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VOC Exposure in an Industry-Impacted Community

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MICKEY LELAND NATIONAL URBAN AIR TOXICS RESEARCH CENTER

ABOUT THE NUATRC

The Mickey Leland National Urban Air Toxics Research Center (NUATRC or the Leland Center) was established in 1991 to develop and support research into potential human health effects of exposure to air toxics in urban communities. Authorized under the Clean Air Act Amendments (CAAA) of 1990, the Center released its first Request for Applications in 1993. The aim of the Leland Center since its inception has been to build a research program structured to investigate and assess the risks to public health that may be attributed to air toxics. Projects sponsored by the Leland Center are designed to provide sound scientific data useful for researchers and for those charged with formulating environmental regulations.

The Leland Center is a public-private partnership, in that it receives support from government sources and from the private sector. Thus, government funding is leveraged by funds contributed by organizations and businesses, enhancing the effectiveness of the funding from both of these stakeholder groups. The U.S. Environmental Protection Agency (EPA) has provided the major portion of the Center's government funding to date, and a number of corporate sponsors, primarily in the chemical and petrochemical fields, have also supported the program.

A nine-member Board of Directors oversees the management and activities of the Leland Center. The Board also appoints the thirteen members of a Scientific Advisory Panel (SAP) who are drawn from the fields of government, academia and industry. These members represent such scientific disciplines as epidemiology, biostatistics, toxicology and medicine. The SAP provides guidance in the formulation of the Center's research program and conducts peer review of research results of the Center's completed projects.

The Leland Center is named for the late United States Congressman George Thomas "Mickey" Leland from Texas who sponsored and supported legislation to reduce the problems of pollution, hunger, and poor housing that unduly affect residents of low-income urban communities.

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VOC Exposure in an Industry-Impacted Community

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PREFACE

The Clean Air Act Amendments of 1990 established a control program for sources of 188 "hazardous air pollutants, or air toxics," which may pose a risk to public health. Also, with the passage of these Amendments, Congress established the Mickey Leland National Urban Air Toxics Research Center (NUATRC) to develop and direct an environmental health research program that would promote a better understanding of the risks posed to human health by the presence of these toxic chemicals in urban air.

Established as a public/private research organization, the Center's research program is developed with guidance and direction from scientific experts from academia, industry, and government and seeks to fill gaps in scientific data. These research results are intended to assist policy makers in reaching sound environmental health decisions. The NUATRC accomplishes its research mission by sponsoring research on human health effects of air toxics by universities and research institutions and by publishing the research findings in its "NUATRC Research Reports," thereby contributing meaningful and relevant data to the peer-reviewed scientific literature.

The study "VOC Exposure of An Industry-Impacted Community" was developed in response to the Mickey Leland National Urban Air Toxics Research Center (NUATRC) Request For Application 98-03 (RFA 98-03), under the NUATRC Small Grants New Investigators Program. This NUATRC support was developed to encourage New Investigators to develop innovative air toxics research areas. This specific RFA was developed to support short-term research projects on exposures and/or health effects of air toxics. The projects were envisioned to be community-based pilot projects that could serve as a basis for more extended research. Preference was given to research that tested new techniques and/or were innovative or high-risk projects. Pilot projects by their nature are limited in scope and are designed to give preliminary results and new insights so that larger studies, yielding results with broader applications, might follow.

Dr. Timothy J. Buckley of the Johns Hopkins University was a recipient of a cost-reimbursable contract from the NUATRC to provide exposure information on an urban community in close proximity to industrial sources. Dr. Buckley had conducted an initial exposure study in this community through pilot funding by the U.S. EPA Region III. Dr. Buckley and his research team addressed this issue by measuring levels of personal, indoor, and outdoor air toxics and assessing indoor and outdoor source contribution. In order to provide the community a perspective on their level of exposure, Dr. Buckley and his research team conducted similar measurements in a comparison community that was not impacted by industrial emissions. They also assessed the utility of measurement of a biomarker for benzene called trans, trans muconic acid for low level exposures to this air toxic in both communities. This report presents a detailed description of the study objectives, design, methods, the nature and quality of the data, an initial descriptive analysis of the data, and interpretation of the results.

When a NUATRC-funded study is completed, the Investigators submit a draft final research report. Every draft final report resulting from NUATRC-funded research undergoes an extensive evaluation procedure, which assesses the strengths and limitations of the study, and comments on clarity of the presentation, data quality, appropiateness of study design, data analysis, and interpretation of the study findings. The objective of the review process is to ensure that the Investigator's report is complete, accurate, and clear.

The evaluation first involves an external review of the report by a team of three external reviewers including a biostatistician. The reviewers' comments are then considered by members of the NUATRC Scientific Advisory Panel (SAP), and the comments of the external reviewers and the SAP are provided to the Investigator. In its communication with the Investigator, the SAP may suggest alternate interpretations for the results and also discuss new insights that the study may offer to the scientitfc literature. The Investigor has the opportunity to exchange comments with the SAP and if necessary revise the draft report. In accordance with the NUATRC policy, the SAP recommends and the Board of Directors approves the publication of the revised final report. The research presented in the NUATRC Research Reports represents the work of its Investigators.

The NUATRC appreciates hearing comments from its readers from industry, academic institutions, government agencies, and the public about the usefulness of the information contained in these reports, and about other ways that the NUATRC may effectively serve the needs of these groups. The NUATRC wishes to express its sincere appreciation to Dr. Buckley and his research team, the SAP, and external peer reviewers whose expertise, diligence, and patience have facilitated the successful completion of this report.

ABSTRACT

Environmental health concerns often arise within communities when pollution emitting industries are located in close proximity. South Baltimore is such a community. To address community concerns about environmentally related health effects, a community-based human exposure study was designed and conducted. Done in cooperation with the community, the study evaluated the impact of industry on community air quality and individual resident exposure to 15 volatile organic compounds (VOCs). The study was designed to examine the potential industry effect by comparing indoor, outdoor, and personal air concentrations in South Baltimore to those in Hampden, an urban Baltimore community with a less intense industrial presence. Households without smokers were representatively sampled from each of the respective communities. Outdoor, indoor, and personal air monitoring was conducted using passive monitoring (3M OVM badges) over three days. The urinary benzene biomarker trans, trans-muconic acid (MA) was evaluated in multiple voids over the monitoring period. A total of 36 non-smoking homes in the industry-impacted community and 21 homes in the control community were enrolled in the study. An industry impact on community exposure is suggested for two of the 15 VOCs (ethylbenzene and m,p-xylene) based on outdoor and indoor concentrations that were greater in South Baltimore relative to Hampden ($p \leq 0.05$). However, these indoor and outdoor differences did not translate into significant differences in personal exposure levels between the two communities. For the remaining 13 VOCs, concentrations at all three levels of monitoring were comparable in the two communities, suggesting no industrial impact or an impact smaller than that detectable with the sample size of this study. The average concentrations of 10 of 15 measured VOCs were on average higher indoors than outdoors, suggesting important indoor sources. A significant association ($p \leq 0.05$) was observed between 24-hour benzene air concentrations and creatinine-corrected MA elimination. Consistent with air monitoring results, no difference was detected between the communities with respect to the benzene urinary biomarker MA. For most of the VOCs, exposures measured between a parent and child within the same household (n=7) were highly correlated, suggesting that measures of a single individual within a home provide a reasonable surrogate for household member exposure.

INTRODUCTION

Communities across the country share a concern over the quality of their environment and the impact that the quality of their environment may have on health. This concern is heightened in communities where either such pollutant sources as chemical industry or heavy traffic are pronounced, or where the prevalence or incidence of such environmentally related illnesses as leukemia or asthma are actually or perceived to be elevated (Pew Environmental Health Commission, 2000). Community-based exposure assessment is an effective and efficient means to address these community concerns (Coborn, 2002). Although limits exist, this approach can provide valuable data that can be used to determine if additional studies are warranted and, if so, to aid in the design of those studies. An exposure assessment approach has several key advantages, namely: (1) the measurement and assessment of exposure is directly responsive to the fundamental community question of "What is in the air that our families breathe?"; (2) exposure monitoring can provide the basis for assessing both air pollution sources and health risk-issues also at the heart of community concern; (3) opportunity exists for direct and active community participation; (4) measurements provide a current assessment of community exposure; (5) exposure to multiple agents can be measured and assessed; and (6) the approach is cost effective. The primary limitation of community-based exposure studies is that associations with disease cannot be directly assessed.

The South Baltimore communities of Brooklyn and Curtis Bay provide an opportunity to use exposure assessment to address community environmental health concerns. Members of these communities have a high level of concern because of the number of large chemical manufacturing industries in each community (Figures 1 and 2). Community leaders have identified cancer as a major health concern in South Baltimore. Community concerns are substantiated by both elevated rates of cancer and because of the presence of carcinogens in the air. In a recent analysis of two years of cancer incidence data (1992 and 1993) of the two zip codes that encompass Brooklyn, Curtis Bay, and Brooklyn Park, the 21226 and 21225 zip codes ranked second and nineteenth, respectively, out of 30 zip codes in Baltimore City (Samet, 1999). For specific cancer sites, zip code 21226 ranked highest for urinary, female genital, and brain cancers and leukemia; second for breast and respiratory cancers; and third for orophryngeal cancer. Higher levels of ambient benzene, 1,3-butadiene, and carbon tetrachloride have been recorded for the South Baltimore location relative to other monitoring stations

Figure 1. Aerial view showing the industrial region of South Baltimore including adjacent communities of Curtis Bay and Brooklyn

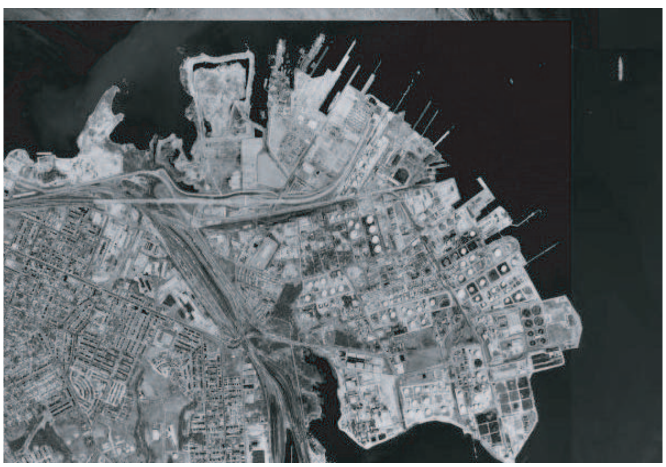

Figure 2. Satellite image of South Baltimore showing the intense industrial activity adjacent to Brooklyn and Curtis Bay

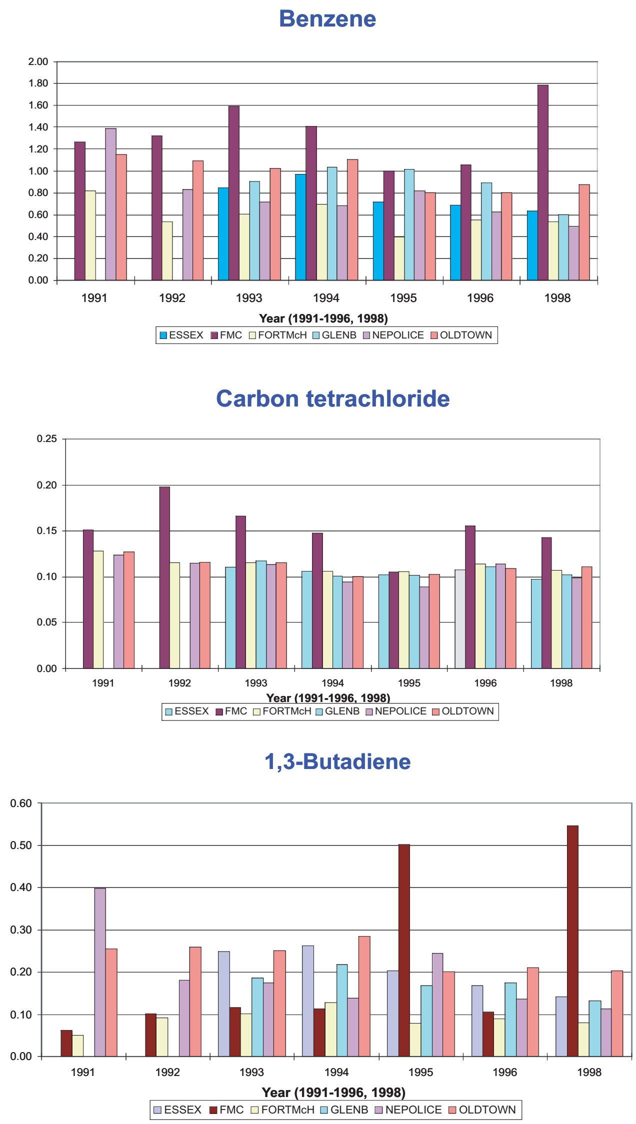

Figure 3. Historical annual average levels of VOCs in South Baltimore (FMC site) relative to other Baltimore City monitoring sites (Maryland Department of the Environment)

across the city and state (Figure 3). Using historical data, Litt et al. (2002) found numerous hazardous operations in Southeast Baltimore, including metal smelting, oil refining, warehousing, transportation, and paints, plastic, and metals manufacturing. Faced with elevated cancer rates and the intensity and proximity of industrial sources, the community asks a fundamental public health question: "What is in the toxic soup that makes up the air that we breathe?" Although health and, especially, cancer are the community's primary concerns, epidemiologic approaches are limited, both practically and technically, because of issues of statistical power, sample size, cost, and disease latency. A study of community exposure potentially addresses many community concerns and questions, provides a basis to assess the exposure distribution of the population for purposes of risk assessment or for comparison to health guidelines, and provides reference location information. In addition to providing the community with valued information about environmental toxics that may contaminate their environment, such studies can provide necessary information to gauge the need for and aid in the design of possible future health studies.

On many levels, the community's interests are consistent with industrial interests. Both seek good schools and a healthy community and environment. However, industry and the community have vastly different perceptions of the effects that industrial activity has on the community's environment and health. Local, state and federal governments become caught in the middle, and the absence of relevant and objective information or data provides fertile ground for speculation and for divisive rhetoric and rancor. Issues of exposure and risk often become volatile when the community is economically or socially disadvantaged. Political and socio-economic factors can become more important than the science. Stakeholders, including the community, industry, and local government, often agree that exposure assessment is an effective means to fill an information void that exacerbates the gap between perception and reality. When such research is available, effective risk communication is recognized as being a key factor in gaining stakeholder acceptance and in managing the dynamic relationship between science and perception (Miller and Solomon, 2003; Payne-Sturges et al., 2004).

Community-based exposure research is most effectively achieved when it is planned and implemented through a process that engages and invests the community. By substantively involving the community in the design, conduct, and interpretation of the study, community members are not only informed, but are also involved in the communication and coordination of the project. The community's active participation increases its awareness, knowledge, and capacity to understand sources and determinants of exposure in the environment (Israel et al., 1998).

Exposure assessment can provide practical information to the community and address a nationally recognized need for information about human exposure to air toxins. Recognition is growing that the current shortage of actual human exposure data seriously hinders efforts to make reasoned and credible decisions about the assessment, management, and communication of environmental health risks (Burke et al., 1992; Burke and Sexton, 1995; Sexton et al., 1992, 1995; Pew Environmental Health Commission, 2000; US GAO, 2000). Exposure data can help to identify such sub-populations as children, low-income groups, or ethnic minorities that may be at increased health risk because they face disproportionately high levels of exposure. Exposure data can strengthen epidemiologic studies by: (1) examining links between human exposures and health outcomes; (2) evaluating current status, historical trends, and possible future directions in human exposure; and (3) evaluating environmental policies designed to reduce exposures and to protect public health. Furthermore, these data can provide key information needed for risk-based decision making. Human exposure data should play a vital role in shaping national environmental health policies.

Hazardous air pollutants (HAPs) or air toxics are generally defined as pollutants known or suspected to cause cancer or other serious health effects or to harm the environment (NATA Glossary of Terms). The Clean Air Act Amendments of 1990 (CAAA) require EPA to regulate ambient sources of 189 HAPS. The HAPs include industrial chemicals and intermediates, pesticides, chlorinated and hydrocarbon solvents, metals, combustion byproducts, auto exhaust, such chemical groups as polychlorinated biphenyls (PCBs), and such mixed chemicals as coke oven emissions. More than 80% of the compounds on the federal HAPs list are VOCs, some of which, including benzene, are ubiquitous ambient air contaminants.

According to the EPA, 42% of total HAP emissions into the ambient environment are from mobile sources, including cars, trucks, buses, and non-road vehicles such as ships and farm equipment. “Area sources” make up 34% of the HAP emissions and include such smaller stationary sources as dry cleaners, solvent cleaning industries, secondary lead smelters, gas stations, and small manufacturing companies. “Major sources,” which include large industrial complexes, chemical plants, oil refineries and steel mills account for 24% of the HAP emissions (Figure 4). Consumer products such as as paints, household cleaners and computer printer cartridges also contain HAPs. However, emissions from these sources, which mainly affect the indoor environment, are not regulated by EPA.

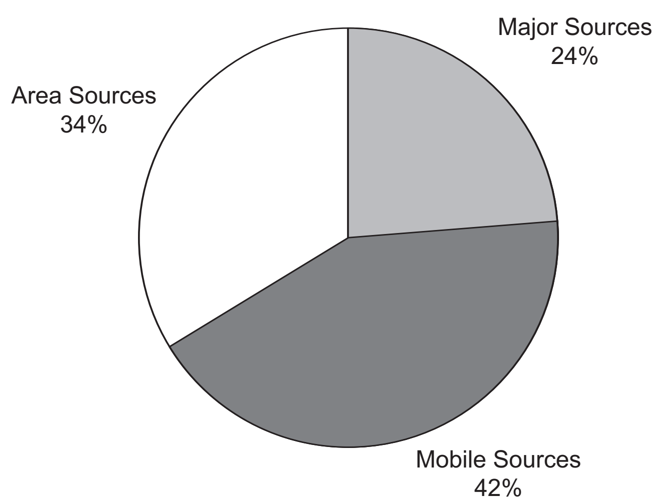

Figure 4. 1993 U.S. total air toxic pollutant emissions (EPA, 1998)

Considerable evidence links VOC exposure to such adverse health effects as asthma and cancer. Ware and coworkers (1993) identified a significant association between VOCs of industrial origin and physician-diagnosed asthma (OR =1.27, 95% CI: 1.09-1.48) and chronic lower respiratory symptoms (OR=1.13; 95% CI: 1.02-1.26). In chamber studies involving exposure of healthy adults to a typical indoor VOC air mixture (0, 25, 50 mg/m^3), Pappas and coworkers (2000) observed a dose-dependent increase in respiratory symptoms. Wieslander and coworkers (1997) found higher rates of asthma and respiratory inflamation among persons exposed to formaldehyde and VOCs off-gassing from newly painted surfaces. This VOC exposure may also pose a cancer risk. Pearson and coworkers (2000) showed a significant association between residences near highly trafficked roadways and children's cancer of all types (odds ratio of 5.90; 95% C.I. from 1.69 to 20.56) and for leukemia (8.28; 95% CI 2.09-32.80). Raaschou-Nielsen and coworkers (2001) reported no increased risk of leukemia or central nervous system tumors associated with benzene exposure but found a significant trend in lymphoma risk for exposure during pregnancy. Feychting and coworkers (1998), who used ambient NO_2 as a surrogate for traffic-related air pollution, found significant relative risks of leukemia and central nervous tumors for exposures ≥80 µg/m^3 ($p \leq 0.05$). Using a case-system control study design, Savitz and Feingold (1989) observed odds ratios of 1.7 (95% CI 1.0-2.8) for total childhood cancers and 2.1 (95% CI 1.1-4.0) for leukemia, with stronger associations observed for higher traffic volumes.

