Health Consultation

Surface Soil in the Surrounding Areas

CABOT CARBON-KOPPERS
SUPERFUND HAZARDOUS WASTE SITE
GAINESVILLE, ALACHUA COUNTY, FLORIDA

EPA FACILITY ID: FLD980709356

Prepared by
Florida Department of Health

NOVEMBER 4, 2013

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
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.

HEALTH CONSULTATION

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Foreword

The Florida Department of Health (DOH) evaluates the public health threat of hazardous waste sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia. This health consultation is part of an ongoing effort to evaluate health effects associated with off-site surface soil near the Cabot Carbon-Koppers Superfund hazardous waste site. The Florida DOH evaluates site-related public health issues through the following processes:

- Evaluating exposure: Florida DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is on and near the site, and how human exposures might occur. The US Environmental Protection Agency (EPA) and consultants for the responsible party provided the information for this assessment.

- Evaluating health effects: If we find evidence that exposures to hazardous substances are occurring or might occur, Florida DOH scientists will determine whether that exposure could be harmful to human health. We focus this report on public health; that is, the health impact on the community as a whole, and base it on existing scientific information.

- Developing recommendations: In this report, the Florida DOH outlines, in plain language, its conclusions regarding any potential health threat posed by surface soil and offers recommendations for reducing or eliminating human exposure to contaminants. The role of the Florida DOH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions for other agencies, including the EPA and the Florida Department of Environmental Protection (DEP). If, however, an immediate health threat exists or is imminent, Florida DOH will issue a public health advisory warning people of the danger, and will work to resolve the problem.

- Soliciting community input: The evaluation process is interactive. The Florida DOH starts by soliciting and evaluating information from various government agencies, individuals, or organizations responsible for cleaning up the site, and those living in communities near the site. We share any conclusions about the site with the groups and organizations providing the information. Once we prepare an evaluation report, the Florida DOH seeks feedback from the public.

If you have questions or comments about this report, we encourage you to contact us.

Please write to: Public Health Toxicology Section
Florida Department Health
4052 Bald Cypress Way, Bin # A-08
Tallahassee, FL 32399-1712

Or call us at: 850 245-4401 or toll-free in Florida: 1-877-798-2772

Summary

INTRODUCTION

At the Cabot Carbon-Koppers Superfund hazardous waste site, the Florida Department of Health (DOH) and the US Agency for Toxic Substances and Disease Registry (ATSDR) serve the public by using the best available science, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful toxic substances.

Between 1916 and 2009, the Koppers facility preserved wood utility poles and timber. At various times they used creosote, pentachlorophenol (PCP), and chromated copper arsenate (CCA). Past waste disposal caused soil and groundwater contamination. Some of these contaminants have affected surface soil near the facility.

In three previous reports, the Florida DOH and ATSDR reviewed results of 2009-2010 surface soil tests in the surrounding residential area. They recommended:

- Parents keep children from playing in the City of Gainesville easement bordering the Koppers facility, and
- The responsible party should determine the full extent of off-site contamination.

OVERVIEW

In this report, Florida DOH and ATSDR review arsenic, polycyclic aromatic hydrocarbon (PAH), and dioxin contaminant levels in surface soil collected in January 2012 in the adjacent neighborhood and surrounding areas.

CONCLUSION #1

Based on January 2012 tests, Florida DOH and ATSDR conclude that incidental ingestion (swallowing) of very small amounts of contaminated surface soil in the adjacent neighborhood and surrounding area is not expected to harm children or adults. People accidentally swallowing very small amounts of this soil over a lifetime are at an estimated "very low" increased risk of cancer. This is an upper estimate of the increased cancer risk. The actual increased cancer risk is likely lower.

BASIS FOR DECISION #1

Surface soil in the adjacent neighborhood and surrounding area is contaminated with arsenic, dioxins, and polycyclic aromatic

hydrocarbons (PAHs). Children who play outside are likely to ingest (swallow) very small amounts of soil. Adults who work outside and eat or smoke before washing their hands may also ingest (swallow) a very small amount of soil.

Based on January 2012 tests, the highest amounts of contaminants that children or adults are likely to ingest are below ATSDR health guidelines and are not expected to cause harm. There is a "very low" increased estimated risk of cancer from exposure to arsenic and dioxins. Surface soil dioxin levels are, however, above the Florida remediation goal of 7 nanograms per kilogram (parts per trillion or ppt) for residential areas.

CONCLUSION #2

Because of their low water solubility, dioxins are not readily absorbed through the roots of most plants. Although there has been no testing of homegrown fruits or vegetables near the Koppers facility, it does not appear that consumption is a public health threat.

BASIS FOR DECISION #2

Zucchini appear to be unique in their ability to absorb dioxins from soil. Other vegetables do not absorb dioxins as readily. There are few gardens near the Koppers facility, and none are known to grow zucchini. Because the estimated maximum zucchini ingestion dioxin dose near the Koppers facility is 50 times less than the lowest observed adverse effect level, non-cancer illness is unlikely.

FOR MORE INFORMATION

If you have concerns about your health or the health of your children, you should contact your health care provider. You may also call the Florida DOH toll-free at 877 798-2772 for more information about the Cabot Carbon-Koppers facility.

Statement of Issue

The purpose of this report is to assess the public health threat from toxic chemicals found in surface soil samples collected January 2012 in the residential area just west of the Koppers facility and surrounding areas. This is the fourth Florida Department of Health (DOH)/US Agency for Toxic Substances and Disease Registry (ATSDR) report assessing soil test results surrounding the Koppers portion of the Cabot Carbon-Koppers Superfund hazardous waste site.

The Alachua County Health Department (CHD) requested this assessment. The Florida DOH evaluates the public health threat of environmental contamination through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia. The conclusions and recommendations in this report are only advisory. They are not regulatory. The US Environmental Protection Agency (EPA), in consultation with Florida Department of Environmental Protection (DEP), has regulatory authority at this site and decides the cleanup requirements.

Background

In the early 1980s, EPA detected various organic chemicals, including aromatic and polycyclic aromatic hydrocarbons (PAHs) in soil and groundwater on both the Cabot Carbon and Koppers portions of the site. Although groundwater is contaminated, nearby homes and businesses receive municipal water from distant wells. In September 1984, EPA added the Cabot Carbon-Koppers site to their Superfund National Priorities List (NPL).

In 1985, Florida DEP installed a surface water interceptor system to prevent contamination from the Cabot Carbon portion of the site from entering the ditch leading to Springstead Creek. In 1995, the party responsible for the Cabot Carbon site excavated sediments from a short section of the North Main Street ditch and installed a trench to intercept contaminated shallow aquifer groundwater.

In 1989, Florida DOH (then known as Health and Rehabilitative Services or HRS) reviewed on-site soil and groundwater test results from the Cabot Carbon-Koppers site. Test results for off-site soil, groundwater, or creek sediments were not available at that time. Based on the on-site contamination, Florida DOH found the Cabot Carbon-Koppers site a potential health risk, recommended warning signs around the site, and recommended additional environmental testing [ATSDR 1989].

In 1993, Florida DOH found most of its 1989 recommendations had been followed but recommended a more comprehensive assessment [ATSDR 1993]. In 1995, they conducted a more comprehensive assessment. Florida DOH found arsenic levels measured during 1981 in Springstead Creek sediments at the Koppers facility drainage ditch outfall that, if ingested for more than a year, could cause gastrointestinal irritation, pigmentation changes, and hyperkeratosis. In subsequent years, however, sediment arsenic levels decreased to levels below those likely to cause illness. Levels of chromium, phenol, and benzene in sediments were not likely to cause illness. Florida

DOH recommended additional testing of sediments in Springstead Creek. They also recommended warning signs be placed around the Koppers facility and site access be restricted [ATSDR 1995a]. Sometime after 1995, the responsible party posted warning signs.

Beazer East, Inc., the party responsible for the Koppers facility, has been treating contaminated groundwater since 1995. In December 2009, the Koppers facility ceased operations.

In three previous reports, Florida DOH and ATSDR reviewed soil test results in the neighborhood just west of the Koppers facility as well as in surrounding areas. They found dioxin contamination in the 30-foot wide City of Gainesville easement between NW 26th and NW 30th Avenues on the western border of Koppers facility could possibly harm children's health. Florida DOH recommended parents keep children from playing in this easement [ATSDR 2009, 2010, 2011]. The responsible party erected a permanent fence and posted permanent warning signs. The responsible party will address the contaminated soil in this easement as part of the site cleanup.

Florida DOH and ATSDR concluded incidental ingestion (swallowing very small amounts) of dioxin-contaminated surface soil in the adjacent neighborhood and surrounding areas is not expected to harm children or adults. Accidentally swallowing very small amounts of this soil over a lifetime may result in a "very low" increased risk of cancer. Florida DOH and ATSDR also recommended more soil testing to determine the full extent of the soil contamination [ATSDR 2009, 2010, 2011a].

In two previous reports, Florida DOH epidemiologists analyzed cancer disease rates for the area around the Koppers facility using data from the Florida Cancer Data System. They were unable to identify an increase in overall area cancer rates between 1981 and 2010 [DOH 2011a, 2012].

In April 2010, representatives for 12 nearby residents claimed a screening test found dioxins in the dust of nine area homes [Parsons 2010]. In February 2011, these representatives also claimed additional screening tests found dioxins in the dust of 105 area homes [Calwell 2011]. Documentation, however, was insufficient to judge the validity of the data or the possible public health implications. In July 2011, a workgroup of local/state/federal health and environmental agencies as well as community leaders, University of Florida toxicologists, and the responsible party recommended EPA investigate indoor dust [DOH 2011b]. In May 2012, EPA collected indoor dust samples from area homes for dioxin analysis. In December 2012, EPA informed nearby residents that levels of dioxins in indoor dust are not a health risk and would not require cleanup. In a May 2013 draft report, Florida DOH and ATSDR found that indoor dust is not likely to cause non-cancer illness and the estimated increased cancer risk is very low [ATSDR 2013].

In early 2011, the party responsible for the Cabot Carbon portion of the site cleaned up tarry wastes in sediments of the North Main Terrace ditch and Springstead and Hogtown creeks.

EPA is requiring cleanup of off-site soil consistent with State of Florida cleanup guidance including excavation and removal of impacted soil that exceeds current land use cleanup goals. The State of Florida cleanup goal for residential soil is no more than 1 in a million (10^{-6}) increased cancer risk based on lifetime exposure. Beazer East, Inc. plans to clean up soil on the Koppers facility and in the adjacent neighborhood in the next 2 or 3 years.

Site Description

The 90-acre Koppers facility is at 200 N.W. 23rd Blvd. northwest of the intersection of NW 23rd Avenue and North Main Street in Gainesville, Alachua County, Florida 32609. The Koppers facility occupies the western part of the larger 140-acre Cabot Carbon-Koppers Superfund hazardous waste site.

The Koppers facility owners used their site for wood treatment between 1916 and 2009. At various times the Koppers facility preserved wood utility poles and timber using three different chemicals: creosote, pentachlorophenol (PCP), and chromated copper arsenate (CCA). Past waste disposal caused soil and groundwater contamination. Nearby residents reported thick black smoke from the site. Historical air monitoring data, however, are nonexistent. Wood preserving chemicals from the Koppers facility have contaminated soil in the adjacent neighborhood west of the site as well as surrounding areas. In 2010, the responsible party demolished the former wood treating buildings and facilities.

Starting in 1945, Cabot Carbon made chemicals and charcoal from pine trees on 50 acres east of the Koppers facility. Past waste disposal at the Cabot Carbon site contaminated soil and groundwater. Cabot Carbon closed in 1966. In 1976, a developer released pine tar waste from the site into a ditch leading to Springstead Creek that flows into Hogtown Creek. Subsequent investigations confirmed citizens' complaints of tarry wastes in these two creeks. A commercial shopping mall, a car dealership, and a series of smaller stores and businesses now occupy the Cabot Carbon site.

Demographics

Approximately 7,170 people live within one mile of the Cabot Carbon-Koppers site. Sixty-three percent (63%) are white, 31% are African-American, 4% are Hispanic origin, and 2% are of other descent. Twenty-two percent (22%) are less than 18 years old and 78% are older than 18. Forty-four percent (44%) have a high school diploma or less and 56% have at least two years of college. Ninety-one percent (91%) of these nearby residents speak only English and 82% make less than $50,000 a year [EPA 2010].

Land Use

Land use immediately west of the Koppers facility is residential. Further to the west, land use is mixed residential/commercial. Land use immediately to the north and south of the Koppers facility is mixed residential/commercial/industrial. Land use on and east of the Cabot Carbon portion of the site is commercial.

Community Health Concerns

For many years nearby residents, especially those in the adjacent neighborhood west of the Koppers facility, have been concerned about the health threat from contaminated soil and indoor dust. Specifically, they are concerned about asthma and other respiratory problems, birth defects, cancer, chloracne, headaches, immune system impairment, lupus, miscarriages, multiple sclerosis, nosebleeds, phantom itch, stillbirths, and thyroid problems. Also, nearby residents are concerned about contaminants in sediments of the creek that drain the site.

Discussion

Environmental Data

In January 2012, consultants for Beazer East, Inc. (the party responsible for the Koppers facility portion of the site) collected surface soil (0-6 inches deep) in the surrounding community. Table 1 lists the analytical results for each sample. These consultants collected two surface soil samples from the residential area just west of the Koppers facility and one from the area south of the Koppers facility (Figure 1). They analyzed these samples for arsenic (Table 2). Next, they collected nine surface soil samples from the adjacent neighborhood and area south of the Koppers facility (Figures 2 and 3). They analyzed for polycyclic aromatic hydrocarbons (PAHs expressed as benzo[a]pyrene toxicity equivalent quotient or BaP-TEQ) and dioxins (expressed as 2,3,7,8-tetrachloro-p-dioxin toxicity equivalent quotient or TCDD-TEQ) (Tables 3 and 4). In addition, they collected one surface soil sample from the City of Gainesville public works property north of the Koppers facility (Figure 3) and analyzed for dioxins (Table 5) [ARCADIS 2012].

