation, please contact Christine Buffington at (478) 751-6115 or Franklin Sanchez at (404) 657-6534.

Sincerely,

Christine Buffington
Environmental Health Risk Communicator

REFERENCES

1. North Central Health District. *Community Survey for Residents of Carver Drive and the Camp John Hope Road, Peach County, GA.* October 2009.

2. U.S. Environmental Protection Agency Region 4. *Woolfolk Chemical Works OU1 Groundwater Sampling Results, Fort Valley, Peach County, Georgia.* Prepared by Black and Veatch Special Projects Corp. April 2008.

3. U.S. Environmental Protection Agency Region 4. *Private Well Sampling Results Woolfolk Chemical Works OU1 Site, Fort Valley, Peach County, Georgia.* Prepared by Black and Veatch Special Projects Corp. March 2009.

4. Agency for Toxic Substances and Disease Registry. *Public Health Assessment Guidance Manual.* Atlanta: US Department of Health and Human Services; January 2005

5. Pediatric Environmental Health Specialty Unit, Southeast Region, Emory University. *Lead*. www.sph.emory.edu/PEHSU.

6. Agency for Toxic Substance and Disease Registry. *Toxicological Profile for Lead (Update).* U.S. Department of Health Human Services. August 2007.

7. Agency for Toxic Substance and Disease Registry. *Toxicological Profile for Aldrin/Dieldrin (Update).* U.S. Department of Health Human Services. September 2002.

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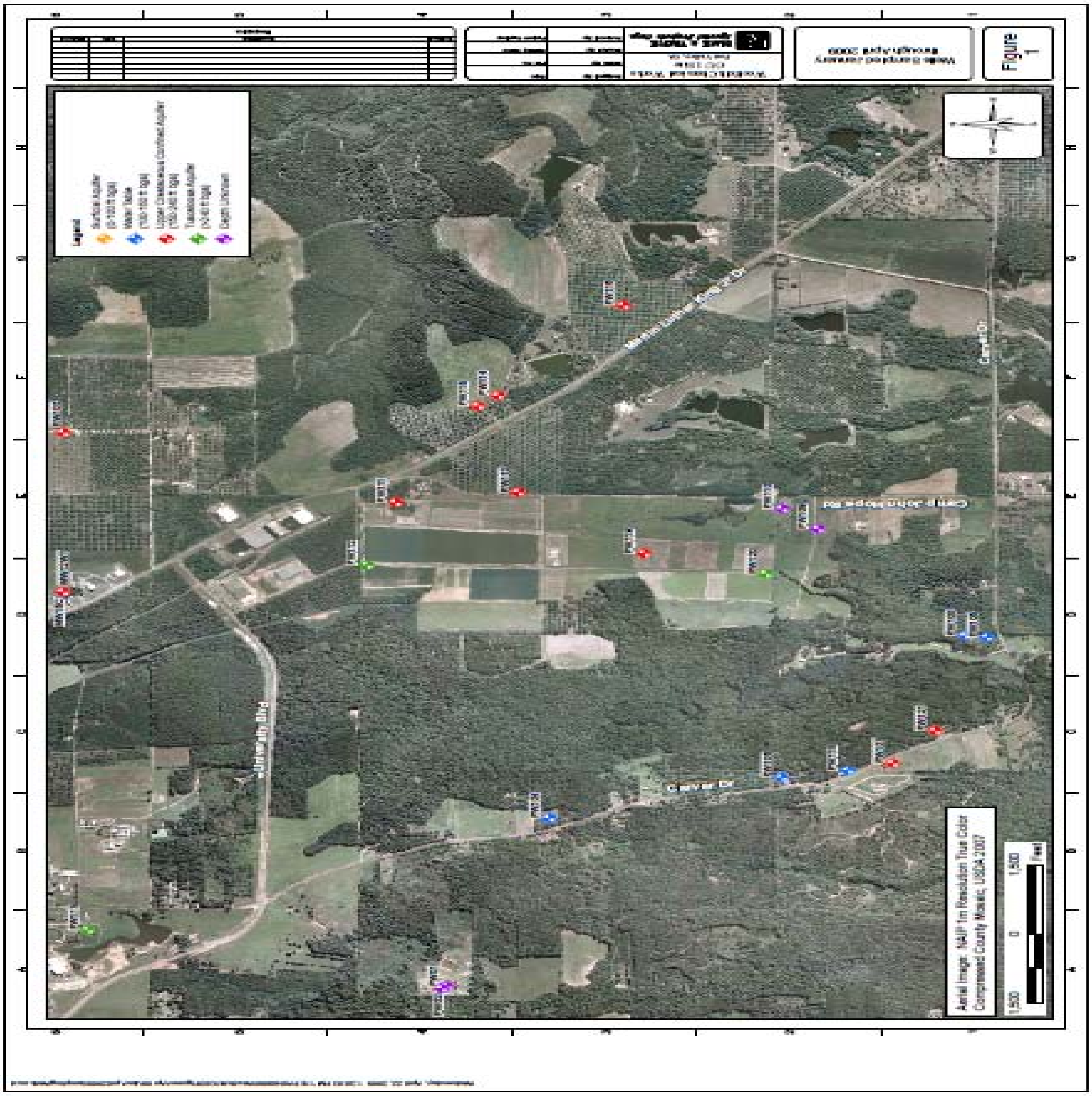
FIGURE 1: Private Wells Sampled from January to April 2009



