

Health Consultation

OAKLAND AVENUE AND 45TH STREET (ALTON PARK AREA 3)

CHATTANOOGA, HAMILTON COUNTY, TENNESSEE

**Prepared by the
Tennessee Department of Health**

SEPTEMBER 10, 2009

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

Health Consultation: A Note of Explanation

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

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

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Foreword

This document summarizes an environmental public health investigation performed by Environmental Epidemiology of the State of Tennessee Department of Health. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

Evaluate Exposure: Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on exposure pathways, risk assessment, toxicology, cleanup actions, and the scientific literature.

Make Recommendations: Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. Reducing or eliminating these actions will prevent possible harmful health effects. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be actions items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, and will work with other agencies to resolve the problem.

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

Please write to: Environmental Epidemiology
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Or call us at: 615-741-7247 or toll-free 1-800-404-3006 during normal business hours

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SUMMARY

INTRODUCTION

Ensuring the wellbeing of those living in, working in, or visiting the city of Chattanooga is a priority of the Tennessee Department of Health (TDH), Environmental Epidemiology Program (EEP).

EEP wrote this health consultation based on the request of the Chattanooga-Hamilton County Regional Planning Agency (CHCRPA). The purpose of this health consultation is to document our review of supplied environmental soil and groundwater sampling data collected from the potential brownfield site Oakland Avenue and 45th Street (Alton Park Area 3) to determine if these parcels are safe for either residential or commercial redevelopment. This site consists of 7 parcels in Chattanooga, Hamilton County, TN. Tax Parcel 167C B 015 is located at 4327 Oakland Avenue, Tax Parcel 167C B 016 is located at 4333 Oakland Avenue, Tax Parcel 167C B 017 is located at 4508 Oakland Avenue, Tax Parcel 167C H 001 is located at 4504 Oakland Avenue, Tax Parcel 167C H 002 is located at 511 West 45th Street, Tax Parcel 167C H 037 is located at 400 West 45th Street, and Tax Parcel 167C H 038 is located at West 40th Street.

All data supplied for this health consultation was compared to residential and industrial health screening values provided by the Agency for Toxic Substance and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). Screening levels are chemical concentrations based on toxicology below which no adverse health effects are predicted to occur. When a screening level is exceeded, it does not immediately indicate that people would be expected to develop adverse health effects. Instead, it simply means that the potential health risk requires further investigation.

CONCLUSIONS

EEP reached six important conclusions in this health consultation:

Conclusion 1

EEP concludes that there are multiple physical hazards on Tax Parcel 167C H 002 that could harm the health of adults or children and these hazards must be removed and properly disposed.

Basis for Conclusion

Scattered debris and mounds of concrete, soil, and wood were observed in and around the rundown and abandoned office building on Tax Parcel 167C H 002 as well as an easily accessible drainage ditch filled with murky water along the railroad tracks on the western side.

Conclusion 2	EEP concludes that contact with metals and pesticides in the soil of Tax Parcel 167C H 002 after its redevelopment for either residential or commercial use is not expected to harm the health of adults or children.
Basis for Conclusion	The measured levels were compared to screening values for residential and industrial soil. All identified metals and pesticides in the soil of Tax Parcel 167C H 002 were below the levels expected to harm the health of adults and children except for arsenic. Although the arsenic concentrations at all sample locations exceeded the screening values for residential and industrial soil, the levels found were similar to background levels. In Tennessee, the upper limit for background concentrations is 10 milligrams per kilograms (mg/kg). The Tennessee Department of Environment and Conservation (TDEC) Division of Remediation (DoR) has demonstrated that background arsenic concentrations in some areas can even exceed 10 mg/kg. ATSDR therefore recommends that the soil comparison value be 20 mg/kg (ATSDR 2009a). The theoretical risk for adults and children exposed to arsenic in the soil of Tax Parcel 167C H 002 is considered to be very low.
Conclusion 3	EEP concludes that contact with polychlorinated biphenyls (PCBs) in the soil of Tax Parcel 167C H 002 is not expected to harm the health of adults or children.
Basis for Conclusion	Risk assessment aims for less than a one-in-a-million (10^{-6}) risk. Risk estimated to be less than one-in-ten thousand (10^{-4}) is often acceptable. Given the worst case scenario, the conservatively estimated theoretical risk for adults and children exposed to PCBs in the soil of Tax Parcel 167C H 002 is in the acceptable range and considered to be very low.
Conclusion 4	EEP concludes that contact with polycyclic aromatic hydrocarbons (PAHs) in the soil of Tax Parcel 167C H 002 is not expected to harm the health of adults or children.
Basis for Conclusion	Risk assessment aims for less than a one-in-a-million (10^{-6}) risk. Risk estimated to be less than one-in-ten thousand (10^{-4}) is often acceptable. Given the worst case scenario, the conservatively estimated theoretical risk for adults and children exposed to PAHs in the soil of Tax Parcel 167C H 002 is in the acceptable range and considered to be very low.
Conclusion 5	EEP concludes that contact with volatile organic compounds (VOCs) in the subsurface soil of Tax Parcel 167C H 002 is not expected to harm the health of adults or children.

**Basis for
Conclusion**

The measured levels were compared to screening values for residential and industrial soil. All VOCs identified in the subsurface soil of Tax Parcel 167C H 002 were below the levels expected to harm the health of adults and children.

Conclusion 6

**Basis for
Conclusion**

EEP concludes that contact with Tax Parcels 167C H 001, 167C H 037, and 167C H 038 is not expected to harm the health of adults or children. Given the historical use of Tax Parcels 167C H 001, 167C H 037, and 167C H 038, the Phase I Environmental Site Assessment (ESA) did not identify the presence of any hazardous substances.

**FOR MORE
INFORMATION**

If you have any questions or concerns about your health, you should contact your healthcare provider. For more information on this site and others, call EEP at 615-741-7247 or toll-free 1-800-404-3006 during normal business hours.

Introduction

On behalf of the City of Chattanooga, Ms. Yuen Lee with the Chattanooga-Hamilton County Regional Planning Agency (CHCRPA) contacted the Tennessee Department of Health (TDH), Environmental Epidemiology Program (EEP) regarding a potential brownfield site on 7 parcels of property owned by the City of Chattanooga. Tax Parcel 167C B 015 is located at 4327 Oakland Avenue, Tax Parcel 167C B 016 is located at 4333 Oakland Avenue, Tax Parcel 167C B 017 is located at 4508 Oakland Avenue, Tax Parcel 167C H 001 is located at 4504 Oakland Avenue, Tax Parcel 167C H 002 is located at 511 West 45th Street, Tax Parcel 167C H 037 is located at 400 West 45th Street, and Tax Parcel 167C H 038 is located at West 40th Street. These parcels have been identified as Alton Park Area 3. Residential use is being considered for Tax Parcels 167C H 001, 167C H 037, and 167C H 038. Commercial use is being considered for Tax Parcels 167C B 015, 167C B 016, 167C B 017, and 167C H 002, with someone currently interested in Tax Parcel 167C H 002 for office use. This property has undergone Phase I and II Environmental Site Assessments (ESAs) and EEP has been involved with meetings, discussions, and planning with stakeholders regarding its future use. EEP was supplied environmental soil and groundwater sampling data to review and were asked to provide guidance in understanding the scope of potential remediation efforts based on current and historical land use. The purpose of this health consultation, state ID number TDOR 33-500, is to document this review and the associated findings.

Background

The site of Oakland Avenue and 45th Street (Alton Park Area 3) has been identified as a potential brownfield site. A brownfield site is a property in which the expansion, redevelopment, or reuse is not possible because the area may be contaminated with a substance that is harmful to human health. To be able to reuse such property, the U.S. Environmental Protection Agency (EPA) developed the Brownfield Program in 1995 which allows interested parties to apply for money to clean up the contaminated area so that it is safe for community members to use (EPA 2007a).

Oakland Avenue and 45th Street (Alton Park Area 3) is in the southern region of Chattanooga, Hamilton County, Tennessee. It consists of 7 parcels owned by the City of Chattanooga. Tax Parcel 167C B 015 is located at 4327 Oakland Avenue, Tax Parcel 167C B 016 is located at 4333 Oakland Avenue, Tax Parcel 167C B 017 is located at 4508 Oakland Avenue, Tax Parcel 167C H 001 is located at 4504 Oakland Avenue, Tax Parcel 167C H 002 is located at 511 West 45th Street, Tax Parcel 167C H 037 is located at 400 West 45th Street, and Tax Parcel 167C H 038 is located at West 40th Street (Figures 1 and 2).

The total area of the subject property is 2.34 acres. The property is currently unoccupied and unused. Research on the historical use of the site has revealed that it was a mix of commercial and residential properties. Tax Parcels 167C H 001, 167C H 037, and 167C H 038 were formally a post office and commercial units but are now vacant lots. Tax Parcel 167C B 015 has been an auto shop, cabinet shop, and vacuum cleaner shop. From before 1930 to after 1964, Tax Parcel 167C B 016 housed a dry cleaning facility. Tax Parcel 167C B 017 had two buildings that were used as residential multi-family units. Tax Parcel 167C H 002 was the administrative office building for the Anchor Glass Corporation. This building is now vacant and condemned.

Across Oakland Avenue, residential areas border Tax Parcels 167C B 015, 167C B 016, and 167C B 017 to the north, west, and south and the former Anchor Glass Corporation is located adjacent to the east. Residential areas also border Tax Parcels 167C H 001, 167C H 037, and 167C H 035 to the south and west across Oakland Avenue. Railroad tracks border Tax Parcels 167C H 001, 167C H 037, and 167C H 038 to the east and the former Anchor Glass Corporation borders Tax Parcels 167C H 001, 167C H 037, and 167C H 038 to the north across West 45th Street. Residential properties border Tax Parcel 167C H 002 to the south and commercial and residential properties border to the east. Railroad tracks border Tax Parcel 167C H 002 to the west and the former Anchor Glass Corporation borders Tax Parcel 167C H 002 to the north across West 45th Street (Figure 3).

