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HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

March 22, 2013

Mr. Tom Taccone
U.S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, New York 10007-1866

Re: Letter Health Consultation
Eighteen Mile Creek
EPA # NYN000206456
Niagara County, New York

Dear Mr. Taccone:

This letter health consultation summarizes the New York State Department of Health (DOH) and Agency for Toxic Substances and Disease Registry (ATSDR) evaluation of environmental data collected in the residential neighborhood east of Water Street and next to Eighteen Mile Creek. This area is called Operable Unit 6 by the New York State Department of Environmental Conservation (DEC) (see Figure 1). The purpose of this letter health consultation is to present the DOH and ATSDR conclusions about the public health implications of the environmental data and provide our recommendations for future actions.

This document is part of the public health assessment, a larger document that DOH and ATSDR are currently preparing. We are providing the United States Environmental Protection Agency (EPA) this evaluation separately from the public health assessment, so that a timely response to public health concerns related to the residential properties can be made. Further evaluation of other potential exposure pathways, community concerns, and more details about the toxicological evaluation will be presented in the public health assessment.

Background

The portion of the Eighteen Mile Creek site in the City of Lockport that flows through and out of several abandoned commercial and industrial properties, as well as a small residential neighborhood, is collectively referred to as the “corridor”. The creek corridor itself consists of about 10 acres between Clinton and Harwood Streets in the City of Lockport (Figure 1). The corridor is bounded by Water Street, residential properties and vacant land to the west, Clinton Street to the south, Mill Street to the east and commercial property to the north.

The Eighteen Mile Creek Corridor Area was subdivided into six Operable Units by the DEC (DEC OUs), as shown on Figure 1. The DEC OU 6, Water Street residential properties, have

been impacted by fill material eroding onto the properties from the Water Street section of DEC OU 2, and by the deposition of contaminated creek sediments during flooding events.

DOH and ATSDR used available environmental and exposure information to complete an assessment of health risks presented by exposure to chemical contaminants in the yards of these residences. Surface soil sampling data for these yards show levels of arsenic ranging from 5.3 to 66.5 milligrams per kilogram (mg/kg), lead from 30 to 4,630 mg/kg, chromium from 10.7 to 164 mg/kg, and total polychlorinated biphenyls (PCBs) ranging from not detected (detection limit 0.11 mg/kg) to 27 mg/kg (DEC, 2006).

Residents along Water Street who have backyards contaminated with site-related contamination that border the creek are likely to come into contact with contaminants during normal backyard use. Residents in the past have been advised to avoid contaminated areas in their backyards and keep the areas covered with grass or vegetation. However, we do not know whether residents have heeded this advice.

Public Health Implications and Adult/Child Health Considerations

Initial Screening of Contaminants

We first compared the highest detected level of contaminants in surface soil to the corresponding New York State residential Soil Cleanup Objectives (SCOs) (DEC/DOH, 2006) and ATSDR comparison values for soil (ATSDR, 2012a).[1]

As shown in Table 1, Appendix A, the levels of PCBs, arsenic, chromium, lead and zinc on the residential properties exceed their residential SCOs or ATSDR comparison values. We therefore selected these contaminants for further evaluation.

Evaluation of Selected Contaminants

Following the initial screening, we further evaluated the residential soil contaminants using health-based comparison values (Table 2, Appendix A).[2] PCBs, arsenic and chromium

[1]Health-based SCOs are soil concentrations that are contaminant-specific remedial goals based on current, intended or reasonably anticipated future land use. They are based on the assumption that people living at a property are exposed through dermal (skin) contact with soil; ingestion of contaminated outdoor soil and indoor dust; inhalation of soil particles in air; and ingestion of homegrown fruits and vegetables. The health-based SCOs are set at a soil concentration at which cancer and noncancer health effects are unlikely to occur (i.e., a cancer risk level of one in one million for carcinogens, or at a hazard quotient of one for noncancer effects). If a health-based SCO is calculated to be lower than the contaminant's rural soil background concentration (i.e., typical levels of the contaminant in soil), the final SCO is set at the rural soil background concentration. ATSDR comparison values for soil are contaminant-specific soil concentrations that are used by ATSDR health assessors and others to identify environmental contaminants that require further evaluation at hazardous waste sites. They incorporate generic (i.e., not region-specific) assumptions of daily exposure to the chemical and a standard amount of soil that someone may take into their body each day.