Exposure to environmental carcinogens is of particular concern in Baltimore City where the cancer mortality rate (255 per 100,000) is significantly higher than for the State of Maryland (191.4 per 100,000). It is noteworthy that Maryland's cancer mortality rate is significantly higher than that of the rest of the United States, which is 172.8 per 100,000 (Maryland Cancer Consortium, 1996). Human exposure to cancer-causing agents in the environment is believed to be a contributing factor to the observed higher urban rates. For the period 1994 to 1998, according to Ries and coworkers (2001), Maryland was ninth in the nation and 7.8% greater than the national average ($p \leq 0.0002$). Maryland also has the unfortunate distinction of being ranked third among U.S. states for estimated cancer risk attributed to exposure to ambient concentrations of air toxics. With an estimated 420 per million air toxics-related excess cancer deaths, Maryland ranked behind the District of Columbia and New York, but above New Jersey. Moreover, Baltimore City ranked as number one for "added cancer deaths attributable to air toxics," with an estimated risk of 970 per million excess cancer deaths. These estimates and rankings are available from the U.S. EPA Cumulative Exposure Project, which provides estimates of outdoor pollution levels for the 10,600 census tracts across the U.S. based on dispersion modeling of point, area, and mobile sources (Woodruff et al., 1998; Caldwell et al., 1998; Rosenbaum et al., 1999). Estimates of cancer risk are derived from the application of standard cancer potency factors to the estimated outdoor concentrations. Since these estimates are based on industrial, area, and mobile source emissions (U.S. EPA Toxic Release Inventory), these data suggest that Baltimore has some of the highest emissions of cancer-causing air pollution in the country.

The 1990 Clean Air Act Amendments require that EPA identify effective control strategies to reduce public health risks from exposure to HAPs. However, for EPA to identify such strategies, basic information is needed about the level of HAPs to which the general population is exposed across the United States. This information must also be linked with potential adverse human health effects. While EPA and state environmental agencies maintain well established ambient monitoring networks for such criteria pollutants as ozone, particulate matter, and carbon monoxide, relatively little is known about the HAP concentrations in outdoor air, and even less is known about actual human exposures to HAPs.

MUCONIC ACID

Exposure assessment that includes measurement of parent compounds and/or metabolites in biological specimens adds substantially to the knowledge gained in such research by providing information on individual variation in absorption and metabolism. This information is essential for understanding the marked differences in human susceptibility for adverse health outcomes routinely observed in populations exposed to toxicants at similar levels. Furthermore, a growing body of literature is available for meaningful interpretation of biological markers (Buckley et al., 1995, 1997; Weaver et al., 2000). Such information will ultimately help to identify high-risk individuals and populations. This is particularly important when the toxicant of interest is a carcinogen.

The optimal biological monitoring method for benzene varies by level of exposure. In recent years, due to its recognition as a human carcinogen, benzene exposure levels have declined. This is due, in large part, to US Occupational Safety and Health Administration (OSHA) and EPA legislation. This decline has had a substantial impact on biological monitoring for benzene. Initially, the benzene metabolite, phenol, was monitored in the urine of exposed workers. It is a relatively easy metabolite to assay, which is an important advantage in medical surveillance and molecular epidemiological research. However, phenol is found in many foods and is a product of protein catabolism. Hence, it lacks the specificity needed for exposures below 5 ppm (Ducos et al., 1992). At these lower levels, it is routinely found in most urine samples and is not correlated with exposure. Currently, phenol is useful as a benzene biomarker only after accidental high-level exposures.

As a result, researchers have explored the biomarker potential of several other benzene metabolites as well as the parent compound itself. Trans, trans-muconic acid (MA), a straight chain metabolite, is both sensitive and specific in workers exposed to a wide range of air benzene concentrations. Correlations between MA and air benzene have been reported at levels of benzene as low as 0.5 ppm, and even lower in some studies (Ducos et al., 1992; Ducos et al., 1990; Lee et al., 1993; Lauwerys et al., 1994). The assay for MA is also relatively fast and simple. Animal data suggest that a greater proportion of benzene is metabolized to MA at lower exposure levels, which is important, since this is thought to be a toxic pathway (Henderson et al., 1989). The effect of dose, dose rate, route of administration, and species on tissue and blood levels of benzene metabolites (Environ Health Perspec. 1989;82:9-17). As with phenol, the use of MA as a biomarker for low-level benzene exposure is complicated by the fact that it is not completely specific for benzene either. Sorbate food preservatives, such as sorbic acid and potassium sorbate, are metabolized to MA (West, 1964). Approximately 0.05 to 0.5 % of ingested sorbic acid tablets is metabolized to MA (Ruppert et al., 1997). Sorbate preservatives are used in several food categories including processed cheese slices and spreads, refrigerated flavored drinks, sweet baked goods, frozen foods, mayonnaise, margarine, and salad dressing.

There is a growing body of literature evaluating associations between MA and low-level ambient benzene exposure, where non-specificity is most likely to be a problem. In general, significantly higher mean levels are found in smokers compared to nonsmokers (Melikian et al., 1993). A linear correlation with cotinine in smokers has also been reported (Ong et al., 1996). Excretion of MA in a 12-hour post-exposure period was correlated with short-term exposure to environmental tobacco smoke in a US population; however, diet was carefully controlled in this study (Yu, 1995). In contrast to phenol, MA is not routinely found in the urine of non-smokers. Bergamaschi and coworkers (1998) studied MA levels in 24 non-smoking volunteers who biked for two hours in urban and rural settings. A statistically significant correlation coefficient ($r = 0.59$) was found between air benzene (ranging from 1.2 to 26.1 ppb) and the increase in MA pre- to post-ride. The correlation increased ($r = 0.68$) when the population was limited to subjects who were homozygous for the wild type epoxide hydrolase genotype. However, Ong and coworkers (1994) found no correlation between air benzene and post-shift MA in low-level occupationally exposed workers (< 0.25 ppm). Urinary benzene and MA were not correlated in a study of 80 bus drivers, whose benzene exposure, based on urine benzene, was calculated to range from 3 to 313 ppb (Gobba et al., 1997). In addition, other studies have noted excessively high MA levels (consistent with exposures to 1.0 ppm benzene) in controls who had no occupational source of benzene exposure to explain the elevated levels (Rauscher et al., 1994; Weaver et al., 1996; Gobba et al., 1997; Johnson and Lucier, 1992).

In order to determine the impact of sorbate preservatives on these inconsistent results, studies have assessed the urinary MA response following ingestion of sorbic acid or potassium sorbate in pill form (Pezzagno et al., 1999; Ruppert et al., 1997) This work indicates that non-specificity of MA as a biomarker for low level benzene exposure may be a problem in populations with substantial consumption of sorbate preserved foods. However, the actual extent of this interference cannot be determined from this research, since the amount of these preservatives in the diet must be estimated. Non-specificity of MA from sorbates is a particular concern in the US where significant consumption of preserved food occurs. Furthermore, most of the MA validation studies were not done in US populations, and so it cannot be assumed that adequate correlations at lower air benzene levels seen in other populations will also apply in the US. Therefore, MA levels were measured in sequential spot urine samples from volunteers who consumed foods containing sorbate preservatives that are common in the US diet and usually ingested in substantial amounts when consumed (Weaver et al., 2000). It has been found that, when refrigerated, flavored drinks and sweet snack foods resulted in the excretion of large amounts of MA in adults and children. These increases were large enough to result in non-specificity of MA as a biomarker for environmental exposure and for many occupational settings in industrialized countries.

If MA is to be used as a biomarker for low-level benzene in countries with significant ingestion of sorbate food preservatives, methods to avoid interference will need to be used. Potential solutions include simultaneously measuring urinary sorbic acid and/or dietary restriction. The latter approach is presently used in biomonitoring for inorganic arsenic. Prior to availability of arsenic speciation, and even currently to reduce costs, seafood ingestion is restricted prior to urine collection in an effort to prevent elevations in total arsenic from organic arsenic in seafood. This approach for sorbic acid may be possible because, although several food types contain sorbate preservatives, the amount of these foods that is consumed in a sitting varies. Those that are consumed only in small quantities likely have less potential to increase MA.

S-phenylmercapturic acid (S-PMA) is another benzene metabolite. It is currently thought to be more specific for benzene exposure than MA, making it attractive as a biomarker for environmental exposure. In addition, it provides information on metabolic protective mechanisms. Thus far, however, its use has been more limited than MA, since a smaller proportion of benzene is metabolized to S-PMA and the assay is extremely time consuming. Nevertheless, results from analysis using a GC/MS assessment method to measure S-PMA from exposed workers showed a linear relation with benzene air levels well below 1.0 ppm (Boogard and van Sittert, 1995; van Sittert et al., 1993). Melikian and coworkers (2002) evaluated both MA and S-PMA in benzene exposed workers and concluded that S-PMA was superior to MA as a biomarker for low levels of benzene exposure. Therefore, measurement of S-PMA may be useful despite the time involved in the assay, when MA levels are high in settings of low benzene exposure.

STUDY DESCRIPTION AND OBJECTIVES

The goal of this study was to provide exposure information to a community concerned about health hazards posed by the intensity and proximity of industrial sources. This goal was achieved by measuring levels of personal, indoor, and outdoor air toxics and assessing indoor and outdoor source contributions for the impacted community and a comparison community that is not industry impacted. This provided the industrially impacted community with a perspective on their level of exposure and the relative importance of indoor and outdoor sources. To assess its utility as a biomarker for low-level environmental exposures, MA was measured in both population groups. In a subset of homes, parent-child pairs were monitored to assess within-home correlations of VOC exposure and MA between parents and those children living within the same home. This provided exposure information on children, a potentially susceptible subpopulation; furthermore, the paired monitoring may provide information on possible age-related differences in benzene metabolism.

These study objectives were achieved through four specific aims. These aims were:

1. To measure personal, indoor, and outdoor concentrations of VOC air toxins and related time/activity patterns over two seasons for a representative sample of individuals from the communities of Brooklyn and Curtis Bay
2. To compare exposures in the Brooklyn / Curtis Bay community to exposures of a sample of individuals who do not live or work in close proximity to industrial/chemical sources
3. To delineate the contribution of indoor and outdoor sources to indoor residential air concentrations in a subset of study homes
4. To evaluate the predictive relationship between benzene exposure and parent / child levels of the biomarker MA

METHODS

EXPERIMENTAL DESIGN

To evaluate the effect of industry on community air quality, levels of air toxics in indoor, outdoor, and personal air were assessed in two Baltimore urban communities having similar demographics but differing industrial profile. In addition, the biomarker MA was measured in both population groups to assess its utility for measuring low-level environmental benzene exposures. In a subset of homes, parent-child pairs were monitored to assess within-home correlation in VOC exposure and excretion between parents and those children living within the same home. Monitoring of children was to provide exposure information on a potentially susceptible sub-population.

SITE DESCRIPTION

The control community of Hampden had a population in 1990 of 15,424 and is located in central Baltimore approximately six miles due north of South Baltimore (Figure 5). According to the 1990 census, the experimental South Baltimore communities (Brooklyn, Brooklyn Park, Brooklyn Manor, Arundel Village, Curtis Bay, and Fairfield) had a total population of 27,956, median household income

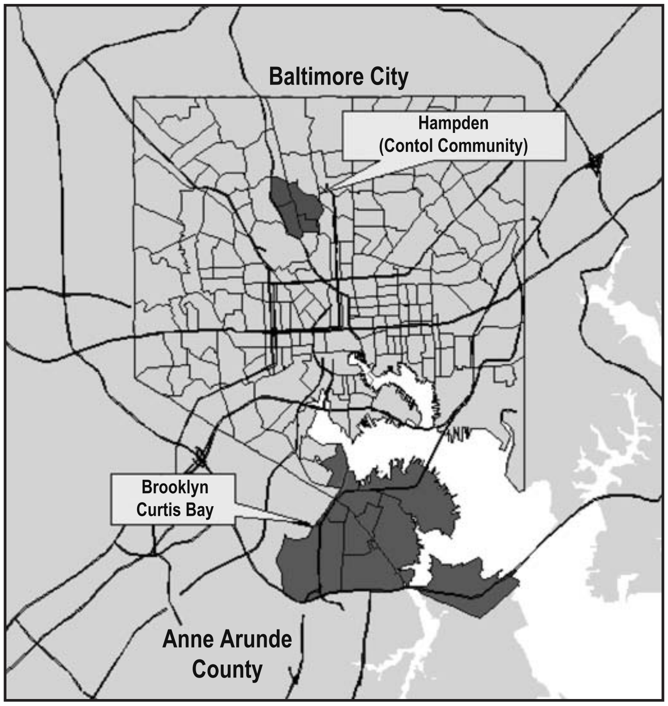

Figure 5. Baltimore City map showing the industry-impacted and control study locations

Table 1. Demographics for South Baltimore and Hampden from 1990 census

Parameter	South Baltimore	Hampden
Population	27,956	15,424
Race		
White	90.3%	93.8%
Black	8.2 %	4.1%
Asian/Pacific Islander	1.0 %	1.5%
Hispanic	0.9%	NA
Other	0.2%	0.51%
Median HH Income	$27,041	$27,223
Education		
<9th grade	17.3%	16.8%
9th - 12th (no - diploma)	27.9%	26.1%
High School Graduate	36.0%	27.6%
Some College (no degree)	14.3%	13.0%
Bachelors Degree	3.5%	8.6%
Graduate or Professional Degree	1.1%	8.0%

of $27,041, with 9.7% of the population comprised of non-whites (Table 1). The South Baltimore community in this study included eight census blocks, specifically, 7502.02, 7502.03, 7501.01, 7501.02, 2504.01, 2504.02, 2505, and 2506 across two zip codes (21225 and 21226). The Hampden community consisted of approximately 2000 households across five census blocks, including 1308.03, 1308.04, 1307, 1306, and 1305. All five census blocks were in the 21211 zip code. At the level of the census block, some aspects of the 2000 census data are available. This includes race data. These data are given in Table 2. A comparison of census data from 1990 and 2000 suggests a comparable change in population demographics for the two communities, namely a decrease in population (13% and 12%) and an approximate doubling of the nonwhite minority population from 9.7% to 21% and 6.2% to 12% for South Baltimore and Hampden, respectively.

Table 2. Population and race for South Baltimore and Hampden according to the 2000 census*

Parameter	South Baltimore	Hampden
Population	24,280	13,601
Race		
White	79.0%	87.8%
Black	14.9%	5.8%
Asian/Pacific Islander	1.6%	2.8%
Hispanic	2.2%	1.8%
Other	2.3%	1.8%

*The 2000 Census does not include Hampden block number 1305

EMISSIONS

According to data from the EPA 1999 Toxic Release Inventory, 61 reporting facilities exist in South Baltimore's 21225 and 21226 zip code regions. Fifteen of these report air toxic releases (Figure 6). This compares to three reporting facilities in Hampden, of which one reports air releases (Figure 7). Among these communities, seven industries in South Baltimore and one in Hampden report releases that

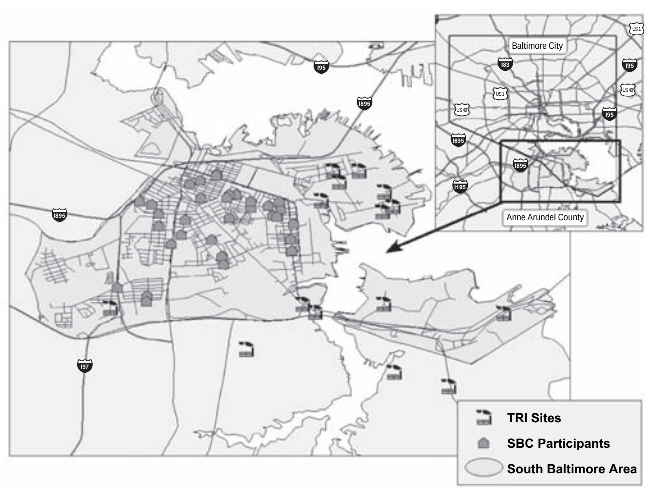

Figure 6. South Baltimore map showing study area, location of participant homes, and TRI sites with VOC releases (from U.S. EPA 1999)

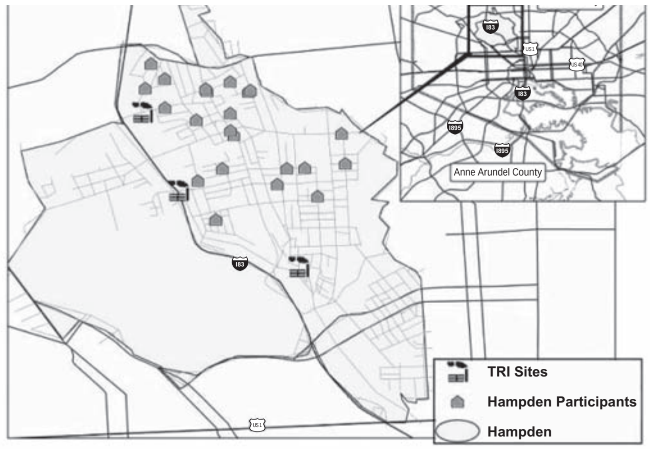

Figure 7. Map of the control location of Hampden showing the study area, location of participating homes, and TRI sites (U.S. EPA 1999)

Table 3. 1999 TRI reported target VOC emissions for South Baltimore and Hampden

Chemical	Total Air Emissions (pounds)	
	South Baltimore 21225/6	Hampden 21211
Benzene	3,661	
Carbon Tetrachloride	90	
Ethylbenzene	1,052	
Methyl Tert-Butyl Ether	44,679	
Toluene	7,815	
Xylene (Mixed Isomers)	3,855	
Styrene		1,317
Total	61,152	1,317

match the VOCs measured in the current study. A total of 61,152 and 1,317 pounds of VOCs were released into the respective communities. This represents a 46-fold difference between the two communities (Table 3). None of the VOCs are common to both communities. With the exception of styrene, emissions of VOCs are higher in South Baltimore. The VOC with the highest release in South Baltimore is methyl tertiary-butyl ether (MTBE).

SURVEY DESIGN

Homes in the South Baltimore communities and in the control community of Hampden were selected at random and in proportion to the community population so that inferences could be made to the entire sampling frame (Whitmore, 1988; Cox et al., 1988; Clickner et al., 1983). The sampling frame was constructed from 1990 census files. The South Baltimore sampling frame consisted of 578 census blocks. A three-stage sampling approach was used to establish the final random selection (Figure 8). In the first stage, census blocks were weighted by population, and 50 blocks were selected at random using Intercooled STATA 6.0 for Windows 98. In the second stage, each block was visited and the homes were enumerated by address. The list of addresses was then randomized using Microsoft Excel™. Residents in each eligible home were approached in turn until residents from the next randomized eligible home agreed to participate. Residents who satisfied preliminary eligibility criteria were also required to meet the following criteria: (1) the selected home must have been their primary residence; (2) no current smokers could live in the home; and (3) subjects could not reside in such institutions as military quarters or prisons. The primary residence criteria were used to select individuals who represent the population actually residing in the study region. Residences without smokers were of interest because exposures from industry were of primary concern in this study and smoking within the home would overwhelm any outdoor source. The contribution of smoking to VOC exposure is well established within the literature (Kim et al., 2001; Ashley et al., 1995; Hajimiragha et al., 1989; Gordon et al., 2002; Wallace 1996; Wallace et al., 1987; Wallace and Pellizzari,1986). However, at the community's request, two homes with smokers were included. Smoking status was considered in data analysis, interpretation, and presentation.