Upon site inspection of Tax Parcel 167C H 002 conducted by Aquaterra Engineering, LLC in 2008, several overturned 55 gallon drums labeled as to contain hydraulic oil were found in the vacant office building of the former Anchor Glass Corporation. Scattered debris and mounds of concrete, soil, and wood were also observed in the abandoned office building and along the grounds outside the building. In addition, oil spills and overturned 55-gallon drums labeled as to contain banana puree and ammonia nitrate were found on the property (Figure 3). For these reasons, Tax Parcel 167C H 002 is a physical hazard and has the potential of being contaminated with volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), heavy metals, pesticides, herbicides, and polychlorinated biphenyls (PCBs). Additionally, there is potential for the groundwater around Tax Parcel 167C B 016 to be contaminated with volatile organic compounds (VOCs) due to the dry cleaning facility that was once present. Previous assessment of Tax Parcels 167C H 001, 167C H 037, and 167C H 038 did not identify any heavy metals and additional contamination of the parcels is not a concern given their past usage.

Discussion

Environmental Sampling

On October 28, 2008, Aquaterra Engineering, LLC collected grab samples of surface soil at 10 locations from 0 to 6 inches in depth, labeled SS-1 through SS-10, on Tax Parcel 167C H 002 (Figure 4). A duplicate sample was also collected at SS-4 for a total of 11 samples. These samples were collected in areas that have the potential to have been impacted by improper storage and/or disposal of chemicals from the former Anchor Glass Corporation office building and were submitted for laboratory analysis of VOCs, PAHs, heavy metals, pesticides, herbicides, and PCBs.

Additionally, three monitoring wells labeled MW-1 through MW-3 were installed using hollow stem auger drilling methods on Tax Parcels 167C B 017, 167C B 016, and 167C B 015, respectively. Groundwater samples were collected from these wells and submitted for laboratory analysis of VOCs. MW-1 was placed in an anticipated up-gradient location of the former dry cleaning facility at a maximum depth of 14 feet. MW-2 was placed in the anticipated potential source area at a maximum depth of 12 feet. Lastly, MW-3 was placed in an anticipated down-gradient location at a maximum depth of 17 feet (Figure 4). Subsurface soil samples were continuously collected during the installation and field screened with an organic vapor analyzer (OVA). The two soil samples exhibiting the highest OVA reading and/or visual or olfactory

signs of contamination from each boring were submitted for laboratory analysis of VOCs. If organic vapors were not detected and there were no visual or olfactory signs of contamination, the soil sample that was collected directly above the groundwater or at the maximum boring depth was submitted. This sampling method is adequate in detecting the possible presence of drycleaner chemicals left from the former use of Tax Parcel 167C B 016 because drycleaner chemicals typically concentrate at the bottom of the water table and in soil where the water table fluctuates. Because the parcels are covered by gravel, surface soils were not sampled.

No environmental sampling was conducted on Tax Parcels 167C H 001, 167C H 037, and 167C H 038. This is because recognized environmental conditions (RECs) were not identified during the Phase I ESA. Due to their past residential usage and current existence as vacant lots, there is no reason to suspect that these parcels contain any kind of significant contamination.

The soil contaminant concentrations for VOCs, PAHs, heavy metals, pesticides, herbicides, and PCBs were then compared to the Agency for Toxic Substances and Disease Registry (ATSDR) child and adult health screening Cancer Risk Evaluation Guides (CREGs) and to the EPA cancer and noncancer risk Regional Screening Levels (RSLs) for residential and industrial soil where established. For the contaminants that do not have established CREGs, concentrations were compared to ATSDR's child and adult health screening Reference Dose Media Evaluation Guides (RMEGs). The groundwater contaminant concentrations for VOCs were also compared to ATSDR's CREGs and RMEGs as well as EPA's cancer and noncancer Regional Screening Levels (RSLs) for drinking water where established.

CREGs, RMEGs, and RSLs are screening levels commonly used during environmental public health investigations. Screening levels are chemical concentrations based on toxicology below which no adverse health effects are predicted to occur. When a screening level is exceeded, it does not immediately indicate that people would be expected to develop adverse health effects. Instead, it simply means that the potential health risk requires further investigation.

Table 1 lists the soil sample analytical results for metals, PCBs, and pesticides identified on Tax Parcel 167C H 002 at the Oakland Avenue and 45th Street (Alton Park Area 3) site. The identified metals include arsenic, barium, cadmium, chromium, lead, mercury, and selenium. The PCBs identified were Aroclor 1254 and Aroclor 1260. The pesticide identified was 4,4-DDT. No herbicides were detected. Table 1 also lists the CREG, RMEG, RSL comparison values. ATSDR's Environmental Media Evaluation Guide (EMEG) for chronic exposure (greater than 365 days) is used as the comparison value for cadmium because it is lower than the RMEG which is 50 mg/kg for children and 700 mg/kg for adults. By using the lower EMEG value for comparison, the worst-case scenario can be assessed.

Metals were detected at all 11 sample locations. PCBs were identified at 5 of the 11 sample locations. The pesticide 4,4-DDT was detected at 1 of the 11 sample locations. Although the arsenic concentrations at all sample locations exceed the CREG and cancer risk RSLs for residential and industrial soil, the upper limit for background concentrations in Tennessee is 10 milligrams per kilograms (mg/kg). The Tennessee Department of Environment and Conservation (TDEC) Division of Remediation (DoR) has demonstrated that background arsenic concentrations in some areas can even exceed 10 mg/kg (EEP). The ATSDR therefore recommends that the soil comparison value be 20 mg/kg (ATSDR 2009a). As a result, exposure to arsenic in the soil of Tax

Parcel 167C H 002 is not expected to cause any harmful health affects. All identified metals, PCBs, and pesticides were below the established screening values for residential soil except for the PCB Aroclor 1254 at the SS-4 duplicate sample which exceeded EPA's residential soil cancer risk RSL. All identified metals, PCBs, and pesticides were below the established screening values for industrial soil.

Table 2 lists the PAH soil data for each sample location where a PAH constituent was identified on Tax Parcel 167C H 002 as well as the CREG, RMEG, and RSL comparison values. It also lists the PAH toxic equivalency factor for each constituent. Benzo(g,h,i)perylene and phenanthrene do not have comparison values and benzo[a]pyrene is the only PAH that has a CREG.

Of the 10 samples tested, 6 had PAH concentrations that were above the detection limit. However, the detection limit for benzo(a)anthracene and benzo(b)fluoranthene at SS-7 and SS-9, the detection limit for indeno(1,2,3-cd)pyrene at SS-4, SS-7, SS-9, and SS-10, and the detection limit for benzo(a)pyrene at SS-2, SS-4, SS-5, SS-7, SS-8, and SS-9 are greater than their respective cancer risk RSLs for residential soil. Therefore, it is not possible to properly assess the potential cancer risk of exposure to these chemicals in residential soil at these locations.

When looking at industrial soil, the detection limits for all the PAH constituents are below the industrial soil cancer risk and noncancer risk RSLs with the exception of benzo(a)pyrene. The detection limit for benzo(a)pyrene at SS-4, SS-7, and SS-9 exceeds the industrial soil cancer risk RSL for benzo(a)pyrene and therefore the potential cancer risk of exposure to benzo(a)pyrene in industrial soil cannot be properly assessed at these sample locations.

Table 3 lists the total PAH soil data by sample location as well as their PAH toxic equivalency for the 6 out of 10 samples in which PAHs were identified on Tax Parcel 167C H 002. These values are also displayed graphically in Figures 5 and 6, respectively. Using the detected concentrations and one-half the detection limit for constituents reported as below the detection limit, as indicated by the less than (<) symbol, the total PAH concentration for all 10 soil samples ranged from 0.18 (below detection limit) to 14.32 mg/kg with an arithmetic mean of 3.93 mg/kg. The PAH toxic equivalency of the entire site ranged from 0.02 to 1.46 mg/kg with an arithmetic mean of 0.39 mg/kg.

Worst-case scenarios can be evaluated by focusing on the contaminated areas of the site. Of the 6 soil samples where PAHs were detected on Tax Parcel 167C H 002, the total PAH concentration ranged from 0.16 to 13.00 mg/kg with an arithmetic mean of 4.63 mg/kg. Soil sampling locations SS-1, SS-4, and SS-10 had total PAH concentrations exceeding the average with SS-10 being more than twice the average (Figure 5). Figure 6 is a schematic illustrating the location of these 6 soil samples. No PAH-contaminated soil was detected at the southern most corner of the parcel. The PAH toxic equivalency of the 6 soil samples ranged from 0.044 to 1.42 mg/kg with an arithmetic mean of 0.43 mg/kg. Soil sampling locations SS-1 and SS-10 had PAH toxic equivalencies exceeding this average. The PAH toxic equivalency of sample location SS-10 was greater than twice the average (Figure 7).

Table 4 lists the results of the VOC subsurface soil sampling for Tax Parcel 167C H 002 and Tax Parcels 167C B 015, 167C B 016, and 167C B 017. None of the identified VOCs have a CREG. The only VOC that was identified on the parcel that has a RSL is 1,2,4-trimethylbenzene. This was identified at sample location SS-4 with a concentration of 0.017 mg/kg. This concentration is far below the RSL value of 280 mg/kg for industrial soil and 67 mg/kg for residential soil. Exposure to VOCs at Tax Parcel 167C H 002 or at Tax Parcels 167C B 015, 167C B 016, and 167C B 017 are therefore not expected to cause any harmful health affects.

Table 5 lists the sample results for VOCs identified in the groundwater of Tax Parcels 167C B 015, 167C B 016, and 167C B 017. Bromodichloromethane is the only VOC with a CREG, RMEGs, a cancer risk RSL, and a noncancer risk RSL. Naphthalene also has RMEGs, a cancer risk RSL, and a noncancer risk RSL but it does not have a CREG. None of the other VOCs identified have a screening value. MW-2 is the only monitoring well in which VOCs were identified at a concentration greater than the specified detection limits for each contaminant. The identified concentrations of naphthalene did not exceed ATSDR's adult or child RMEGs but it did exceed EPA's cancer risk RSL and noncancer risk RSL. The cancer risk from exposure to naphthalene in the groundwater of MW-1 and MW-3 cannot be properly assessed because the detection limit for naphthalene exceeds the cancer risk RSL for naphthalene. The identified concentration of bromodichloromethane did not exceed ATSDR's adult or child RMEGs either, but it did exceed ATSDR's CREG and EPA's cancer risk RSL at MW-2. The cancer risk from exposure to bromodichloromethane in the groundwater of MW-1 and MW-3 cannot be properly assessed because the detection limit for bromodichloromethane exceeds the CREG for bromodichloromethane. However, considering that no one drinks from a private well in this area, VOCs in the groundwater of Tax Parcels 167C B 015, 167C B 016, and 167C B 017 is not of concern.