APPENDICES

APPENDIX A: Explanation of Toxicological Evaluation

Step 1--The Screening Process

In order to evaluate the available data, GDPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the health consultation process where substances found in amounts greater than their CVs might be selected for further evaluation. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses, or EPA's reference concentrations for ingestion and inhalation exposure. When a cancer and non-cancer CV exist for the same chemical, the lower of these values is used as a conservative measure. The chemical and media-specific CVs used in the preparation of this health consultation are listed below:

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for exposure that is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

A **Reference Dose Media Evaluation Guide (RMEG)** is an estimated comparison concentration that is based on EPA's estimate of daily exposure to a contaminant that is unlikely to cause adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is an estimated comparison concentration that is based on an excess cancer rate of one in a million persons exposed over a lifetime (70 years), and is calculated using EPA's cancer slope factor.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses used in this health consultation are presented below. Calculated doses are reported in units of milligrams per kilogram per day (mg/kg/day).

Ingestion of contaminants present in drinking water

Exposure doses for ingestion of contaminants present in drinking water were calculated using the average detected concentrations of contaminants in micrograms per liter (ug/L [ug/L = ppb]). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated drinking water:

$$ED_w = \frac{C \times IR \times EF}{BW}$$

where;

ED_w = exposure dose from drinking water (mg/kg/day)
C = contaminant concentration (mg/L)
IR = intake rate of contaminated medium (based on default values of 2 L/day for adults, and 1 L/day for children.

EF = exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for the purpose of this analysis was one. This is the most conservative exposure factor assuming exposure is occurring 24 hours per day, 7 days per week.

BW = body weight (based on average rates: for adults, 70 kg; children, and 25 kg)

Non-cancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an EPA reference dose (RfD), in order to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level (NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The known toxicological values are doses derived from human and animal studies that are summarized in ATSDR's *Toxicological Profiles (www.atsdr.cdc.gov/toxpro2.html).* The NOAEL is modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected to cause adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies.

For non-cancer health effects, the following health guidelines were used in this health consultation:

Minimal Risk Levels (MRLs) are developed by ATSDR for contaminants commonly found at hazardous waste sites. The MRL is developed for ingestion and inhalation exposure, and for lengths of exposures: acute (less than 14 days); intermediate (between 15-364 days), and chronic (365 days or greater). ATSDR has not developed MRLs for dermal exposure (absorption through skin).