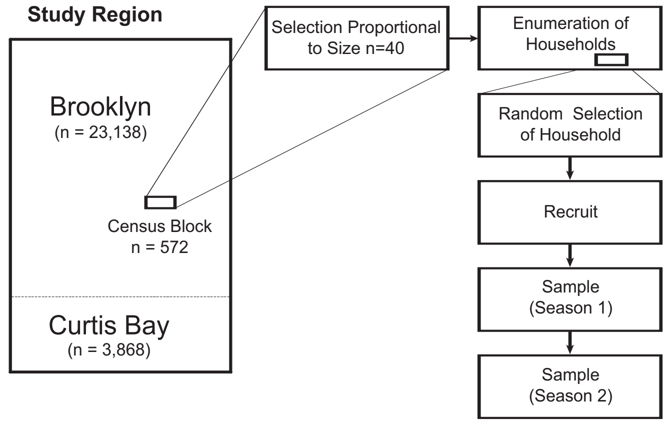

Figure 8. Survey design schematic overview for South Baltimore

Recruitment and enrollment in the community-based exposure study and exposure monitoring were carried out concurrently over a period of 18 months, from January 2000 to July 2001. Personnel responsible for participant recruitment and environmental monitoring included a community resident hired part-time and four students from the Johns Hopkins Bloomberg School of Public Health who were available part-time. Homes were recruited by visiting the home and knocking on the door. If there was no answer, a letter of invitation was left that included study personnel contact information (see Appendix F-1). Five separate visits at different times and days were made before the home was classified as a "no answer refusal" and the next home on the randomized list was approached. For addresses where such factors as boarded windows and doors, tips from neighbors, or other indicators made it clear that the home was unoccupied, the address was logged as "vacant" and the next random address selected. Where contact with a resident in a home was established, the household was screened for eligibility requirements. If the resident was unwilling to participate, the address was logged as "refusal," or if the resident was determined to be a smoker, the address was logged as "smoker" and the next home on the random list was approached. If a resident agreed to participate and met the eligibility requirements, the address was recorded and an appointment was made for a home visit to further explain the study, obtain consent, and set up the monitoring. Only one adult from each enrolled household was monitored. If children resided in the South Baltimore homes, they were also invited to participate.

QUESTIONNAIRES

Four questionnaires were administered to each study participant. The Baseline Questionnaire was used to collect such demographic information as age, race, occupation, household income, and potential sources of exposure to VOCs, including use of air fresheners, exposure to dry cleaned clothes, and modes of transportation (Appendix F-5). The Technician Walk-Through Questionnaire was used to gather such housing characteristic information as number of floors, number of rooms, and distance of the home from the street (Appendix F-3). Both the Baseline Questionnaire and the Technician Walk-Through Questionnaire were administered by study personnel on the first day of monitoring. The Time Diary and Activity Questionnaire was used to determine the amount of time each participant spent indoors and outdoors and to help identify possible VOC sources encountered during the three-day monitoring period (Appendix F-4). This questionnaire was completed by each participant at the end of each day of monitoring and collected by study personnel at the end of the monitoring period. The questionnaires were developed from existing questionnaires (such as NHEXAS and TEAM-VOC). For each day of monitoring, subjects were asked to complete a food diary to document the ingestion of foods containing sorbic acid or potassium sorbate as an interference for the biomarker MA (Appendix F-6).

VOC SAMPLING AND ANALYSIS

At the home visit, signatures on consent forms were obtained and the questionnaires were administered. Personal, residential indoor, and residential outdoor samplers were set up for each study participant. The 3M (London, Ontario) Organic Vapor Monitor (OMV 3500) sampling badges were used for monitoring. Study participants were asked to wear the sampling badges on a shirt lapel or collar near their breathing zone whenever possible, but not when bathing, sleeping or swimming. During these specific times, the participants were asked to keep their badges within the same microenvironment they occupied. Indoor residential sampling badges were placed in the room where the participant spent most of his or her time when not sleeping. The residential outdoor sampling badges were placed in a protected but unobstructed location just outside the home, for example, on the front porch.

Passive sampling badges, OVM 3500, were used to monitor personal exposure as well as outdoor and indoor residential concentrations of VOCs for each study participant. Concentrations of VOCs were measured in μg/m³. Target analytes (n=15) are identified in Table 4.

Table 4. VOC analytes targeted for assessment

	Compound	Molecular Formula	MW	*HAP	**PAP	***EPA Cancer Class
1	Methylene Chloride	CH_2Cl_2	84	T		B2
2	Methyl Tert-Butyl Ether (MTBE)	$C_5H_{12}0$	88	T		D
3	Chloroprene	C_4H_5Cl	88			D
4	Chloroform	$CHCl_3$	119	T	T	B2
5	Carbon Tetrachloride	CCl_4	152	T	T	B2
6	Benzene	C_6H_6	78	T	T	A
7	Trichloroethylene (TCE)	C_2HCl_3	130	T	T	B/C
8	Toluene	C_7H_8	92	T		D
9	Tetrachloroethylene (perc)	C_2Cl_4	164	T	T	B/C
10	Ethylbenzene	C_8H_{10}	106	T		D
11	m,p-Xylene	C_8H_{10}	106	T		D
12	o-Xylene	C_8H_{10}	106	T		D
13	Styrene	C_8H_8	104	T		C
14	1,2,4-Trimethylbenzene	C_9H_{12}	120			D
15	1,4-Dichlorobenzene	$C_6H_4Cl_2$	147			C

* Listed as hazardous air pollutants (HAPs) under the Clean Air Act Amendments of 1990
** Listed among the 33 urban priority air toxics
*** U.S. EPA Air Toxics Website, "www.epa.gov/ttn/atw"

Group A - Carcinogenic to Humans
Group B - Probably Carcinogenic to Humans
Group C - Possibly Carcinogenic to Humans
Group D - Not Classifiable as to Human Carcinogenicity

These include 12 VOCs considered hazardous air pollutants under the CAAA. Six of targeted VOCs are also considered priority urban air pollutants by EPA under the Integrated Urban Air Toxics Strategy. These six pollutants have been determined by EPA to present the greatest threat to public health in the largest number of urban areas and are, therefore, subject to health risk reduction goals under the CAAA. Selection of target analytes was based on these more generic public health concerns, as well specific community concerns regarding environmental carcinogens. In addition, these analytes satisfied logistical criteria since they could be sampled using the 3M OVM badges.

All monitoring was conducted over a nominal 72-hour period. Badges absorb target VOCs by Fick's First Law of Diffusion, which states that flux is proportional to the concentration gradient (Shields, 1987; Brown, 1984). The badge samples each VOC at a unique characteristic rate as specified by the manufacturer.

Sampling was initiated by a trained field technician. The sampler was removed from its sealed canister, and the exact time of removal was recorded on a sampling data form. Also recorded were the date, type of sample (indoor, outdoor, or personal), badge serial number, and home/subject identification. Sampling was discontinued three days later by replacing the diffusion membrane with an air-tight cap, placing the sampler in its canister and sealing the canister with a resealable plastic cap. Additional precautions were instituted to minimize contamination. This included sealing the canister with parafilm and placing the canister into a zip-lock plastic bag. The date and time of closeout were recorded onto the sample data sheet, and the data sheet was placed with the badge-containing canister in the zip-lock bag. Samples were transported to the laboratory within two hours of closeout and stored at -20° C in the laboratory until analyzed.

Samples were extracted and analyzed according to methods described by Chung and coworkers (1999). Samples were first extracted by removing the sampler charcoal pad using Teflon-coated tweezers. The pad was folded and transferred to a labeled 1.8 mL amber vial. To each vial was added one mL of extraction solvent made up of 2:1 v/v acetone (99.9+% Capillary Gas Chromatograph Grade, Sigma-Aldrich, Milwaukee, WI) and carbon disulfide (99.9+% low benzene, Sigma-Aldrich, Milwaukee, WI) An extraction surrogate, 4-bromofluorobenzene, was also added to each sample. The vial was placed in an ultrasonic bath with crushed ice for 50 minutes. The sample extract was then filtered using a syringe with a 0.45 µm Acrodisc 4 CR PTEF filter (VWR, Bridgeport, NJ). Ten µl of internal standard made up in 2:1 acetone: CS_2 was added to 200 µl of each extract, and the extracts were transferred to an amber auto sampler vial with a glass insert. Extraction standards were bromofluoromethane for analytes one through three, 1,4-difluorobenzene for analytes four through six, and chlorobenzene-d_5 for analytes seven through fifteen. Each sample solution was injected by autosampler onto a Restek Rtx - 624, 60 m, 0.25 mm ID, 1.4 Φm thickness column (Restek Corp., Bellefonte, PA) housed in a gas chromatograph-mass spectrometer (GC/MS). Initial samples were anlayzed with a Hewlett Packard 5890 II gas chromatograph interfaced with a 5971 mass spectrometer. Later samples were analyzed on a Shimadzu GC (GC-17A Ver3) / MS(QP-5000). Both instruments were set to operate under the following conditions using single ion monitoring:

- Scan mode from 35 to 260 amu
- Injection splitless for 0.5 minutes and splitting 50:1 for the rest of the run
- Helium carrier; initial pressure 3psi for 0.5 minutes ramp 90psi/min to 22.5 psi; linear velocity 31.1 cm/sec
- Injection port temperature 180° C
- Detector temperature 250° C
- Temperature program: start at 40° C, hold for 12 minutes, ramp at 8° C/min to 200° C
- Injection volume = 1.0 µL

Sample analytes were quantified based on response factors derived from internal standards as described in Equation 1 (EPA TO-17,1999).

$$C_x = (A_x C_{is})/(A_{is} RF) \quad [1]$$

Where:

C_x = the concentration of the VOC analyte to be determined (ng/mL)

A_x = Area of the quantitation ion for the analyte to be measured

C_{is} = concentration internal standard within the injected sample (ng/mL)

A_{is} = area of the quantitation ion for the specific internal standard

RF = the response factor (unitless)

The value of C_x is readily calculated from a combination of A_x and A_{is}, given by the sample chromatogram, and RF/C_{is}, given by the slope of the calibration curve. External standards were obtained from AccuStandard Inc. (New Heaven, CT). Once the concentration of the VOC within the extract solution was determined (Equation 1), the VOC air concentration was determined from Equation 2.

$$C = (WU)/(TR\,RC) \quad [2]$$

Where:

C = integrated air toxin concentration (µg/m³)

W = mass of analyte measured in 1.0 mL of extract solution (µg)

T = sampling duration (min)

R = the sampling rate given by 3M (mL/min)

RC = the recovery coefficient (unitless)

U = a units conversion factor, 1 x 106 mL/m³

The sampling rate was adjusted for temperature according to Table 5.

QUALITY ASSURANCE/QUALITY CONTROL

Procedures for assessing the quality of measurements made with the 3M OVM badges were extensive and included the elements given in Table 6. The method limit of detection (LOD), defined as the lowest concentration of an analyte that the analytical process can reliably detect (MacDougall et al., 1980), was evaluated in two ways, depending upon whether a discernable chromatographic peak could be identified for the analyte. For analytes that could be discerned in the field blanks, the detection limit was determined to be the upper 99% confidence interval given by the t value corresponding to the number of blanks (p=0.01) multiplied by the standard deviation of the analyte in the measured blanks. For analytes not found in the blank, the limit of detection was determined from the upper 99% confidence interval given by the repeated analysis of a low level spike. Field blanks were treated in the same way as collected samples, except, the blank was immediately closed upon initiation of sampling. The field blank was kept in the home during the period of monitoring and was transported in and out of the field with the collected sample.

Blank and duplicate indoor samples were collected from each household. Field blanks were collected to account for contamination of the badges during manufacturing, transport, sampling, storage, and/or analysis. All samples were adjusted for blanks by subtracting the mean quantity of VOC measured on the blanks from samples. Temperature and humidity were monitored, since they have been shown to influence diffusion sampling (Larson, 1996; Chung et al, 1999). The precision of the 3-day 3M OVM air measurement was estimated from 19 indoor and 38 outdoor duplicate samples. Precision was evaluated by the coefficient of variation of duplicate samples; that is, the standard deviation divided by the mean.

An intercomparison study was conducted with the University of Texas to evaluate measurement precision. The protocol of this intercomparison study is given in Appendix A. Badges were spiked at six levels (0, 0.1, 0.5, 1.0, 5.0, and 10 µg/badge) by each laboratory. Six badges were spiked at each of six levels (0, 0.1, 0.5, 1.0, 5.0, and 10 µg/badge) by each of two laboratories for a total of 72 badges (n= 6 x 6 x 2). One half of the badges was retained by each laboratory, and the other half was shipped on ice by next day service to the other laboratory. Each laboratory had a total of 36 badges

Table 5. Adjustment for temperature dependent variability in sampling rate

(° C)	(° F)	(CF_T)
44	111	0.97
37	99	0.98
31	88	0.99
25	77	1.00
19	66	1.01
13	55	1.02
7	45	1.03
2	36	1.04
-3	27	1.05
-8	18	1.06

From the above table, every 10-11° F above or below 77° F requires one percent correction at the calculated time-weighted average concentration. CF_T is the temperature-dependant correction factor.

Table 6. Elements of quality assurance / quality control of 3M OVM badges

Measurement Parameter	Method of Evaluation
Precision	Duplicate sampling
Recovery Inter-Laboratory Comparison	Analysis of badges spiked at six levels analyzed at Johns Hopkins and the University of Texas
Detection Limit	Analysis of field blanks (for analytes present) or low-level spike samples
Method Comparison	Side-by-side indoor sampling comparing the 3M OVM with SKC charcoal tube active sampling

to analyze, one half of which were generated in their own laboratory. In addition, side-by-side sampling was conducted indoors and outdoors at a residence. Six samplers were placed at each location in South Baltimore. One half of the side-by-side samples were sent to the University of Texas for analysis.

Exposure results for each VOC expressed in µg/m³ were downloaded into an Excel spreadsheet. These were identified by participant number. For exposure samples with values below the LOD, simple substitution using one-half of the LOD was made (Hornung and Reed, 1990). For duplicate indoor samples, which were always taken in the same location as the primary indoor sample, the concentration was recorded as the mean of the two values. Results from each run were adjusted for the concentration of analytes measured in field blanks by subtracting the mean concentration.

To evaluate the accuracy of the 3M OVM sampling method in a subset of homes (n=27), indoor side-by-side sampling was conducted using SKC coconut charcoal tubes. Comparability between the two sampling methods was assessed using scatter plots and regression analysis.

DATA CODING

Questionnaires were reviewed for completeness and coded. Where questionnaires were not complete or answers were unclear, attempts were made to immediately contact the participant for clarification. Questionnaire responses were entered into an Access database. The combination of participant birth date and participant number was used to create a unique identifier for each participant. Separate database tables were created for adults and children for the baseline and time activity questionnaires. These tables were linked by the unique identifiers.

DATA ANALYSIS

The distribution of VOC concentrations for each location was summarized using SAS Univariate procedures to include the mean, median, and quartiles. Each distribution and its log transform were tested for normality using the Shapiro-Wilk statistic. Parametric and non-parametric tests were applied accordingly. The predictive relationship between various measured variables paired by individual (such as duplicate sampling, personal exposure versus indoor and outdoor air, and personal exposure versus MA) or between individuals (such as child/parent exposure and MA monitoring results) were examined by SAS regression procedures.

OUTDOOR CENTRAL SITE MONITORING

This monitoring was conducted in South Baltimore at two locations, one in Brooklyn and the other in Wagner's Point (Figure 9). The levels of VOCs in Wagner's Point were of historical interest since this community was relocated in 1999. In part this was because of the health threat posed by emissions from the surrounding industry. This site was also of interest because of its close proximity to a number of industrial sources (Figure 6). The Brooklyn location was near Potapsco Avenue. The Wagner's Point location was under a gazebo at a small park. At the Potapsco Avenue. location, the 3M OVM badges were placed on a telephone

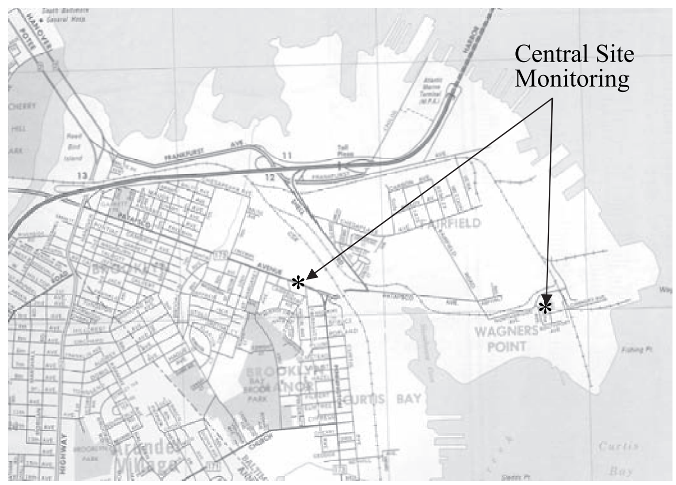

Figure 9. Locations of outdoor central site monitoring in South Baltimore

pole within an aluminum foil shelter. Samples were collected continuously during the study duration, integrated over times of one week, two weeks, and one month.

SAMPLING AND ANALYSIS OF MA

Urine samples for the aliphatic benzene metabolite, MA, were obtained from subjects in both communities at three time points during each study day. The initial sample was the first void of the morning after air monitoring was started. Subsequent samples included a late afternoon void (to coincide with the return home of participants who worked outside the home or who were children in school) and the last void of the day before participants went to sleep. During the three-day study period, specimens were stored in the participant's home in a cooler and on ice. At the end of the three-day monitoring period, the cooler was transported to the lab and stored at -70° C until analyzed.

Dietary instructions were provided to each participant to reduce the ingestion of sorbate preservatives. This preservative is an important source of MA, and can interfere with the specificity of MA as a benzene biomarker (Weaver et al., 2000). Participants were asked to avoid the following three food types during the entire study:

1. Refrigerated fruit punch drinks such as Sunny Delight®
2. Store brand fruit drinks
3. Baked sweets/snacks such as Hostess Cupcakes®, Little Debbie®, or grocery store cakes
4. Packaged soft cookies such as Snack Wells® and Fig Newtons
5. Soft cheeses, including processed cheese slices, cottage cheese, cheese spreads, Velveeta™, cheese dips, low fat cream cheese, and low fat shredded cheese.

Participants were asked to keep a log with brand names of all processed foods consumed during the study. Those participants who were monitored for benzene in 24-hour personal air samples were asked to avoid all products with sorbate food preservatives during the sampling period. To help determine which foods to avoid, participants were given sample labels from foods containing sorbate preservatives with the specific preservative highlighted on the ingredients label. Particpants were asked to avoid all packaged foods unless the ingredients label did not contain the words "sorbic acid" or "potassium sorbate."