Exposure Assessment

The term "chemical of concern" is often applied when the concentration of a screening level, such as a CREG, RMEG, or RSL is exceeded. Chemicals of concern require further investigation. With the identification of a chemical of concern, the exposure scenario, including exposure potential, dose, duration, and frequency, needs to be thoughtfully considered.

People have to come into contact with a contaminant and there must be a *completed exposure pathway* for adverse health effects to occur. A completed exposure pathway consists of five main parts including:

1. a source of contaminant in the environment;
2. a means for the contaminant to migrate from its source;
3. a place where people come into contact with the contaminant;
4. a pathway (route) by which people come into contact with the contaminant such as breathing; and,
5. people who could potentially be exposed (receptor population).

Pathways are also characterized based on whether the exposure occurred in the past, is occurring in the present, or may occur in the future. Due to the past residential usage and current existence

as vacant lots, there is no reason to suspect that people were exposed to any kind of significant contamination in the past or present at Tax Parcels 167C H 001, 167C H 037, and 167C H 038, nor is there reason to suspect that people will be exposed to any kind of significant contamination in the future. Additionally, past, present, and future exposure to VOCs in the subsurface soil of Tax Parcels 167C B 015, 167C B 016, and 167C B 017 is not of concern because the VOC concentrations identified were very low. Past and present exposure to the groundwater of Tax Parcels 167C B 015, 167C B 016, and 167C B 017 is also not of concern because no one drinks from a private well in this area. For these parcels to be redeveloped for either residential or commercial use in the future, then restriction of groundwater use or institutional controls to prevent the use of groundwater at Tax Parcels 167C B 015, 167C B 016, and 167C B 017 is an option.

Lastly, Tax Parcel 167C H 002 is mostly covered by vegetation. Vegetative cover is an effective barrier in limiting exposure to contaminated soils. Right now, incidental ingestion of soil and dermal contact with the soil are not expected to be major pathways of exposure because the site is well vegetated and people who use the site will be wearing shoes and clothing which provide a simple yet efficient barrier to dermal exposure. However, if the vegetative cover is worn away, then incidental ingestion and dermal contact may occur. Inhalation of PAHs is not believed to be a major pathway of exposure. This is because all of the PAHs identified at the proposed site are high molecular weight compounds. As such, they do not readily volatilize. Even if volatilization were to occur, the contaminated soil is located on or below ground surface whereas the breathing zone is several feet above ground surface. Over an area of this size, any PAHs that volatilize into the air are likely to be diluted, wind-mixed, and not detectable. Inhalation of metals, PCBs, and pesticides is also not believed to be a major pathway of exposure because of the low concentrations identified in the soil of Tax Parcel 167C H 002. Inhalation exposure to metals, PCBs, and pesticides in the soil of Tax Parcel 167C H 002 is likely to be small and people are not likely to experience any negative health effects. Past, present, and future exposure to VOCs in the subsurface soil of Tax Parcel 167C H 002 is also not of concern because the concentrations identified were very low.

Chemicals of Concern

All identified metals, PCBs, and pesticides detected in the soil of Tax Parcel 167C H 002 at the Oakland Avenue and 45th Street (Alton Park Area 3) site were below the established screening values for industrial soil and all identified metals, PCBs, and pesticides were below the established screening values for residential soil except for the PCB Aroclor 1254 at the SS-4 duplicate sample (Table 1). Because the concentration of Aroclor 1254 exceeds EPA's cancer risk RSL for residential soil, Aroclor 1254 is considered a chemical of concern.

When looking at the PAHs identified in the soil of Tax Parcel 167C H 002 at the Oakland Avenue and 45th Street (Alton Park Area 3) site, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(a)pyrene exceeded their respective EPA cancer risk RSL for residential soil at several locations and benzo(a)pyrene exceeded the cancer risk RSL for industrial soil at 2 locations (Table 2). However, because the detection limits of benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(a)pyrene also exceed their respective EPA cancer risk RSL for residential soil and the detection limit for benzo(a)pyrene at SS-4, SS-7, and SS-9 exceeds

the cancer risk RSL for industrial soil, the potential health risk of exposure to these PAHs cannot be properly assessed. Therefore, the potential cancer risk due to exposure to benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(a)pyrene cannot be concluded and these 4 PAHs are considered chemicals of concern.

Polychlorinated Biphenyls (PCBs) in Surface Soil

Polychlorinated biphenyls (PCBs) are a group of synthetic organic chemicals; no natural PCB is known to exist. PCBs enter the environment as mixtures of chlorinated biphenyl compounds. PCBs are either oily liquids or solids; some can volatilize and exist as vapor in the air. PCBs have no known odor or taste.

PCBs do not burn easily and are good insulators; because of these properties, PCBs were widely used as coolants and lubricants in electrical components such as transformers and capacitors (ATSDR 2000). PCB mixtures are commonly referred to by industrial trade names such as Aroclor. Aroclors are usually followed by a four-digit number. The first two digits generally refer to the number of carbon atoms attached to the biphenyl ring. The second two numbers indicate the percentage of chlorine (Murugesan 2007). For example, Aroclor 1254 has 12 carbon atoms and is 54% chlorine.

The production of PCBs was stopped in the United States in August 1977 due to evidence that PCBs accumulate in the environment and may cause adverse human health effects. They are understood to be a long-term chronic hazard. Evidence of cancer in rats and liver damage in humans exposed to PCBs over many years has been reported. PCBs are listed as a Group B2, probable human carcinogen, by the EPA (ATSDR 2002). PCBs are not known to cause birth defects. PCBs are not thought to be a risk in short duration, acute exposure situations (ATSDR 2000).

The neurological effects of PCBs have been extensively investigated in humans. Studies show that even low levels of PCBs transferred to a fetus across the placenta may induce long-lasting neurological damage. In addition, PCBs are lipophilic substances and could be transferred from mother to nursing infant via breast milk (ATSDR 2000).

Evidence exists that the immune status of both adults and infants was altered after oral PCB exposure. Infants exposed *in utero* and/or via breast feeding seem to be particularly sensitive to the immunological effects of PCBs. An association was observed between infectious illness and PCBs in the children of mothers who consumed Lake Michigan or Sheboygan River fish (ATSDR 2000). Animal research provides strong support to the immunotoxicity of PCBs in humans.

There were two commercial mixtures of PCBs identified within Tax Parcel 167C H 002. These PCBs were Aroclor 1254 and Aroclor 1260. Aroclor 1254 was identified in 4 samples, SS-4, SS-4 Dup, SS-9, and SS-10. Of these 4 samples, the concentration of 0.31 mg/kg at SS-4 Dup exceeds the EPA RSL for Aroclor 1254 in residential soil which is 0.22 mg/kg. It does not exceed the EPA RSL for Aroclor 1254 in industrial soil which is 0.74 mg/kg. Aroclor 1260 was identified in one sample, SS-6, at a concentration of 0.029 mg/kg. This value does not exceed

the EPA RSL for Aroclor 1260 in industrial soil which is 0.74 mg/kg, nor does it exceed the EPA RSL for Aroclor 1260 in residential soil which is 0.22 mg/kg (EPA 2008). Neither Aroclor 1254 nor Aroclor 1260 have a CREG (Table 1).

The screening levels referenced for residential exposure are to bare soil. These screening levels are often derived from a scenario of constant, daily exposure over a lifetime. Likely exposure scenarios are not daily, nor constant. As mentioned earlier, when a chemical concentration exceeds a health screening level, it does not immediately indicate that people would be expected to develop adverse health effects. It does mean that the exposure scenario, including exposure potential, duration, and frequency, needs to be thoughtfully considered.

Polycyclic Aromatic Hydrocarbons (PAHs) in Surface Soil

Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals derived following the incomplete combustion of organic materials such as coal, oil, gas, wood, garbage, tobacco or meat. PAHs usually are found as complex mixtures of chemicals rather than just as individual chemicals. Many of the PAHs are ever-present in the environment. PAHs occur naturally or can be manufactured. More than 100 types of PAHs are known to exist throughout the environment, including in the air, water, and soil. Only a few of these PAHs are known to be harmful. The ATSDR Toxicological Profile (1995) is a good source of information on the toxicology and epidemiology of polycyclic aromatic hydrocarbons.

PAHs including benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene, have caused tumors in laboratory animals through inhalation, ingestion, and long-term dermal exposure. Studies of people showed that some individuals exposed, by inhaling or by skin contact, for long periods of time to mixtures that contain PAHs and other compounds can develop cancer (ATSDR 1995). The observed effect level for carcinogenic endpoints is much, much lower than for non-cancer endpoints. Thus, it is commonplace to focus on the potential cancer effects of PAHs.

There are many uncertainties in the toxicological assessment of PAHs. It is known that different PAHs have different toxic potencies. A Toxic Equivalency Factor (TEF) methodology has been developed that combines the relative toxicities of individual PAHs in relation to benzo[a]pyrene (B[a]P), the PAH determined to be the most hazardous (EPA 2004a).

Using the detected concentrations and one-half the detection limit for constituents reported as below the detection limit, toxic equivalency concentrations for the entire site ranged from 0.02 to 1.46 mg/kg with an arithmetic mean of 0.39 mg/kg. The concentration range for B[a]P was 0.0165 to 1.1 mg/kg with an arithmetic mean of 0.29 mg/kg.

For the 6 samples collected within Tax Parcel 167C H 002 where PAHs were detected, toxic equivalency concentrations ranged from 0.72 to 1.42 mg/kg (Table 3) with an arithmetic mean of 0.43 mg/kg (Figure 7). B[a]P was identified in 4 of the 6 samples. These samples were SS-1, SS-3, SS-6, and SS-10. The concentration range for B[a]P was 0.089 to 1.1 mg/kg (Table 2) with an arithmetic mean of 0.47 mg/kg. B[a]P concentrations at SS-1, SS-6, and SS-10 exceed

the ATSDR health screening CREG for a one-in-a-million (10^{-6}) excess cancer risk of 0.1 mg/kg. B[a]P concentrations at all 4 sample locations where the contaminant was identified exceed the EPA direct contact exposure pathways RSL of 0.015 mg/kg for residential soil. B[a]P concentrations at SS-1 and SS-10 exceed the EPA direct contact exposure pathways RSL of 0.21 mg/kg for industrial soil (EPA 2008).