To determine area background concentrations, consultants for Beazer East, Inc. collected 10 surface soil samples from the right-of-way of busy streets over a mile from the Koppers facility (Figure 4) and analyzed for PAHs and dioxins [ARCADIS 2012]. For a more comprehensive evaluation of background conditions, Florida DOH combined these background test results with those from earlier reports (Tables 2 thru 5).

The highest surface soil concentrations of acenaphthene, anthracene, fluoranthene, fluorene, naphthalene, and pyrene (all polycyclic aromatic hydrocarbons or PAHs) were below their ATSDR screening values for non-cancer illness. Therefore, Florida DOH did not select these PAHs as contaminants of concern. However, the highest concentration of the following PAHs, expressed as benzo(a)pyrene toxicity equivalence (BaP-TEQ), was greater than the ATSDR cancer risk evaluation guide.

Dibenz[a,h]anthracene
Benzo[a]pyrene
Benz[a]anthracene
Benzo[b]fluoranthene
Benzo[k]fluoranthene

Indeno[1,2,3-c,d]pyrene
Anthracene
Benzo[g,h,i]perylene
Chrysene
Acenaphthene
Acenaphthylene
Fluroanthene
Fluorene
Phenanthrene
Pyrene

Therefore, Florida DOH selected these PAHs, expressed as BaP-TEQ, as contaminants of concern to evaluate their cancer risk. Florida DOH and ATSDR selected BaP-TEQ even though the concentrations are within the range of BaP-TEQ concentrations found in surface soil along busy residential streets in background areas of Gainesville. Asphalt road paving and vehicle exhaust are both sources of PAHs, including BaP-TEQ.

Because the highest surface soil concentration of arsenic was above the ATSDR screening guideline, Florida DOH selected it as a contaminant of concern. For consistency with previous reports, Florida DOH also selected dioxins as contaminants of concern.

The concentrations of dioxins in surface soil of the adjacent neighborhood and surrounding areas measured in January 2012 are similar to those measured in 2009 and 2010. Although these levels are below ATSDR screening guidelines, they are none-the-less above the Florida remediation goal of 7 nanograms per kilogram (parts per trillion or ppt) for residential areas.

For this health consultation, surface soil testing has been inadequate to determine the full extent of contamination from the Koppers facility. EPA should require the responsible party to determine the full extent of contamination in the adjacent neighborhood and surrounding areas.

Because people are usually only exposed to the top 3 inches of soil, Florida DOH and ATSDR recommend collection of surface soil from the top 3 inches. Florida DEP guidelines, however, call for collection of surface soil from the top 6 inches. For dust-borne, water insoluble contaminants such as arsenic, PAHs, and dioxins; analysis of samples from the top 6 inches may underestimate exposure . At this site, EPA decided to collect surface soil samples from the top 6 inches. Although not preferable, in this report Florida DOH and ATSDR assessed the health threat based on the only available data: surface soil samples from the top 6 inches.

Pathway Analyses

Chemical contamination in the environment can harm your health, but only if you have contact with those contaminants (exposure). Without contact or exposure, there is no harm to health. If there is contact or exposure, the risk of harm is determined by the amount of the contaminants you come into contact with (concentration), how often you contact them (frequency), for how long you contact them (duration), and the danger of the contaminant (toxicity).

Knowing or estimating the frequency with which people could have contact with hazardous substances is essential to assessing the public health importance of these contaminants. To decide if people can contact contaminants at or near a site, the Florida DOH looks at human exposure pathways. Exposure pathways have five parts. They are:

1. a source of contamination like a hazardous waste site,
2. an environmental medium like air, water, or soil that can hold or move the contamination,
3. a point where people come into contact with a contaminated medium like water at the tap or soil in the yard,
4. an exposure route like ingesting (contaminated soil or water) or breathing (contaminated air), and
5. a population who could be exposed to contamination, like nearby residents.

The Florida DOH eliminates an exposure pathway if at least one of the five parts referenced above is missing and will not occur in the future. Exposure pathways not eliminated are determined to be either completed or potential. For completed pathways, all five pathway parts exist and exposure to a contaminant has occurred, is occurring, or will occur. For potential pathways, at least one of the five parts is missing now, but could exist. Also for potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

Compared to ingestion (eating/drinking), the risk from dermal exposure (skin absorption) to chemicals in soil is usually insignificant. Therefore, human health risk assessments do not typically evaluate the risk from skin absorption.

For this assessment, we evaluate the long-term health threat from accidentally ingesting (swallowing) very small amounts of surface soil in the adjacent neighborhood and surrounding areas (Table 6). Incidental soil ingestion is common in children less than 6 years old who put soiled fingers or toys in their mouth. Incidental soil ingestion occurs to a lesser degree with adults who smoke or eat without washing their hands after working outside.

The five exposure pathway elements are:

1. The Koppers facility is the source.
2. Small soil particles (dust) blown by the wind from the site into the nearby neighborhood is the environmental medium.
3. The residential area just west of the Koppers facility and surrounding areas is the point of exposure.
4. Ingestion, accidentally swallowing very small amounts of soil, is the exposure route.
5. Nearby residents are the exposed population.

This assessment also evaluates the long-term health threat from accidentally ingesting (swallowing) very small amounts of surface soil at the City of Gainesville public works property north of the Koppers facility (Table 6).

1. The Koppers facility is the source.
2. Small soil particles (dust) blown by the wind from the site is the environmental medium.
3. The City of Gainesville public works property north of the Koppers facility is the point of exposure.
4. Ingestion, accidentally swallowing very small amounts of soil, is the exposure route.
5. City of Gainesville workers are the exposed population.

This assessment also evaluates the future potential threat from eating vegetables grown in dioxin contaminated surface soil (Table 7). The major source of human exposure to dioxins in food is <u>not</u>, however, fruits and vegetables but meat, fish, and dairy products. Meat, fish, and dairy products contribute about 98% of the daily food intake of dioxins while fruits and vegetables contribute about 1%. In a previous report, Florida DOH and ATSDR did not find a significant health threat from ingestion of the eggs from chickens raised near the Koppers facility [ATSDR 2011b].

For most plants, atmospheric deposition is the primary mechanism of contamination. Because of dioxins' low water solubility, plant uptake from the soil via the roots is usually negligible. Dioxins from contaminated soil may adhere to the outside of plant roots, but, as in the case of carrots, peeling easily removes the contamination [ATSDR 1998].

Zucchini, however, appear to be unique in their ability to absorb dioxins from soil [Zhang 2009]. Other cucurbits, such as pumpkins and cucumbers, do not absorb dioxins as readily [Inui 2013]. This assessment evaluates the potential health effects from ingestion of homegrown zucchini.

Public Health Implications

Florida DOH evaluates exposures by estimating daily doses for children and adults. Karmin [1988] explains the concept of dose as follows:

> "…all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus, the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.

Thus instead of using the amount that is administered or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus, 1 ounce administered to a 1-pound rat is equivalent to 2,000 ounces to a 2,000-pound (1-ton) elephant. In each case, the amount per weight is the same; 1 ounce for each pound of animal."

This amount per weight is the *dose*. Toxicology uses dose to compare toxicity of different chemicals in different animals. We use the units of milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day) to express doses in this assessment. A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds. For dioxins, we use the units of micrograms (µg) per kilogram per day (µg/kg/day).

To calculate the daily doses of each contaminant, the Florida DOH uses standard factors for dose calculation [ATSDR 2005; EPA 2011]. Florida DOH assumes that people are exposed daily to the maximum concentration measured and makes the health protective assumption that 100% of the ingested chemical is absorbed into the body. The percent actually absorbed into the body is likely less.

Non-carcinogens - For an assessment of the non-cancer health risk, Florida DOH and ATSDR use the following formula to estimate a dose:

D = (C x IR x EF x CF) / BW

D = exposure dose (milligrams per kilogram per day or mg/kg/day)
C = contaminant concentration (milligrams per kilogram or mg/kg)
IR = intake rate of contaminated soil (milligrams per day or mg/day)
EF = exposure factor (unitless)
CF = conversion factor (10^{-6} kilograms per milligram or kg/mg)
BW = body weight (kilograms or kg)

EF = F x ED / AT

EF = exposure factor (unitless)
F = frequency of exposure (days/year)
ED = exposure duration (years)
AT = averaging time (days) (ED x 365 days/year for non-carcinogens; 70 years x 365 days/year for carcinogens)

To estimate exposure from the incidental ingestion (swallowing) of contaminated soil, the Florida DOH uses the following assumptions:

1) Children ingest (swallow) an average of 200 milligrams (mg) of soil per day (about the weight of a postage stamp),
2) The unusual child with soil-pica behavior ingests an average of 5,000 mg of soil per day, 3 days per week,
3) Adults ingest an average of 100 mg of soil per day,
4) Adults weigh an average of 80 kg, or about 176 pounds,

5) A 1-2 year old child weighs an average of 11.4 kg, or about 25 pounds
6) Exposure duration for an adult resident is 78 years,
7) Children and adults ingest (swallow) contaminated surface soil at the maximum concentration measured for each contaminant.

This assessment also estimates exposure for the unusual child who repeatedly ingests (swallows) unusually large amounts of soil: “soil-pica” behavior. An assessment of soil-pica behavior is only appropriate for acute exposures (less than two weeks). Children with this unusual soil-pica behavior can eat up to a teaspoon of dirt (5,000 milligrams/ day). This is 25 times the default soil ingestion rate for normal children (200 milligrams/ day). Soil-pica behavior is usually limited to preschool children. One and two-year-old children have the greatest tendency for this unusual soil-pica behavior. This tendency decreases in children older than two years old.

For non-cancer illnesses, we first estimate the health risk for children. Because children are smaller and are assumed to swallow more soil than adults do, their exposure dose is higher. Therefore, if children are not at risk then adults are not either.

Carcinogens – For carcinogens that do not have a mutagenic mode of action, such as arsenic and dioxins, Florida DOH and ATSDR use the following equation to estimate cancer risk for children and adults:

Risk = [C x IR x CF x EF x ED x SF] / [BW x AT]

C = maximum arsenic soil concentration in milligrams per kilogram (mg/kg)
IR = incidental soil ingestion rate in milligrams per day (mg/day)
CF = conversion factor from kilograms to milligrams
EF = exposure frequency in days per year
ED = exposure duration in years (yrs.)
SF = cancer slope factor per milligrams per kilogram per day $(mg/kg/day)^{-1}$
BW = body weight in kilograms (kg)
AT = averaging time in days

For carcinogens that do have a mutagenic mode of action, such as BaP, Florida DOH and ATSDR use the following equation to estimate the cancer risk for various age groups:

Risk = [C x IR x CF x EF x ED x SF x ADAF] / [BW x AT]

C = maximum arsenic soil concentration in milligrams per kilogram (mg/kg)
IR = incidental soil ingestion rate in milligrams per day (mg/day)
CF = conversion factor from kilograms to milligrams
EF = exposure frequency in days per year
ED = exposure duration in years (yrs.)
SF = cancer slope factor per milligrams per kilogram per day $(mg/kg/day)^{-1}$
ADAF = age-dependent adjustment factor
BW = body weight in kilograms (kg)
AT = averaging time in days

To put numerical estimates of increased cancer risks into perspective, Florida DOH uses the following descriptors:

1 in	10 (10^{-1})	"very high" increased cancer risk
1 in	100 (10^{-2})	"high" increased cancer risk
1 in	1,000 (10^{-3})	"moderate" increased cancer risk
1 in	10,000 (10^{-4})	"low" increased cancer risk
1 in	100,000 (10^{-5})	"very low" increased cancer risk
1 in	1,000,000 (10^{-6})	"extremely low" increased cancer risk

To select one of the above increased cancer risk descriptors, Florida DOH rounds the calculated cancer risk to the nearest power of ten. For example, a calculated increased cancer risk of 9×10^{-6} would round to 10×10^{-6} or 10^{-5}, which is a "very low" increased cancer risk.

Residential Area Just West of the Koppers Facility and Surrounding Areas

This section evaluates the health risk from exposure to arsenic, polycyclic aromatic hydrocarbons (PAHs), and dioxins in the surface soil in the adjacent neighborhood and surrounding areas. It also evaluates potential future exposure to dioxins in homegrown zucchini.

Arsenic

Arsenic is a naturally occurring metal widely distributed in soil. Scientists usually find it combined with oxygen, chlorine, and sulfur. Most arsenic compounds have no smell or special taste. The Koppers facility used arsenic to make wood resistant to rot and decay ("pressure treated" wood).

Non-cancer risk - Children in the adjacent neighborhood and surrounding areas who incidentally ingest (swallow) very small amounts of surface soil with the highest arsenic levels are not likely to suffer any non-cancer illnesses. The estimated maximum arsenic dose for children playing in this soil (0.00005 mg/kg/day) is less than the ATSDR chronic oral minimal risk level (MRL) (0.0003 mg/kg/day) [ATSDR 2007]. Doses below the MRL are not likely to cause any non-cancer illnesses.