[2]The health-based comparison values are similar to the SCOs in that they are soil concentrations at which health effects are unlikely (based on an excess lifetime cancer risk level of one in one million for carcinogens, and a hazard quotient of one for noncancer effects), but use site-specific exposure assumptions, such as how long and how often people may be exposed to site contaminants. The health comparison values also include exposure parameters from the recent EPA Exposure Factors Handbook (EPA, 2011). For carcinogens, the comparison values assume a person is exposed to residential soil contaminants by incidental ingestion and skin contact two to five days each week (depending on whether the person is an adult or a child) during non-winter months for the first 30 years of life. The noncancer comparison value assumes a child is exposed by incidental ingestion and skin contact five days a week during the non-winter months. For residential properties, we generally

exceeded their cancer and noncancer health-based comparison values, and we therefore characterized the health risks for these contaminants and for lead, which has no comparison value.

Risk Characterization

The primary health effects associated with exposure to PCBs are cancer and noncancer effects on the immune system (ATSDR, 2001). Surface soil samples from the creek bank showed elevated levels of total PCBs (27 mg/kg and 17.4 mg/kg) at two of the eight residential yards sampled. Exposure to PCBs in soils at the creek bank via homegrown fruits and vegetables is unlikely (a creek bank is an unlikely site for a garden), and therefore for these samples, we evaluated the risks for soil ingestion and dermal contact only. Repeated, long-term exposure to soil PCB levels of 27 mg/kg and 17.4 mg/kg at the creek bank locations (the highest levels found at residential properties) is estimated to pose a moderate risk for noncancer health effects, because the estimated exposures are about 6 to 10 times higher than the health-based comparison value (which corresponds to the reference dose[3]), and are only 25 to 39 times lower than the lowest PCB exposures that caused immune toxicity in laboratory animals (a margin of exposure that we consider too small to adequately protect human health). Repeated and long-term (30 years) exposure to soil PCB levels of 27 mg/kg or 17.4 mg/kg at the creek bank locations is estimated to pose a low increased risk for getting cancer, which means the estimated increased risk is between one in one million and one in ten thousand.

Ten additional soil samples from these properties in areas other than the creek bank show lower total PCB levels, ranging from less than detection limits to 0.46 mg/kg. This suggests that the elevated PCB levels along the creek bank may not be representative of levels over the entire properties. The elevated health risks from PCB exposures may only be associated with creek bank soils.

Arsenic is a known human carcinogen (EPA, 1998) and causes noncancer effects on the blood vessels and skin (ATSDR, 2007a). The primary health effects associated with exposure to chromium are cancer and noncancer effects on the digestive and lymphatic systems, blood and liver (ATSDR, 2012b). The levels of arsenic and chromium exceed their residential SCOs (16 mg/kg and 22 mg/kg) at four of the eight residential properties sampled. The levels also exceeded health-based comparison values. The levels above the SCOs at these properties ranged from 23.1 mg/kg to 66.5 mg/kg for arsenic and 25.6 mg/kg to 164 mg/kg for chromium. The following table (Table A) characterizes the estimated cancer and noncancer health risks for long-term, repeated exposure to the highest and average soil levels of arsenic and chromium in individual yards where the levels exceeded the residential SCOs. Risk characterization for both the highest and average contaminant levels are presented since there is uncertainty about which measure is more representative of a person's exposure on these properties. An example of cancer and noncancer risk calculations is presented in Appendix B.

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assume, unless otherwise noted, that additional exposure to soil contaminants could occur through ingestion of homegrown fruits and vegetables when we evaluated the cancer and the noncancer risks. For specific exposure parameters used to calculate the comparison values, please see footnotes 1 and 2 of Table 2, Appendix A.