Three urine samples from each participant were analyzed. Two criteria were used to select which of the eight samples from each participant were analyzed. First, for participants who collected 24-hour personal air benzene samples, urine specimens provided during and immediately following the air sampling period were assayed. Based on the short half life of MA, these samples were considered most likely to represent benzene exposure during the sampling period. Secondly, food logs were reviewed to determine which periods were least likely to have confounding by sorbate food preservative ingestion. Specimens from these periods were then selected. Where possible, three sequential specimens were selected.

The HPLC -based assay for MA was a modification of the assay described by Ducos and coworkers (1990). For each sample, one mL of urine was acidified to a pH of 4.50 to 5.75 with 6.0 M HCl to ensure reproducible recovery of MA (Bartczak et al., 1994). Using a Gilson minipulse peristaltic pump (Middleton, WI), urine samples were applied to Bond Elut LRC strong anion exchange (SAX) 500-mg cartridges (Varian, Inc., Harbor City, CA) that were preconditioned with 3.0 mL of 100% methanol and 3.0 mL of water. The flow rate of application was 1.0 mL/min. After addition of the urine, the cartridges were washed with 3.0 mL of 1% acetic acid at a flow rate of 2.0 mL/min, and the MA was eluted with 4.0 mL of 10% acetic acid at a flow rate of 1.25 mL/min.

The eluate (30 µL) was injected into an HPLC system consisting of a Rainin Dynamax SD-200 pump with a Varian ProStar 330 photodiode-array detector (Varian, Inc., Walnut Creek, CA). An Altima C18 5 µm (25 cm x 4.6 mm) analytical column preceded by an Altima 5 µm (7.5 x 4.6 mm) guard cartridge (Alltech Associates Inc., Deerfield, IL) was used. Chromatography was isocratic in a mobile phase consisting of 0.45% glacial acetic acid, 0.18% 1.0 M sodium acetate, and 10% methanol. The flow rate was 1.0 mL/min. The column temperature was maintained at 40° C. MA was detected by UV at 8 = 262 nm. Peak area was quantified by the area under the curve method of the Star workstation software (Varian, Inc. Walnut Creek, CA). Concentration of MA was calculated from a standard curve regression line. Diode array detection was used to assess spectra as an additional confirmation other than retention time. Ten percent duplicate samples were routinely analyzed.

RESULTS

SURVEY

A total of 59 and 22 subject-monitoring periods were conducted in South Baltimore and Hampden, respectively. The 59 South Baltimore subject-monitoring days included four pilot studies, repeated measurements for 10 individuals, and monitoring of 8 children. Therefore, to evaluate community differences, a total of 37 (59 less 4 pilots less 10 repeats less 8 children) and 22 person-monitoring periods were available from each community.

Table 7 provides a summary description of the individuals and homes selected for sampling in each community. The individual level data are provided in Appendix B. Subjects from the two communities were similar with respect to race, sex, and age ($p<0.05$). They differed in body mass index. The body mass index of South Baltimore subjects, on average, exceeded that of Hampden by 5 kg/m^2 ($p=0.005$). The two groups of subjects differed most significantly with respect to education. Subjects in the

the Hampden sample were more highly educated (p<0.0001). The Hampden subjects were also more likely to be employed outside of the home (p=0.045). Room deodorizers were more likely to be used in South Baltimore homes (68% versus 36%, p=0.02) and respondents in Hampden were more likely to dry clean their clothes. Many of the differences between the two subject cohorts (such as income, dry cleaning, use of room deodorizers, employment outside of the home) may partly reflect that men made up a larger proportion of the Hampden sample.

Table 7. Comparison of sample characteristics for South Baltimore (n=37) and Hampden (n=22) determined from the baseline questionnaire

Demographic	Hampden Adults	South Baltimore Adults	South Baltimore Children	Difference[1] p value
n	22	37	8	NA
%Male	45.5%	29.7%	75.0%	0.22
Mean Age (years)	44.6	50.9	9	0.20
Median BMI (kg/m^2)	23.6	28.6	4.4	0.005
Household Income				0.87
Refused/Don't Know	13.6%	14.7%	NA	
<$20,000	22.7%	17.6%	NA	
$20,000-$49,999	36.4%	44.1%	NA	
$50,000-$74,999	22.7%	14.7%	NA	
$>75,000	4.6%	8.8%	NA	
Race				0.96
White	81.8%	83.8%	62.5%	
African American	9.1%	10.8%	37.5%	
Hispanic	4.5%	2.7%	0.0%	
Asian	4.5%	2.7%	0.0%	
Education				<0.0001
Primary/Middle School	9.5%	29.7%	NA	
High School Graduate	23.8%	59.5%	NA	
College Graduate	66.7%	10.8%	NA	
Employed outside of home	73%	46%	NA	0.045
Home AC	86%	84%	NA	0.79
Use Mothballs	5%	8%	NA	0.99
Use Room deodorizer	36%	68%	NA	0.02
Dry Clean Clothes	64%	32%	NA	0.02

[1] Test for difference between adults in South Baltimore and Hampden determined by Chi Square and t-test for categorical and continuous responses, respectively

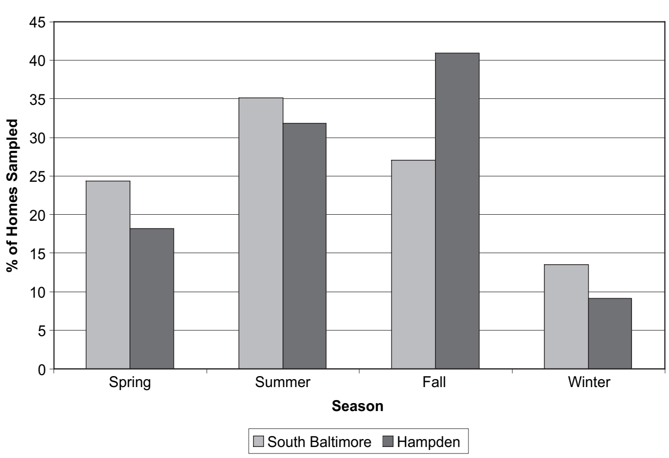

Figure 10. Percent of homes sampled by season and community

Sampling across seasons by community is shown in Figure 10. This analysis reveals that Hampden homes were over-represented by fall sampling (41% relative to South Baltimore's 27%). This over-representation of Hampden subjects during the fall sampling period was offset by evenly distributed increases in South Baltimore across the remaining three seasons.

A response rate of 37% was observed across both

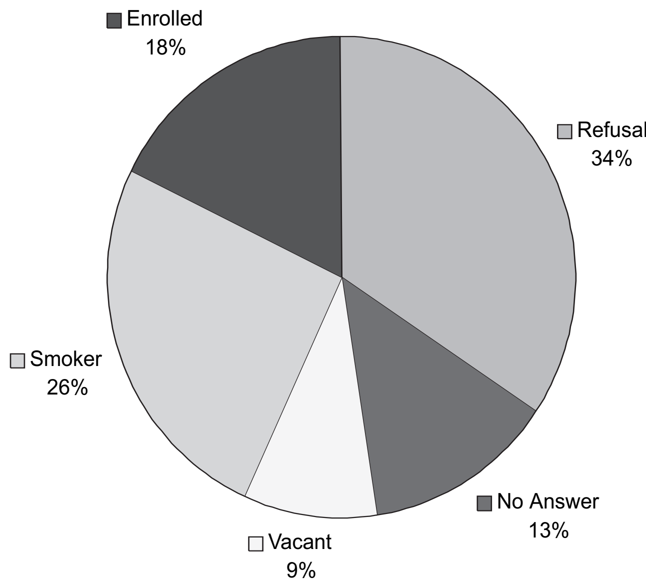

Figure 11. Recruitment response across both communities

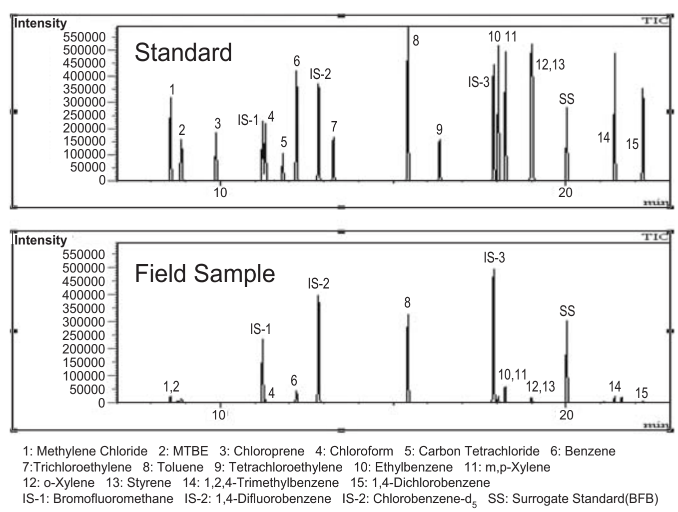

Figure 12. Representative chromatogram from the GC/MS analysis of 3M OVM air sample and associated standard

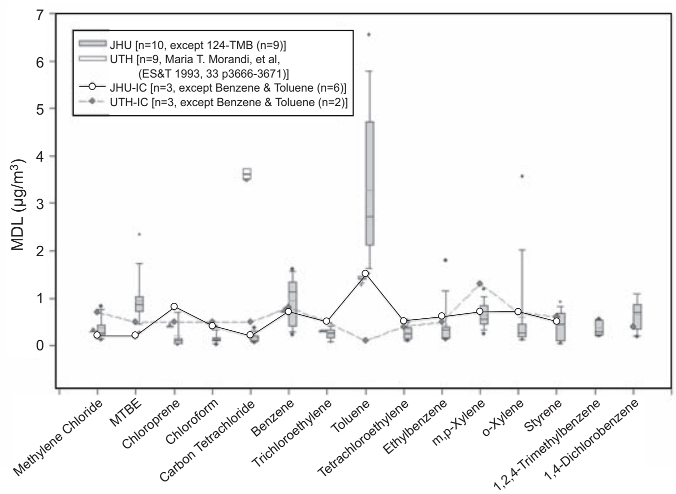

Figure 13. Comparison of detection limits based on the intercomparison study with the University of Texas and published article by Chung et al, 1999

communities. A total of 356 home contacts were made. Thirty-three homes were vacant (9.27%), and 91 (25.3%) were ineligible because a smoker resided in the home. Of the remaining eligible and available to be recruited, 63 agreed, giving a response rate of 37% (Figure 11).

QUALITY ASSURANCE/QUALITY CONTROL

Representative chromatograms for a standard and field sample are provided in Figure 12. Measurement limits of detection for each of the analytes are given in Table 8 and are shown graphically in Figure 13. Table 8 also provides an estimate of measurement precision based on side-by-side sampling. Detection limits varied from 0.11 µg/m³ for chloroform and chloroprene to 3.10 µg/m³ for toluene. A large percentage of measurements were above the limit of detection, with the exception of chloroprene (13%) and styrene (44%). The average percent coefficient of variance (CV) ranged from 15 to 30% across the measured analytes, with the largest variability observed for 1,4-dichlorobenzene.

Table 8. 3M OVM badge measurement detection limit (MDL), recovery, and precision for 72-h indoor measurements

Analyte	Quantification ion [1]		MDL [2]		Recovery [3]	Precision (%) [4]			
	Primary	Secondary	(ug/m ^{3})	% of > MDL	(%)	N	Mean	SD	Median
Methylene Chloride	49	84	0.41	59.3	94.9	68	27.4	41.5	9.0
1,3-Butadiene	39	54	Not Quantified						
MTBE	73	41	0.99	94.2	99.0	68	27.7	31.6	19.8
Chloroprene	88	90	0.11	12.7	95.6	68	14.1	32.7	0.1
Chloroform	83	85	0.11	90.5	94.6	68	25.7	42.2	12.4
Carbon Tetrachloride	117	119	0.42	95.0	97.0	68	20.0	15.9	17.8
Benzene	78	50	1.15	76.2	95.7	68	24.3	29.5	12.2
Trichloroethylene	130	132	0.33	36.0	88.7	68	20.8	36.3	0.2
Toluene	91	92	3.10	84.7	89.0	68	22.9	28.6	13.4
Tetrachloroethylene	166	164	0.32	76.2	87.7	68	24.8	31.1	14.6
Ethylbenzene	91	106	0.31	83.6	88.9	68	18.1	26.2	9.0
p-Xylene	91	106	0.55	96.0	89.6	68	17.9	2 1.2	10.7
o-Xylene	91	106	0.21	86.2	89.1	68	15.0	20.8	9.0
Styrene	104	78	0.45	44.4	88.6	68	19.7	33.7	0.4
1,2,4-Trimethylbenzene	105	120	0.33	82.8	89.3	59	20.5	31.2	11.0
1,4-Dichlorobenzene	146	148	0.56	59.8	88.0	68	30.4	53.4	6.6

[1] Ref : Compendium of Methods for Toxic Organic Air Pollutants, TO-15, p42
[2] MDLs were calculated by $t_{(n-1, 0.01)}$*SD with field blanks and the assumption of 72 hours as sampling period
Ref : Compendium of Methods for Toxic Organic Air Pollutants, TO-17, p28
[3] Recoveries were obtained by averaging the reference standard level of 5000 and 500 ng.
[4] The measurements of analytical precision were relative difference between two identical indoor samples from each subject's house

$$\text{Analytical precision} = \frac{|\text{Indoor sample - Indoor duplicate}|}{\text{Average value of two}}$$

Ref : Compendium of Methods for Toxic Organic Air Pollutants, TO-17, p29

Table 9. Comparison of %CV from indoor and ambient side-by-side duplicate sampling using 3M OVM badges

Compound	No. Duplicates		Mean CV (%)		CV Standard Deviation		Median CV(%)		Difference p-value
	Indoor	Ambient	Indoor	Ambient	Indoor	Ambient	Indoor	Ambient	
Methylene Chloride	68	19	19.4	15.7	29.3	30.8	6.4	0.0	**0.01**
MTBE	68	19	19.6	11.6	22.4	14.0	14.0	6.5	0.11
Chloroprene	68	19	10.0	10.3	23.2	20.8	0.1	0.1	0.78
Chloroform	68	19	18.2	16.3	29.8	14.5	8.8	12.6	0.28
Carbon Tetrachloride	68	19	14.2	7.6	11.2	7.1	12.6	3.2	**0.03**
Benzene	68	19	17.2	8.4	20.9	9.5	8.6	5.5	0.16
Trichloroethylene	68	19	14.7	14.5	25.7	19.9	0.1	9.4	0.28
Toluene	68	19	16.2	11.3	20.2	16.3	9.5	5.5	0.16
Tetrachloroethylene	68	19	17.5	7.4	22.0	5.9	10.3	6.8	0.31
Ethylbenzene	68	19	12.8	9.8	18.5	10.8	6.4	7.1	0.86
m,p-Xylene	68	19	12.7	10.8	15.0	14.6	7.6	5.8	0.30
o-Xylene	68	19	10.6	8.0	14.7	8.6	6.3	4.8	0.80
Styrene	68	19	13.9	9.1	23.8	25.1	0.3	0.0	**0.005**
1,2,4-Trimethylbenzene	59	19	14.5	8.6	22.1	8.0	7.8	4.3	0.56
Dichlorobenzene	68	19	21.5	2.5	37.8	4.8	4.7	0.0	**0.008**

P-values were obtained from Wilcoxon two sample test.
(The P-value in bold-print represents statistically significant difference at the significance level of 0.05).

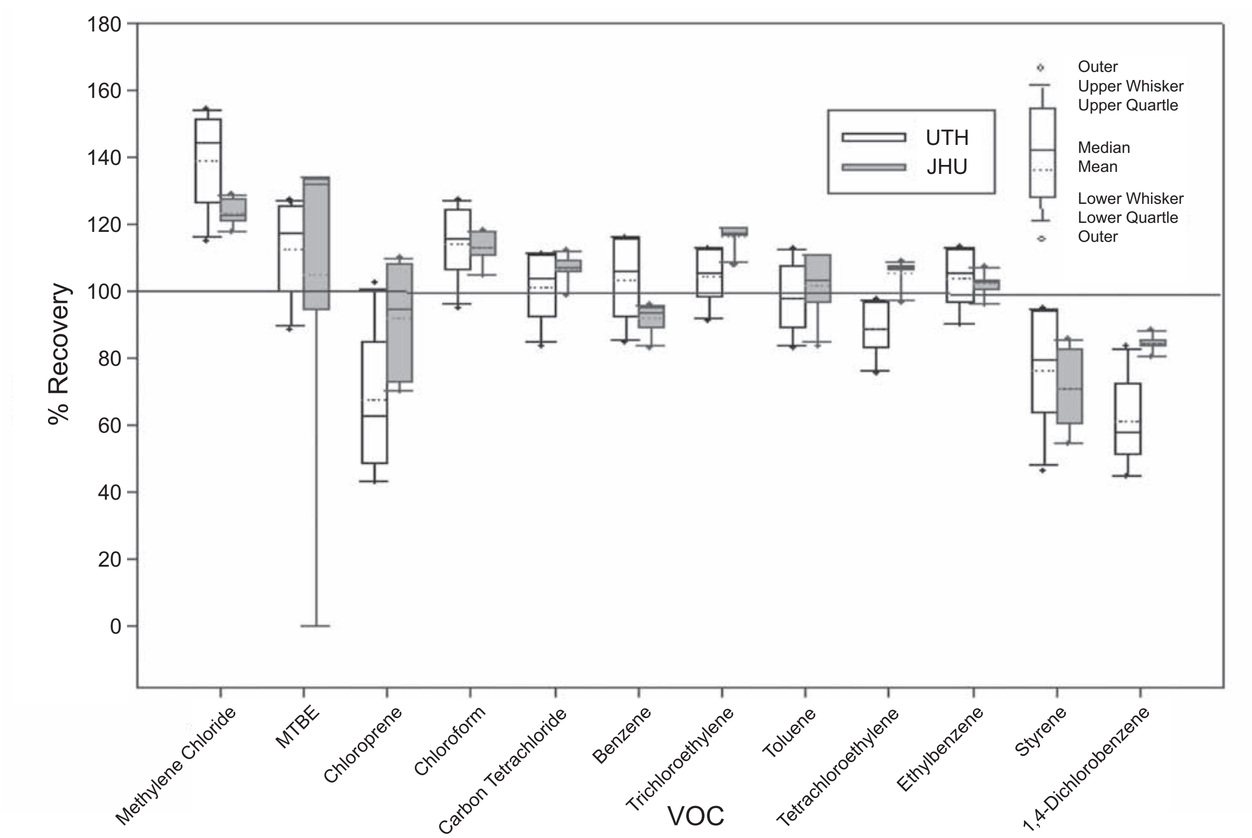

Figure 14. Distribution of recovery results of 1000 ng spiked badges by VOC and lab from an intercomparison study with the University of Texas. In most cases, recovery is determined based on the analysis of six spiked badges; i.e., three spiked badges generated from each laboratory.