The risk from exposure to B[a]P in residential soil at SS-2, SS-5, and SS-8 cannot be properly assessed because the residential soil RSL for B[a]P is 0.015 mg/kg and the detection limit at these sample locations was set at 0.033 mg/kg. Likewise, the risk from exposure to B[a]P in residential soil at SS-4, SS-7, and SS-9 cannot be properly assessed because the CREG and the RSL of B[a]P in residential soil is also exceeded by the detection limit of 0.66 mg/kg at these sample locations. It is therefore assumed that the B[a]P concentrations at all 10 sample locations exceed the CREG and the RSL for residential soil. Additionally, the cancer risk from exposure to B[a]P in industrial soil at sample locations SS-4, SS-7, and SS-9 cannot be properly assessed because the CREG for B[a]P is 0.1 mg/kg and the detection limit for B[a]P was set at 0.66 mg/kg. This detection limit also exceeds the RSL of 0.21mg/kg for industrial soil. It is therefore assumed that the B[a]P concentrations at SS-4, SS-7, and SS-9 exceed the CREG and the RSL for industrial soil.

As mentioned earlier, when a chemical concentration exceeds a health screening level, it does not immediately indicate that people would be expected to develop adverse health effects. It does mean that the exposure scenario, including exposure potential, duration, and frequency, needs to be thoughtfully considered. Based on the sampling results at this site, the detected levels of PAHs are similar to the background concentrations found in urban soil (ATSDR 1995).

Physical Hazards

A site visit conducted by the Chattanooga-Hamilton County Health Department on May 7, 2009 revealed that much of Tax Parcel 167C H 002 at the Oakland Avenue and 45th Street (Alton Park Area 3) site resembles a junkyard. Thousands of very high and steeply stacked wooden pallets were observed in and around the abandoned office building (Figures 8 and 9) as well as scattered debris, old tires, boxes of used plastic, and mounds of concrete, wood, and soil (Figures 10 through 14). In addition to trash, an easily accessible drainage ditch filled with murky runoff water runs along the railroad tracks on the western side of Tax Parcel 167C H 002 (Figure 15) and the former Anchor Glass Office Building still stands although it is very rundown and appears as though it could collapse. Aquetera Engineering, LLC did conduct an asbestos and lead-based paint survey on the former Anchor Glass Office Building. Lead-based paint was not found but the floor tiles and the black mastic which is used to glue the tiles to the subfloor are both asbestos-containing. Although the floor tiles and the black mastic are still in take, there is the risk that these building materials could begin to crumble. It is important that the public stays away from such physical hazards at Tax Parcel 167C H 002 until the site can be properly restored.

There was also some minor trash observed on the vacant lots of Tax Parcels 167C H 001, 167C H 038, and 167C H 037 (Figure 16) which are collectively surrounded by a chain-link fence. However, there is no gate on the fence so the lots are easily accessible. In addition to trash, there

were 3 drums in the northeastern corner of Tax Parcel 167C B 015 (Figure 17). One drum was clearly labeled as to contain non-hazardous waste (Figure 18) but the labels on the other 2 drums were too faded to read. According to Aquetera Engineering, LLC, all 3 of these drums contain soil cuttings and purge water that were generated during the drilling and sampling of the site and these drums were disposed of during the first week of June, 2009.

Children's Health Considerations

In the preparation of this public health document, the health and wellbeing of children was thoughtfully considered.

In communities faced with environmental contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances (ATSDR 1997, 1998). Children's bodily systems are still developing. These systems can sustain permanent damage if toxic exposure levels are high enough during critical growth stages. Children also eat more food, drink more liquids, and breathe more air in proportion to their body weight. This lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body size. Behavior patterns of children as well as their limited ability to understand environmental public health can also result in more exposure to hazardous substances. Because children are dependent on adults for access to housing, medical care, and risk identification, adults need as much information as possible to make informed decisions regarding their children's health (ATSDR 1997a).

PCBs and PAHs will adhere to soil particles. Children could therefore be exposed to PCBs and PAHs at the Oakland Avenue and 45th Street (Alton Park Area 3) site by getting the soil from Tax Parcel 167C H 002 on their skin. Consequently, the hand-to-mouth behavior of young children requires special attention. Toddlers will sometimes display pica behavior in which they eat non-food substances such as dirt or clay.

In addition to incidental ingestion, PCBs and PAHs adhered to soils can travel on clothes and pets into homes. Thus, the outdoor activities of children and teenagers require thoughtful consideration. That said, the worse case scenario for childhood exposure to PCBs and PAHs in soil was calculated and did not show a problem.

Although unique health risks associated with exposure to PCBs and PAHs were not identified for children at this site, careful consideration of their wellbeing is still appropriate.

Community Concerns

A meeting regarding potential brownfield sites in the city of Chattanooga was held on September 25th, 2007. At this meeting, 10 potential brownfield sites were identified and discussed. Participants were then asked to rank these sites in order of priority. The Oakland Avenue and 45th Street (Alton Park Area 3) site was ranked third and was since selected to undergo a Phase I and II ESAs. In 2008, a resident of Chattanooga did however call the CHCRPA to voice concern

over the debris located on Tax Parcel 167C H 002. This resident feels that the debris is an eyesore and has turned the site into a hazard.

Site Considerations

The idea of Oakland Avenue and 45th Street (Alton Park Area 3) being a potential brownfield site has merit. Although the site's use has not yet been finalized, redevelopment options for the site may include community-use facilities, industrial warehousing, or multi-family residences.

Determining the site's reuse early in the redevelopment process can ensure that proper cleanup measures are implemented and correspond with the goal of the property's reuse. To determine the property's appropriate reuse, it is essential to identify the presence and extent of contamination (EPA 2006). The Phase I ESA did not identify contamination at Tax Parcels 167C H 001, 167C H 037, and 167C H 038 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, Tennessee. Contamination was however suspected at Tax Parcels 167C H 002, 167C B 015, 167C B 016, and 167C B 017, thus resulting in the performance of a Phase II ESA in which sampling for specific hazards was conducted. With this information, a remedial action plan can be developed.

Based on the remedial action plan, property cleanup is conducted depending on the type, quantity, and toxicity of contamination found onsite (EPA 2006). Cleanup activities for the Oakland Avenue and 45th Street (Alton Park Area 3) site could include groundwater remediation or institutional controls to prevent the use of groundwater at Tax Parcels 167C B 015, 167C B 016, and 167C B 017 as well as soil remediation and debris removal at Tax Parcel 167C H 002.

There were several contaminants for which the detection limits exceeded their respective screening values. The parcel areas in which this occurred cannot be fully characterized and EEP cannot conclude whether exposure to these contaminants could harm people's health. Although EEP requested re-sampling of these parcels using lower detection limits, it is the opinion of Aquaterra Engineering, LLC that these parcels should be limited to commercial use only and therefore additional assessment is not required.

Overall, ensuring public safety needs to be a main concern when considering future uses of this site. Planning to maintain incomplete exposure pathways that will minimize potential exposure scenarios needs to be a priority. Any construction or institutional controls that remove the exposure pathway to soil at Tax Parcel 167C H 002 and to groundwater at Tax Parcels 167C B 015, 167C B 016, and 167C B 017 are reasonable options and should be considered during the planning process. If construction is the option chosen, the final development should be inspected regularly to ensure that they remain effective in protecting human health and the environment.

Conclusions

EEP reached six important conclusions in this health consultation:

EEP concludes that there are multiple physical hazards on Tax Parcel 167C H 002 that could harm the health of adults or children. Scattered debris and mounds of concrete, soil, and wood were observed in and around the rundown and abandoned office building on Tax Parcel 167C H 002 as well as an easily accessible drainage ditch filled with murky water along the railroad tracks on the western side.

EEP concludes that contact with metals and pesticides in the soil of Tax Parcel 167C H 002 is not expected to harm the health of adults or children. All identified metals and pesticides were below the levels expected to harm the health of adults and children.

EEP concludes that contact with polychlorinated biphenyls (PCBs) in the soil of Tax Parcel 167C H 002 is not expected to harm the health of adults or children. Given the worst case scenario, the conservatively estimated theoretical risk for adults and children exposed to PCBs in the soil of Tax Parcel 167C H 002 is in the acceptable range and considered to be very low.

EEP concludes that contact with polycyclic aromatic hydrocarbons (PAHs) in the soil of Tax Parcel 167C H 002 is not expected to harm the health of adults or children. Given the worst case scenario, the conservatively estimated theoretical risk for adults and children exposed to PAHs in the soil of Tax Parcel 167C H 002 is in the acceptable range and considered to be very low.

EEP concludes that contact with volatile organic compounds (VOCs) in the subsurface soil of Tax Parcel 167C H 002 is not expected to harm the health of adults or children. All identified VOCs were below the levels expected to harm the health of adults and children.

EEP concludes that contact with Tax Parcels 167C H 001, 167C H 037, and 167C H 038 is not expected to harm the health of adults or children. Given the historical use of Tax Parcels 167C H 001, 167C H 037, and 167C H 038, the Phase I Environmental Site Assessment (ESA) did not identify the presence of any hazardous substances.

Recommendations

The main focus of this health consultation is to protect the health of children and adults who come into contact with the Oakland Avenue and 45th Street (Alton Park Area 3) site. With that in mind, the following recommendations are believed to be appropriate based on EEP's review of the sampling data.

- All solid waste found at the Oakland Avenue and 45th Street (Alton Park Area 3) site must be removed and properly disposed of to eliminate physical hazards prior to demolition or renovation of the site.

Public Health Action Plan

The public health action plan for the Oakland Avenue and 45th Street (Alton Park Area 3) site contains a list of actions that have been or will be taken by EEP and other agencies. The purpose of the public health action plan is to ensure that this health consultation identifies public health hazards and offers a plan of action designed to mitigate and prevent harmful health effects that result from breathing, eating, drinking, or touching hazardous substances in the environment. Included is a commitment on the part of EEP to follow up on this plan to ensure that it is implemented.