[3]The noncancer comparison value is a soil concentration that will result in a contaminant exposure equal to the contaminant's reference dose if a person is exposed according to the assumptions for residential exposure. The reference dose is a level of exposure to a contaminant that is unlikely to result in adverse noncancer health effects assuming a person is exposed for up to a lifetime.

Table A. Cancer and Noncancer Risk Descriptors for Highest and Average Levels of Arsenic and Chromium in Soil at Individual Residential Properties Along the Eighteen Mile Creek.

Highest Level in Soil (mg/kg)	Cancer Risk Descriptor	Noncancer Risk Descriptor	Average Level in Soil (mg/kg)	Cancer Risk Descriptor	Noncancer Risk Descriptor
Arsenic					
23.1	moderate	low	14.2	moderate	low
26.4	moderate	low	15.9	moderate	low
30.4	moderate	low	29.9	moderate	low
66.5	moderate	moderate	30.7	moderate	low
Chromium[a]					
25.6	moderate	minimal	--[b]	--[b]	--[b]
39.1	moderate	minimal	26.8	moderate	minimal
114.5	moderate	low	48.2	moderate	low
164.0	moderate	low	58.0	moderate	low

[a]Environmental sampling results are for total chromium. Risk characterization assumes all the chromium is in the hexavalent form.

[b]Only one sample available.

mg/kg: milligrams per kilogram of soil

Lead on Residential Properties

Scientific studies show that elevated blood lead levels in children (before or after birth) cause or are associated with adverse effects on the developing nervous system. These include reductions in several measures of cognitive ability, which are an indicator of a child's ability to learn (ATSDR, 2007b). There is no evidence from these studies that a threshold (i.e., a level of exposure below which health effects do not occur) exists for lead. At all eight properties, lead was detected in residential surface soil above its residential SCO (400 mg/kg), and ranged from 29.8 mg/kg to 4630 mg/kg. The presence of lead at these properties could result in increased exposure of children to lead through incidental ingestion of soil during typical residential activities. Based on the soil lead levels and likely nature of expected exposures, the soil levels would be the primary contributor to potential increases in blood lead levels, which, when added to other background lead exposures, could be considerable in light of the recent Centers for Disease Control and Prevention revision of the blood lead reference value to 5 micrograms per deciliter of blood (mcg/dL) (CDC, 2012). Whether the exposures in soil would actually increase blood lead levels of a child depends primarily on the actual lead level in the soil the child contacts, the bioavailability of lead, the frequency and duration of exposure, and how much soil the child ingests.

Conclusions

The DOH and ATSDR conclude that repeated contact with contaminants in soil in some residents' backyards on Water Street could harm people's health. The soil contains levels of PCBs, arsenic, and chromium that exceed New York State SCOs for residential uses and pose a moderate risk for adverse health effects. Exposure to lead in soil at the properties could increase blood lead levels in children.

Recommendations

Actions should be taken to reduce the potential for residents, especially children, to be exposed to PCBs, arsenic, chromium, and lead in soil in the backyards of residences along Water Street.

Further Actions

The DOH and ATSDR are preparing a public health assessment for Eighteen Mile Creek that evaluates all potential exposure pathways related to the creek and provides additional conclusions, recommendations, and a description of any possible need for public health actions.

If you have any questions, please call me at 716-847-4501.

Sincerely,

Matthew Forcucci
Public Health Specialist
Bureau of Environmental Exposure Investigation

Attachments: Figure 1
ec: Ralph VanHouten
K. Anders / D. Ripstein / eFILE
T. Johnson
J.Devald / P. Dicky - NCHD
G. Sutton / G. May - DEC Region 9
G. Ulirsch – ATSDR
L. Graziano – ATSDR

<u>New York State Department of Health Contributing Authors</u>

Kaycee Cole, M.S. and Thomas Johnson, Ph.D., Research Scientists, Bureau of Toxic Substance Assessment and Don Miles, Public Health Specialist, Bureau of Environmental Exposure Investigation