Table 10. Results of 3M OVM laboratory intercomparison study with the University of Texas

	Standard Level (ng)	No. of Data		Recovery (%)		CV (%)		P-value
		Texas	JHU	Texas	JHU	Texas	JHU	from T-test
	100	6	0	89.4	.	77.53	.	.
	500	6	5	113.7	145.8	36.54	10.89	0.14
	1000	6	6	139.2	123.5	11.36	3.52	0.06
Methylene Chloride	5000	6	5	120.1	88.8	22.12	7.25	0.08 w
	10000	6	6	132.1	86.0	9.26	6.99	**<0.001**
	Mean			**118.9**	**111.0**	**31.36**	**7.16**	
	Median			120.1	106.1	22.12	7.12	
	SD			19.3	28.8	27.98	3.01	
	100	4	0	109.3	.	48.50	.	.
	500	6	1	103.1	179.6	31.10	.	.
	1000	6	4	112.7	131.4	13.57	2.78	**0.03**
MTBE	5000	6	5	109.8	94.2	9.75	7.44	**0.02**
	10000	6	6	107.7	90.5	9.44	7.24	**0.006**
	Mean			**108.5**	**123.9**	**22.47**	**5.82**	
	Median			109.3	112.8	13.57	7.24	
	SD			3.5	41.4	17.05	2.63	
	100	2	0	27.5	.	8.23	.	.
	500	6	0	52.7	.	21.32	.	.
	1000	6	6	67.6	91.9	35.10	19.25	0.07
Chloroprene	5000	6	5	89.2	74.9	17.29	15.87	0.12
	10000	6	6	92.8	73.4	16.48	11.92	**0.02**
	Mean			**66.0**	**80.0**	**19.68**	**15.68**	
	Median			67.6	74.9	17.29	15.87	
	SD			27.0	10.3	9.85	3.67	
	100	6	0	82.1	.	59.88	.	.
	500	6	6	101.4	108.0	26.15	18.56	0.64
	1000	6	6	114.2	112.8	11.08	4.60	0.80
Chloroform	5000	6	5	108.2	100.2	9.13	7.43	0.17
	10000	6	6	107.9	95.8	9.15	6.89	**0.03**
	Mean			**102.8**	**104.2**	**23.08**	**9.37**	
	Median			107.9	104.1	11.08	7.16	
	SD			12.4	7.6	21.77	6.25	
	100	6	0	73.5	.	55.77	.	.
	500	6	5	90.6	108.7	24.82	16.03	0.18
	1000	6	6	101.1	106.6	10.99	4.15	0.28
Carbon Tetrachloride	5000	6	5	104.1	94.1	7.32	7.79	0.055
	10000	6	6	102.2	91.4	9.38	6.82	**0.04**
	Mean			**94.3**	**100.2**	**21.66**	**8.70**	
	Median			101.1	100.3	10.99	7.30	
	SD			12.8	8.7	20.27	5.12	
	100	5	6	90.7	111.2	96.22	86.13	0.72
	500	6	6	96.5	79.0	32.87	27.22	0.29
	1000	6	6	103.5	91.8	12.72	5.22	0.08
Benzene	5000	6	5	100.0	87.4	7.16	7.20	**0.01**
	10000	6	6	95.3	83.3	9.75	6.15	**0.02**
	Mean			**97.2**	**90.5**	**31.74**	**26.38**	
	Median			96.5	87.4	12.72	7.20	
	SD			4.9	12.5	37.44	34.63	
	100	6	2	70.0	328.4	61.51	29.84	**0.001**
	500	6	6	95.6	126.6	23.49	15.55	**0.03**
	1000	6	6	104.2	116.2	8.98	3.58	**0.02 w**
Trichloroethylene	5000	6	5	103.1	91.8	7.19	8.39	**0.04**
	10000	6	6	99.4	86.2	9.52	7.28	**0.02**
	Mean			**94.5**	**149.9**	**22.14**	**12.93**	
	Median			99.4	116.2	9.52	8.39	
	SD			14.1	101.2	22.96	10.40	

Table 10. (continued)

	Standard Level (ng)	No. of Data		Recovery (%)		CV (%)		P-value
		Texas	JHU	Texas	JHU	Texas	JHU	from T-test
Toluene	100	3	5	94.0	209.4	30.72	82.14	0.30
	500	6	6	78.3	72.6	31.56	40.35	0.72
	1000	6	6	98.1	101.5	11.26	10.11	0.60
	5000	6	5	94.7	86.0	7.21	7.76	0.06
	10000	6	6	89.3	82.3	9.38	7.56	0.13
	Mean			**90.9**	**110.4**	**18.03**	**29.58**	
	Median			94.0	86.0	11.26	10.11	
	SD			7.7	56.3	12.06	32.48	
Tetrachloroethylene	100	6	0	66.8	.	51.81	.	.
	500	6	6	82.9	113.5	22.02	16.34	0.07 w
	1000	6	6	88.6	105.7	9.82	4.35	**0.002**
	5000	6	5	89.2	85.5	6.42	8.84	0.38
	10000	6	6	86.3	79.7	9.46	8.05	0.15
	Mean			**82.8**	**96.1**	**19.90**	**9.40**	
	Median			86.3	95.6	9.82	8.45	
	SD			9.3	16.1	18.81	5.02	
Ethylbenzene	100	6	5	71.3	142.7	59.77	47.63	0.06
	500	6	6	94.6	92.8	21.88	24.66	0.89
	1000	6	6	104.0	102.2	9.49	3.75	0.69
	5000	6	5	100.7	93.1	6.15	8.87	0.11
	10000	6	6	94.2	87.7	9.62	7.11	0.18
	Mean			**93.0**	**103.7**	**21.38**	**18.40**	
	Median			94.6	93.1	9.62	8.87	
	SD			12.8	22.4	22.28	18.21	
m,p - Xylene	100	6	5	119.8	153.5	87.81	50.82	0.56
	500	6	6	143.5	94.6	53.24	26.44	0.19
	1000	6	6	152.6	104.4	40.09	4.32	0.11
	5000	6	5	146.3	93.1	36.72	8.84	0.06
	10000	6	6	135.6	87.7	36.39	7.17	0.06
	Mean			**139.5**	**106.7**	**50.85**	**19.52**	
	Median			143.5	94.6	40.09	8.84	
	SD			12.6	26.9	21.77	19.53	
o - Xylene	100	4	3	29.9	238.5	28.28	35.64	**0.004**
	500	5	6	42.2	99.5	78.40	24.49	**0.009**
	1000	6	6	46.2	98.3	94.35	3.19	**0.03**
	5000	5	5	55.1	82.7	81.25	9.05	0.83 w
	10000	6	6	45.5	77.0	88.94	7.18	0.12
	Mean			**43.8**	**119.2**	**74.24**	**15.91**	
	Median			45.5	98.3	81.25	9.05	
	SD			9.1	67.4	26.45	13.67	
Styrene	100	6	1	57.8	215.6	69.72	.	.
	500	6	6	71.6	72.3	36.80	4.51	0.95
	1000	6	6	76.3	70.9	25.02	18.87	0.59
	5000	6	5	78.7	60.6	13.70	17.34	**0.021**
	10000	6	6	75.1	57.8	13.05	10.04	**0.004**
	Mean			**71.9**	**95.4**	**31.66**	**12.69**	
	Median			75.1	70.9	25.02	13.69	
	SD			8.3	67.5	23.39	6.68	
Dichlorobenzene	100	6	6	28.6	167.0	32.93	41.89	**0.004**
	500	6	6	51.8	82.1	15.11	25.99	**0.02**
	1000	6	6	61.3	84.6	23.93	3.21	**0.01**
	5000	6	5	67.9	71.7	14.39	9.88	0.48
	10000	6	6	66.7	67.3	13.21	8.46	0.89
	Mean			**55.3**	**94.6**	**19.92**	**17.88**	
	Median			61.3	82.1	15.11	9.88	
	SD			16.2	41.1	8.43	15.89	
The P-values in bold-print represent statistically significant difference at the significance level of 0.05								
(w : obtained from wilcoxon two sample test)								

The median CVs were considerably lower than mean values (which ranged from 1% to 20%) indicating the influence of extreme values. In Table 9, the CV from indoor duplicates is compared to the CV given from ambient duplicate side-by-side sampling. On an average, the CV values given by the outdoor central site measurements were lower than values observed for the indoor measurements, although the difference was statistically significant in only four cases (methylene chloride, carbon tetrachloride, styrene, and 1,4-dichlorobenzene).

Two recovery studies were conducted. The first study was conducted using the HP5971 GC/MS in the the inter-laboratory study conducted in collaboration with the University of Texas. The second study was conducted using the Shimadzu GC/MS. In both cases, evaluation of recovery was based on the analysis of multiple badges spiked at multiple levels. Table 10 provides the results of the first study. Graphical results for the 1000-ng spike level are given in Figure 14. For each analyte, the data were first analyzed for normality using the Shapiro-Wilk test. Within each spike level, the null hypothesis that the data were normally distributed could not be rejected (p≤0.05). The data were next analyzed using Analysis of Variance (ANOVA) to test for an effect of the spiking laboratory. For each analyte and spike level, the laboratory where the spike was conducted was found to be nonsignificant (p≤0.05). Because no effect due to spiking laboratory was detected, subsequent analyses investigating laboratory differences combined spiked badges from both laboratories (n=6 for each level). For five of six spike levels, the Johns Hopkins University (JHU) standard deviation was less than the University of Texas at Houston (UTH). Based on both the side-by-side sampling and the analysis of the low level standard, it is clear that the JHU laboratory is less sensitive than UTH. It is likely that this difference is attributable to analytical instrumentation. The JHU laboratory used a HP5971 mass spectrometer, while the UTH laboratory used a more current instrument, the HP 5973. Hewlett Packard specifies that the HP5972 is three to five times more sensitive than the HP5971, and the HP5973 is five times more sensitive than the HP5972. Therefore, the HP5973 should be 15 to 25 times more sensitive than the HP5971.

A similar second recovery study was conducted for samples analyzed by the Shimadzu instrument. These study results were compared to HP recovery results (Figure 15). All results have been adjusted for recovery based on recovery efficiency for the instrument used. For the HP analyzed samples, the mean recovery from the 1000-ng/badge study was used, whereas for the Shimadzu, the mean recovery was applied by level for the 100, 500, and

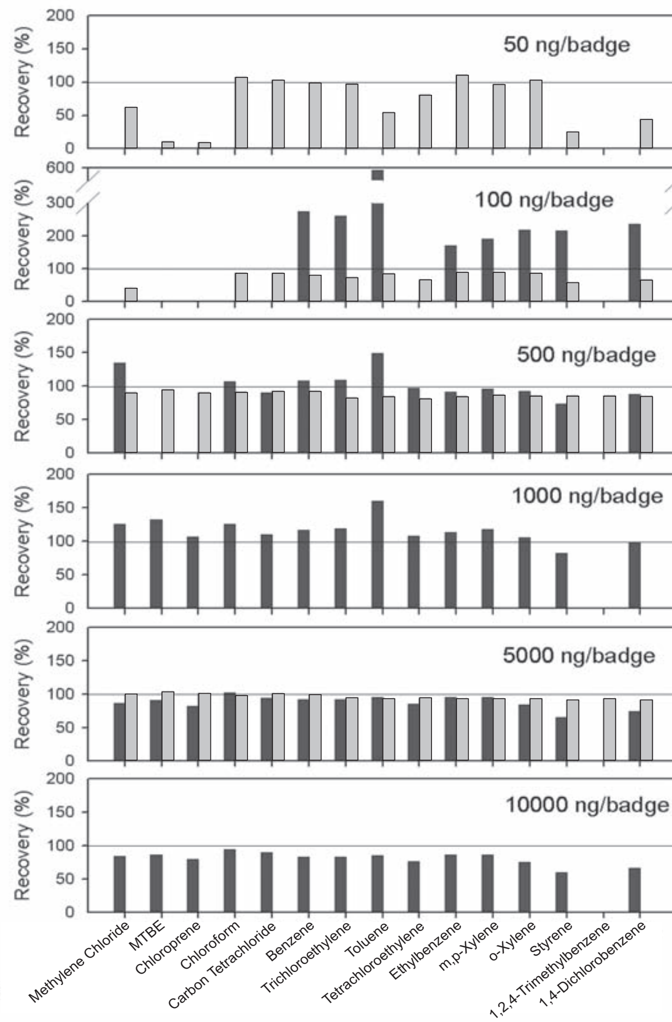

Figure 15. Comparison of recoveries between the HP5971 Series II and Shimadzu QP-5000 GC/MS

Table 11. Regression results of 3M OVM and SKC charcoal tube 72-h side-by-side sampling

VOC	n	Slope	Intercept	R^2	Paired t
Methylene Chloride	27	1.52	0.29	0.90	0.074
MTBE	27	1.30	-0.14	0.96	**0.039**
Chloroprene	27	0.26	0.04	0.16	0.207
Chloroform	27	0.94	0.94	0.82	**0.000**
Carbon Tetrachloride	27	0.35	0.75	0.07	0.109
Benzene	27	0.79	1.59	0.47	**0.005**
Trichloroethylene	27	0.18	0.12	0.57	**0.024**
Toluene	27	1.03	-0.07	0.86	0.760
Tetrachloroethylene	27	0.76	0.38	0.29	0.183
Ethylbenzene	27	1.01	0.25	0.80	**0.048**
m,p-Xylene	27	0.89	0.82	075	0.606
o-Xylene	27	0.98	0.16	0.84	0.230
Styrene	27	0.088	0.90	0.06	**0.025**
1,2,4-Trimethylbenzene	27	0.87	-0.25	0.90	**0.001**
1,4-Dichlorobenzene	27	0.87	0.05	1.00	0.263

Differences with probability ≤0.05 are shown in bold

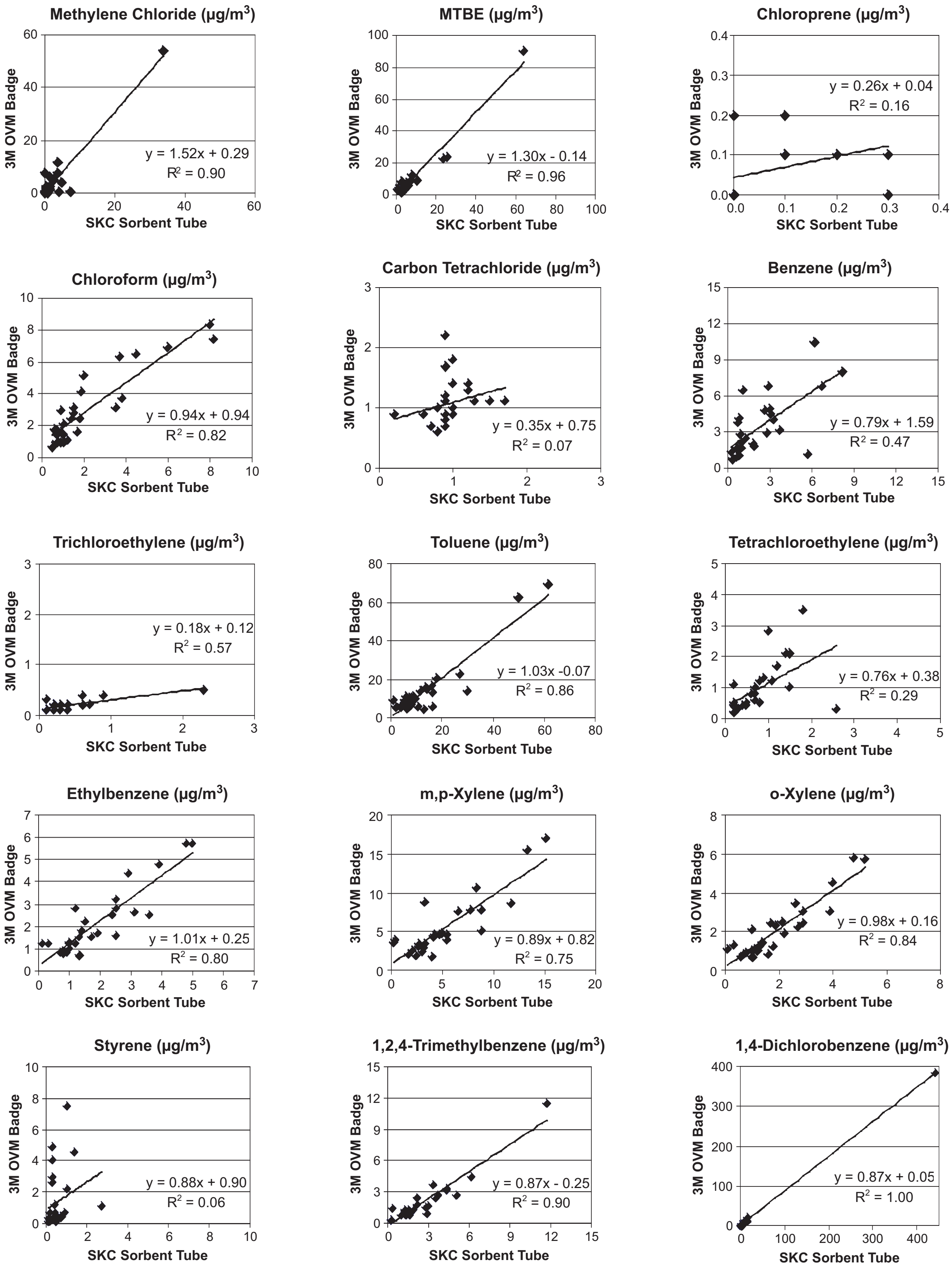

Figure 16a-s. Scatter plots with regression showing comparability between 72-h 3M OVM passive sampling and SKC charcoal tube active sampling

Table 12. Urine cotinine (ng/mL) measured above detection among Hampden and South Baltimore samples. Smoker samples in bold.

Subject ID	Cotinine (ng/mL)	Smoker[1]
H-013	20	No
H-019	6	No
H-020	**3852**	**Yes**
H-021	**129**	**Yes**
SB-001	**6853**	**Yes**
SB-002	12	No
SB-005C	6	No
SB-006	**3486**	**Yes**
SB-006C	28	No
SB-006R	**3624**	**Yes**
SB-007	14	No
SB-008	63	No
SB-009	8	No
SB-010	6	No
SB-010R	7	No
SB-031	10	No
SB-032	9	No
SB-038	**819**	**Yes**
SB-044	11	No
SB-044C	7	No
SB-046	**852**	**Yes**

[1] Assuming a threshold of 100 ng/mL from Benowitz et al. 1994

1000-ng/badge level spikes that were used.

Scatter-plot and regression results comparing the side-by-side sampling with the SKC coconut charcoal tubes are shown in Figures 16a-s and Table 11, respectively. These results indicate considerable variability in method comparability across the 15 analytes. For the lighter analytes, including methylene chloride and MTBE, regression results suggest a positive bias in the 3M OVM badges as indicated by a slope greater than 1.0, although a strong R^2 was observed in both cases (≥0.90). Good agreement was observed between methods for chloroform, benzene, toluene, ethylbenzene, m,p-xylene, o-xylene, and 1,2,4-trimethylbenzene, where slopes were within 0.21 of 1.0 and at least 47% of the variability was explained. A paired t-test indicated significant differences ($p \leq 0.05$) for MTBE, chloroform, benzene, trichloroethylene, ethylbenzene, styrene, and 1,2,4-trimethylbenzene.