For the unusual child with soil-pica behavior, short-term (< 2 weeks) exposure to soil in the adjacent neighborhood with the highest arsenic concentration is not likely to cause illness. This assumes children 1 to <2 years old with the unusual soil-pica behavior live at a residence with the maximum surface soil arsenic concentration of 3.9 mg/kg. It assumes a child with soil-pica behavior ingests 5,000 mg soil/day, 3 day/ week. Because this unusual soil-pica behavior can occur for several months, it assumes acute length exposure (2 weeks) and intermediate length exposure (12 weeks).

$$EF_{acute} = \frac{ED}{\text{Av Time}} = \frac{3 \text{ days/wk} \times 2 \text{ wks}}{7 \text{ days/wk} \times 2 \text{ wks}} = 0.429 \text{ or } EF = 3/7$$

$$EF_{intermediate} = \frac{ED}{\text{Av Time}} = \frac{3 \text{ days/wk} \times 12 \text{ wks}}{7 \text{ days/wk} \times 12 \text{ wks}} = 0.429 \text{ or } EF = 3/7$$

D_{pica} = 3.9 mg/kg x 5,000 mg/day x 0.429 x 10^{-6} kg/mg / 11.4 kg
D_{pica} = 0.0007 mg/kg/day

ATSDR acute oral MRL for arsenic = 0.005 mg/kg/day

Since the acute length dose for a child with unusual soil-pica behavior exposed to the maximum arsenic level in off-site soil is less than the ATSDR acute MRL, non-cancer illness is not likely. There is no ATSDR MRL for intermediate length exposure.

Cancer risk - People in the adjacent neighborhood and surrounding area who incidentally ingest (swallow) very small amounts of surface soil with the highest arsenic levels over an entire lifetime (78 years) are at a "very low" increased theoretical risk of cancer (Table 8). To select the "very low" increased cancer risk descriptor, Florida DOH rounded the 14 x 10^{-6} calculated cancer risk to 1 x 10^{-5}. This estimate uses the highest soil concentration measured, higher end estimate of incidental soil ingestion, and the upper range of the cancer potency. Thus, this is an upper estimate of the increased cancer risk for exposure to arsenic in soil. The actual increased cancer risk is likely lower.

To put this "very low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 100,000 people, on average about 33,333 will get some form of cancer during their lifetime. Exposure to this soil with the highest arsenic concentration would, at most, increase the lifetime cancer risk from 33,333 cases in 100,000 people to 33,334 cases in 100,000 people.

Polycyclic Aromatic Hydrocarbons (PAHs): Benzo[a]pyrene Toxicity Equivalence Quotient (BaP-TEQ)

Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals formed during the incomplete burning of coal, oil, gas, wood, garbage, tobacco, and charbroiled meat. More than 100 different PAHs exist. PAHs generally occur as complex mixtures. Scientists also find PAHs in asphalt, crude oil, coal, coal tar pitch, creosote, and roofing tar. In the past, the Koppers facility treated wood with creosote that contained PAHs. Scientists often find small amounts of PAHs throughout the environment in air and soil. Other sources include cigarette smoke, vehicle exhaust, wildfires, agricultural burning, and residential wood burning. PAHs do not easily dissolve in water but stick tightly to soil particles.

The laboratory reported the concentrations of individual PAHs. To summarize the toxicity of the mixture of carcinogenic PAHs found in surface soil, the laboratory also reported PAH concentrations in relation to the toxicity of benzo[a]pyrene, one of the most studied PAHs. In animals, ingestion of benzo[a]pyrene causes cancer of the stomach, esophagus, and larynx. Florida DOH evaluated the toxicity of the carcinogenic PAHs in terms of benzo[a]pyrene toxicity equivalents (BaP-TEQ).

The concentrations of BaP-TEQ found in the neighborhood surface soil adjacent to the Koppers facility are within the range of BaP-TEQ concentrations found in surface soil along busy residential streets in background areas of Gainesville. As discussed above asphalt road paving and vehicle exhaust are both sources of PAHs, including BaP-TEQ.

Non-cancer risk - Children in the adjacent neighborhood and surrounding area who incidentally ingest (swallow) very small amounts of surface soil with the highest PAH concentrations are not likely to suffer any non-cancer illnesses. The highest concentrations of acenaphthene, anthracene, fluoranthene, fluorene, naphthalene, and pyrene (all PAHs) were below their ATSDR screening values and thus not likely to cause any non-cancer illness.

For the unusual child with soil-pica behavior, exposure to soil in the adjacent neighborhood with the highest BaP-TEQ concentration is not likely to cause illness. This assumes children 1 to <2 years old with unusual soil-pica behavior live at a residence with the highest surface soil BaP-TEQ concentration of 1.9 mg/kg. It also assumes a child with soil-pica behavior ingests 5,000 mg soil/day, 3 day per week. Because this unusual soil-pica behavior can occur for several months, it assumes acute length exposure (2 weeks) and intermediate length exposure (12 weeks). Florida DOH and ATSDR calculate a dose using the following equation:

D_{pica} = 1.9 mg/kg x 5,000 mg/day x 0.429 x 10^{-6} kg/mg / 11.4 kg
D_{pica} = 0.0004 mg/kg/day

There is too little information for ATSDR to derive an MRL for *acute or intermediate* length oral exposure to BaP-TEQ. However, the lowest observed adverse effect level (LOAEL) in an acute length animal study was 40 mg/kg/day. The highest estimated dose for a child with the unusual soil-pica behavior near the Koppers facility is 100,000 times less than this LOAEL.

There are no ATSDR MRLs for *acute* length oral exposure to other PAHs. There are, however, ATSDR MRLs for *intermediate* length oral exposure to other PAHs such as acenapthene (0.6 mg/kg/day), fluoranthene (0.4 mg/kg/day), fluorene (0.4 mg/kg/day), and anthracene (10 mg/kg/day). The highest estimated dose for a child with the unusual soil-pica behavior near the Koppers facility is 1,000 to 25,000 times less than these MRLs.

Although there is uncertainty in the lowest BaP-TEQ dose that causes non-cancer health effects, the large difference in the dose between these studies and the dose estimated for a child with the unusual soil-pica behavior, makes non-cancer illness near the Koppers facility unlikely.

Cancer risk – People in the adjacent neighborhood and surrounding area who incidentally ingest (swallow) very small amounts of surface soil with the highest BaP-TEQ levels over an entire lifetime (78 years) are at a "low" increased theoretical risk of cancer (Table 9). To select the "low" increased cancer risk descriptor, Florida DOH rounded the 9.1 x 10^{-5} calculated cancer risk to 1 x 10^{-4}. This estimate uses the highest soil concentration measured, higher end estimate of incidental soil ingestion, and the upper range of the cancer potency. Thus, this is an upper estimate of the increased cancer risk for exposure to BaP-TEQ in soil. The actual increased cancer risk is likely lower.

To put this "low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 10,000 people, on average about 3,333 will get some form of cancer during their lifetime. Exposure to this soil with the highest BaP-TEQ concentration would, at most, increase the lifetime cancer risk from 3,333 cases in 10,000 people to 3,334 cases in 10,000 people.

Dioxins: 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxicity Equivalence (TCDD-TEQ)

Dioxins are a family of chlorinated compounds with similar structures but varying toxicities. They have very low solubility in water and tend to stick to ash, soil, plant leaves, or any surface with a high organic content. Small amounts of dioxins are produced by forest fires, manufacturing of pentachlorophenol wood preservative/ bleached paper, and burning municipal garbage that contains plastic [ATSDR 1998].

One of the most toxic and well-studied dioxins is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). TCDD-TEQ (2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent quotient) estimates the toxicity of a group of closely related dioxins. Florida DOH bases the following assessment on the current understanding of the toxicology of dioxins. The understanding of the toxicology of dioxins, however, continues to evolve.

Non-cancer risk – Children in the adjacent neighborhood and surrounding area who incidentally ingest (swallow) very small amounts of surface soil with the highest TCDD-TEQ levels are not likely to suffer any non-cancer illnesses. The maximum TCDD-TEQ dose for children playing in this soil (4 x 10^{-10} milligrams per kilogram per day or mg/kg/day) is less than the ATSDR chronic oral minimal risk level (1 x 10^{-9} mg/kg/day) [ATSDR 1998]. Doses at or below the ATSDR chronic oral minimal risk level are not likely to cause any non-cancer illnesses.

For the unusual child with soil-pica behavior, exposure to soil in the adjacent neighborhood with the highest dioxin concentration is not likely to cause illness. This assumes children 1 to <2 years old with soil-pica behavior live at a residence with the highest surface soil dioxin concentration of 0.00003 mg/kg. It also assumes a child with the unusual soil-pica behavior ingests 5,000 mg soil/day, 3 day per week. Because soil-pica behavior can occur for several months, it assumes acute length exposure (2 weeks) and intermediate length exposure (12 weeks). Florida DOH and ATSDR calculate a dose using the following equation:

D_{pica} = 0.00003 mg/kg x 5,000 mg/day x 0.429 x 10^{-6} kg/mg / 11.4 kg
D_{pica} = 6 x 10^{-9} mg/kg/day

The ATSDR acute length exposure oral MRL for dioxins is 2 x 10^{-7} mg/kg/day and the intermediate length exposure oral MRL is 2 x 10^{-8} mg/kg/day. Therefore, the unusual child with soil-pica behavior near the Koppers facility is not likely to suffer any non-cancer illness.

Because of their low water solubility, dioxins are not readily absorbed through the roots of most plants. Although there has been no testing of homegrown fruits or vegetables near the Koppers facility, it does not appear that consumption is a public health threat.

Florida DOH is unaware of anyone growing zucchini near the Koppers site but none-the-less considered the risk from ingestion. Zucchini (*Cucurbita pepo*) appear to have a greater ability than most plants to absorb and translocate dioxins [Zhang 2009]. Other cucurbits, such as pumpkins and cucumbers, do not absorb dioxins as readily.

In one German study, a soil dioxin concentration of 148 parts per trillion (ppt) TEQ resulted in a concentration of 20 ppt (ng/kg) TEQ (dry weight basis) in the edible portion of zucchini [Hulster 1994]. This represents a zucchini dioxin concentration equal to 13.5% of the soil dioxin concentration. Using this same 13.5% ratio of soil/zucchini dioxin concentrations and assuming similar soil organic content, the most highly dioxin contaminated residential soil near the Koppers facility (70 ppt TEQ) could result in a dioxin concentration of 9 ppt (9 x 10^{-6} mg/kg) TEQ (dry weight basis) in homegrown zucchini.

NHANES reports a mean zucchini ingestion rate of 0.0007 kilograms zucchini/kilogram body weight-day [EPA 2011, Table 9-6]. This rate, however, assumes ingestion of zucchini on a "as is, wet weight" basis. The following equation converts the wet weight ingestion rate to a dry weight ingestion rate:

IR_{dw} = (IR_{ww}) x (100 – W/100)

IR_{dw} = intake rate, dry weight
IR_{ww} = intake rate, wet weight
W = percent water content

Assuming an average zucchini moisture content of 94% [EPA 2011, Table 9-37], the mean zucchini dry weight ingestion rate is 4.2 x 10^{-5} kg zucchini/kg body weight-day.

IR_{dw} = (0.0007 kg zucchini/kg body weight-day) x (100-94/100)
= 0.000042 kg zucchini/kg body weight-day
= 4.2 x 10^{-5} kg zucchini/kg body weight-day

The following equation gives the daily dose from eating zucchini grown in soil near the Koppers site with the highest dioxin concentration. (Because the ingestion rate incorporates body weight, the equation does not include a body weight term.)

D = CL x CR x EF

D = dose (in mg/kg/day)
CL = contaminant concentration (in mg/kg) = 9 x 10^{-6} mg/kg
CR = consumption rate (in kg/kg body weight-day) = 4.2 x 10^{-5} kg zucchini/kg body weight-day
EF = exposure factor (unit less) = 1

EF = F x ED / AT

F = frequency of exposure (days/year) = 365 days/year
ED = exposure duration (years) = 10 years
AT = averaging time (days) = (ED x 365 days/year for non-carcinogen effects) = 3650 days

$D_{zucchini}$ = (9 x 10^{-6} mg dioxin/kg zucchini) x (4.2 x 10^{-5} kg zucchini/kg body weight-day) x (1)
$D_{zucchini}$ = 4 x 10^{-10} mg/kg/day

EPA derived a lowest observed adverse effect level (LOAEL) of 2 x 10^{-8} mg/kg/day from two epidemiological studies. One study found a decreased sperm count in men exposed as boys for 10 years to 2 x 10^{-8} mg/kg/day of dioxins. Another study found increased thyroid stimulating hormone (TSH) levels in newborns of mothers exposed over 30 years to 2 x 10^{-8} mg/kg/day dioxins [EPA 2013].

Because the estimated maximum zucchini ingestion dioxin dose of 4 x 10^{-10} mg/kg/day near the Koppers facility is 50 times less than the LOAEL of 2 x 10^{-8} mg/kg/day, non-cancer illness is unlikely.

Uncertainties exist, however, in this risk assessment for consumption of zucchini grown near the Koppers facility. First, this assessment uses the highest measured dioxin soil concentration. Using lower soil concentrations would result in lower predicted levels in zucchini. Second, is it unknown if any zucchini are actually grown near the Koppers facility or if they were grown in the past. Third, because the organic content of soil has a significant influence on dioxin uptake by plants, the difference in soil organic content between the German study and Gainesville soil is a significant uncertainty. Lastly, differences exist in dioxin uptake by zucchini subspecies [Inui 2008].

<u>Cancer risk</u> – People in the adjacent neighborhood and surrounding area who incidentally ingest (swallow) very small amounts of surface soil with the highest TCDD-TEQ levels over an entire lifetime (78 years) are at a “very low” increased estimated risk of cancer (Table 10). To select the “very low” increased cancer risk descriptor, Florida DOH rounded the 11 x 10^{-6} calculated cancer risk to 1 x 10^{-5}. This estimate uses the highest soil concentration measured, higher end estimate of incidental soil ingestion, and the

upper range of the cancer potency. Thus, this is an upper estimate of the increased cancer risk for exposure to TCDD-TEQ in soil. The actual increased cancer risk is likely lower.