If the estimated exposure dose to an individual is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the health consultation. A direct comparison of site-specific exposures and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. This calculation estimates a theoretical excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios. For children, the theoretical excess cancer risk is not calculated for a lifetime of exposure, but from a fraction of lifetime; based on known or suspected length of exposure, or years of childhood.

Because of conservative models used to derive CSFs, using this approach provides a theoretical estimate of risk; the true or actual risk is unknown and could be as low as zero. Numerical risk estimates are generated using mathematical models applied to epidemiologic or experimental data for carcinogenic effects. The mathematical models extrapolate from higher experimental doses to lower experimental doses. Often, the experimental data represent exposures to chemicals at concentrations orders of magnitude higher than concentrations found in the environment. In addition, these models often assume that there are no thresholds to carcinogenic effects--a single molecule of a carcinogen is assumed to be able to cause cancer. The doses associated with these estimated hypothetical risks might be orders of magnitude lower that doses reported in toxicology literature to cause carcinogenic effects. As such, a low cancer risk estimate of 1×10^{-6} and below may indicate that the toxicology literature supports a finding that no excess cancer risk is likely. A cancer risk estimate greater than 1×10^{-6}, however, indicates that a careful review of toxicology literature before making conclusions about cancer risks is in order.

APPENDIX B: ATSDR Lead Model

(Source: ***Agency for Toxic Substances and Disease Registry, Toxicological Profile for Lead, 1999)***

Numerous longitudinal and cross-sectional studies have attempted to correlate environmental lead levels with blood lead levels. The studies have provided a number of regression analyses and corresponding slope factors for various media including air, soil, dust, water, and food. In an attempt to use this valuable body of data, ATSDR has developed an integrated exposure regression analysis. This approach utilizes slope values from selected studies to integrate all exposures from various pathways, thus providing a cumulative exposure estimate expressed as total blood lead. The worktable in the text can be used to calculate a cumulative exposure estimate on a site-specific basis. To use the table, environmental levels for outdoor air, indoor air, food, water, soil, and dust are needed. In the absence of such data, default values can be used. In most situations, default values will be background levels unless data are available to indicate otherwise. Based on the US Food and Drug Administration's Total Diet Study data, lead intake from food for infants and toddlers is about 5 micrograms per day. In some cases, a missing value can be estimated from a known value**.** For example, EPA has suggested that indoor air can be considered 0.03 times the level of outdoor air.

Empirically determined or default environmental levels are multiplied by the percentage of time one is exposed to a particular source and then multiplied by an appropriate regression slope factor. Slope factor studies were based upon an assumption that exposure is continuous. The slope factors can be derived from regression analysis studies that determine blood lead levels for a similar route of exposure. Typically, these studies identify standard errors describing the regression line of a particular source of lead exposure. These standard errors can be used to provide an upper and lower confidence limit contribution of each estimate of blood lead. The individual source contributions can then be summed to provide an overall range estimate of blood lead. While it is known that such summing of standard errors can lead to errors of population dynamics, detailed demographic analysis (e.g., Monte Carlo simulations) would likely lead to a model without much utility. As a screening tool, estimates provided by the table have a much greater utility than single value central tendency estimates, yet still provide a simple-to-use model that allows the health assessor an easy means to estimate source contributions to blood lead.

Tables 1, 2, and 3 provide estimated blood lead levels from exposure to environmental and dietary sources of lead for persons exposed to contaminated drinking water in Peach County, Georgia.

Table 1: Estimated blood lead levels from exposure to environmental and dietary sources for persons exposed to lead in PW 105

Media	Concentration*	Relative Time Spent (fraction of a day)	Slope Factor**	Estimated Blood Lead Level micrograms per deciliter (µg/dL)	
Outdoor Air	0.15 µg/m^3	0.2	1.32 (low)[1]	0.0396	
			2.52 (high)[1]		0.0756
Indoor Air	0.15 µg/m^3	0.8	1.32 (low)[2]	0.1584	
			2.52 (high)[2]		0.3024
Food	5 µg/day	1	0.24 [3]	1.2	
Water	29 µg/day	1	0.16 [4]	4.64	
Soil	40 mg/kg	0.2	0.00583 (low)[5]	0.04664	
			0.00777 (high)[5]		0.06216
Dust	40 mg/kg	0.8	0.00628 (low)[6]	0.20096	
			0.008 (high)[6]		0.256
			Total	**Low 6.28**	**High 6.54**

When suggested default values are a range of values, the average of the range is used as the default value.