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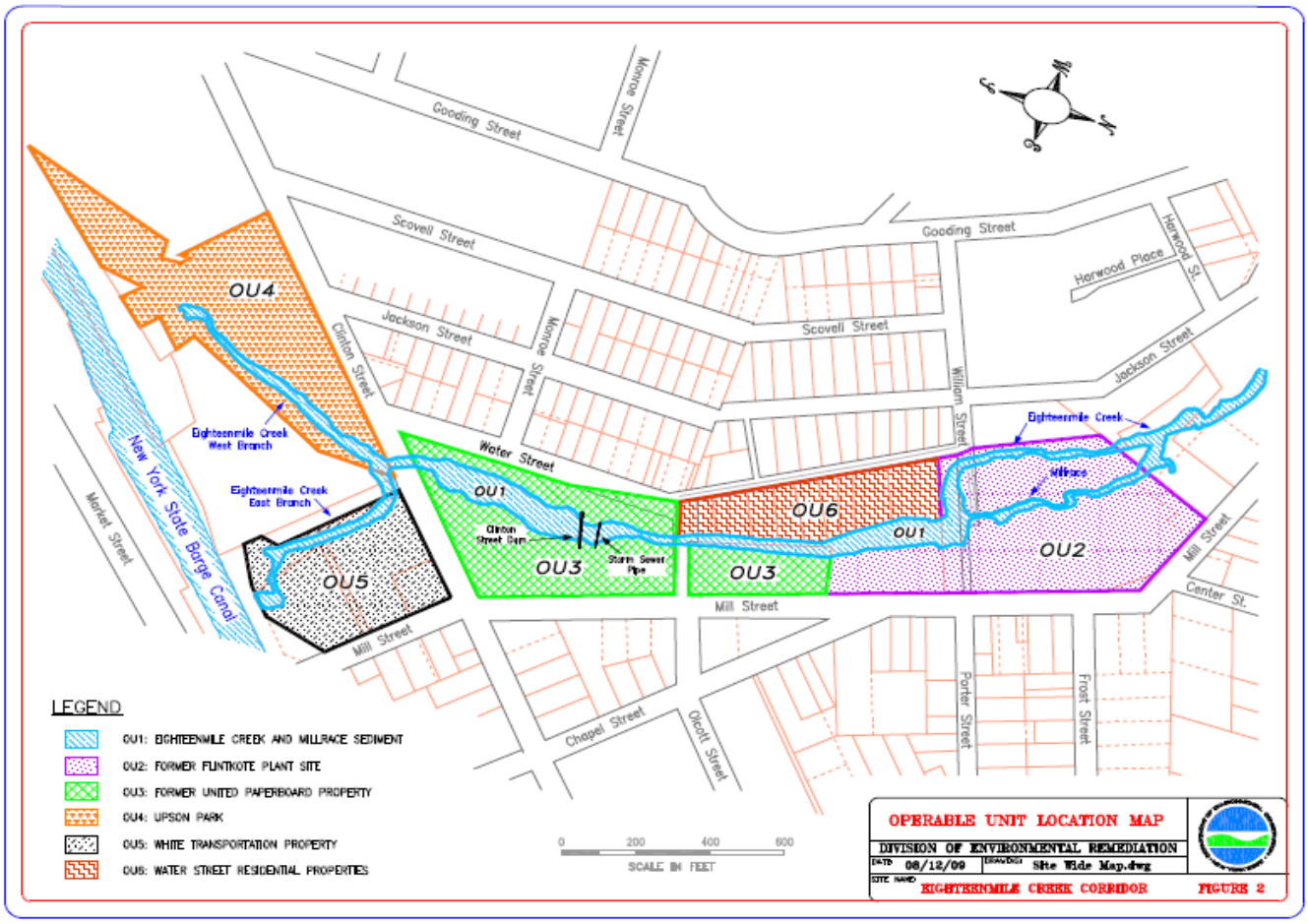
Figure 1. Eighteen Mile Creek Corridor portion of the Eighteen Mile Creek NPL Site with DEC Operable Units 1-6 identified.



APPENDIX A
Tables

Table 1. Contaminants Detected Above Residential Soil Cleanup Objectives and ATSDR Comparison Values at Residential Properties on Eighteen Mile Creek.