To put this "very low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 100,000 people, on average about 33,333 will get some form of cancer during their lifetime. 33 years of ingestion of soil with the highest TCDD-TEQ concentration would, at most, increase the lifetime cancer risk from 33,333 cases in 100,000 people to 33,334 cases in 100,000 people.

City of Gainesville Public Works Property North of the Koppers Facility

This section evaluates the health risk for outdoor workers with low soil contact exposed to dioxins in the surface soil in the City of Gainesville public works property north of the Koppers facility.

Dioxins: 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxicity Equivalence (TCDD-TEQ)

Non-cancer risk – Outdoor workers (with low soil contact) at the City of Gainesville public works property north of the Koppers facility who incidentally ingest (swallow) very small amounts of surface soil with the highest TCDD-TEQ levels are not likely to suffer any non-cancer illnesses. This assumes 80 kg adult workers contact surface soil with the highest dioxin concentration of 0.00005 mg/kg. It also assumes these workers ingest 100 mg soil/day, 5 day per week (0.7143). Florida DOH and ATSDR calculate a dose using the following equation:

D_{worker} = 0.00005 mg/kg x 100 mg/day x 0.7143 x 10^{-6} kg/mg / 80 kg
D_{worker} = 4 x 10^{-11} mg/kg/day

The maximum estimated TCDD-TEQ dose (4 x 10^{-11} milligrams per kilogram per day or mg/kg/day) is less than the ATSDR chronic oral minimal risk level (1 x 10^{-9} mg/kg/day) [ATSDR 1998]. Doses at or below the ATSDR chronic oral minimal risk level are not likely to cause any non-cancer illnesses.

Cancer risk – Workers at the City of Gainesville public works property north of the Koppers facility who incidentally ingest (swallow) very small amounts of surface soil with the highest TCDD-TEQ levels for 20 years are at an "extremely low" (2 in a million or 2 x 10^{-6}) estimated increased risk of cancer (Table 11). This estimate uses the higher end estimate of incidental soil ingestion and the upper range of the cancer potency. Thus, this is an upper estimate of the increased cancer risk for exposure to TCDD-TEQ in soil. The actual increased cancer risk is likely lower.

To put this "extremely low" increased cancer risk into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 1,000,000 people, on average about 333,333 will get some form of cancer during their lifetime. Exposure to this soil with the highest TCDD-TEQ concentration would, at most, increase the lifetime cancer risk from 333,333 cases in 1,000,000 people to 333,335 cases in 1,000,000 people.

Health Outcome Data

In two previous reports, Florida DOH epidemiologists analyzed cancer rates for the area around the Koppers facility using data from the Florida Cancer Data System. They were unable to identify an increase in overall area cancer rates between 1981 and 2010 [DOH 2011a, 2012].

Child Health Considerations

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

This assessment takes into account the special vulnerabilities of children. It specifically assesses the health risk for children playing in the soil near the Koppers facility. In a previous report, Florida DOH and ATSDR found that incidental ingestion (swallowing) of very small amounts of dioxin-contaminated surface soil from the 30-foot wide City easement between NW 26th Avenue and NW 30th Avenue on the western boundary of the Koppers facility for more than a year could possibly harm children's health. This finding applies only to the soil in the 30-foot wide City easement on the western boundary of the Koppers facility. The maximum dioxin dose for children playing in this City easement is only one-quarter of the dose that causes moderate endometriosis and altered social behavior in monkeys. It is also just 21 times less than the lowest dose found to cause increased abortions, reduced reproduction, severe endometriosis, decreased offspring survival, and learning impairment in monkeys [ATSDR 1998]. Given the uncertainty in interspecies extrapolation, this is too small a margin of safety to say with certainty this dioxin dose would not cause illness in children playing in this easement. Therefore, Florida DOH and ATSDR found it prudent to recommend parents keep children from playing in this easement [ATSDR 2009]. In November/December 2010, the responsible party erected a permanent fence restricting access to this easement and posted warning signs.

Children who incidentally ingest (swallow) very small amounts of surface soil in other parts of the adjacent neighborhood and surrounding areas are not likely to suffer harm.

Community Health Concerns Evaluation

1. For many years nearby residents, especially those in the Stephen Foster neighborhood west of the Koppers facility, have been concerned about the health threat from contaminated soil in their neighborhood. Specifically they are concerned about asthma and other respiratory problems, birth defects, cancer, chloracne, headaches, immune system impairment, lupus, miscarriages, multiple sclerosis, nosebleeds, phantom itch, stillbirths, and thyroid problems.

Although levels of dioxins in surface soil in some parts of the adjacent neighborhood and surrounding areas are slightly above state cleanup standards, they are not likely to harm people's health. This is because state cleanup standards are set with large safety factors to ensure a large margin for public health and safety. Additional testing in the adjacent neighborhood is necessary, however, to determine the full extent of surface soil contamination. Historical levels of air-borne contaminants, however, are unknown.

<u>Asthma and Other Respiratory Problems</u> – Incidental ingestion (swallowing) of contaminants in adjacent neighborhood surface soil and surrounding areas is not likely to cause asthma or other respiratory problems.

Asthma is a chronic but reversible immunological condition that causes inflammation, excessive mucous secretion (phlegm) and constriction (narrowing) of the lung's airways. Asthma can produce coughing, wheezing, and shortness of breath. A wide variety of environmental factors may trigger an asthma attack. Factors include cold air and allergens (pet dander, dust mites, pollen). Inhaling an irritant (cigarette smoke, pollution) can prompt an asthma attack. Strenuous exercise, stress, and anxiety can also trigger attacks. The stimuli that trigger asthma attacks are different for each person who has asthma. Asthma attacks can vary widely in how severe they are and how long they last. It affects at least 17 million people in the United States and is becoming more widespread. It can affect people of any age or gender, but tends to begin in childhood. The incidence of asthma is higher among black and Hispanic populations living in cities where there is more air pollution [MERCK 2003, AMA 2003].

<u>Birth Defects</u> – Incidental ingestion (swallowing) of arsenic in adjacent neighborhood surface soil and surrounding areas is not likely to cause birth defects. The ability of dioxins and PAHs to cause birth defects in people is unknown.

Birth defects are abnormalities obvious at birth or detectable early in infancy. Also called congenital defects, they encompass both minor abnormalities, such as birthmarks and serious disorders such as spina bifida (a failure of the spinal column to close completely). About 2 percent of babies born in the United States have a defect but only about half of them require treatment [AMA 2003].

Birth defects may be due to one or more known causes, but unknown factors also play a part. Among the recognized causes are:

1. Chromosomal defects where babies have greater or less than the normal 23 pairs of chromosomes, or there are extra or missing bits of chromosomes as in Down's syndrome.

2. Genetic or hereditary defects inherited from one or both parents, as in albinism.

3. Defects caused by smoking, alcohol, and other drugs (teratogens) such as thalidomide, a widely used sedative in the late 1950s and early 1960s.

4. Irradiation defects from overexposure of the fetus to x-rays or cancer radiation therapy. Heavy radiation exposure in Hiroshima in 1945 caused serious mental and physical birth defects.

5. Maternal infection defects caused by infections such as German measles and toxoplasmosis in the mother during pregnancy.

Dioxins cause birth defects in animals. Human studies, however, have been too limited to conclude if dioxins cause birth defects in people or to quantify the risk [ATSDR 1998]. Some offspring of pregnant mice fed benzo(a)pyrene suffered birth defects. Similar effects could occur in people, but we have no information to show that these effects do occur [ATSDR 1995b].

<u>Cancer</u> - Over a lifetime, people accidentally swallowing (incidental ingestion) very small amounts of surface soil from the adjacent neighborhood are at a "low to very low" increased estimated risk of cancer. This assumes the highest soil contaminant concentration measured, higher end estimate of incidental soil ingestion, and the upper range of the cancer potency. Thus, this is an upper estimate of the increased cancer risk for exposure to contaminants in soil. The actual increased cancer risk is likely lower.

Florida DOH epidemiologists analyzed cancer data from the Florida Cancer Data System for the area around the Koppers facility. They were unable to identify an increase in overall area cancer rates between 1981 and 2010 [DOH 2011a, 2012].

Cancer is very common. The American Cancer Society estimates that doctors will diagnose one in three Americans with some form of cancer during their lifetime and one in four Americans will die of cancer. Cancer is second only to heart disease as a cause of death in the U.S. [ACS 2011]. Cancer is not just one disease; it is a group of them. Cancer happens when something damages the way the body controls a group of cells. After that, cells grow rapidly and no longer in a normal way. Growths that are cancerous or malignant can form within any tissue or organ system. Health scientists usually group malignancies into two categories [MERCK 2003]:

> Non-tumor forming - This includes leukemia, which is a type of cancer in which white blood cells displace normal blood. Lymphoma is another type, which starts in the lymph nodes.

Tumor forming - This includes carcinoma, which is a kind of tumor that starts in the surface layer of an organ or body part and may spread to other parts of the body. A second kind of tumor-forming cancer is sarcoma. This tumor grows in connective tissue like muscle, bone, fat, or cartilage. Both kinds of tumors occur more often in older people.

Risk factors for cancer include family history, age (60% of all cancers in the US occur in people over 65), environmental factors (cigarette smoking, alcohol consumption, pollution from industrial waste, and radiation), geography, diet (high in saturated fat/high alcohol intake), viral infections, and inflammatory diseases [MERCK 2003].

Excluding nonmelanoma skin cancer, the most common types of cancer in Florida are prostate (men), breast (women), lung/bronchus, colorectal, bladder, head/neck, uterine (women), and non-Hodgkin's lymphoma [DOH 2006].

<u>Chloracne</u> – Incidental ingestion (swallowing) of contaminants in the adjacent neighborhood surface soil and surrounding areas is not likely to cause chloracne.

Chloracne is a severe skin disease characterized by acne-like lesions (sores). Chloracne generally occurs on the face and upper body, but may occur elsewhere on the body. Unlike common acne, severe chloracne is harder to cure and can be more disfiguring. In milder cases, the lesions heal several months after exposure ends. In more severe cases, the lesions may last for many years after exposure. Health scientists attribute most of the chloracne cases to accidental exposure to high doses of 2,3,7,8-TCDD. They observed chloracne in some workers following an explosion at a Nitro, West Virginia plant in 1949 and in some residents of Seveso, Italy following a factory explosion in 1976 [ATSDR 1998]. The highest concentrations of dioxins in the adjacent neighborhood surface soil, however, are not likely to cause chloracne.

<u>Headaches</u> – Incidental ingestion (swallowing) of arsenic and PAHs in the adjacent neighborhood surface soil and surrounding areas is not likely to cause headaches. The data are insufficient to determine the risk of headaches from incidental ingestion of dioxins.

One of the most common types of pain; headache is very rarely a sign of some underlying, serious disorder. The pain of a headache comes from outside the brain (the brain tissue itself does not contain sensory nerves.) Pain arises from the meninges (the outer linings of the brain) and from the scalp and its blood vessels and muscles. Tension in, or stretching of, these structures produces pain.

People may feel the pain all over the head or may occur in one part only – for example, in the back of the neck, the forehead, or one side of the head. Sometimes the pain moves to another part of the head during the course of the headache. The pain may be superficial or deep, throbbing or sharp, and there may be accompanying or preliminary symptoms, such as nausea, vomiting, and visual or sensory disturbances.

Many headaches are simply the body's response to some adverse stimulus, such as hunger or a change in the weather. These headaches usually clear up in a few hours and leave no aftereffects.

Tension headaches, caused by tightening in the muscles of the face, neck, and scalp because of stress or poor posture, are also common. They may last for days or weeks and can cause variable degrees of discomfort.

Some types of headaches are especially painful and persistent, but, despite these symptoms, do not indicate any progressive disorder. Migraine is a severe, incapacitating headache preceded or accompanied by visual and/or stomach disturbances. Cluster headaches cause intense pain behind one eye and may wake the sufferer nightly for periods of weeks or months.

Common causes of headache include hangover, irregular meals, prolonged travel, poor posture, a noisy or stuffy work environment, excitement, and excessive sleep. Recent research has shown that certain foods (such as cheese, chocolate, and red wine) trigger migraine attacks in susceptible people. Food additives may also cause headache. Other causes include sinusitis, toothache, ear infection, head injury, and cervical osteoarthritis.

Among the rare causes of headache are brain tumor, hypertension (high blood pressure), temporal arteritis (inflammation of the arteries of the brain and scalp), aneurysm (localized swelling of a blood vessel), and increased pressure within the skull.

If headaches are persistent, without obvious cause, and do not respond to self-help treatment, medical advice should be sought. The physician will ask about the nature and site of the pain and at what intervals the headaches occur. A doctor will perform a careful general physical and neurological examination. They may order CT scanning or MRI (magnetic resonance imaging) if they suspect a neurological cause.

Prevention is more important than treatment; many of the know causes can easily be avoided, particularly if the sufferer knows what triggers the headaches. One the headache has started, however, (if it is not a migraine or cluster headache), one or more of the following measures should ease the pain: relaxing in a hot bath, lying down, avoidance of aggravating factors (such as excessive noise or a stuffy room), stretching and massaging the muscles in the shoulders, neck, face, and scalp, taking a mild analgesic, such as acetaminophen, and if convenient, sleeping a few hours [AMA 2003]

One human study reported headaches following an oral (ingestion) arsenic dose of 0.005 mg/kg/day [ATSDR 2007]. This dose, however, is 100 times higher than the highest estimated arsenic dose from incidental soil ingestion (swallowing) by a child in the adjacent neighborhood (0.00005 mg/kg/day). Although workers exposed to dioxins reported a number of symptoms including headache, the data are insufficient to quantify the risk [ATSDR 1998].

<u>Immune System Impairment</u> - Incidental ingestion (swallowing) of arsenic and dioxins in the adjacent neighborhood surface soil and surrounding areas is not likely to cause immune system impairment. The ability of PAHs to cause immune system suppression is unknown.