Table 2: Estimated blood lead levels from exposure to environmental and dietary sources for persons exposed to lead in PW 109

Media	Concentration*	Relative Time Spent (fraction of a day)	Slope Factor**	Estimated Blood Lead Level micrograms per deciliter (µg/dL)	
Outdoor Air	0.15 µg/m^3	0.2	1.32 (low)[1]	0.0396	
			2.52 (high)[1]		0.0756
Indoor Air	0.15 µg/m^3	0.8	1.32 (low)[2]	0.1584	
			2.52 (high)[2]		0.3024
Food	5 µg/day	1	0.24 [3]	1.2	
Water	74.9 µg/day	1	0.16 [4]	11.98	
Soil	40 mg/kg	0.2	0.00583 (low)[5]	0.04664	
			0.00777 (high)[5]		0.06216
Dust	40 mg/kg	0.8	0.00628 (low)[6]	0.20096	
			0.008 (high)[6]		0.256
			Total	**Low 13.63**	**High 14.03**

When suggested default values are a range of values, the average of the range is used as the default value.

Table 3: Estimated blood lead levels from exposure to environmental and dietary sources for persons exposed to lead in PW 110

Media	Concentration*	Relative Time Spent (fraction of a day)	Slope Factor**	Estimated Blood Lead Level micrograms per deciliter (µg/dL)	
Outdoor Air	0.15 µg/m^3	0.2	1.32 (low)[1]	0.0396	
			2.52 (high)[1]		0.0756
Indoor Air	0.15 µg/m^3	0.8	1.32 (low)[2]	0.1584	
			2.52 (high)[2]		0.3024
Food	5 µg/day	1	0.24 [3]	1.2	
Water	23.4 µg/day	1	0.16 [4]	3.74	
Soil	40 mg/kg	0.2	0.00583 (low)[5]	0.04664	
			0.00777 (high)[5]		0.06216
Dust	40 mg/kg	0.8	0.00628 (low)[6]	0.20096	
			0.008 (high)[6]		0.256
			Total	**Low 5.39**	**High 5.79**

When suggested default values are a range of values, the average of the range is used as the default value.

* Suggested default values references:

Outdoor Air	0.1–0.2 µg/m^3	Eldred and Cahill 1994 [7]
Indoor Air	0.1–0.2 µg/m^3	EPA 1986 [8]
Food	5 µg/day	Bolger et al 1991 [6]
Water	4 µg/day	EPA 1991 [2]
Dust	10–70 mg/kg	Shacklette and Boerngen 1972 [10]

** Slope values references

[1,2]Outdoor, Indoor air	1.32 (low)–2.52 (high)	µg/dL per µg Pb/m^3	Angle et al 1984 [11]
[3]Food	0.24	µg/dL per µg Pb/day	Ryu et al 1983[12]
[4]Water	0.16	µg/dL per µg Pb/day	Laxen et al 1977 [13]
[5]Soil	0.00583 (low)–0.008 (high)	µg/dL per µg Pb/kg	Angle et al 1984 [11]
[6]Dust	0.00628 (low)–0.008 (high)	µg/dL per µg Pb/kg	Angle et al 1984 [11]

APPENDIX B References:

1. Eldred RA, Cahill TA, *Trends in elemental concentrations of fine particles at remote sites in the United States of America,* Atmospheric Environ 28:1009-1019, 1994.
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CERTIFICATION

This letter health consultation was prepared by the Georgia Division of Public Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial Review was completed by the Georgia Division of Public Health.

Technical Project Officer, CAT, CAPEB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Team Lead, CAT, CAPEB, DHAC, ATSDR