(All values in milligrams per kilogram soil (mg/kg))

Contaminant	Highest Level Detected in Soil at Residential Properties	NYS Residential Soil Cleanup Objective[1]	ATSDR Comparison Value[2]
PCBs (total)	27	1	0.35
arsenic	66.5	16	0.47
chromium	164	22	50
lead	4,630	400	---
zinc	2,390	2,200	15,000

[1]DEC/DOH, 2006
[2]ATSDR, 2012a

Table 2. Contaminant Levels in Residential Surface Soil and Health Comparison Values Based on Ingestion and Dermal Exposure for Eighteen Mile Creek Contaminants Selected for Further Evaluation

(All values in milligrams per kilogram of soil (mg/kg))

Contaminant	Contaminant Level	Comparison Value			
		Cancer[1]	Basis	Noncancer[2]	Basis
Aroclor 1248	14	0.67	EPA CPF[3]	2.7	ATSDR MRL[4]
Aroclor 1254	13	0.67	EPA CPF[3]	2.7	ATSDR MRL[4]
Aroclor 1260	8	0.67	EPA CPF[3]	2.7	ATSDR MRL[4]
Total PCBs	27	0.67	EPA CPF[3]	2.7	ATSDR MRL[4]
arsenic	66.5	0.29	EPA CPF	13	EPA RfD
chromium	164	0.88	CA EPA CPF	44	ATSDR MRL
zinc	2,390	--	--	13,300	EPA RfD

[1]Cancer comparison values are based on the dose corresponding to a one in one million increased risk level and calculated for a person who contacts soil for 31 weeks each year (5 days per week for the first 17 years of life and 2 days per week for the next 13 years) and is exposed by incidental ingestion and dermal absorption. For the first year of life, we assumed a child ingests 30 mg/day outdoor soil and 15 mg/day indoor dust originating as outdoor soil (EPA 2011); for ages 1 through 5 years, we assumed the child ingests 80 mg/day outdoor soil and 40 mg/day indoor dust originating as outdoor soil, for a total of 120 mg/day soil (DEC/DOH, 2006); for ages 6 through 30 years, we assumed an outdoor soil ingestion rate of 100 mg/day (EPA 1989). Body weights are those recommended by the EPA Exposure Factors Handbook (EPA, 2011). For the first year of life, we assumed soil contact of a child's face, forearms, hands, lower legs and feet (DEC/DOH, 2006). Beyond the first year of life, surface area recommendations are those recommended by the EPA (2004). Dermal absorption factors are from Chapter 3 (Exhibit 3-4) of EPA (2004) or from EPA (2012). Comparison value = [1 mg/kg x 0.000001/cancer potency factor $(mg/kg/day)^{-1}$]/total dose. Total dose is the sum of oral and dermal doses. A sample calculation of oral and dermal doses for residential exposure is in Appendix B. A factor of 5 is used to account for exposure via homegrown fruits and vegetables (DEC/DOH, 2006) except for Aroclors and PCBs, because the elevated PCB levels were located on the creek bank where gardening is unlikely.

[2]Noncancer comparison values are based on the reference dose or similar value and calculated for a 11.4 kg child who contacts sediments 5 days per week, 31 weeks per year. A soil to skin adherence factor of 0.2 mg/cm^2-day, a daily soil ingestion rate of 120 mg/day, and a surface area value for upper and lower extremities of 2800 cm^2 are assumed (DEC/DOH, 2006). Calculation: Comparison value = 1 mg/kg x reference dose (mg/kg/day)/total dose. Total dose is the sum of oral and dermal doses. Oral dose = 1 mg/kg x 120 mg/day x 1/11.4 kg x 10^{-6} kg/mg x 5 days/7 days x 31 weeks/52 weeks. Dermal dose = [1 mg/kg x 2800 cm^2 x 0.2 mg/cm^2-day x dermal absorption factor x 10^{-6} kg/mg x 5 days/7 days x 31 weeks/52 weeks]/11.4 kg. Dermal absorption factors are from Chapter 3 (Exhibit 3-4) of EPA (2004) or from EPA (2012). A factor of 5 is used to account for exposure via homegrown fruits and vegetables (DEC/DOH, 2006) except for Aroclors and PCBs, because the elevated Aroclor/PCB levels were located on the creek bank where gardening is unlikely.