The immune system stops and fights infection. The lymphatic system is the group of organs that make up the immune system. This system is composed of the adenoids, tonsils, lymph nodes, thymus, spleen, appendix, and bone marrow. It makes the body's natural and adaptive immune response work to fight off diseases from bacteria, viruses, and fungi. The immune system also combats cells that are not normal in the body, such as cancer (MERCK 2003).

Problems with the body's mechanisms for protecting itself against viruses, bacteria, fungi, parasites, and other foreign substances cause immune system disorders. Immune system impairment result in conditions in which some portions of the immune response is weak or absent. They occur when there is a breakdown in the complex network of specialized cells and organs that normally defends the body against invasions by harmful agents [AMA 2003].

Although dioxins can cause immune system suppression in animals, data are insufficient to determine their ability to cause immune system suppression in people. The highest estimated dose from incidental soil ingestion (swallowing) in children from the adjacent neighborhood (4×10^{-7} µg/kg/day) is less than the ATSDR chronic length minimal risk level (1×10^{-6} µg/kg/day). Thus, based on extrapolation from animal studies, incidental ingestion (swallowing) of dioxins in soil from the adjacent neighborhood is unlikely to cause immune system suppression.

Although there is some evidence that PAHs may cause immune suppression in animals, the data are insufficient to determine their ability to cause immune suppression in people [ATSDR 1995b].

<u>Lupus</u> - Incidental ingestion (swallowing) of contaminants in adjacent neighborhood surface soil and surrounding areas is not likely to cause lupus.

Lupus is an autoimmune disorder. It makes the body's tissues inflamed for a long time. Discoid lupus erythematosus (DLE) affects only the skin. DLE is the less common form of the disease. Systemic lupus erythematosus (SLE) is the most common and is the most severe form. This disorder produces a form of arthritis that affects several tissues and organs within the body. Lupus affects nine times more women than men. Most of the time, the onset of the disease occurs in women ranging in age from 20 to 40. It also affects more black women than white women. The cause of SLE remains unknown. Studies show that risk factors might be hormones, things in someone's environment and their family history. The symptoms of Lupus can vary widely, ranging from mild to severe. The most common symptoms are usually extreme fatigue, painful or swollen joints, unexplained fevers, anorexia (losing weight), anemia (low iron), skin rashes, and kidneys that do not work as they should [AMA 2003, MERCK 2003].

<u>Miscarriages</u> – Incidental ingestion (swallowing) of contaminants in adjacent neighborhood surface soil and surrounding areas is not likely to cause miscarriages.

Miscarriage is the loss of a pregnancy before the fetus fully develops (usually before 20 weeks). 15 – 20% of all pregnancies end in miscarriage. Vaginal bleeding (with or without pain) is the most common symptom of miscarriage. If bleeding occurs during pregnancy, a woman should consult a doctor immediately. Women past the age of 35 are at a greater risk of miscarriage. Women who smoke or have certain illnesses, such as diabetes, lupus, or hormonal imbalance, are at a greater risk of miscarriage. Doctors do not completely understand the causes but they are often times linked with physical problems in the mother. These problems include uterine fibroids (benign growths in the womb), abnormally shaped uterus, and scar tissue. In some instances, problems with the genetic material in the fetus may cause miscarriages [AMA 2003].

Multiple Sclerosis – Incidental ingestion (swallowing) of contaminants in adjacent neighborhood surface soil and surrounding areas is not likely to cause multiple sclerosis.

Multiple sclerosis is a progressive disease of the central nervous system in which scattered patches of the protective covering (myelin) of the nerve fibers are destroyed. This causes symptoms ranging from numbness and tingling to paralysis and incontinence. The severity of multiple sclerosis (MS) varies markedly among sufferers.

The cause of MS is unknown. Doctors think it is an autoimmune disease in which the body's defense system begins to treat the myelin in the central nervous system as foreign, gradually destroying it, with subsequent damage to the underlying nerve fibers. There seems to be a genetic factor since a relative of affected people is eight times more likely to contract the disease than others. They think a virus picked up by a susceptible person may be responsible for the disease. In high-risk temperate areas, the incidence is about one in every 1,000 people. The ratio of women to men sufferers is 3 to 2.

MS usually starts in early adult life. Symptoms may last from several weeks to several months. In some sufferers, injury, infection, or physical/emotional stress may precipitate a relapse. Attacks vary considerably in their severity from person to person. In some, the disease may consist of mild relapses and long symptom-free periods with few permanent effects. In some, they become gradually more disabled following each attack [AMA 2003].

Nosebleeds – Incidental ingestion (swallowing) of contaminants in adjacent neighborhood surface soil and surrounding areas is not likely to cause nosebleeds.

Nosebleeds are frequent in children between 2 and 10. Also called epistaxis, a nosebleed is commonly due to dryness caused by low humidity in the home or to nose picking. Other causes include inflammation of the nasal lining from a cold or allergies, a foreign object in the nose, blowing the nose too hard, or falling on or hitting the nose. Rarely, abnormal growths or a problem with blood clotting causes nosebleeds. Although nosebleeds may be frightening, they are usually not a serious cause for concern [AMA 2003].

Phantom itch – Incidental ingestion (swallowing) of contaminants in adjacent neighborhood surface soil and surrounding areas is not likely to cause itching.

Itching (pruritus) ranges from a mild urge to scratch to an overwhelming, unbearable itch. Common causes include insect bites, allergic contact dermatitis (such as poison ivy); irritants such as chemicals, detergents, soaps, and wool; dry skin; allergic reaction to food or drugs; hives; lichen planus; and parasites (such as lice or scabies). Itching that occurs all over the body without skin lesions can be a sign of diabetes, liver disorder, kidney failure, thyroid disorders, cancer, or psychological problems. Whatever its underlying causes, stress can worsen itching [AMA 2003].

Skin contact with arsenic can lead to irritation (dermatitis) and itching. However, available data do not permit a quantitative estimate of the concentration of arsenic on the skin that would cause this effect. One human study reported itching following an oral (ingestion) arsenic dose of 0.05 mg/kg/day [ATSDR 2007]. This dose, however, is 1,000 times higher than the highest estimated arsenic dose from incidental soil ingestion (swallowing) by a child from the adjacent neighborhood (0.00005 mg/kg/day).

Stillbirths - Incidental ingestion (swallowing) of arsenic and dioxins in adjacent neighborhood surface soil and surrounding areas is not likely to cause stillbirths. The ability of PAHs to cause stillbirth in people is unknown.

Stillbirth is the birth of a dead baby after the 28^{th} week of pregnancy. Stillbirths can have many causes, the most common being severe birth defects. Other causes include a lack of oxygen to the fetus because of placental abruption or a knot in the umbilical cord. Hemorrhage, high blood pressure, diabetes, Rh incompatibility, and maternal smoking can cause stillbirth. Infections, including measles, chickenpox, influenza, toxoplasmosis, rubella, genital herpes, syphilis, and malaria can also cause stillbirth. In about a third of all stillbirths, the cause is unknown [AMA 2003].
Two human studies reported stillbirths following oral (ingestion) arsenic doses of 0.008 to 0.020 mg/kg/day [ATSDR 2007]. These doses, however, are between one and three thousand times higher than the highest estimated arsenic dose from incidental soil ingestion (swallowing) by an adult in the adjacent neighborhood (0.000006 mg/kg/day).

Although there is some evidence that PAHs may cause stillbirth in animals, the data are insufficient to determine the risk in people [ATSDR 1995b].

Thyroid Problems – Incidental ingestion (swallowing) of arsenic and PAHs in the adjacent neighborhood surface soil and surrounding areas is not likely to cause thyroid problems. The ability of dioxins to cause thyroid problems in people is unknown.

The thyroid gland secretes hormones that control the body's metabolism, use of other hormones and growth. The two most common thyroid disorders are hypothyroidism and hyperthyroidism.

Hypothyroidism (an under-active thyroid) can occur when the body does not make enough thyroid hormone. This condition slows down the body's metabolism, which results in having less energy and makes the body less likely to control body temperature. Hypothyroidism is common in older adults, although it can occur at any age. This disorder affects about 10% of older women. The symptoms of an under active thyroid can include sensitivity to cold temperatures, constipation, dry skin, chronic fatigue, poor appetite and weight gain. The common cause of hypothyroidism is Hashimoto's thyroiditis, an autoimmune reaction that runs in families.

An overproduction of thyroid hormone causes hyperthyroidism (an overactive thyroid) . The symptoms of hyperthyroidism vary widely but can include increased perspiration, increased heart rate, irritability, nervousness, elevated blood pressure and unexplained weight loss. Hyperthyroidism affects about 1% of the US population. The disorder can occur at any age, but is most common in women after childbirth and during menopause. Hyperthyroidism has several causes including overactive pituitary gland, radiation exposure, inflammation from toxic substances, thyroiditis (when the thyroid gland is inflamed), and Grave's disease (autoimmune disorder) [AMA 2003, MERCK 2003].

Dioxins can affect thyroid function in rats and mice. Human epidemiological studies suggest that exposure to high concentrations of dioxins may induce subtle alterations in thyroid function. The ability of dioxins to cause thyroid problems in people at lower concentrations, however, is unknown [ATSDR 1998].

2. Nearby residents are concerned about contaminants in sediments of the Springstead and Hogtown creeks that drain the Cabot Carbon-Koppers hazardous waste site.

In a separate May 24, 2011 report, the Florida DOH assessed the public health threat from sediments in the creeks that drain this site. Florida DOH found that contaminant levels measured between 2006 and 2010 are not likely to cause non-cancer illness. The highest contaminant concentrations would result in, at most, a very low to extremely low cancer risk [ATSDR 2011]. Contaminant concentrations are none-the-less above state standards. In early 2011, the party responsible for the Cabot Carbon portion of the site removed tarry sediments from Springstead and Hogtown Creeks.

Conclusions

1. Based on January 2012 tests, Florida DOH and ATSDR conclude that incidental ingestion (swallowing) very small amounts of contaminated surface soil in the adjacent neighborhood and surrounding areas is not expected to harm children or adults. People accidentally swallowing very small amounts of this soil over a lifetime are at a "low to very low" increased estimated risk of cancer. This is an upper estimate of the increased cancer risk. The actual increased cancer risk is likely lower. Surface soil dioxin levels are, however, above the Florida remediation goal of 7 nanograms per kilogram (parts per trillion or ppt) for residential areas.

2. Because of their low water solubility, dioxins are not readily absorbed through the roots of most plants. Although there has been no testing of homegrown fruits or vegetables near the Koppers facility, it does not appear that consumption is a public health threat.

Recommendations

1. EPA should require the responsible party to determine the full extent of surface soil contamination in the adjacent neighborhood and surrounding areas.

Public Health Action Plan

Actions Undertaken

1. In May 2009, the Alachua CHD hand delivered letters to 20 nearby residences advising them to keep their children from playing in the City easement just west of the Koppers facility. Contractors for the responsible party erected a temporary fence to discourage trespassing on this easement and posted temporary "keep out" and "no trespassing" signs.
2. In June 2009, the Florida DOH, Alachua CHD, EPA, and Florida DEP held an open house meeting attended by about 120 nearby residents.
3. In July 2009, the Florida DOH distributed a health consultation report and summary fact sheet on off-site surface soil.
4. In June 2010, the Florida DOH and the Alachua CHD distributed two community updates: one soliciting public comment on a draft creek sediment report and another alerting the community to a second off-site surface soil report.
5. In October 2010, the Florida DOH, Alachua CHD, EPA, and Florida DEP held an open house meeting attended by over 100 nearby residents.
6. In November/December 2010, the responsible party erected a permanent fence along the City easement just west of the Koppers facility and posted permanent warning signs.
7. In January 2011, the Florida DOH and the Alachua CHD distributed a community update informing nearby residents about a preliminary review of the soil sampling data further analyzed in this report.
8. In early 2011, the Cabot Carbon Corporation removed tarry waste from sediment in the ditches that drain the Cabot Carbon portion of the site as well as from sediments in Springstead and Hogtown creeks.
9. In an April 14, 2011 report, Florida DOH assessed the potential health risks for a family near the Koppers facility from dioxins in homegrown chicken eggs.
10. In a May 24, 2011 report, Florida DOH evaluated the public health risk from exposure to sediments in Springstead and Hogtown Creek sediments.
11. In June 2011 and March 2012 reports, Florida DOH evaluated area cancer rates.
12. On August 29, 2011, Florida DOH and Alachua CHD held an open house meeting to answer questions about the cancer data review report and to solicit comments on a draft soil health consultation report.
13. On June 7, 2012, the Alachua CHD distributed a community update informing nearby residents of an update to the cancer statistics review and of EPA's indoor dust collection.
14. In December 2012, EPA informed nearby residents that levels of dioxins in indoor dust are not a health risk and would not require cleanup.

15. In an August 2013 neighborhood update, the Florida DOH and the Alachua CHD initially cautioned nearby residents to limit their consumption of homegrown zucchini. They later lifted this advisory.

Actions Underway

1. The Alachua CHD continues to recommend people living near the Koppers facility practice good general hygiene. This includes hand washing with soap and water after contacting bare soil in areas between NW 26 Avenue and NW 32 Avenue west of the Koppers facility.
2. Florida DOH and ATSDR are evaluating EPA sampling results to determine the public health threat from contaminants in indoor dust of adjacent houses.

Actions Planned

1. Florida DOH will continue to keep nearby residents informed of their findings.

References

[ACS 2011] American Cancer Society Web Page: www.cancer.org. Accessed February 7, 2011.

[AMA 2003] American Medical Association. Complete Medical Encyclopedia. JB Leinkin and MS Lipsky, eds. Random House Reference. New York.