Public health actions that have been taken include:

- Phase I Environmental Health Assessment of Tax Parcels 167C B 015, 167C B 016, 167C B 017, 167C H 001, 167C H 002, 167C H 037, 167C H 038 conducted by Aquaterra, LLC in 2008 at the request of CHCRPA
- Phase II Environmental Health Assessment of Tax Parcels 167C B 015, 167C B 016, 167C B 017, and 167C H 002 conducted by Aquaterra, LLC in 2008 at the request of CHCRPA
- Asbestos and lead-based paint survey completed on the former Anchor Glass Office Building
- Chattanooga-Hamilton County Health Department site visit
- TDH EEP health consultation

Public health actions that will be taken include:

- The City of Chattanooga will remove and properly dispose of all solid waste stored on Tax Parcel 167C H 002.
- Aquaterra Engineering, LLC will properly abandon the monitoring wells installed as part of the Phase II Environmental Site Assessment on Tax Parcels 167C B 015, 167C B 016,

and 167C B 017.

- Aquaterra Engineering, LLC will properly manage and dispose of the drums on Tax Parcel 167C H 002 as Special Waste.
- Any additional sampling at the site will be the responsibility of the City of Chattanooga.
- TDH EEP will provide copies of this health consultation to state, federal, and local government, academia, environmental groups, community groups, and others interested in the Oakland Avenue and 45th Street (Alton Park Area 3) site.
- TDH EEP will maintain dialogue with ATSDR, EPA, TDEC, CHCRPA, the City of Chattanooga, and other interested stakeholders to safeguard public health and to prevent people from future exposure to PCBs, PAHs, and VOCs at the Oakland Avenue and 45th Street (Alton Park Area 3) site.
- TDH EEP will be available to review additional environmental data, as requested.

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Table and Figures

Table 1. Soil sample analytical results for metals, polychlorinated biphenyls (PCBs), and pesticides on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. No herbicides were detected. Only contaminants that were detected in at least one soil sample are listed.

Contaminant	CREG (mg/kg)	RMEG (mg/kg) (** denotes EMEG)		Soil RSL (mg/kg)				Sample Location										
		Child	Adult	Residential		Industrial		SS-1	SS-2	SS-3	SS-4	SS-4 Dup	SS-5	SS-6	SS-7	SS-8	SS-9	SS-10
				Cancer	Noncancer	Cancer	Noncancer											
Metals																		
Arsenic	0.5*	20	200	0.39	22.0	1.6	260	1.1	5.8	12.0	3.0	1.5	2.0	3.8	4.3	3.8	10.0	<5.0
	NE	10,000	100,000	NE	15,000	NE	190,000	9.3	360.0	140.0	150.0	220.0	22.0	690.0	120.0	44.0	87.0	160.0
Barium	NE	10**	100**	1,800	70	9,300	810	<0.25	2.3	1.5	1.9	1.9	0.91	1.5	1.2	0.96	3.3	0.95
Cadmium	NE	NE	NE	280	NE	1,400	NE	0.81	9.7	19.0	31.0	30.0	6.80	9.2	28.0	9.7	120.0	14.0
Chromium	NE	NE	NE	NE	400	NE	800	12.0	100.0	32.0	250.0	230.0	11.0	47.0	120.0	30.0	270.0	210.0
Lead	NE	NE	NE	NE	6.7	NE	28	0.15	0.078	0.038	0.18	3.90	<0.02	<0.02	0.07	<0.02	0.11	0.13
Mercury	NE	300	4,000	NE	390	NE	5,100	<1.0	1.10	4.80	<5.0	0.64	<10.0	<5.0	2.20	<5.0	26.0	9.0
PCBs																		
Polonium	NE	1	10	0.22	1.1	0.74	11	<0.017	<0.017	<0.017	0.16	0.31	<0.017	<0.017	<0.017	<0.017	0.10	0.11
Aroclor 1254	NE	NE	NE	0.22	NE	0.74	NE	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	0.029	<0.017	<0.017	<0.017	<0.017
Pesticides																		
4,4-DDT	2	30	400	1.4	NE	5.1	NE	<0.2	<0.1	<0.1	<0.2	0.29	<0.1	<0.2	<0.2	<0.1	<0.2	<0.2

CREG – Cancer Risk Evaluation Guide.

RMEG – Reference Dose Media Evaluation Guide.

RSL – Regional Screening Level.

NE – Not established.

Results reported in milligrams per kilogram (mg/kg).

Values that are below detection limit (BDL) are designated with a less than (<) symbol.

Bold type indicates constituent above screening value for residential soil.

Bold italic type indicates constituent above screening value for residential and industrial soil.

* The CREG for arsenic in soil (0.5 mg/kg) is below background levels. Therefore, the recommended soil comparison value is 20 mg/kg.

** ATSDR's Environmental Media Evaluation Guide (EMEG) for chronic exposure (greater than 365 days) is used as the comparison value for cadmium because it is lower than the RMEG which is 50 mg/kg for children and 700 mg/kg for adults. By using the lower EMEG value for comparison, the worst-case scenario can be assessed.

Table 2. Polycyclic aromatic hydrocarbon (PAH) soil sample analytical results for Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. Only PAHs that were detected in at least one soil sample are listed.

PAH Constituent	CREG (mg/kg)	RMEG (mg/kg)		Soil RSL (mg/kg)				Sample Location										PAH Toxic Equivalency Factor (mg/kg)
		Child	Adult	Residential		Industrial		SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS-10	
				Cancer	Noncancer	Cancer	Noncancer											
Benzo(a)anthracene	NE	NE	NE	0.15	NE	2.1	NE	0.51	<0.033	0.073	0.71	<0.033	0.13	<0.66	<0.033	<0.66	1.4	0.1
Benzo(b)fluoranthene	NE	NE	NE	0.15	NE	2.1	NE	0.86	0.035	0.11	0.87	<0.033	0.17	<0.66	<0.033	<0.66	1.7	0.1
Benzo(k)fluoranthene	NE	NE	NE	1.5	NE	21	NE	<0.33	<0.033	0.06	<0.66	<0.033	0.1	<0.66	<0.033	<0.66	<0.66	0.01
Benzo(g,h,i)perylene	NE	NE	NE	NE	NE	NE	NE	<0.33	<0.033	0.043	<0.66	<0.033	0.054	<0.66	<0.033	<0.66	<0.66	0.01
Benzo(a)pyrene	0.1	NE	NE	0.015	NE	0.21	NE	0.58	<0.033	0.089	<0.66	<0.033	0.11	<0.66	<0.033	<0.66	1.1	1
Chrysene	NE	NE	NE	15	NE	210	NE	0.57	<0.033	0.073	<0.66	<0.033	0.12	<0.66	<0.033	<0.66	1.0	0.001
Fluoranthene	NE	2,000	30,000	NE	2,300	NE	22,000	1.0	0.044	0.081	1.4	<0.033	0.25	<0.66	<0.033	<0.66	3.0	0.001
Indeno(1,2,3-cd)pyrene	NE	NE	NE	0.15	NE	2.1	NE	<0.33	<0.033	0.044	<0.66	<0.033	0.054	<0.66	<0.033	<0.66	<0.66	0.1
Naphthalene	NE	1,000	10,000	3.9	150	20	670	1.4	0.045	<0.033	<0.66	<0.033	0.064	<0.66	<0.033	<0.66	<0.66	0
Phenanthrene	NE	NE	NE	NE	NE	NE	NE	1.4	<0.033	0.037	1.0	<0.033	0.16	<0.66	<0.033	<0.66	2.0	0.001
Pyrene	NE	2,000	20,000	NE	1,700	NE	17,000	0.92	0.039	0.068	1.3	<0.033	0.21	<0.66	<0.033	<0.66	2.8	0.001

CREG – Cancer Risk Evaluation Guide.

RMEG – Reference Dose Media Evaluation.

RSL – Regional Screening Level.

NE – Not established.

Results reported in milligrams per kilogram (mg/kg).

Values that are below detection limit (BDL) are designated with a less than (<) symbol.

Bold type indicates constituent above screening value for residential soil.

Bold italic type indicates constituent above screening value for residential and industrial soil.

Table 3. Total PAHs and PAH toxic equivalency by sample location where 6 out of 10 soil samples were identified as being contaminated with PAHs on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN.

Sample Location	Total PAHs (mg/kg) by Location	PAH Toxic Equivalency (mg/kg) by Location
SS-1	7.24	0.72
SS-2	0.16	0.004
SS-3	0.68	0.11
SS-4	5.28	0.16
SS-6	1.42	0.15
SS-10	13.00	1.42
All PAH-Contaminated Sample Locations	27.78	2.57
Entire Site*	39.33	3.93

* Calculations based on the detected PAH concentrations and one-half the detection limit for non-detected PAH concentrations.

Table 4. Volatile organic compound (VOC) subsurface soil sample analytical results for Tax Parcel 167C H 002 and Tax Parcels 167C B 015, 167C B 016, and 167C B 017 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. Only VOCs that were detected in at least one subsurface soil sample are listed.

VOC Constituent	CREG (mg/kg)	RMEG (mg/kg)		Soil RSL (mg/kg)				Sample Location													
								Tax Parcel 167C H 002											Tax Parcels 167C B 015, 167C B 016, and 167C B 017		
		Child	Adult	Residential		Industrial		SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS-10	MW-1	MW-2		MW-3
				Cancer	Noncancer	Cancer	Noncancer												2 - 4' Depth	8 - 10' Depth	
n-Butylbenzene	NE	NE	NE	NE	NE	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	2.0	<0.005	<0.025
sec-Butylbenzene	NE	NE	NE	NE	NE	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	6.7	<0.005	<0.025
tert-Butylbenzene	NE	NE	NE	NE	NE	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	6.0	<0.005	<0.025
1,2,3-Trimethylbenzene	NE	NE	NE	NE	NE	NE	NE	<0.005	<0.005	<0.005	0.0076	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.25	<0.005	<0.025
1,2,4-Trimethylbenzene	NE	NE	NE	NE	67	NE	280	<0.005	<0.005	<0.005	0.017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.25	<0.005	<0.025

CREG – Cancer Risk Evaluation Guide.

RMEG – Reference Dose Media Evaluation.

RSL – Regional Screening Level.

NE – Not established.

Results reported in milligrams per kilogram (mg/kg).

Values that are below detection limit (BDL) are designated with a less than (<) symbol.

Bold type indicates constituent above screening value for residential soil.

Bold italic type indicates constituent above screening value for residential and industrial soil.