[3]Based on upper-bound cancer potency factor for high risk and persistence (EPA, 1997).

[4]The ATSDR value is used to evaluate unspecified mixtures of polychlorinated biphenyls (PCBs) and is based on Aroclor 1254.

ATSDR MRL: Agency for Toxic Substances and Disease Registry Minimal Risk Level (ATSDR, 2000; 2012b).
CA EPA CPF: California Environmental Protection Agency Cancer Potency Factor (CA EPA, 2011).
EPA CPF: United States Environmental Protection Agency Integrated Risk Information System Cancer Potency Factor (EPA, 1997; 1998).
EPA RfD: United States Environmental Protection Agency Integrated Risk Information System Reference Dose (EPA, 1998; 2005a).

APPENDIX B

Spreadsheets for Calculation of Contaminant Oral and Dermal Doses from a Soil Concentration of 1 mg/kg for Cancer Risk Evaluation of Residential Soil Contaminant Exposure

PCB Dose from Soil Ingestion

Yr	Range	*C* (mg/kg)	*IR* (mg/d)	*CF* (kg/mg)	*BW* (kg)	d/wk	wk/y	*E* *(d/d)*	365 d/y Ing Dose (mg/kg/d)	*E*-weighted Ing Dose (mg/kg/d)	
1	0 to <1	1	45	1.E-06	7.8	0.714	0.596	0.426	5.77E-06	**2.46E-06**	
2	1 to <2	1	120	1.E-06	11.4	0.714	0.596	0.426	1.05E-05	**4.48E-06**	
3	2 to <3	1	120	1.E-06	18.6	0.714	0.596	0.426	6.45E-06	**2.75E-06**	
4	3 to <4	1	120	1.E-06	18.6	0.714	0.596	0.426	6.45E-06	**2.75E-06**	
5	4 to <5	1	120	1.E-06	18.6	0.714	0.596	0.426	6.45E-06	**2.75E-06**	
6	5 to <6	1	100	1.E-06	18.6	0.714	0.596	0.426	5.38E-06	**2.29E-06**	
7	6 to <7	1	100	1.E-06	31.8	0.714	0.596	0.426	3.14E-06	**1.34E-06**	
8	7 to <8	1	100	1.E-06	31.8	0.714	0.596	0.426	3.14E-06	**1.34E-06**	
9	8 to <9	1	100	1.E-06	31.8	0.714	0.596	0.426	3.14E-06	**1.34E-06**	
10	9 to <10	1	100	1.E-06	31.8	0.714	0.596	0.426	3.14E-06	**1.34E-06**	
11	10 to <11	1	100	1.E-06	31.8	0.714	0.596	0.426	3.14E-06	**1.34E-06**	
12	11 to <12	1	100	1.E-06	56.8	0.714	0.596	0.426	1.76E-06	**7.50E-07**	
13	12 to <13	1	100	1.E-06	56.8	0.714	0.596	0.426	1.76E-06	**7.50E-07**	
14	13 to <14	1	100	1.E-06	56.8	0.714	0.596	0.426	1.76E-06	**7.50E-07**	
15	14 to <15	1	100	1.E-06	56.8	0.714	0.596	0.426	1.76E-06	**7.50E-07**	
16	15 to < 16	1	100	1.E-06	56.8	0.714	0.596	0.426	1.76E-06	**7.50E-07**	
17	16 to <17	1	100	1.E-06	71.6	0.714	0.596	0.426	1.40E-06	**5.95E-07**	
									Avg PCB Dose	**1.68E-06**	**mg/kg/d**