[ARCADIS 2012] Arcadis, US, Inc. Electronic mail from, Alissa Weaver with ARCADIS to Scott Miller with the US Environmental Protection Agency regarding the January 2012 surface soil testing near the Koppers Superfund site. June 5, 2012.

[ATSDR 1989] Agency for Toxic Substances and Disease Registry. Health Assessment for Cabot Carbon/Koppers Site. U.S. Department of Health and Human Services. Atlanta, GA. April 24, 1989.

[ATSDR 1993] Agency for Toxic Substances and Disease Registry. Site Review and Update for Cabot Carbon/Koppers Site. U.S. Department of Health and Human Services. Atlanta, GA. September 24, 1993.

[ATSDR 1995a] Agency for Toxic Substances and Disease Registry. Health Consultation for Cabot Carbon/Koppers Superfund Site. U.S. Department of Health and Human Services. Atlanta, GA. November 15, 1995.

[ATSDR 1995b] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHS) (Update). Atlanta: US Department of Health and Human Services; August 1995.

[ATSDR 1998] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chlorinated dibenzo-p-dioxins (Update). Atlanta: US Department of Health and Human Services; December 1998.

[ATSDR 2001] Agency for Toxic Substances and Disease Registry. Summary Report for the ATSDR Soil-Pica Workshop. June 2000 Atlanta, Georgia. March 20, 2001

[ATSDR 2005] Agency for Toxic Substance and Disease Registry. Public Health Assessment Guidance Manual (Update). U.S. Department of Health and Human Services, Atlanta, GA. January 2005.

[ATSDR 2007] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Arsenic (Update). Atlanta: US Department of Health and Human Services; August 2007.

[ATSDR 2009] Agency for Toxic Substances and Disease Registry. Health Consultation Off-Site Surface Soil, Koppers Hazardous Waste Site. Gainesville, Alachua County, Florida. U.S. Department of Health and Human Services. Atlanta, GA. July 17, 2009.

[ATSDR 2010] Agency for Toxic Substances and Disease Registry. Health Consultation Additional Off-Site Surface Soil, Koppers Hazardous Waste Site. Gainesville, Alachua County, Florida. U.S. Department of Health and Human Services. Atlanta, GA. June 17, 2010.

[ATSDR 2011a] Agency for Toxic Substances and Disease Registry. Health Consultation, Springstead and Hogtown Creek Sediments, Cabot Carbon-Koppers Hazardous Waste Site. Gainesville, Alachua County, Florida. U.S. Department of Health and Human Services. Atlanta, GA. May 24, 2011.

[ATSDR 2011b] Agency for Toxic Substances and Disease Registry. April 14, 2011 Health Consultation Letter from the Florida Department of Health to Anthony Dennis, Alachua County Health Department regarding Stephen Foster Neighborhood Chicken Egg Dioxin Evaluation.

[ATSDR 2013] Agency for Toxic Substances and Disease Registry. May 9, 2013. Health Consultation, Public Comment Version. Indoor Dust, Nearby Residential Houses. Cabot Carbon-Koppers Superfund Hazardous Waste Site. Gainesville, Alachua County, Florida.

[Calwell 2011] The Calwell Practice, PLLC. Letter to E. Randall Merchant from Stuart Calwell concerning dust testing in Gainesville, Florida. February 15, 2011.

[DOH 2006] Florida Department of Health. Cancer Cluster Investigations: What Are They? What Do They Do? Nine-page booklet. 2006. Tallahassee, Florida.

[DOH 2011a] Florida Department of Health. Stephen Foster Neighborhood Cancer Review, Alachua County. June 2011. Tallahassee, Florida.

[DOH 2011b] Florida Department of Health. Indoor Dust Investigation/Interpretation Plan, Stephen Foster Neighborhood, Gainesville, Florida. July 2011. Prepared by the Indoor Dust Dioxin Workgroup. Tallahassee, Florida.

[DOH 2012] Florida Department of Health. Alachua County Report, Review of Cancer Rates for Census Tract 3 (Containing Stephen Foster Neighborhood). Division of Environmental Health. March 2012. Tallahassee, Florida.

[EPA 1994] US Environmental Protection Agency. Estimating Exposure to Dioxin-Like Compounds. Volume II: Properties, Sources, Occurrence, and Background Exposures. EPA/600/6-88/005Cb

[EPA 2010] US Environmental Protection Agency. EnviroFacts. Demographics around Koppers, 200 N.W. 23rd Blvd. Gainesville, FL, 32609. Washington, DC (updated March 18, 2010; accessed March 18, 2010). Available at http://www.epa.gov/enviro.

[EPA 2011] US Environmental Protection Agency. Exposure Factors Handbook: 2011 Edition, Table 9-6. EPA/600/R-090/052F. September 2011

[EPA 2013] US Environmental Protection Agency. Integrated Risk Information System (IRIS) summary for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Accessed 2-13-13 at www.epa.gov/iris/subst/1024.htm.

[Hulster 1994] Hulster, A , Muller, J, and Marschner, H. Soil-Plant Transfer of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans to Vegetables of the Cucumber Family (*Cucurbitaceae*). Environ. Sci. Technol. 1994, 28, 1110-1115.

[Inui 2008] Inui H, Wakai T, Gion K, Kim YS, Eun H. Differential uptake for dioxin-like compounds by zucchini subspecies. Chemosphere. 2008 Nov; 73(10): 1602-7.

[Karmin 1988] Toxicology – A Primer on Toxicology Principles and Applications. Lewis Publications. Chelsea MI. 1988.

[MERCK 2003] The Merck Manual of Medical Information. Second Home Edition. Pocket Division of Simon & Schuster, Inc. 2003. New York.

[Parsons 2010] Parsons, et al v Koppers Inc., et al. Case 1:10-cv-00071-MP-AK, Document 1. Filed 4/20/10. United States District Court, Northern District of Florida, Gainesville Division.

[Zhang 2009] Zhang H, Chen J, Ni Y, Zhang Q, Zhao L. Uptake by roots and translocation to shoots of polychlorinated dibenzo-p-dioxins and dibenzofurans in typical crop plants. Chemosphere. 2009 Aug: 76(6) 740-6.

Appendix A

Table 1. Summary of Arsenic, PAH, and Dioxin Concentrations in Surface Soil Near the Koppers Facility, January 2012

Soil Sample Number	Arsenic (mg/kg)	PAH (BaP-TEQ) (mg/kg)	Dioxins (TCDD-TEQ) (ng/kg)
SS 270	0.75		
SS 272	1.82		
SS 274		0.36	
SS 276		0.032	
SS 277		0.39	
SS 279			8.51
SS 281			29.65
SS 283			5.15
SS 284			0.295
SS 287			0.424
SS 288			2.82
SS 350	3.9	0.385	
SS 352		0.24	
SS 354		1.4	
SS 355		1.2	
SS 356		1.9	
SS 357		1.8	
SS 358			5.94
SS 359			50.2
SS 360			12.2
SS 362			19.2

mg/kg = milligrams per kilogram   ng/kg = nanograms per kilogram
PAH (Bap-TEQ) = polycyclic aromatic hydrocarbon, benzo[a]pyrene toxicity equivalence
TCDD-TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalence
Source of data: [ARCADIS 2012]

Table 2. Surface Soil (0-6 inches deep) Arsenic Concentrations in the Adjacent Neighborhood and Surrounding Areas, January 2012

Contaminant	Concentration Range (mg/kg)	Screening Guideline* (mg/kg)	Source of Screening Guideline	# Above Screening Guideline/Total #	Background Concentration Range Busy Residential Right-of-Way (mg/kg)†
Arsenic	0.75 -3.9	0.5	ATSDR CREG	3/3	0.3 – 14.5

CREG = cancer risk evaluation guideline mg/kg = milligrams per kilogram * Screening guidelines are used to select chemicals for further scrutiny, not to determine the risk of illness. †Background concentrations combined from previous reports. Source of data: [ARCADIS 2012]

Table 3. Surface Soil (0-6 inches deep) Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in the Adjacent Neighborhood and Surrounding Areas, January 2012

Contaminant	Concentration Range (mg/kg)	Screening Guideline* (mg/kg)	Source of Screening Guideline	# Above Screening Guideline/Total #	Background Concentration Range Busy Residential Right-of-Way (mg/kg)†
BaP-TEQ	0.03 – 1.9	0.1	ATSDR CREG	8/9	0.005 – 2.7

BaP-TEQ = Benzo[a]pyrene toxicity equivalence CREG = cancer risk evaluation guideline mg/kg = milligrams per kilogram
* Screening guidelines are used to select chemicals for further scrutiny, not to determine the risk of illness. †Background concentrations combined from previous reports. Source of data: [ARCADIS 2012]

Table 4. Surface Soil (0-6 inches deep) Dioxin Concentrations in the Adjacent Neighborhood and Surrounding Areas, January 2012

Contaminant	Concentration Range (ng/kg)	Screening Guideline* (ng/kg)	Source of Screening Guideline	# Above Screening Guideline/Total #	Background Concentration Range Busy Residential Right-of-Way (ng/kg)†
TCDD – TEQ	0.3 – 30	50	ATSDR chronic child EMEG	0/9	0.2 - 71

TCDD-TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalence EMEG = environmental media evaluation guide ng/kg = nanograms per kilogram * Screening guidelines are used to select chemicals for further scrutiny, not to determine the risk of illness. †Background concentrations combined from previous reports. Source of data: [ARCADIS 2012]

Table 5. Surface Soil (0-6 inches deep) Dioxin Concentrations in the City of Gainesville Public Works Property North of the Koppers Site, January 2012

Contaminant	Concentration (ng/kg)	Screening Guideline* (ng/kg)	Source of Screening Guideline	# Above Screening Guideline/Total #	Background Concentration Range Busy Residential Right-of-Way (ng/kg)†
TCDD – TEQ	50	700	ATSDR chronic adult EMEG	0/1	0.2 - 71

TCDD-TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalence EMEG = environmental media evaluation guide ng/kg = nanograms per kilogram * Screening guidelines are used to select chemicals for further scrutiny, not to determine the risk of illness. †Background concentrations combined from previous reports. Source of data: [ARCADIS 2012]

Table 6. Completed Human Exposure Pathway

COMPLETED PATHWAY NAME	COMPLETED EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Residential soil ingestion (swallowing)	Contaminated dust from Koppers site	Dust/Soil	Residential yards and street right-of-ways	Incidental ingestion (swallowing)	Nearby residents	1916 to 2012 and future
Worker soil ingestion (swallowing)	Contaminated dust from Koppers site	Dust/Soil	City of Gainesville public works property north of the Koppers site	Incidental ingestion (swallowing)	City of Gainesville workers	Past, present, and future

Table 7. Potential Human Exposure Pathway

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Homegrown vegetables	Contaminated surface soil	Homegrown vegetables	Nearby homes	Ingestion	Nearby residents with vegetable gardens	Future

Table 8. Upper Estimate of the Increased Cancer Risk from Incidental Ingestion (Swallowing) of Surface Soil with Maximum **Arsenic** Concentration Collected in the Adjacent Neighborhood January 2012.

Age Group (years)	Ingestion Rate (mg/day)	Exposure Duration (yrs.)	Body Weight (kg)	Increased Cancer Risk: Upper Estimate
Child (0.5 to <21)	200	20.5	33	8.9×10^{-6}
Adult (21 to 78)	100	57	80	5.1×10^{-6}
Upper Estimate Total Lifetime Increased Cancer Risk				14×10^{-6}

Concentration = 3.9 mg/kg, Conversion Factor = 10^{-6}, Exposure Frequency = 350 days per year, Slope Factor = 1.5 $(mg/kg/day)^{-1}$, Averaging Time = 28,470 days (78 years)

Table 9. Upper Estimate of the Increased Cancer Risk from Incidental Ingestion (Swallowing) of Surface Soil with Maximum **Benzo[a]pyrene-TEQ** Concentration Collected in the Adjacent Neighborhood January 2012.

Age Group (years)	Ingestion Rate (mg/day)	Exposure Duration (yrs.)	Body Weight (kg)	Age-Dependent Adjustment Factor	Increased Cancer Risk: Upper Estimate
Child 0.5 to <2	150	1.5	10.3	10	3.7×10^{-5}
Child 2 to <16	200	14	35.3	3	4.1×10^{-5}
Child 16 to <21	100	5	71.6	1	0.1×10^{-5}
Adult 21 to 78	100	57	80	1	1.2×10^{-5}
Upper Estimate Total Lifetime Increased Cancer Risk					9.1×10^{-5}

Concentration = 1.9 mg/kg, Conversion Factor = 10^{-6}, Exposure Frequency = 350 days per year, Slope Factor = 7.3 $(mg/kg/day)^{-1}$, Averaging Time = 28,470 days (78 years)

Table 10. Upper Estimate of the Increased Cancer Risk from Incidental Ingestion (Swallowing) of Surface Soil with Maximum **Dioxin** Concentration Collected in the Adjacent Neighborhood January 2012.

Age Group (years)	Ingestion Rate (mg/day)	Exposure Duration (yrs.)	Body Weight (kg)	Increased Cancer Risk: Upper Estimate
Child (0.5 to <21)	200	20.5	33	6.9×10^{-6}
Adult (21 to 78)	100	57	80	3.9×10^{-6}
Upper Estimate Total Lifetime Increased Cancer Risk				11×10^{-6}

Concentration = 0.00003 mg/kg, Conversion Factor = 10^{-6}, Exposure Frequency = 350 days per year, Slope Factor = 150,000 $(mg/kg/day)^{-1}$, Averaging Time = 28,470 days (78 years)

Table 11. Upper Estimate of the Increased Cancer Risk for Workers (Low Soil Contact) from Incidental Ingestion (Swallowing) of Surface Soil with Maximum **Dioxin** Concentration Collected in the City of Gainesville Public Works Property North of the Koppers Site, January 2012.