COTININE

To assure that only nonsmokers were included in the analysis of community differences, urinary cotinine was measured. Cotinine was assayed from a composite sample produced by combining sample aliquots proportional to

Table 13. Outdoor VOC concentration distributions measured in South Baltimore compared to Hampden (µg/m^3)

Compound	Site	N	Miss	Mean	SD	Min	10th	25th	50th	75th	90th	Max	Wilcoxon	T-test
Methylene Chloride	SB	36	1	0.47	0.38	0.1	0.1	0.2	0.4	0.6	1.2	1.7	0.084	0.017
	HD	21	1	0.87	1.17	0.3	0.3	0.3	0.5	0.9	1.4	5.7		
MTBE	SB	36	1	5.07	2.54	0.3	1.8	3.8	4.7	6.6	9.1	10.4	0.875	0.492
	HD	21	1	5.54	3.43	1.3	3.0	3.8	4.7	6.1	7.4	17.9		
Chloroprene	SB	36	1	0.11	0.14	0.0	0.0	0.0	0.1	0.1	0.4	0.4	0.165	0.427
	HD	21	1	0.06	0.10	0.0	0.0	0.0	0.0	0.1	0.1	0.4		
Chloroform	SB	36	1	0.44	0.60	0.1	0.1	0.2	0.3	0.5	0.7	3.4	0.980	0.772
	HD	21	1	0.61	1.21	0.1	0.1	0.2	0.3	0.4	1.1	5.7		
Carbon Tetrachloride	SB	36	1	1.01	0.40	0.1	0.6	0.7	0.9	1.3	1.7	1.8	0.721	0.400
	HD	21	1	1.14	0.74	0.6	0.8	0.8	1.0	1.2	1.4	4.2		
Benzene	SB	36	1	1.88	1.06	0.5	0.6	0.8	1.9	2.7	3.2	4.8	0.791	0.799
	HD	21	1	2.00	1.63	0.6	0.6	1.2	1.8	2.1	2.8	8.4		
Trichloroethylene	SB	36	1	0.21	0.17	0.1	0.1	0.1	0.2	0.2	0.3	1.0	0.771	0.753
	HD	21	1	0.19	0.12	0.1	0.1	0.1	0.2	0.2	0.3	0.5		
Toluene	SB	36	1	4.39	2.33	1.0	1.7	2.4	4.1	5.9	7.4	10.7	0.211	0.219
	HD	21	1	3.46	1.52	1.1	1.7	2.5	3.1	4.4	5.2	7.1		
Tetrachloroethylene	SB	36	1	0.50	0.45	0.1	0.1	0.3	0.3	0.7	1.2	2.1	**0.006**	**0.006**
	HD	**21**	**1**	**0.91**	**0.74**	**0.1**	**0.2**	**0.5**	**0.7**	**1.1**	**1.7**	**3.3**		
Ethylbenzene	**SB**	**36**	**1**	**1.44**	**1.05**	**0.1**	**0.3**	**0.7**	**1.2**	**2.0**	**3.4**	**4.5**	**0.026**	**0.051**
	HD	21	1	0.89	0.61	0.2	0.3	0.6	0.7	1.1	1.9	2.6		
m,p-Xylene	**SB**	**36**	**1**	**3.60**	**2.10**	**0.6**	**1.2**	**2.1**	**3.4**	**5.1**	**6.5**	**9.9**	**0.011**	**0.024**
	HD	21	1	2.27	1.18	0.6	1.1	1.4	2.0	2.8	4.2	5.3		
o-Xylene	SB	36	1	1.42	0.99	0.2	0.3	0.8	1.3	1.7	2.6	4.4	0.199	0.282
	HD	21	1	1.11	0.74	0.2	0.4	0.6	1.0	1.3	2.5	2.8		
Styrene	SB	36	1	0.67	1.32	0.1	0.1	0.1	0.3	0.4	2.4	7.2	0.278	0.409
	HD	21	1	0.61	0.80	0.1	0.1	0.2	0.3	0.9	1.2	3.7		
1,2,4-Trimethylbenzene	SB	32	5	0.94	0.68	0.1	0.3	0.6	0.8	1.2	1.6	3.4	0.439	0.444
	HD	20	2	0.86	0.70	0.1	0.3	0.3	0.6	1.2	2.2	2.5		
1,4-Dichlorobenzene	SB	36	1	1.17	2.90	0.1	0.2	0.4	0.4	0.8	1.4	17.3	0.535	0.450
	HD	21	1	0.61	0.63	0.1	0.2	0.3	0.4	0.6	0.9	3.0		

Table 14. Indoor VOC concentration distributions measured in South Baltimore compared to Hampden (µg/m^3)

Compound	Site	N	Miss	Mean	SD	Min	10th	25th	50th	75th	90th	Max	Wilcoxon	T-test
Methylene Chloride	SB	31	2	3.18	5.49	0.1	0.1	0.4	1.2	3.0	7.8	28.2	1.000	0.752
	HD	20	0	4.65	11.86	0.3	0.3	0.5	0.9	4.0	7.0	54.1		
MTBE	SB	31	2	11.58	18.28	0.3	2.9	3.7	5.2	9.2	23.0	81.7	0.289	0.739
	HD	20	0	11.64	22.41	1.9	2.1	3.9	4.6	6.2	34.6	90.0		
Chloroprene	SB	31	2	0.12	0.14	0.0	0.0	0.0	0.1	0.2	0.4	0.4	0.280	0.483
	HD	20	0	0.08	0.11	0.0	0.0	0.0	0.0	0.1	0.3	0.4		
Chloroform	SB	31	2	4.35	5.83	0.1	0.7	1.6	2.4	6.0	8.0	31.0	0.396	0.671
	HD	20	0	3.38	3.40	0.6	0.7	1.0	1.7	5.2	8.1	13.1		
Carbon Tetrachloride	SB	31	2	1.02	0.46	0.1	0.6	0.8	0.9	1.2	1.4	2.7	0.771	0.499
	HD	20	0	1.05	0.38	0.6	0.7	0.8	1.0	1.2	1.6	2.2		
Benzene	SB	31	2	3.99	2.70	0.7	1.1	1.4	3.1	6.3	7.4	10.2	0.423	0.465
	HD	20	0	3.47	2.85	0.6	1.1	1.7	2.2	4.4	8.5	10.4		
Trichloroethylene	SB	31	2	0.43	0.75	0.1	0.1	0.1	0.2	0.4	0.6	4.0	0.058	**0.014**
	HD	20	0	0.16	0.06	0.1	0.1	0.1	0.2	0.2	0.2	0.3		
Toluene	**SB**	**31**	**2**	**21.64**	**23.83**	**4.8**	**6.4**	**7.9**	**13.6**	**21.6**	**53.8**	**110.1**	**0.005**	**0.008**
	HD	20	0	11.33	13.48	2.5	3.1	5.2	7.9	11.0	22.6	62.1		
Tetrachloroethylene	**SB**	**31**	**2**	**2.25**	**5.59**	**0.1**	**0.2**	**0.3**	**0.6**	**1.2**	**3.5**	**24.4**	**0.051**	**0.118**
	HD	20	0	1.48	1.43	0.4	0.4	0.6	1.0	1.9	2.9	6.4		
Ethylbenzene	**SB**	**31**	**2**	**3.34**	**3.61**	**0.5**	**1.1**	**1.3**	**2.2**	**4.3**	**5.7**	**19.4**	**0.005**	**0.014**
	HD	20	0	1.93	2.35	0.6	0.8	0.8	1.2	1.8	4.3	10.7		
m,p-Xylene	**SB**	**31**	**2**	**8.39**	**10.55**	**1.6**	**3.0**	**3.8**	**5.3**	**7.9**	**15.4**	**60.2**	**0.009**	**0.019**
	HD	20	0	4.99	5.25	1.5	1.8	2.2	3.4	4.6	12.9	21.8		
o-Xylene	SB	31	2	3.28	3.58	0.6	1.0	1.2	2.3	3.5	5.8	17.0	0.165	0.260
	HD	20	0	2.69	3.28	0.7	0.7	0.9	1.4	2.3	8.1	12.8		
Styrene	SB	31	2	2.99	7.91	0.1	0.2	0.3	0.4	2.5	7.5	43.3	0.930	0.968
	HD	20	0	1.41	1.44	0.1	0.2	0.3	0.9	2.4	3.6	4.9		
1,2,4-Trimethylbenzene	SB	28	5	2.92	3.37	0.3	0.3	1.0	2.1	3.1	7.1	14.8	0.318	0.585
	HD	19	1	3.94	6.89	0.3	0.3	0.8	1.2	3.2	11.5	28.8		
1,4-Dichlorobenzene	SB	31	2	24.22	75.27	0.2	0.4	0.4	1.0	3.7	19.6	384.4	0.290	0.132
	HD	20	0	2.54	5.26	0.2	0.3	0.4	0.8	2.4	4.6	24.1		

Table 15. Personal VOC concentration distributions measured in South Baltimore and Hampden (µg/m^3)

Compound	Site	N	Miss	Mean	SD	Min	10th	25th	50th	75th	90th	Max	Wilcoxon	T-test
Methylene Chloride	SB	31	2	2.54	4.34	0.0	0.3	0.4	1.6	2.3	5.6	23.8	0.609	0.570
	HD	20	0	3.62	8.53	0.3	0.4	0.8	1.7	2.3	4.9	39.4		
MTBE	SB	31	2	16.15	19.27	1.3	3.7	4.5	7.2	17.6	54.1	68.3	0.165	0.232
	HD	20	0	10.65	15.50	2.9	3.3	4.3	5.6	8.3	25.5	67.1		
Chloroprene	SB	31	2	0.12	0.14	0.0	0.0	0.0	0.1	0.2	0.4	0.4	0.265	0.094
	HD	20	0	0.07	0.09	0.0	0.0	0.0	0.1	0.1	0.1	0.4		
Chloroform	SB	31	2	5.01	6.41	0.3	0.7	1.6	2.5	6.9	9.6	34.4	0.714	0.960
	HD	20	0	4.51	5.35	0.8	1.1	1.6	2.2	5.8	8.9	24.5		
Carbon Tetrachloride	SB	31	2	0.98	0.45	0.3	0.6	0.7	0.9	1.2	1.5	2.1	0.210	0.108
	HD	20	0	1.08	0.30	0.7	0.8	0.9	1.0	1.3	1.6	1.7		
Benzene	SB	31	2	3.78	2.40	0.6	1.4	1.7	3.0	5.7	6.8	10.1	0.475	0.330
	HD	20	0	3.09	2.00	0.6	0.7	1.9	2.5	4.2	6.5	7.6		
Trichloroethylene	SB	31	2	1.78	7.63	0.1	0.1	0.2	0.2	0.4	0.8	42.8	0.652	0.420
	HD	20	0	0.37	0.49	0.1	0.1	0.2	0.2	0.3	0.8	2.3		
Toluene	SB	31	2	24.25	25.61	1.7	6.3	10.7	14.6	30.7	44.4	108.0	0.107	0.226
	HD	20	0	18.24	20.24	2.4	5.1	7.7	9.4	15.1	58.0	71.3		
Tetrachloroethylene	**SB**	**31**	**2**	**2.33**	**4.97**	**0.1**	**0.2**	**0.3**	**0.7**	**2.3**	**3.4**	**24.3**	**0.020**	**0.024**
	HD	20	0	2.20	1.80	0.3	0.8	1.2	1.6	2.5	5.4	7.0		
Ethylbenzene	SB	31	2	3.65	3.64	0.3	1.2	1.5	2.5	4.5	6.9	19.0	0.101	0.189
	HD	20	0	2.83	3.30	0.2	0.8	1.1	1.8	2.8	6.8	14.4		
m,p-Xylene	SB	31	2	9.50	10.60	1.2	3.1	4.0	6.3	10.5	18.5	58.7	0.135	0.238
	HD	20	0	7.87	10.25	1.5	2.1	3.1	4.4	7.8	16.2	47.3		
o-Xylene	SB	31	2	3.67	3.50	0.4	1.1	1.3	2.6	5.4	7.0	16.9	0.401	0.358
	HD	20	0	3.05	2.83	0.2	0.7	1.2	2.0	3.5	8.6	9.7		
Styrene	SB	31	2	3.83	9.17	0.1	0.2	0.3	1.3	4.2	6.8	51.3	0.977	0.994
	HD	20	0	2.01	1.81	0.1	0.2	0.5	1.3	3.3	4.7	6.4		
1,2,4-Trimethylbenzene	SB	28	5	3.43	3.43	0.3	0.6	1.2	2.6	3.2	8.4	14.6	0.481	0.839
	HD	19	1	3.74	5.02	0.6	0.7	1.0	1.7	4.3	11.4	20.5		
1,4-Dichlorobenzene	SB	31	2	21.17	61.41	0.3	0.4	0.4	1.1	12.3	29.9	313.3	0.343	0.208
	HD	20	0	3.10	5.79	0.2	0.2	0.4	1.5	3.1	5.4	26.6		

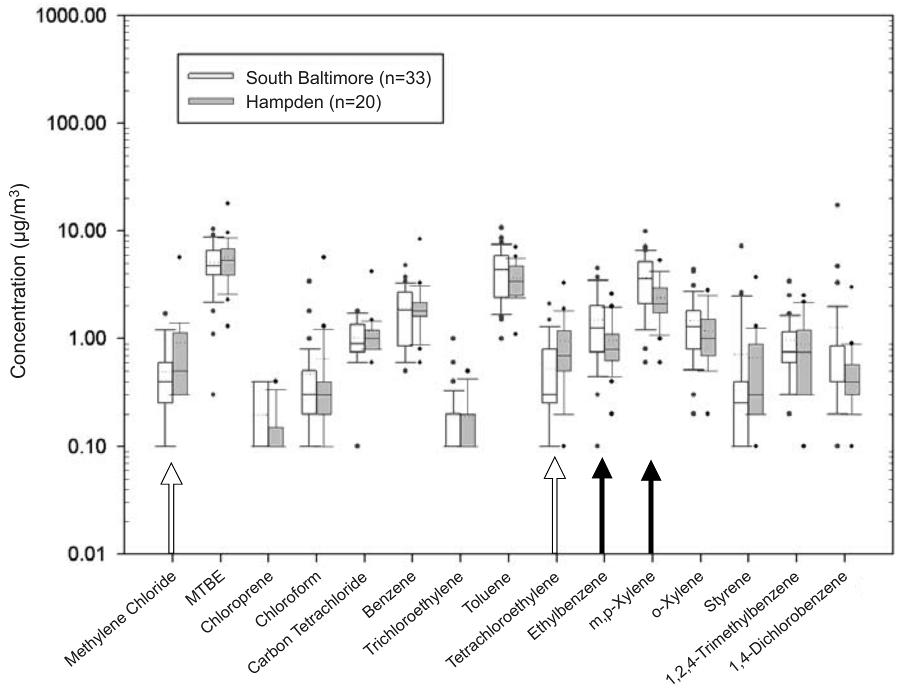

Figure 17. Outdoor VOC concentrations in South Baltimore compared to the Hampden control community. The black arrows indicate the VOCs where concentrations in South Baltimore were significantly ($p \leq 0.05$) greater than Hampden based on the Wilcoxon sign rank test and/or t-test. The white arrows indicate the VOCs where concentrations in Hampden were significantly ($p \leq 0.05$) greater than South Baltimore.

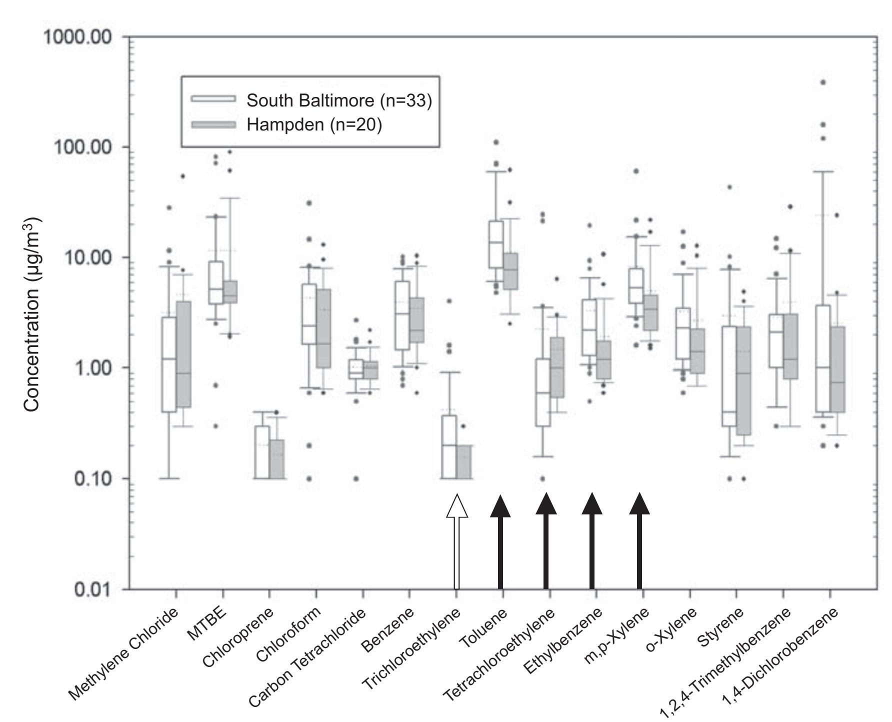

Figure 18. Indoor VOC concentrations in South Baltimore compared to the Hampden control community. The black arrows indicate the VOCs where concentrations in South Baltimore were significantly ($p \leq 0.05$) greater than Hampden based on the Wilcoxon sign rank test and/or t-test. The white arrow indicates the VOCs where concentrations in Hampden were significantly ($p \leq 0.05$) greater than South Baltimore.

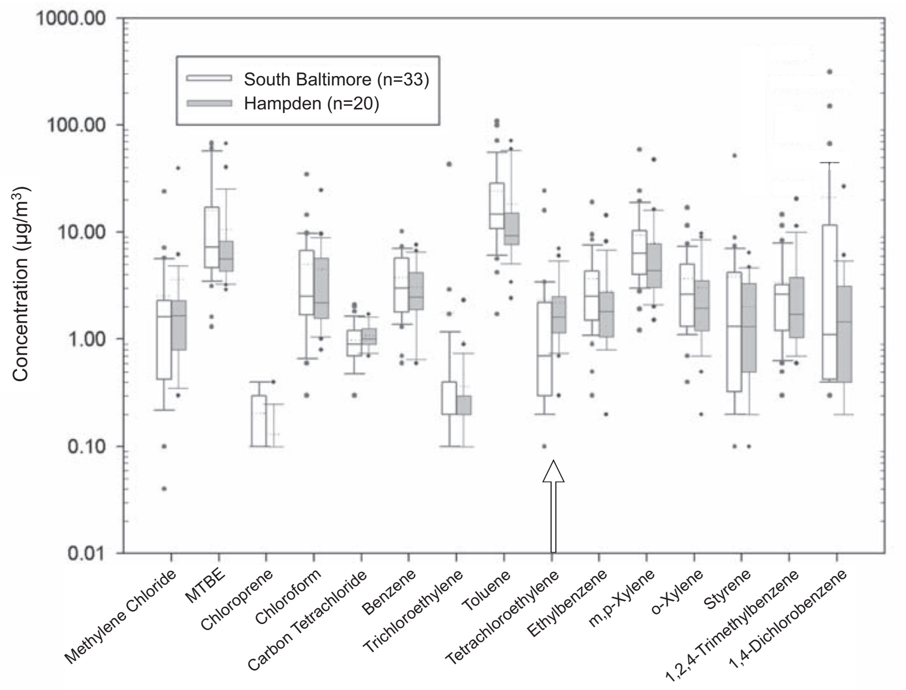

Figure 19. Personal VOC concentrations in South Baltimore compared to the Hampden control community. The white arrow indicates the VOCs where concentrations in Hampden were significantly ($p \leq 0.05$) greater than South Baltimore.

sample volume from the sample voids that were provided. Among the 81 person-samples assayed, all concentrations were below detection, except for the 21 cases given in Table 12. Based on information provided by Benowitz (1996), subjects with cotinine levels greater than 100 ng/mL were classified as active smokers and eliminated from consideration of indoor and personal community differences. Therefore, data from two Hampden (H-020 and H-021) and four South Baltimore subjects (SB-001, SB-006, SB-006R, SB-038, and SB-046) were removed from the analysis of personal and indoor community differences, giving a total subject number of 53 and 20 in each of the respective communities. However, smoking would not be expected to affect the outdoor concentrations, and these homes were not omitted from the outdoor results comparison. Because children and repeat measurements were not conducted in the control community of Hampden, comparisons with South Baltimore excluded these measurements; that is, monitoring results from ten repeated measures and eight children were excluded. These exclusions resulted in a final community comparison data set of 36 and 21 outdoor home measurements and 31 and 20 indoor and personal measurements for the two communities, respectively. Tables 13 through 15 and Figures 17 through 19 give the VOC concentration distributions for the two communities based on these numbers, together with the results of parametric and nonparametric statistical tests.