Table 5. Volatile organic compound (VOC) groundwater sample analytical results for Tax Parcels 167C B 015, 167C B 016, and 167C B 017 of at the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. Only VOCs that were detected in at least one groundwater sample are listed.

VOC Constituent	CREG (µg/kg)	RMEG (µg/L)		Drinking Water RSL (µg/L)		Sample Location		
						MW-1 on Tax Parcel 167C B 017	MW-2 on Tax Parcel 167C B 016	MW-3 on Tax Parcel 167C B 015
		Child	Adult	Cancer	Noncancer			
Bromodichloromethane	0.6	200	700	1.1	730	<1.0	2.0	<1.0
n-Butylbenzene	NE	NE	NE	NE	NE	<1.0	1.4	<1.0
sec-Butylbenzene	NE	NE	NE	NE	NE	<1.0	3.0	<1.0
tert-Butylbenzene	NE	NE	NE	NE	NE	<1.0	4.2	<1.0
Naphthalene	NE	200	700	0.14	6.2	<5.0	30.0	<5.0
n-Propylbenzene	NE	NE	NE	NE	NE	<1.0	2.3	<1.0
CREG – Cancer Risk Evaluation Guide. RMEG – Reference Dose Media Evaluation. RSL – Regional Screening Level. NE – Not established. Results reported in micrograms per liter (µg/L). Values that are below detection limit (BDL) are designated with a less than (<) symbol. Bold type indicates constituent above screening value for drinking water.								

FIGURE 1. USGS topographic map showing the approximate site location of Oakland Avenue and 45th Street (Alton Park Area 3), Chattanooga, Hamilton County, TN.

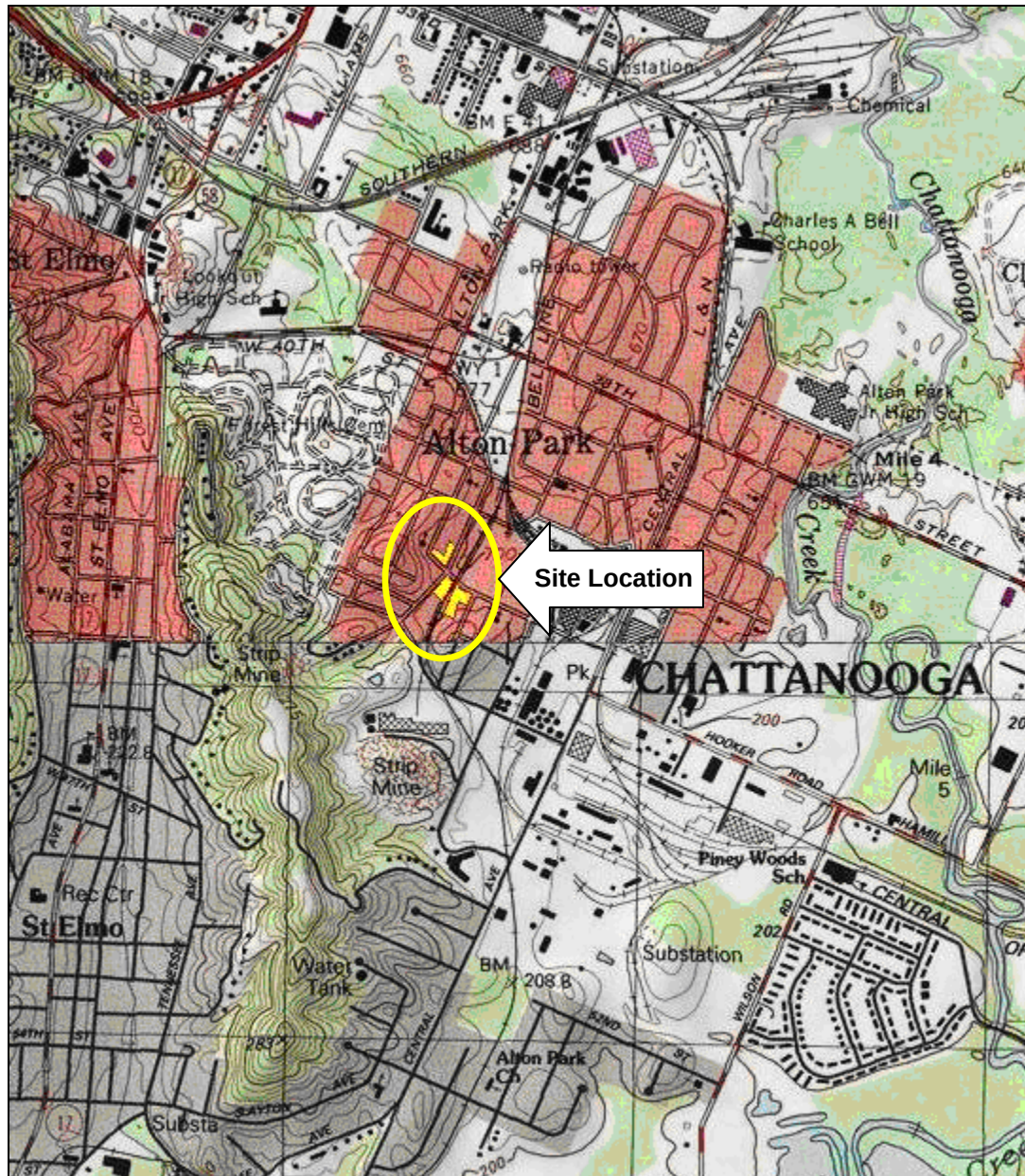


FIGURE 2. Aerial image showing the site location of Oakland Avenue and 45th Street (Alton Park Area 3), Chattanooga, Hamilton County, TN. (Image credit: Google 2009)



Figure 3. Schematic showing the locations of Oakland Avenue and 45th Street (Alton Park Area 3) parcels and the drums on Tax Parcel 167C H 002. (Image credit: Aquaterra Engineering, LLC)

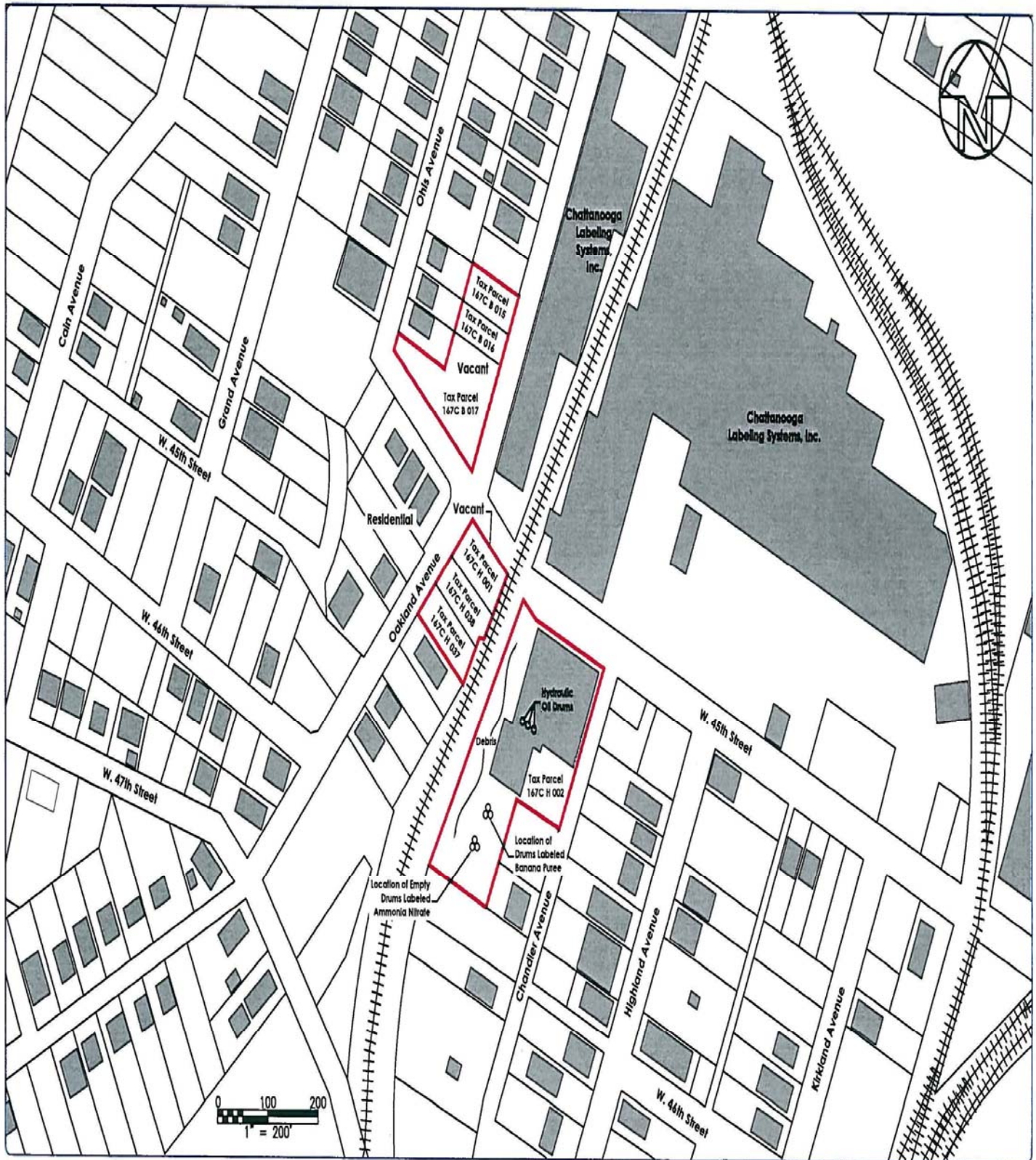


Figure 4. Schematic showing the soil sample and monitoring well locations of Oakland Avenue and 45th Street (Alton Park Area 3) site. (Image credit: Aquaterra Engineering, LLC)