Yr	Range	C (mg/kg)	IR (mg/d)	CF (kg/mg)	BW (kg)	d/wk	wk/y	*E* *(d/d)*	365 d/y Ing Dose (mg/kg/d)	*E*-weighted Ing Dose (mg/kg/d)	
18	17 to <18	1	100	1.E-06	71.6	0.286	0.596	0.170	1.40E-06	**2.38E-07**	
19	18 to <19	1	100	1.E-06	71.6	0.286	0.596	0.170	1.40E-06	**2.38E-07**	
20	19 to <20	1	100	1.E-06	71.6	0.286	0.596	0.170	1.40E-06	**2.38E-07**	
21	20 to <21	1	100	1.E-06	71.6	0.286	0.596	0.170	1.40E-06	**2.38E-07**	
22	21 to <22	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
23	22 to <23	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
24	23 to <24	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
25	24 to <25	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
26	25 to <26	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
27	26 to <27	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
28	27 to <28	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
29	28 to <29	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
30	29 to <30	1	100	1.E-06	80.0	0.286	0.596	0.170	1.25E-06	**2.13E-07**	
									Avg PCB Dose	**2.21E-07**	**mg/kg/d**

Age Period	ED/Lifetime	Avg PCB Dose	Dose Weight (mg/kg/day over 70 years)
0 to 17	0.2429	1.68E-06	4.07E-07
18 to 30	0.1857	2.21E-07	4.10E-08
30 years			**4.48E-07**

PCB Dose from Dermal Absorption

Yr	Range	*C* (ppm)	*SA* (cm2)	*AF* (mg/cm2-d)	DABS	CF (kg/mg)	*BW* (kg)	*EF1* d/wk	*EF2* wk/y	*E* (d/d)	365 d/y Derm Dose (mg/kg/d)	*E*-weighted Derm Dose (mg/kg/d)
1	0 to <1	1	1,900	0.20	0.140	1.0E-06	7.8	0.714	0.596	0.426	6.821E-06	**2.904E-06**
2	1 to <2	1	2,800	0.20	0.140	1.0E-06	11.4	0.714	0.596	0.426	6.877E-06	**2.928E-06**
3	2 to <3	1	2,800	0.20	0.140	1.0E-06	18.6	0.714	0.596	0.426	4.215E-06	**1.795E-06**
4	3 to <4	1	2,800	0.20	0.140	1.0E-06	18.6	0.714	0.596	0.426	4.215E-06	**1.795E-06**
5	4 to <5	1	2,800	0.20	0.140	1.0E-06	18.6	0.714	0.596	0.426	4.215E-06	**1.795E-06**
6	5 to <6	1	2,800	0.20	0.140	1.0E-06	18.6	0.714	0.596	0.426	4.215E-06	**1.795E-06**
7	6 to <7	1	5,700	0.07	0.140	1.0E-06	31.8	0.714	0.596	0.426	1.757E-06	**7.480E-07**
8	7 to <8	1	5,700	0.07	0.140	1.0E-06	31.8	0.714	0.596	0.426	1.757E-06	**7.480E-07**
9	8 to <9	1	5,700	0.07	0.140	1.0E-06	31.8	0.714	0.596	0.426	1.757E-06	**7.480E-07**
10	9 to <10	1	5,700	0.07	0.140	1.0E-06	31.8	0.714	0.596	0.426	1.757E-06	**7.480E-07**
11	10 to <11	1	5,700	0.07	0.140	1.0E-06	31.8	0.714	0.596	0.426	1.757E-06	**7.480E-07**
12	11 to <12	1	5,700	0.07	0.140	1.0E-06	56.8	0.714	0.596	0.426	9.835E-07	**4.188E-07**
13	12 to <13	1	5,700	0.07	0.140	1.0E-06	56.8	0.714	0.596	0.426	9.835E-07	**4.188E-07**
14	13 to <14	1	5,700	0.07	0.140	1.0E-06	56.8	0.714	0.596	0.426	9.835E-07	**4.188E-07**
15	14 to <15	1	5,700	0.07	0.140	1.0E-06	56.8	0.714	0.596	0.426	9.835E-07	**4.188E-07**
16	15 to < 16	1	5,700	0.07	0.140	1.0E-06	56.8	0.714	0.596	0.426	9.835E-07	**4.188E-07**
17	16 to <17	1	5,700	0.07	0.140	1.0E-06	71.6	0.714	0.596	0.426	7.802E-07	**3.322E-07**