Worker Age Group (years)	Ingestion Rate (mg/day)	Exposure Duration (yrs.)	Body Weight (kg)	Increased Cancer Risk: Upper Estimate
Adult (21 to 78)	100	20	80	1.7×10^{-6}

Concentration = 0.00005 mg/kg, Conversion Factor = 10^{-6}, Exposure Factor = 0.7143, Slope Factor = 150,000 $(mg/kg/day)^{-1}$

Figure 1. January 2012 Koppers Area Arsenic Surface Soil Test Locations

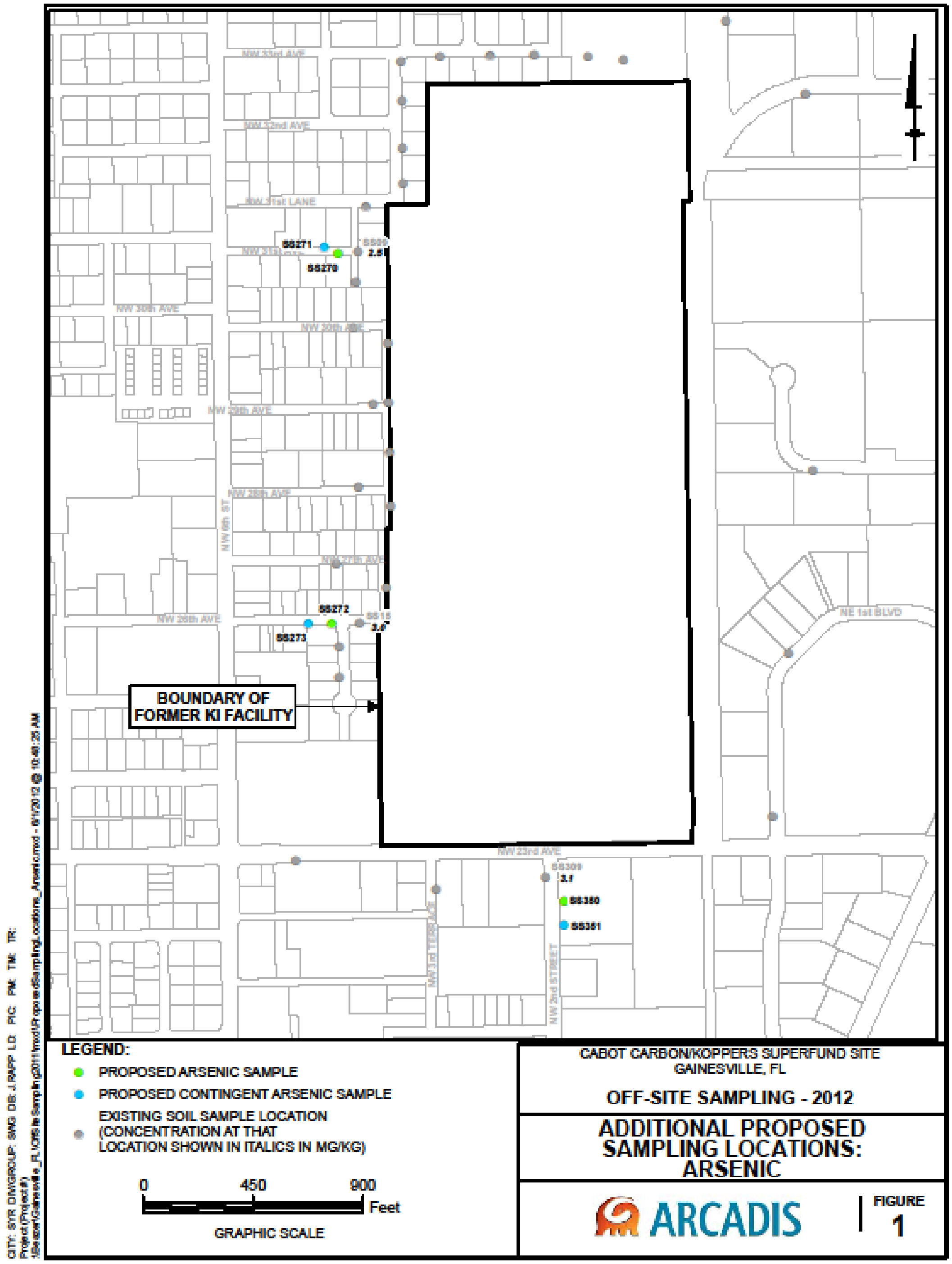


Figure 2. January 2012 Koppers Area Polycyclic Aromatic Hydrocarbon (PAH) Surface Soil Test Locations

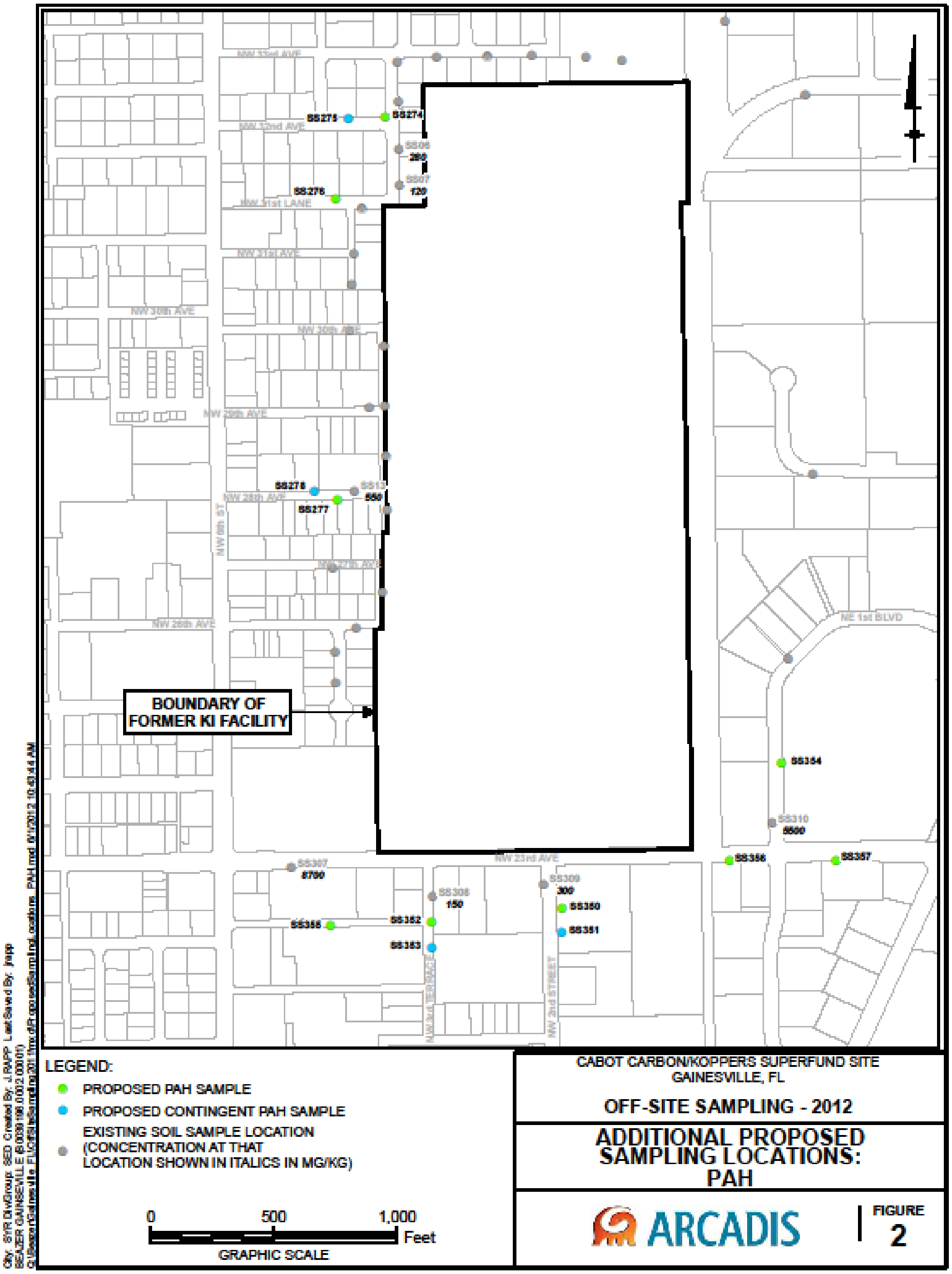


Figure 3. January 2012 Koppers Area Dioxin Surface Soil Test Locations

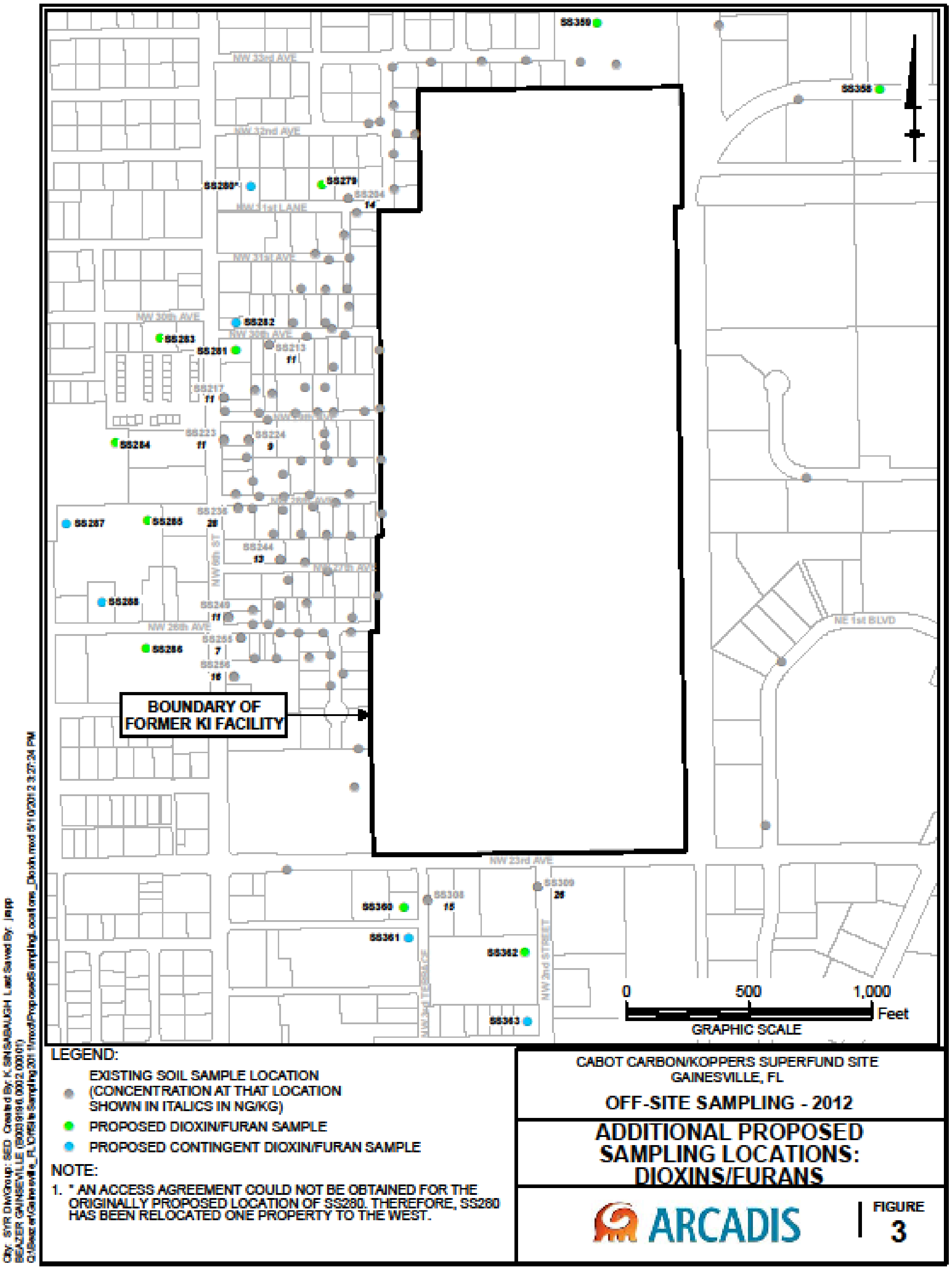
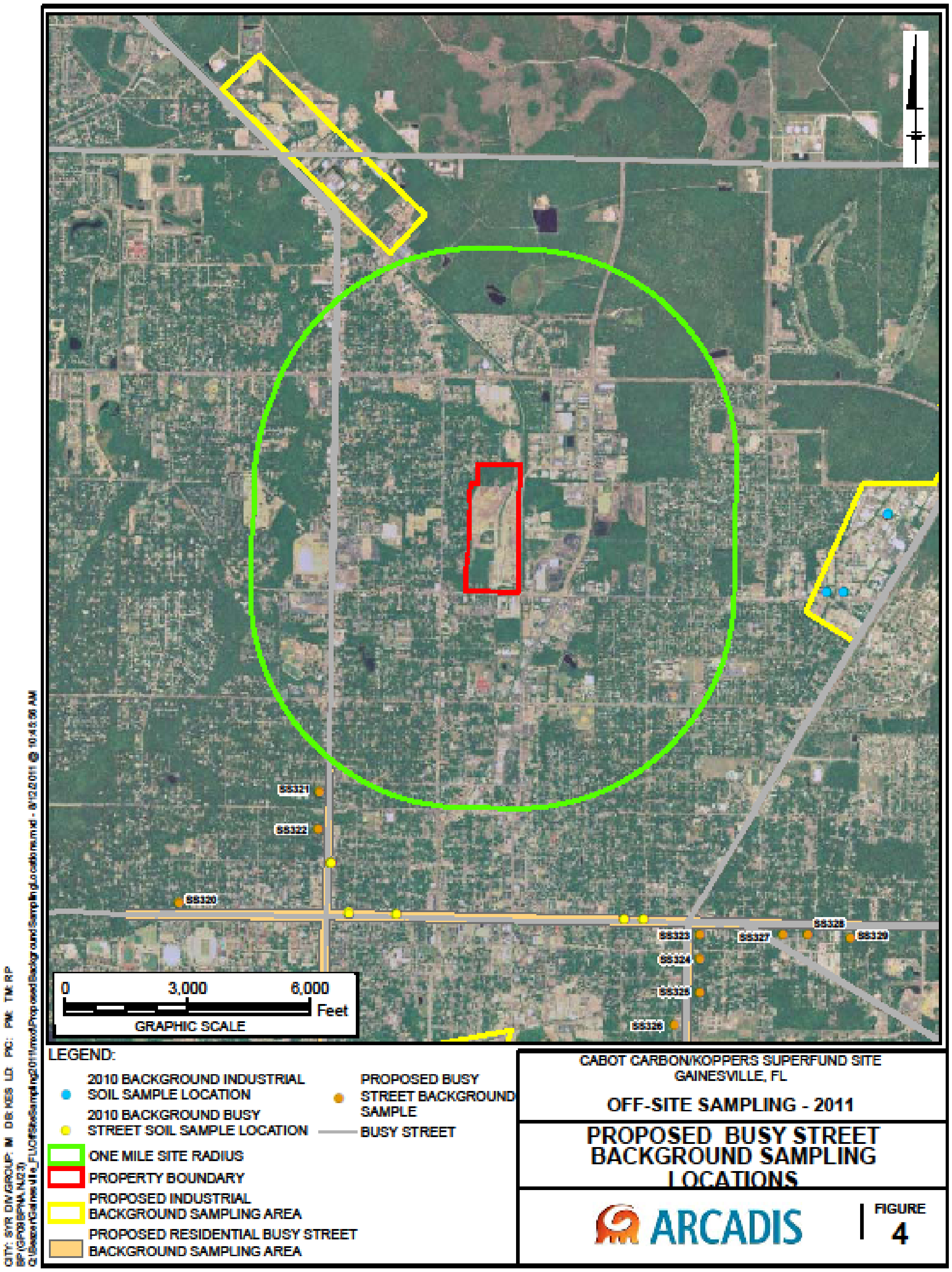