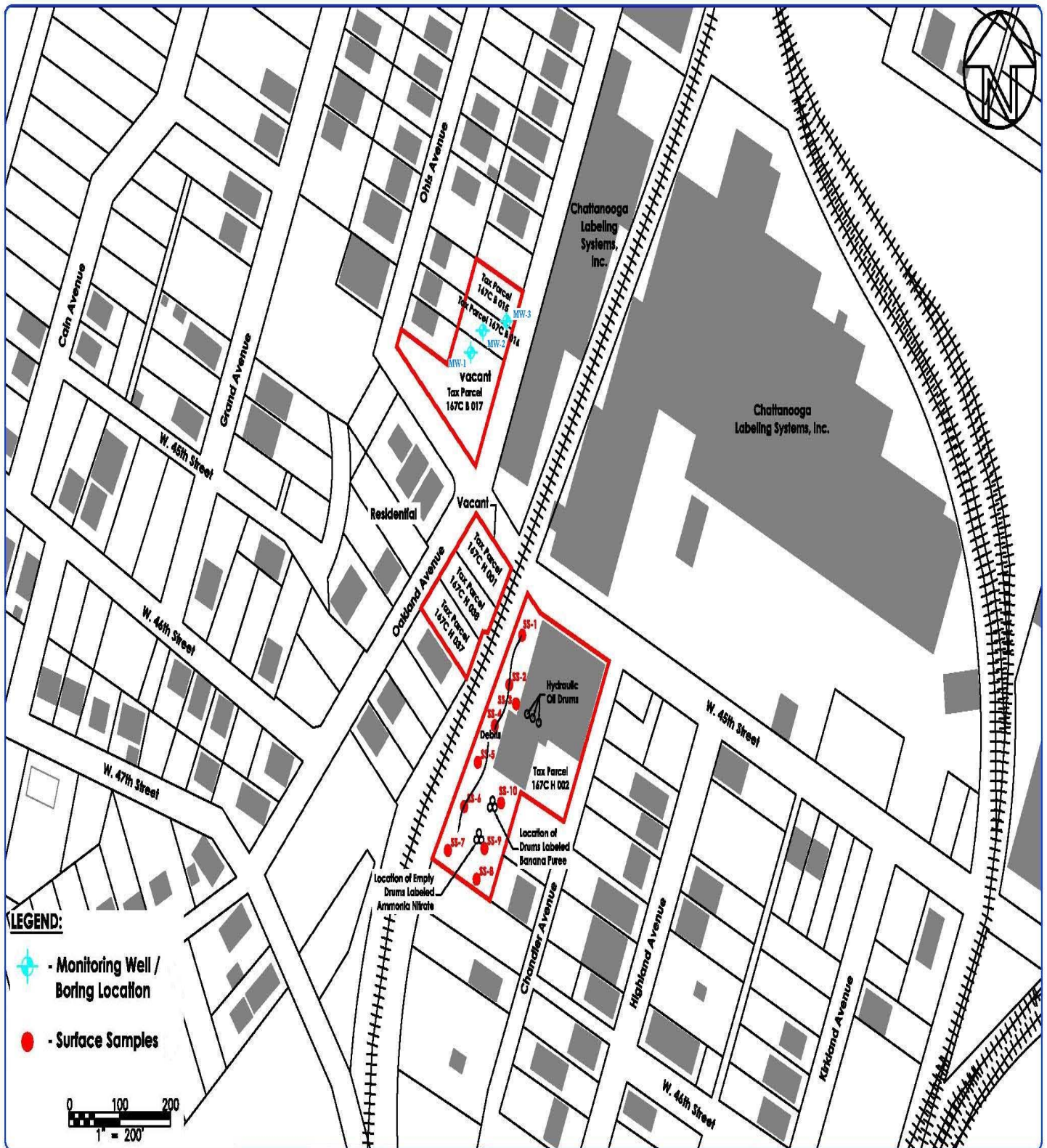


Figure 5. Total PAH concentrations where 6 out of 10 soil samples were identified as being contaminated with PAHs on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. The average for the 6 samples was 4.63 mg/kg. The average for all 10 samples was 3.93 mg/kg.

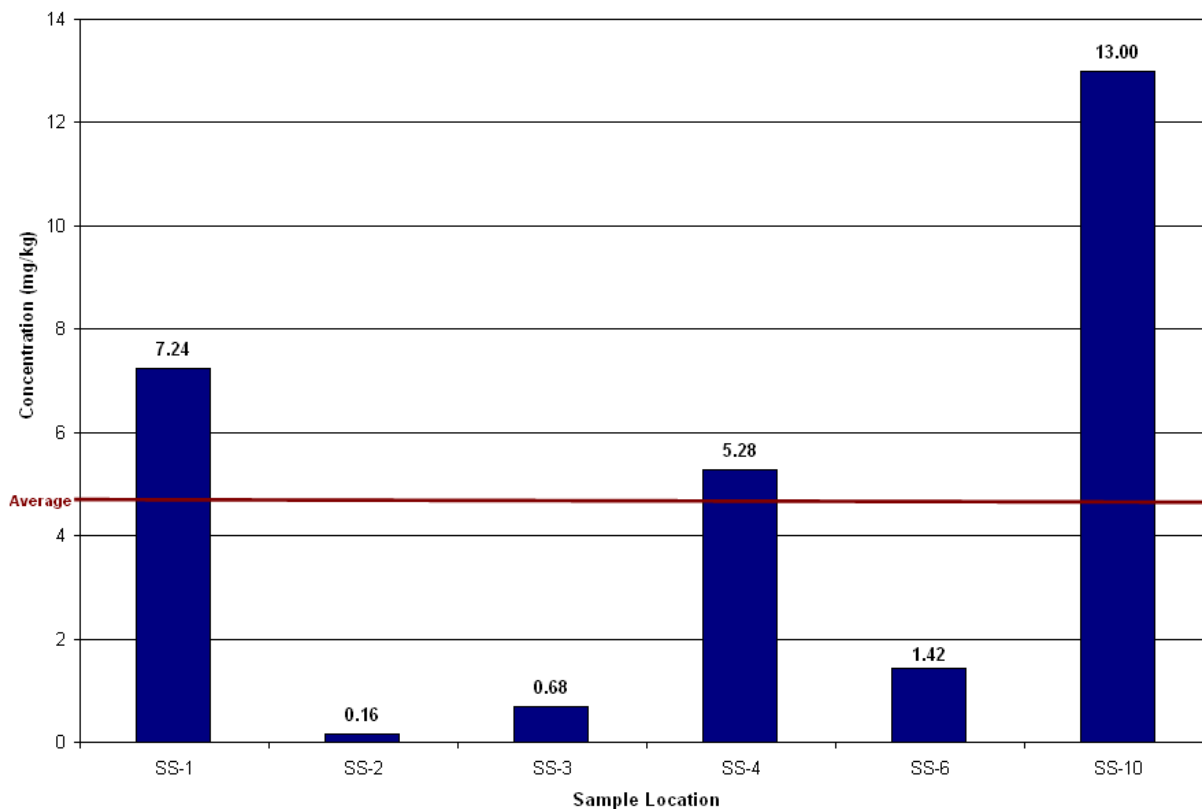


Figure 6. Schematic identifying the locations where 6 out of 10 soil samples were identified as being contaminated with PAHs on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Image credit: Aquaterra Engineering, LLC)

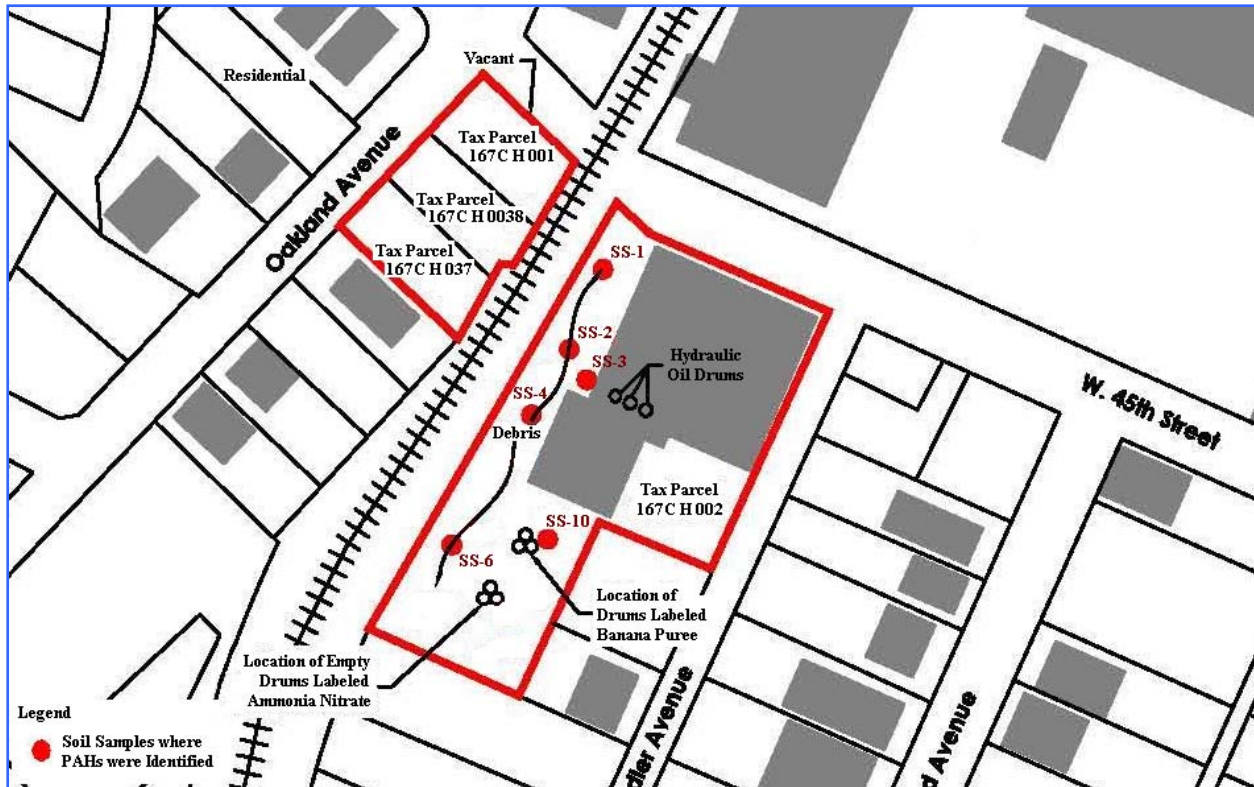


Figure 7. Toxic equivalencies where 6 out of 10 soil samples were identified as being contaminated with PAHs on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. The average for the 6 samples was 0.43 mg/kg. The average for all 10 samples was 0.39 mg/kg.