Avg PCB Dose **1.13E-06** **mg/kg/d**

Yr	Range	*C* (ppm)	*SA* (cm2)	*AF* (mg/cm2-d)	DABS	CF (kg/mg)	*BW* (kg)	*EF1* d/wk	*EF2* wk/y	*E* (d/d)	365 d/y Derm Dose (mg/kg/d)	*E*-weighted Derm Dose (mg/kg/d)
18	17 to <18	1	5,700	0.07	0.140	1.0E-06	71.6	0.286	0.596	0.170	7.802E-07	**1.329E-07**
19	18 to <19	1	5,700	0.07	0.140	1.0E-06	71.6	0.286	0.596	0.170	7.802E-07	**1.329E-07**
20	19 to <20	1	5,700	0.07	0.140	1.0E-06	71.6	0.286	0.596	0.170	7.802E-07	**1.329E-07**
21	20 to <21	1	5,700	0.07	0.140	1.0E-06	71.6	0.286	0.596	0.170	7.802E-07	**1.329E-07**
22	21 to <22	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
23	22 to <23	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
24	23 to <24	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
25	24 to <25	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
26	25 to <26	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
27	26 to <27	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
28	27 to <28	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
29	28 to <29	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**
30	29 to <30	1	5,700	0.07	0.140	1.0E-06	80.0	0.286	0.596	0.170	6.983E-07	**1.189E-07**

Avg PCB Dose **1.232E-07** **mg/kg/d**

Age Period	ED/Lifetime	Avg PCB Dose	Dose Weight (mg/kg/day over 70 years)
0 to 17	0.2429	1.13E-06	2.74E-07
18 to 30	0.1857	1.23E-07	2.29E-08
30 years			**2.97E-07**

C = soil concentration; IR = soil ingestion rate; CF = conversion factor; BW = body weight; EF = exposure frequency; ED = exposure duration; SA = skin surface area in contact with soil; AF = soil-to-skin adherence factor.

Sample PCB Cancer Risk Calculation (using results from above residential spreadsheet)

Total Dose from 1 mg/kg_s

Total Dose = Oral Dose + Dermal Dose = 4.48E-7 mg/kg/day + 2.97E-7 mg/kg/day = 7.45E-7 mg/kg/day*

Total Dose from 27 mg/kg_s PCBs

Total Dose = (7.45E-7 mg/kg/day x 27 mg/kg_s)/ 1 mg/kg_s = 2.01E-5 mg/kg/day

Cancer Risk from 27 mg/kg_s PCBs

Cancer Risk = Total Dose x Cancer Potency Factor = 2.01E-5 mg/kg/day x 2.0/mg/kg/day = 4.0E-5 (low)

NOTE: The cancer risk estimates for arsenic and chromium were calculated using age-dependent adjustment factors (ADAFs) according to EPA guidance (EPA, 2005b; 2006). The specific ADAFs used were 10 for 0 to <2 years, 3 for ages 2 to <16 years, and 1 for ages > 16 years.

Sample PCB Noncancer Risk Calculation

Oral Dose = 27 mg/kg_s x 120 mg_s/day x 1/11.4 kg x 1E-6 kg_s/mg_s x 5 d/7 d x 31 wks/52 wks = 1.21E-4 mg/kg/day*

Dermal dose = [27 mg/kg_s x 2800 cm^2 x 0.2 mg_s/cm^2-d x 0.14 x 1E-6 kg_s/mg_s x 5 d/7 d x 31 wks/52 wks]/11.4 kg = 7.91E-5 mg/kg/day

Total Dose = 1.21E-4 mg/kg/day + 7.91E-5 mg/kg/day = 2.00E-4 mg/kg/day

Hazard Quotient = Total Dose/Reference Dose = 2.00E-4 mg/kg/day / 2E-5 mg/kg/day = 10 (moderate)

*A factor of 5 is applied to the oral dose to account for exposure via homegrown fruits and vegetables. This factor was not used in the calculation for PCBs because the creek bank location of the samples is an unlikely site for a garden.