The concentration of outdoor VOCs was higher on average in South Baltimore than in Hampden for eight of the fifteen measured VOCs. However, this difference only reached statistical significance ($p \leq 0.05$) for three of the measured VOCs. Both ethylbenzene (median of 1.2 versus 0.7 µg/m³) and m,p-xylene (median of 3.4 versus 2.0 µg/m³) were higher in South Baltimore than in Hampden. However, the reverse was the case for tetrachloroethylene, where Hampden average levels exceeded South Baltimore.

The average indoor levels of 11 of the 15 VOCs measured were greater in South Baltimore than in Hampden. The difference between concentrations reached statistical significance in three cases. As with the outdoor VOCs, both ethylbenzene (median 2.2 versus 1.2 µg/m³) and m,p-xylene (median 5.3 versus 3.4 µg/m³) were significantly ($p \leq 0.05$) higher in South Baltimore homes than in Hampden homes. In contrast to the absence of an observed difference in outdoor toluene, indoor toluene was nearly two times higher in South Baltimore than in Hampden ($p \leq 0.05$). The relative concentrations of indoor tetrachloroethylene in South Baltimore and Hampden were the reverse of those observed outdoors, with South Baltimore concentrations exceeding those of Hampden ($p \leq 0.05$). Although average

Table 16. One-week fixed-site outdoor VOC concentrations measured at Wagner's Point (W) and on Patapsco Avenue in Brooklyn (P) (µg/m^3)

Compound	Site	N	Miss	Mean	SD	Min	10th	25th	50th	75th	90th	Max	Paired test
Methylene Chloride	P	35	0	0.35	0.22	0.1	0.1	0.1	0.4	0.5	0.6	0.9	0.816
	W	34	1	0.35	0.24	0.1	0.1	0.1	0.3	0.5	0.7	0.9	
MTBE	P	35	0	7.54	4.12	1.8	3.2	5.9	6.9	8.9	10.2	25.3	**<.0001**
	W	**34**	**1**	**25.70**	**13.95**	**0.5**	**10.5**	**15.4**	**24.6**	**32.6**	**43.2**	**58.9**	
Chloroprene	P	35	0	0.03	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.2	**0.007**
	W	**34**	**1**	**0.05**	**0.04**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.2**	
Chloroform	P	35	0	0.46	0.34	0.1	0.2	0.3	0.4	0.5	0.6	1.6	0.532
	W	34	1	0.49	0.26	0.0	0.3	0.4	0.4	0.5	0.9	1.5	
Carbon Tetrachloride	P	35	0	1.19	0.59	0.4	0.6	0.9	1.0	1.4	1.7	3.7	0.857
	W	34	1	1.16	0.50	0.1	0.5	0.8	1.1	1.4	1.9	2.1	
Benzene	P	35	0	6.00	20.95	0.3	1.3	1.5	2.1	3.3	4.5	126.2	0.370
	W	34	1	3.78	7.03	0.4	1.3	1.7	2.4	3.1	5.2	42.7	
Trichloroethylene	P	35	0	0.17	0.15	0.0	0.1	0.1	0.1	0.2	0.5	0.6	0.804
	W	34	1	0.16	0.12	0.0	0.1	0.1	0.1	0.2	0.3	0.6	
Toluene	P	35	0	5.98	3.10	1.2	2.2	4.6	5.4	7.7	9.2	16.6	0.341
	W	34	1	6.41	3.08	1.4	3.1	4.2	5.9	8.5	10.8	14.8	
Tetrachloroethylene	P	35	0	0.67	0.57	0.3	0.4	0.4	0.5	0.8	1.0	3.5	0.133
	W	34	1	0.85	0.54	0.0	0.4	0.5	0.7	1.0	1.4	2.8	
Ethylbenzene	P	35	0	2.47	1.60	0.5	0.8	1.6	2.0	3.0	5.0	7.3	0.737
	W	34	1	2.36	1.34	0.1	1.1	1.6	2.2	2.9	4.2	6.6	
m,p-Xylene	P	35	0	6.59	4.11	1.5	2.0	3.5	5.2	8.1	13.3	19.1	0.919
	W	34	1	6.65	4.10	0.2	2.9	3.9	5.8	8.9	11.2	18.2	
o-Xylene	P	35	0	1.95	1.07	0.5	0.8	1.4	1.8	2.2	3.6	5.3	0.737
	W	34	1	1.88	0.95	0.1	0.9	1.3	1.8	2.3	3.1	4.7	
Styrene	**P**	**35**	**0**	**0.66**	**0.47**	**0.0**	**0.1**	**0.2**	**0.7**	**1.0**	**1.4**	**1.7**	**0.002**
	W	34	1	0.40	0.38	0.0	0.0	0.2	0.2	0.5	0.9	1.5	
1,2,4-Trimethylbenzene	P	35	0	1.45	0.99	0.4	0.7	0.8	1.3	1.6	2.2	5.8	0.190
	W	34	1	1.25	0.73	0.1	0.5	0.8	1.2	1.5	2.2	4.0	
1,4-Dichlorobenzene	**P**	**35**	**0**	**0.35**	**0.29**	**0.0**	**0.2**	**0.2**	**0.2**	**0.5**	**0.6**	**1.6**	**0.011**
	W	34	1	0.23	0.15	0.0	0.0	0.2	0.2	0.2	0.4	0.7	

Table 17. Two-week fixed-site outdoor concentrations measured at Wagner's Point (W) and on Patapsco Avenue in Brooklyn (P) (µg/m^3)

Compound	Site	N	Miss	Mean	SD	Min	10th	25th	50th	75th	90th	Max	Paired test
Methylene Chloride	P	18	0	0.17	0.14	0.0	0.0	0.0	0.2	0.3	0.3	0.4	0.138
	W	18	0	0.20	0.14	0.0	0.0	0.1	0.2	0.3	0.4	0.4	
MTBE	P	18	0	5.73	2.19	2.1	2.8	3.9	5.7	7.1	9.4	9.7	**<.0001**
	W	**18**	**0**	**23.91**	**12.58**	**7.5**	**11.0**	**13.1**	**20.3**	**30.1**	**48.2**	**52.6**	
Chloroprene	P	18	0	0.02	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**<.0001**
	W	**18**	**0**	**0.04**	**0.02**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	
Chloroform	P	18	0	0.22	0.06	0.1	0.1	0.2	0.2	0.3	0.3	0.3	**0.000**
	W	**18**	**0**	**0.39**	**0.19**	**0.2**	**0.2**	**0.3**	**0.3**	**0.5**	**0.7**	**0.8**	
Carbon Tetrachloride	P	18	0	0.86	0.29	0.3	0.5	0.6	0.9	1.1	1.2	1.3	0.080
	W	18	0	1.01	0.37	0.4	0.5	0.8	1.1	1.3	1.5	1.7	
Benzene	P	18	0	2.32	1.82	0.7	0.9	1.3	1.9	2.9	3.2	8.9	**0.002**
	W	**18**	**0**	**2.96**	**2.21**	**0.9**	**1.0**	**1.9**	**2.8**	**3.0**	**3.8**	**11.2**	
Trichloroethylene	P	18	0	0.11	0.06	0.0	0.0	0.1	0.1	0.1	0.2	0.2	**0.027**
	W	**18**	**0**	**0.13**	**0.08**	**0.0**	**0.0**	**0.1**	**0.1**	**0.2**	**0.3**	**0.3**	
Toluene	P	18	0	5.03	2.23	2.0	2.3	3.2	4.9	6.2	8.1	10.8	**0.017**
	W	**18**	**0**	**6.67**	**2.56**	**1.7**	**3.2**	**5.5**	**6.7**	**8.2**	**9.4**	**13.1**	
Tetrachloroethylene	P	18	0	0.42	0.19	0.2	0.2	0.3	0.4	0.5	0.8	0.8	**0.001**
	W	**18**	**0**	**0.73**	**0.39**	**0.3**	**0.4**	**0.4**	**0.5**	**1.0**	**1.4**	**1.8**	
Ethylbenzene	P	18	0	2.02	1.24	0.8	0.9	1.2	1.6	2.4	4.5	4.8	0.337
	W	18	0	2.38	1.39	0.5	1.1	1.4	2.2	2.6	4.0	6.6	
m,p-Xylene	P	18	0	5.66	3.64	1.9	2.2	3.3	4.2	7.7	12.7	13.1	0.257
	W	18	0	7.00	4.22	1.2	3.1	5.0	6.3	7.2	11.1	20.5	
o-Xylene	P	18	0	1.52	0.72	0.7	0.7	1.0	1.4	1.7	3.0	3.2	0.230
	W	18	0	1.77	0.86	0.4	0.8	1.3	1.6	2.0	3.0	4.3	
Styrene	P	18	0	0.52	0.27	0.1	0.2	0.3	0.5	0.7	0.9	1.1	0.688
	W	18	0	0.57	0.45	0.1	0.1	0.3	0.4	0.8	1.5	1.8	
1,2,4-Trimethylbenzene	P	18	0	1.05	0.32	0.6	0.6	0.8	1.1	1.3	1.5	1.6	0.714
	W	18	0	1.07	0.37	0.4	0.5	0.8	1.2	1.3	1.5	1.8	
1,4-Dichlorobenzene	P	18	0	0.23	0.09	0.1	0.1	0.1	0.2	0.3	0.3	0.4	0.234
	W	18	0	0.19	0.09	0.1	0.1	0.1	0.2	0.3	0.3	0.3	

Table 18. One-month fixed-site outdoor concentrations measured at Wagner's Point (W) and on Patapsco Avenue in Brooklyn (P) (µg/m³)

Compound	Site	N	Miss	Mean	SD	Min	10th	25th	50th	75th	90th	Max	Paired test
Methylene Chloride	P	10	1	0.06	0.07	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.343
	W	10	1	0.04	0.10	0.0	0.0	0.0	0.0	0.0	0.2	0.3	
MTBE	P	10	1	4.89	2.91	0.4	1.5	2.8	5.4	6.2	8.8	11.0	**0.001**
	W	**10**	**1**	**18.00**	**11.12**	**4.8**	**7.6**	**10.4**	**14.9**	**23.9**	**35.9**	**42.9**	
Chloroprene	P	10	1	0.02	0.02	0.0	0.0	0.0	0.0	0.0	0.1	0.1	**0.005**
	W	**10**	**1**	**0.04**	**0.03**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	
Chloroform	P	10	1	0.18	0.11	0.0	0.1	0.1	0.2	0.3	0.3	0.4	**0.000**
	W	**10**	**1**	**0.29**	**0.14**	**0.2**	**0.2**	**0.2**	**0.2**	**0.4**	**0.5**	**0.6**	
Carbon Tetrachloride	P	10	1	0.60	0.31	0.1	0.2	0.4	0.6	0.9	1.0	1.1	0.055
	W	10	1	0.72	0.34	0.4	0.4	0.4	0.6	1.1	1.2	1.2	
Benzene	P	10	1	2.21	1.44	0.2	0.5	0.9	2.2	2.9	4.3	4.8	0.055
	W	10	1	2.54	1.53	0.7	0.9	1.2	2.4	2.7	5.1	5.7	
Trichloroethylene	P	10	1	0.12	0.08	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.229
	W	10	1	0.13	0.09	0.0	0.0	0.1	0.1	0.2	0.3	0.3	
Toluene	P	10	1	4.38	2.23	0.4	1.4	2.4	5.2	5.8	6.8	7.8	**0.027**
	W	**10**	**1**	**5.57**	**2.30**	**1.6**	**2.5**	**4.8**	**5.5**	**6.0**	**9.0**	**10.1**	
Tetrachloroethylene	P	10	1	0.40	0.21	0.1	0.2	0.3	0.4	0.6	0.7	0.7	**0.003**
	W	**10**	**1**	**0.63**	**0.32**	**0.2**	**0.3**	**0.4**	**0.6**	**0.8**	**1.1**	**1.2**	
Ethylbenzene	P	10	1	1.71	1.08	0.2	0.5	0.8	1.6	2.8	3.2	3.5	0.257
	W	10	1	1.99	1.00	0.8	0.9	1.3	1.8	2.7	3.6	3.7	
m,p-Xylene	P	10	1	4.79	3.03	0.6	1.3	2.1	4.5	7.8	8.9	9.4	0.177
	W	10	1	5.73	2.87	2.1	2.4	4.0	4.8	7.5	10.3	11.1	
o-Xylene	P	10	1	1.35	0.74	0.2	0.4	0.7	1.5	1.9	2.3	2.5	0.307
	W	10	1	1.49	0.68	0.6	0.7	1.1	1.4	2.0	2.5	2.6	
Styrene	P	10	1	0.31	0.16	0.1	0.1	0.2	0.3	0.5	0.5	0.5	0.950
	W	10	1	0.31	0.21	0.1	0.1	0.2	0.3	0.4	0.6	0.9	
1,2,4-Trimethylbenzene	P	10	1	0.98	0.53	0.1	0.3	0.6	0.8	1.5	1.7	1.8	0.429
	W	10	1	0.92	0.44	0.4	0.5	0.6	0.8	1.0	1.6	2.0	
1,4-Dichlorobenzene	**P**	**10**	**1**	**0.26**	**0.17**	**0.1**	**0.1**	**0.2**	**0.2**	**0.3**	**0.6**	**0.6**	**0.015**
	W	10	1	0.20	0.16	0.1	0.1	0.1	0.2	0.2	0.5	0.6	

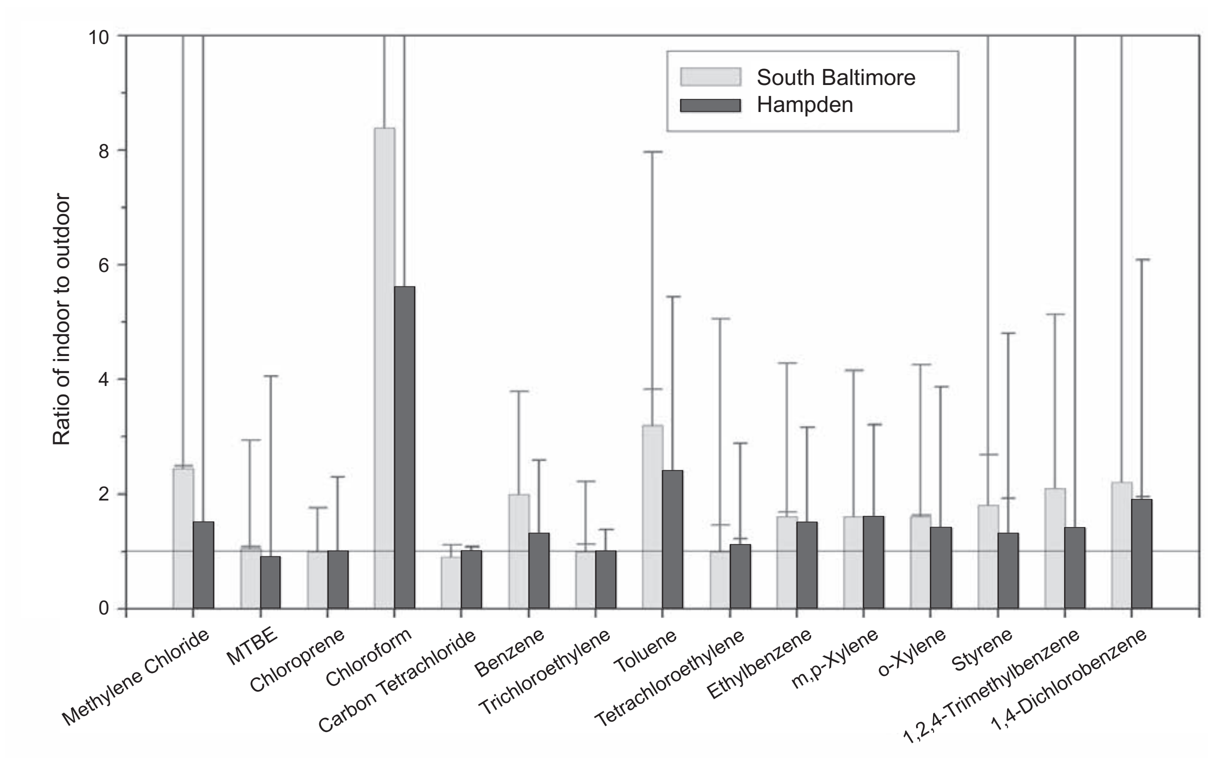

Figure 20. Distribution of VOC indoor-to-outdoor ratios within non-smoking households by community

personal exposures to VOCs were greater in South Baltimore than in Hampden for 12 of the 15 VOCs, only for tetrachloroethylene was this difference great enough to achieve statistical significance ($p \leq 0.05$).

CENTRAL SITE MONITORING

Tables 16, 17, and 18 summarize results for the outdoor central site sampling at Wagner's Point and Brooklyn for samples collected over periods of one, two and four weeks. The VOC levels in Wagner's Point and the adjacent community of Brooklyn varied in the period of sample collection, although VOC levels tended to be higher in Wagner's Point. Across all three sampling periods, the concentration of nine VOCs differed significantly in locations ($p \leq 0.05$) based on a paired t-test. In all but two of those cases (1,4-dichlorobenzene and styrene), VOC concentrations were greater at Wagner's Point. The concentration of MTBE, the one VOC measured consistently higher in all three sample categories, was three- to four-fold higher at Wagner's Point than in Brooklyn.

Figure 20 provides a comparison of indoor-to-outdoor ratios in South Baltimore and Hampden. On average, indoor-to-outdoor ratios for most of the VOCs are greater than 1.0, indicating an indoor source contribution.

Exceptions to this generalization are MTBE, chlorprene, carbon tetrachloride, trichloroethylene, and tetrachloroethane. For these compounds, mean ratios are very close to 1.0. The highest ratios were for chloroform, where indoor concentrations exceed outdoor levels by a factor that ranges from five to eight. Where mean indoor- to-outdoor ratios of VOCs were greater than 1.0, South Baltimore mean ratios exceeded the Hampden ratios. This suggests that, in general, South Baltimore had greater indoor source contributions than Hampden.