Figure 4. January 2012 Koppers Area Background Surface Soil Test Locations



Appendix B: Response to Public Comment

The Florida DOH posted a public comment version of this report dated September 13, 2012 on their web site and solicited review through November 13, 2012. On October 6, 2012 the Alachua CHD hand delivered/mailed/e-mailed to 500 individuals a community update that summarized this draft report and solicited public comment. Florida DOH granted a request for an extension of the public comment period to December 14, 2012.

Florida DOH received five sets of comments on this draft report: three sets of comments from individual residents, one set from the party responsible for the site, and one set from a representative of some nearby residents. The following summarizes the comments and the Florida DOH/ATSDR response.

Individual Residents

Comment #1: The maps in the on-line version are illegible.
Response #1: Florida DOH provided the commenter with maps that were easier to read and saved the maps in a higher resolution format.

Comment #2: The units and the results on the maps are confusing.
Response #2: Florida DOH and ATSDR have included a table summarizing the results and verified the units.

Comment #3: Are local lawn maintenance personnel advised of the need for special masks while working in this area?
Response #3: The advice—contained in the October 2012 community update distributed by the Alachua County Health Department —that residents avoid prolonged exposure to dust from mowing also applies to local lawn maintenance personnel.

Comment #4: When will deadlines be established for actions by the responsible party?
Response #4: The US Environmental Protection Agency is overseeing cleanup of the site by the responsible party. EPA determines the schedule for testing and remediation by the responsible party.

Comment #5: The report should carefully distinguish between the limited residential area with contaminants levels above state cleanup standards and the larger Stephen Foster neighborhood with soil contaminant levels below state cleanup standards.
Response#5: Florida DOH and ATSDR have revised the report to distinguish between the residential area with contaminated soil and the larger Stephen Foster neighborhood.

Party Responsible for the Site

Comment #1: The phrase "Koppers Hazardous Waste Site" should be changed to "Koppers Facility" to be consistent with the terminology used by EPA.
Response #1: Florida DOH and ATSDR have modified the report to use the term "Koppers Facility."

Comment #2: In the Introduction on page 1, the paragraph summarizing past operations is inaccurate and omits that operations ceased in 2009.
Response #2: Florida DOH and ATSDR have revised this paragraph to accurately summarize past operations, including the date operations ceased.

Comment #3: For Conclusion #1 on page 2, the report should explain the meaning of "very low" increased cancer risk in relation to the description of cancer risk on page 10.
Response #3: Florida DOH and ATSDR have clarified how rounding of the increased lifetime cancer risk to the nearest power of ten in the tables results in the category of increased cancer risk described in the text.

Comment #4: Remove or revise the Next Steps section for Conclusion #1 on page 2.
Response #4: Determining the representativeness of an environmental data set is an important and necessary step in assessing the public health threat. The report authors use their professional judgment, erring on the side of caution, to judge whether testing of off-site soil in nearby residential areas has been adequate to assess the health threat. Conclusions about the representativeness of testing and recommendations for additional testing are appropriate for this report. Report recommendations are, however, advisory, not regulatory.

Recommendations to protect public health are also an important and necessary part of the public health assessment process. While EPA establishes cleanup levels and makes other risk management decisions, it is appropriate for these reports to recommend cleanup levels protective of public health. As above, report recommendations are advisory, not regulatory.

Comment #5: Delete Conclusion #2 on page 2 and all references in the report to indoor dust testing.
Response #5: Florida DOH and ATSDR have revised the report to reference EPA's indoor dust testing in the Background section and refer the reader to a separate Florida DOH/ATSDR report for an assessment of indoor dust.

Comment #6: The responsible party has not yet developed a plan to address contaminated soil in the City of Gainesville easement on the western boundary of the Koppers site.
Response #6: Florida DOH and ATSDR have modified the report to clarify this distinction.

Comment #7: Correct the sentence on page 4 that states “Koppers used their site for wood treatment between 1916 and 2010.”
Response #7: Florida DOH and ATSDR have corrected the dates the site was used.

Comment #8: Delete the word “Toxic” on page 5.
Response #8: Florida DOH and ATSDR have replaced “Toxic” with “Wood preserving”

Comment #9: The sentence under “Land Use” on page 5 incorrectly implies that all land use south, west, and north of Koppers is exclusively residential.
Response #9: Florida DOH and ATSDR have modified this section to more accurately reflect land use south, west, and north of Koppers.

Comment #10: On page 6, correct the number of background soil samples collected in January 2012.
Response #10: Florida DOH and ATSDR have corrected the number of background soil samples collected in January 2012.

Comment #11: Remove or revise the first full paragraph on page 7 that finds soil testing has been inadequate and recommends more testing.
Response #11: See Response #4, above.

Comment #12: In the discussion of arsenic on page 11, the report should explain the meaning of “very low” increased cancer risk in relation to the description of cancer risk on page 10.
Response #12: Florida DOH and ATSDR have clarified how rounding of the increased lifetime cancer risk to the nearest power of ten in the tables results in the category of increased cancer risk described in the text.

Comment #13: On page 12, explain that the highest BaP-TEQ concentrations found in residential soil near the Koppers site are within the range of BaP-TEQ concentrations in background soils near busy streets.
Response #13: Florida DOH and ATSDR have noted that the highest BaP-TEQ concentrations found in residential soil near the Koppers site are within the range of BaP-TEQ concentrations in background soils near busy Gainesville streets.

Comment #14: In the discussion of dioxins on page 13, the report should explain the meaning of “very low” increased cancer risk in relation to the description of cancer risk on page 10.
Response #14: Florida DOH and ATSDR have clarified how rounding of the increased lifetime cancer risk to the nearest power of ten in the tables results in the category of increased cancer risk described in the text.

Comment #15: On page 22, put the “very low” increased cancer risk into context by comparing it to other exposures such as food.

Response #15: To put a "very low" increased cancer risk for each contaminant into context, in the Public Health Implications section, Florida DOH and ATSDR have added a comparison of the increased cancer risk to the background US cancer rate.

Comment #16: In Table 1 on page 27, indicate that background soil samples for arsenic were collected in September 2010. Also, add a column showing the number of background samples with arsenic concentrations above the screening guideline.
Response #16: Florida DOH and ATSDR have compiled all of the previous background soil test results and included them in Tables 1 through 4. Showing the background concentration range is adequate for the reader to compare the concentrations found in the adjacent neighborhood.

Comment #17: In Table 2 on page 27, add the PAH concentrations from testing of background soil prior to January 2012.
Response #17: Florida DOH and ATSDR have compiled all of the previous background soil test results and included them in Tables 1 through 4.

Comment #18: In Table 3 on page 27, add a column showing the number of background samples with dioxin concentrations above the screening guideline.
Response #18: Showing the background concentration range is adequate for the reader to compare the concentrations found in the adjacent neighborhood.

Representative of Some Nearby Residents

Comment #1: Include childhood exposure in the lifetime cancer risk calculations.
Response #1: Florida DOH and ATSDR have revised the calculations in this report to show the contribution of childhood exposure to the lifetime cancer risk.

Comment #2: Add the cancer risk from dioxins to the cancer risk from BaP-TEQ to get a total cancer risk.
Response #2: Data regarding interactions affecting the carcinogenicity of BaP-TEQ by dioxins are too limited to accurately and reliably quantify the interaction. One study actually found dermal pretreatment with 2,3,7,8-TCDD reduced rather than increased the induction of skin tumors by subsequent applied benzo(a)pyrene or dimethylbenz(a)anthracene in Sencar mice [Cohen, et al 1979]

[Cohen, et al 1979] Cohen GM, Bracken WM, Iyer RP, et al. 1979. Anticarcinogenic effects of 2,3,7,8-tetrachlorodibenzo-p-dioxin on benzo(a)pyrene and 7,12-dimethylbenz(a)anthracene tumor initiation and its relationship to DNA binding. Cancer Res 39:4027-4033.

Comment #3: In addition to contaminated surface soil, consider other exposure pathways to dioxins such as homegrown vegetables and indoor dust.
Response #3: Florida DOH and ATSDR have modified this report to address homegrown vegetables, specifically zucchini because of their unique ability to absorb

dioxins. Florida DOH and ATSDR will address the indoor dust pathway in a separate report.

Comment #4: The cancer risk from exposure to dioxins is not as low as zero.
Response #4: Florida DOH and ATSDR have revised the text in keeping with the non-threshold cancer risk model.

Comment #5: For dioxins, surface soil 0 to 3 inches deep rather than 0 to 6 inches deep is more appropriate for estimating routine human exposure.
Response #5: Florida DOH and ATSDR have clarified the rationale for using the available 0 to 6 inches deep soil data.

Comment #6: Consider soil ingestion for children with "pica" behavior.
Response #6: Data on the magnitude and frequency of soil-pica behavior are very sparse. Therefore, health risk estimates for children with the unusual soil-pica behavior are uncertain. Discussions continue nationally on the most appropriate ingestion rates, exposure frequencies, etc. for soil-pica behavior [ATSDR 2001]. None-the-less, Florida DOH and ATSDR modified this report to include dose calculations for a child with soil-pica behavior.

Comment #7: Clarify the sentence on page 14 that ingesting soil from the City easement between NW 26th Avenue and NW 30th Avenue west of Koppers could possibly harm children's health.
Response #7: Florida DOH and ATSDR have modified this report to explain the health risk to children from exposure to soil in the City easement and that this finding applies only to soil in this easement.

Comment #8: Soil samples 2 miles from Koppers may be impacted by air deposition from the site and not indicative of "background."
Response #8: Although soil testing is ongoing, a preliminary analysis of over 100 samples using the standard GC/MS test appears to show dioxin concentrations approaching background less than 0.5 mile from the site. Therefore, it is reasonable to assume that soil samples 2 miles from the site are representative of background.

Comment #9: Using the CALUX analysis, data are now available to assess the health threat from indoor dust.
Response #9: Florida DOH and ATSDR will consider the indoor dust pathway in a separate report.

Comment #10: Rather than finding "no increase in the overall cancer rate," two previous Florida DOH reports were "unable to identify an increase in the overall cancer rate."
Response #10: Florida DOH and ATSDR revised the report to more accurately reflect the findings of the two previous Florida DOH cancer reports.

Glossary

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk of for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose-response relationship
The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

EPA
United States Environmental Protection Agency.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching), and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

mg/kg
Milligram per kilogram.

mg/m3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might

occur in the future, but where the exposure is not expected to cause any harmful health effects.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites]**

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard

categories might be appropriate for each site. The five public health hazard categories are **no public health hazard, no apparent public health hazard**, **indeterminate public health hazard**, **public health hazard**, and **urgent public health hazard**.

Public meeting
A public forum with community members for communication about a site.

Receptor population
People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Risk
The probability that something will cause injury or harm.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see **uncertainty factor]**

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or environment.

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents which, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Report Preparation

The Florida Department of Health prepared this Health Consultation for the Koppers hazardous waste site under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, and procedures existing at the date of publication. ATSDR has reviewed this document and concurs with its findings based on the information presented.

Author

Florida Department of Health
Randy Merchant
Public Health Toxicology Section
Division of Disease Control and Health Protection
850-245-4401

Florida Department of Health Reviewers

Dr. Mark Higginbotham
Public Health Toxicology Section
Division of Disease Control and Health Protection

Dr. Kendra Goff
Public Health Toxicology Section
Division of Disease Control and Health Protection

Technical Advisor

Agency for Toxic Substances and Disease Registry Reviewer
Alan Parham
Technical Project Officer
Division of Community Health Investigations