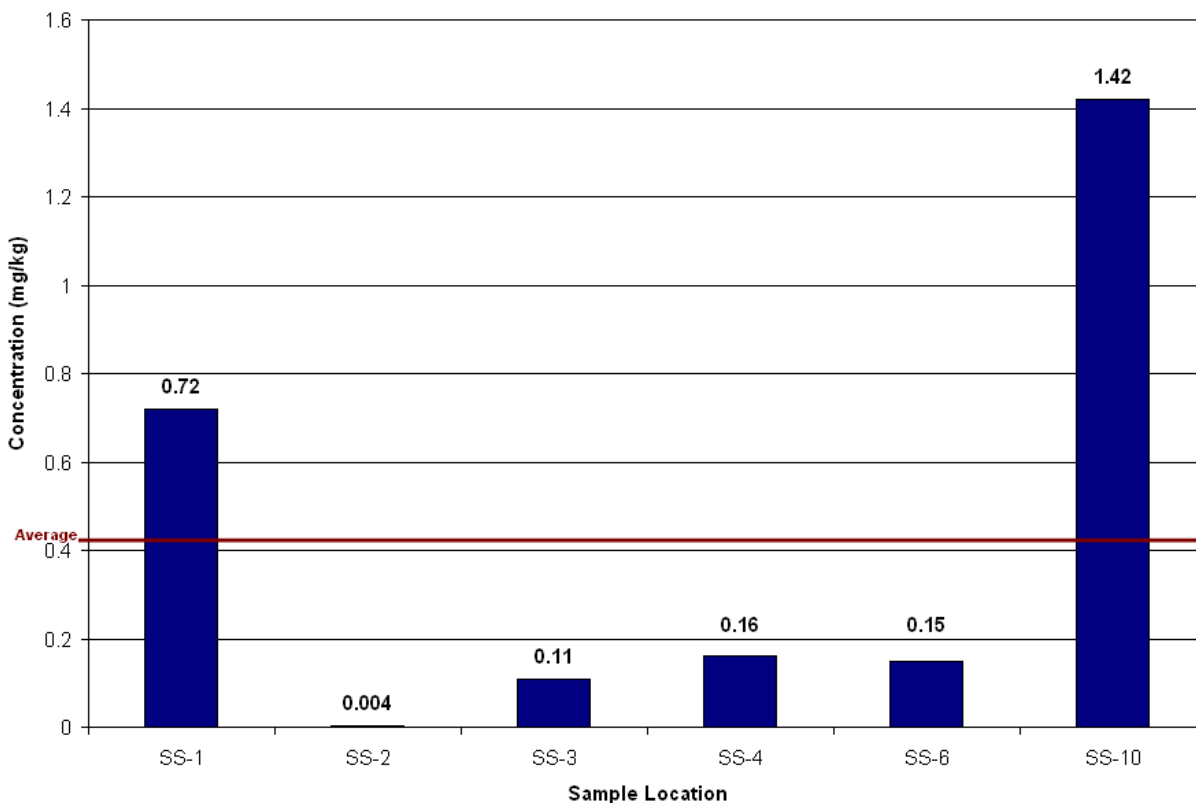


Figure 8. Wooden pallets steeply stacked along the outside of the former Anchor Glass Corporation office building on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 9. Steeply stacked wooden pallets near the railroad tracks outside the former Anchor Glass Corporation office building on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 10. Scattered debris inside the former Anchor Glass Corporation office building on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 11. Scattered debris, old tires, and piles of wood on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 12. Wooden pallets and boxes of used plastic along the outside of the former Anchor Glass Corporation office building on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 13. Mounds of concrete and wooden pallets on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 14. Boxes of soil, mounds of concrete, and old tires on Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 15. Drainage ditch filled with murky runoff water along the railroad tracks on the western side of Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 16. Trash observed on the vacant lots of Tax Parcels 167C H 001, 167C H 038, and 167C H 037 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 17. Two of the three drums in the northeaster corner of Tax Parcel 167C B 015 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Figure 18. Drum clearly labeled as to contain non-hazardous waste in the northeaster corner of Tax Parcel 167C B 015 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, Chattanooga, Hamilton County, TN. (Photo credit: Sarah Stuart Chewning and Sabrina Novak, Chattanooga-Hamilton County Health Department – 5/7/09)



Appendix

Calculating an Intake Dose

To determine if people are at an increased risk of adverse health effects from a contaminant, a health investigator will often calculate the dose received when various exposure scenarios are considered. The following equation can determine the amount of a contaminant a person ingests by incidentally eating contaminated soil:

$$Dose = \frac{Concentration \times AmountEaten \times FractionIngested \times ExposureDuration \times ExpFrequency}{BodyWeight \times AveragingTime}$$

Taking the maximum concentration of a contaminant coupled with a 24 hour per day exposure duration makes a worst case scenario example. Standard assumptions of 70 kg adult body weight and 30-year exposure duration were incorporated. For children, 35 kg and 16 years are common assumptions. The amount of soil incidentally ingested is also a standard assumption of 100 mg/day for adults and 200 mg/day for small children. We can assume the fraction ingested was 1 or all soil eaten is of maximum contaminant concentration. Also, assume complete contaminant absorption by the human body. In this scenario, exposure to contaminated soil happens for 24 hours every day, 365 days a year. Assuming exposure for 30 years for adults and 16 years for children, this equals a total exposure (averaging time) of 10,950 days for adults and 5,840 days for children.

For contaminated drinking water, the following equation can determine the amount of a contaminant a person ingests:

$$Dose = \frac{Concentration \times AmountDrank \times FractionIngested}{BodyWeight}$$

Assumptions of a 70 kg body weight for adults and a 35 kg body weight for children is standard. The amount of contaminated drinking water ingested is also a standard assumption of 2 L/day for adults and 1 L/day for children. We can assume the fraction ingested was 1 or all water drank is of maximum contaminant concentration. Also, assume complete contaminant absorption by the human body.

PCB Intake Dose

At Tax Parcel 167C H 002 of the Oakland Avenue and 45th Street (Alton Park Area 3) site, the maximum Aroclor 1254 concentration measured in surface soil was 0.31 mg/kg. The following are worst case scenario calculations for adults and children exposed to Aroclor 1254 at Tax Parcel 167C H 002:

$$\frac{0.31mg}{kg} \times \frac{1kg}{10^6 mg} \times \frac{100mg}{day} \times 1 \times \frac{8hrs}{day} \times \frac{1day}{24hrs} \times 30yrs \times \frac{365days}{yr} = 4.4 \times 10^{-7} \frac{mg}{kg \times day}$$

$70kg \times 10,950days$

$$\frac{\frac{0.31mg}{kg} \times \frac{1kg}{10^6 mg} \times \frac{200mg}{day} \times 1 \times \frac{24hrs}{day} \times \frac{1day}{24hrs} \times 16yrs \times \frac{365days}{yr}}{35kg \times 5,840days} = 1.8 \times 10^{-6} \frac{mg}{kg \times day}$$

To determine if this worst case scenario dose is problematic for public health, the EPA established 2.0E+0 as the slope factor for the carcinogenic effects of PCBs (EPA 2009). A slope factor is a line derived from dose-response research outcomes that predicts a theoretical risk of excess cancers from exposure to the chemical. It has units of (mg/kg-day)⁻¹ and when multiplied by the dose provides a value for risk. The adult dose of 4.4x10⁻⁷ mg/kg-day produces a conservatively estimated theoretical risk of 0.089 excess cancers per 100,000 adults (8.9x10⁻⁷). The child dose of 1.8x10⁻⁶ mg/kg-day equals a conservatively estimated theoretical risk of 0.35 excess cancers per 100,000 children (3.5x10⁻⁶).

Risk assessment aims for less than a one-in-a-million (10⁻⁶) risk. Risk estimated to be less than one-in-ten thousand (10⁻⁴) is often acceptable (EPA 1991). Therefore, the cancer risk of an adult or child exposed to Aroclor 1254 at Tax Parcel 167C H 002 is very low. Given that the worst case scenario is in the acceptable range, lesser exposure scenarios would have even lower associated risk.

PAH Intake Dose

The maximum PAH toxic equivalency concentration at Tax Parcel 167C H 002 was measured to be 1.42 mg/kg (Table 3). The following are worst case scenario calculations for adults and children exposed to PAHs at Tax Parcel 167C H 002:

$$\frac{\frac{1.42mg}{kg} \times \frac{1kg}{10^6 mg} \times \frac{100mg}{day} \times 1 \times \frac{24hrs}{day} \times \frac{1day}{24hrs} \times 30yrs \times \frac{365days}{yr}}{70kg \times 10,950days} = 6.8 \times 10^{-7} \frac{mg}{kg \times day}$$

$$\frac{\frac{1.42mg}{kg} \times \frac{1kg}{10^6 mg} \times \frac{200mg}{day} \times 1 \times \frac{24hrs}{day} \times \frac{1day}{24hrs} \times 16yrs \times \frac{365days}{yr}}{35kg \times 5,840days} = 2.7 \times 10^{-6} \frac{mg}{kg \times day}$$

To determine if this worst case scenario dose is problematic for public health, the EPA established 7.3E+0 as the slope factor for the carcinogenic effects of benzo[a]pyrene. A slope factor is a line derived from dose-response research outcomes that predicts a theoretical risk of excess cancers from exposure to the chemical. It has units of (mg/kg-day)⁻¹ and when multiplied by the dose provides a value for risk. The adult dose of 6.8x10⁻⁷ mg/kg-day produces a conservatively estimated theoretical risk of 0.49 excess cancers per 100,000 adults (4.9x10⁻⁶). The child dose of 2.7x10⁻⁶ mg/kg-day equals a conservatively estimated theoretical risk of 2.0 excess cancers per 100,000 children (2.0x10⁻⁵).

Risk assessment aims for less than a one-in-a-million (10⁻⁶) risk. Risk estimated to be less than one-in-ten thousand (10⁻⁴) is often acceptable (EPA 1991). Therefore, the cancer risk of an adult

or child exposed to PAHs at Tax Parcel 167C H 002 is very low. Given that the worst case scenario is in the acceptable range, lesser exposure scenarios would have even lower associated risk.

Certification

This Public Health Consultation: *Oakland Avenue and 45th Street (Alton Park Area 3), Chattanooga, Hamilton County, Tennessee*, was prepared by the Tennessee Department of Health Environmental Epidemiology under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement Partner.

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

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

Team Leader, CAT, CAPEB, DHAC, ATSDR