In a subset of seven homes, a parent and child were monitored over the 72-hour monitoring period. While the sample size was small, a strong association was observed between the two measures for most VOCs, suggesting similar time and location patterns of activity between the parent and child (Figure 21). For nine of the 15 VOCs (chlorprene, MTBE, chloroform, trichloroethylene, ethylbenzene, m,p- and o-xylene, trimethylbenzene and dichlorobenzene), at least 95% of the variability in the child's exposure could be explained by the parent R^2 values, which ranged from 0.63 to 0.82 for benzene, trichloroethylene, toluene, and styrene (Table 19). No apparent association or trend for carbon tetrachloride or methylene chloride was seen in the data.

TRANS, TRANS-MUCONIC ACID (MA)

Figure 22 presents a chromatogram and spectra from a standard spiked lab urine used for quality assurance purposes. The concentration was chosen to reflect concentrations commonly found in environmental exposure. The spectra presented in Figure 23 show consistency except for the final tail of the peak where some distortion is present from the subsequent peak.

Summary statistics for the measurement of MA in a subset of adults and children are reported in Table 20 and, by community, in Table 21. Consistent with the air benzene results, a nonparametric test (Wilcoxon Sum Rank test) for differences between communities was not significant ($p \leq 0.05$). The relationship between benzene exposure (24-hour TWA) and MA levels is shown in Figure 24. Regression results are given in Table 22.

Table 19. Regression analysis results comparing personal air 72-h concentration measurements on parent and child within the same home (p-values ≤ 0.05 are bold)

VOC	N	Intercept			Slope			Model	
			SE	p-value		SE	p-value	**R^2**	p-value
Benzene	7	-0.33	0.88	0.72	**0.79**	**0.16**	**0.0053**	**0.82**	**0.0053**
Carbon Tetrachloride	7	**1.06**	**0.41**	**0.05**	-0.37	0.35	0.34	0.18	0.34
Chloroprene	7	0.01	0.01	0.38	**1.01**	**0.027**	**<0.0001**	**0.99**	**<0.0001**
Chloroform	6	0.13	0.63	0.85	**0.74**	**0.08**	**0.0008**	**0.95**	**0.0008**
Dichlorobenzene	7	-1.18	0.94	0.26	**0.90**	**0.02**	**<0.0001**	**0.99**	**<0.0001**
Ethyl Benzene	7	-0.15	0.41	0.73	**0.83**	**0.05**	**<0.0001**	**0.98**	**<0.0001**
Methylene Chloride	7	0.60	0.84	0.51	0.23	0.31	0.4959	0.1	0.4959
MTBE	7	-1.76	1.69	0.35	**0.88**	**0.06**	**<0.0001**	**0.98**	**<0.0001**
Styrene	7	-0.51	0.79	0.54	**0.84**	**0.21**	**0.0094**	**0.77**	**0.0094**
Tetrachloroethylene	7	**-0.27**	**0.1**	**0.04**	**0.77**	**0.01**	**<0.0001**	**0.99**	**<0.0001**
Trichloroethylene	7	0.08	0.17	0.65	**0.62**	**0.21**	**0.032**	**0.63**	**0.032**
Trimethylbenzene	6	-0.15	0.76	0.85	**0.87**	**0.07**	**0.0002**	**0.97**	**0.0002**
Toluene	7	-0.16	8.19	0.99	**0.59**	**0.14**	**0.0093**	**0.77**	**0.0093**
m,p-Xylene	7	-1.09	1.12	0.37	**0.81**	**0.05**	**<0.0001**	**0.98**	**<0.0001**
o-Xylene	7	-0.16	0.66	0.82	**0.84**	**0.08**	**0.0002**	**0.95**	**0.0002**

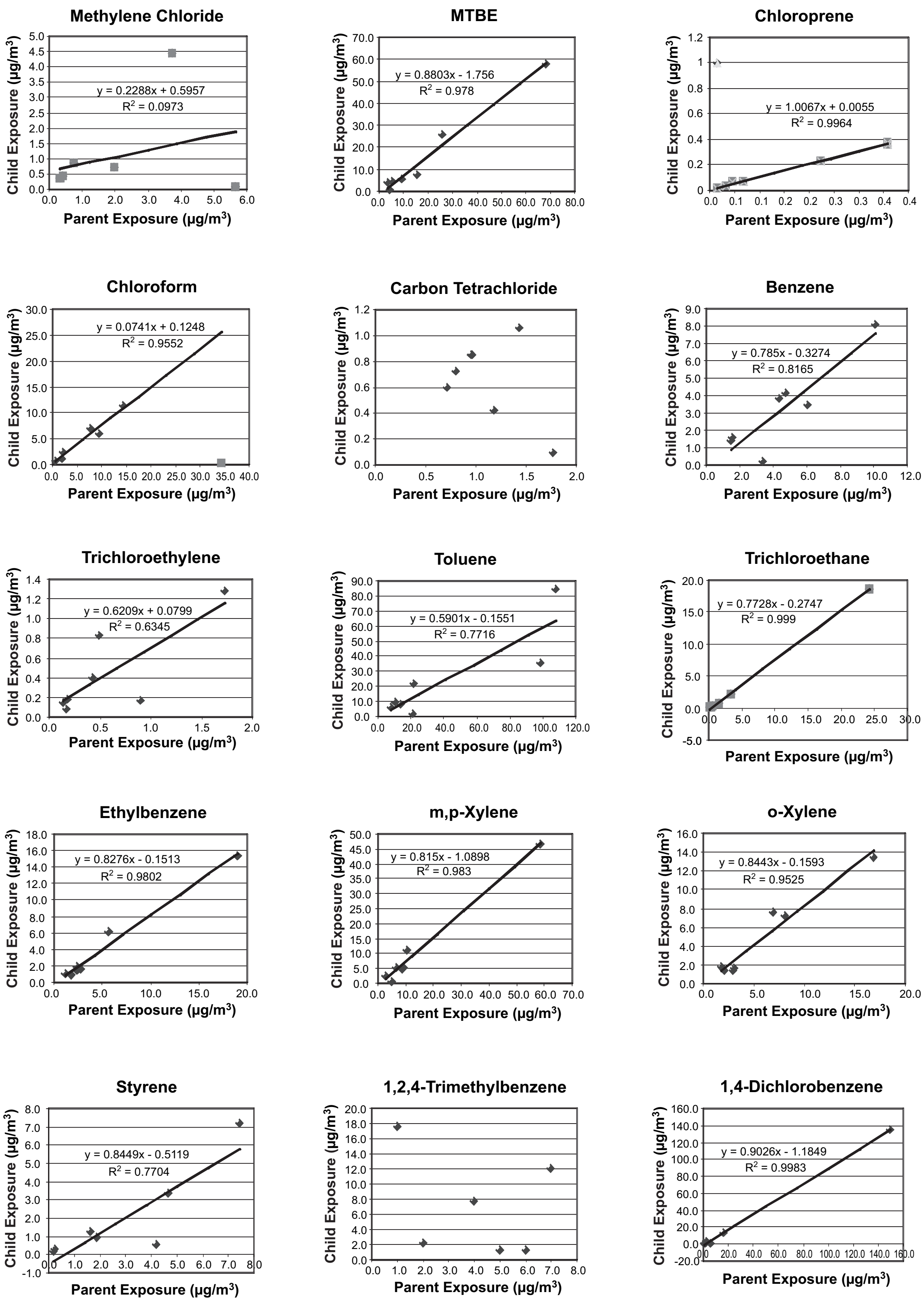

Figure 21. Scatter plots with linear regression analysis of VOCs concurrently measured (72-h) on parent and child

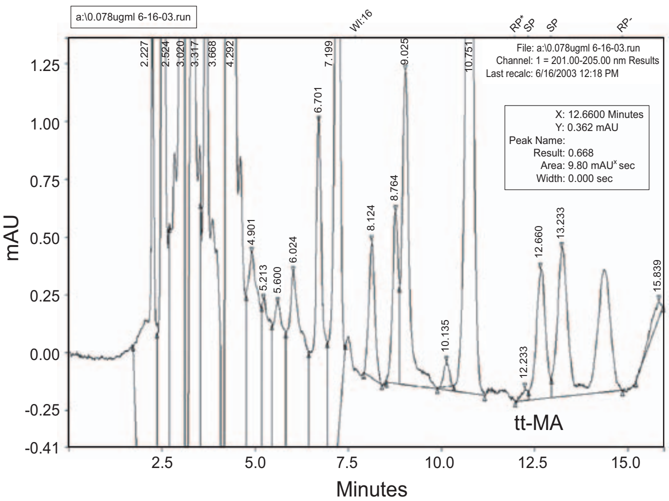

Figure 22. Chromatogram showing the separation and detection of 78 ng/mL MA on baseline of 13.2 ng/mL in urine

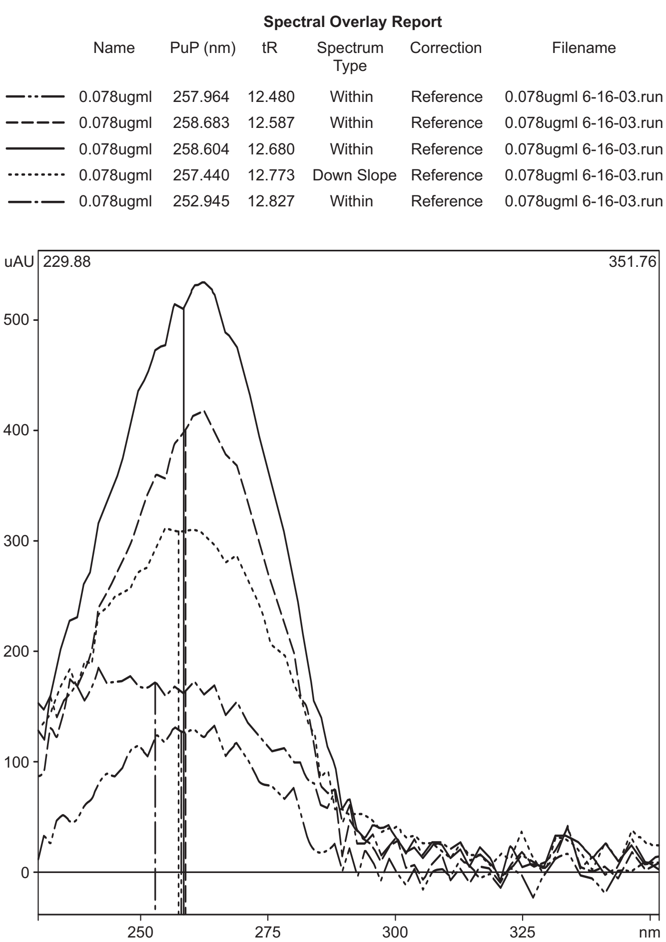

Figure 23. Photo diode array (PDA) spectra of MA providing peak confirmation

Table 20. Concentration of MA relative to 24-h air concentration levels measured in adults and children

	Adults	Children
n	40	2
Mean 24 hr Benzene (ug/m^3) (SD)	4.1 (4.2)	9.5 (5.0)
Median	2.3	9.5
Mean MA (ng/mg creatinine) (SD)	119.8 (94.4)	386.0 (172.2)
Median MA	92.9	386.0
Range	21.7, 494.4	264.2, 507.7

Table 21. MA concentration measured in South Baltimore residents relative to Hampden

	South Baltimore	Hampden
N	24	16
Mean MA (ng/mg creatinine) (SD)	115.5 (107.4)	126.2 (73.6)
Median MA	85.9	98.9

Table 22. Regression results of MA on 24-h TWA personal air benzene concentration

n	Intercept			Air Conc. Coefficient			Model	
		SE	p-value		SE	p-value	R^2	p-value
42	94	24	<0.00	8.7	3.8	0.03	0.11	0.03
39	99	18	<0.00	2.9	3.9	0.47	0.01	0.47
34	65	24	0.01	20	7.6	0.01	0.18	0.01

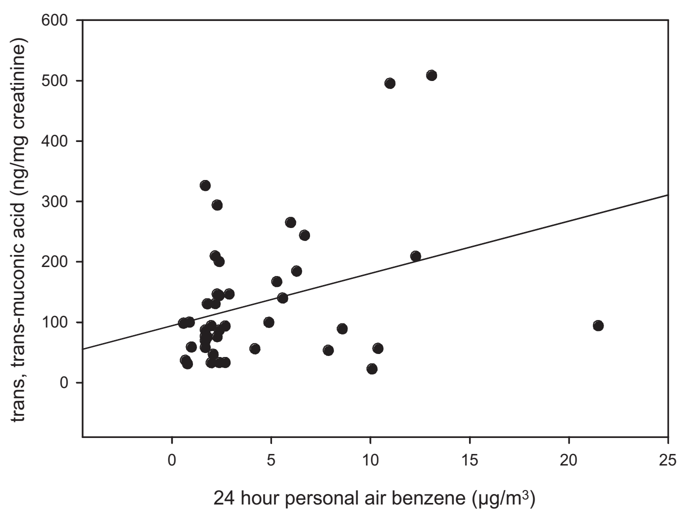

Figure 24. Comparison of urine MA concentrations to 24-h TWA personal air benzene concentration

DISCUSSION AND CONCLUSIONS

This study was designed to investigate the impact of an intense industrial region on concentrations of VOCs in outdoor, indoor, and personal environments. The effect of industry was evaluated by comparing VOCs in air levels in the heavily industrialized community to those in a community that is comparable in every other respect except

Table 23. Summary of key VOC exposure study results (all units in µg/m³)

VOC	Lower Rio Grande Valley[1] U.S. EPA 9 homes		Kanawha Valley[2] Cohen et. al. 35 homes		NHEXAS[2] Clayton et. al. 250 people			TEAM-Baltimore[3] Wallace et. al. 70 people	TEAM[1] New Jersey Wallace et. al. 350 people		German Study[4] Hoffmann et. al.	Canadian Study[5] Otson et. al.	Birmingham Study[5] Leung et. al	
	Indoor (Range)	Outdoor (Range)	Indoor	Outdoor	Indoor	Outdoor	Personal	Personal (Range)	Outdoor (Range)	Personal (Range)	Personal	Indoor	Indoor Non-Smoking Homes	Personal
Benzene	1.3 - 5.0	0.5 - 2.7	2.1	2.5	4.35	2.92	5.37	11.2 (0.11 - 129)	5.35 (0.07 - 255)	17.5 (0.02 - 260)	11	5	11.5 (2.24)	14.98 (2.33 - 283.01)
Chloroform	0.2 - 2.1	0.2 - 0.2			2.13	0.86	1.96	3.10 (0.15 - 51.0)	1.06 (0.05 - 12.2)	3.75 (0.08 - 152)		2		
Carbon Tetrachloride	0.7- 0.7	0.7 - 0.7	3.3	2.3				0.85 (0.18 - 16.1)	0.91 (0.14 - 7.06)	1.53 (0.2 - 551)				
Ethylbenzene	0.4 -2.3	0.2 - 1.6	2.7	1.1				3.90 (0.16 - 409)	3.70 (0.19 - 13.5)	7.15 (0.46 - 752)	7	8		
1,4-dichlorobenzene			1.9	0.9				2.50 (0.13 - 385)	0.95 (0.08 - 12.2)	3.78 (0.14 - 1140)				
Styrene	0.7 - 0.7	0.7 - 0.8	1.3	0.9				1.75 (0.26 - 173)	0.75 (0.07 - 3.65)	1.90 (0.08 - 3250)	2	<1		
Tetrachloroethylene	0.0 - 0.7	0.1 - 0.3	1.3	0.8	1.89	1.24	1.98	2.40 (0.19 - 280)	3.30 (0.10 - 30.3)	8.35 (0.39 - 6010)	2	3		
Trichloroethylene	0.3 -3.5	0.4 - 0.4	2.6	1.3	0.56	0.32	0.63	1.11 (0.14 - 401)	1.90 (0.13 - 9.75)	2.87 (0.24 - 701)	<1	< 1		
Toluene	1.7 - 8.1	1.1 - 6.0									69	41	21.9 (6.03)	31.8 (3.6 - 536.3)
Xylenes o,m&p	1.5 - 11.7	0.8 - 7.8	9.9	3.3				18.4 (0.42 - 1845)	14.47 (1.13 - 43.0)	25.2 (3.19 -2000)	21	26	11.28 (4.34)	11.33 (1.02 - 357.53)

[1] 24-hour TWA minimum and maximum values; [2] median values, no measures of variability given; [3] 12-hour TWA median values and (minimum and maximum values); [4] 7-day TWA; [5] 24-hour TWA

industrial presence. Therefore, a second Baltimore City urban community was selected that has similar demographics but lacks the intense industrial presence. In contrast to South Baltimore where the community is adjacent to large chemical industrial complexes, the community of Hampden is adjacent to the Johns Hopkins undergraduate campus and is not close to large chemical industrial complexes. Although the communities of Hampden and South Baltimore had comparable demographics based on the 1990 census, the 1999-2000 sampling conducted under this study showed inconsistencies primarily associated with education level. Based on 2000 census data now available, the observed differences appear to be consistent with actual changes in Hampden demographics. Although socioeconomic status has been linked to differential exposure, the impact of education by itself is unclear.

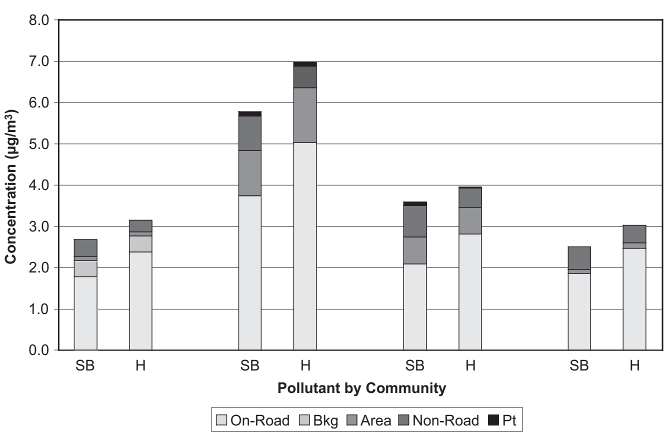

Figure 25. Average ASPEN 1996 estimates of ambient VOC concentrations primarily of mobile source origin across Hampden (H) and South Baltimore (SB) census blocks

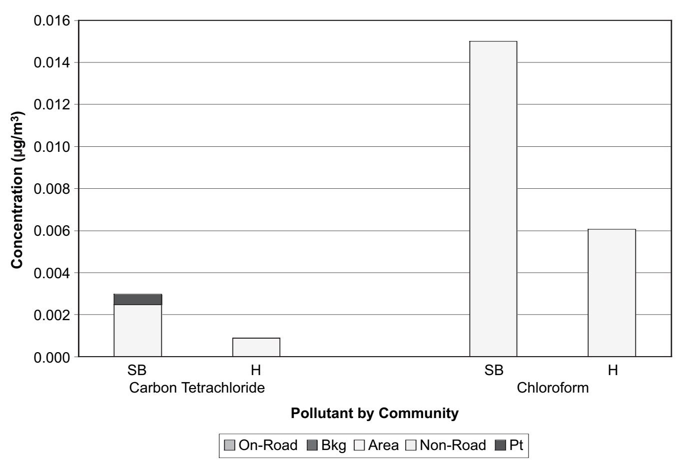

Figure 26. Average ASPEN 1996 estimates of annual ambient VOC concentration primarily of area source origin across Hampden (H) and South Baltimore (SB)

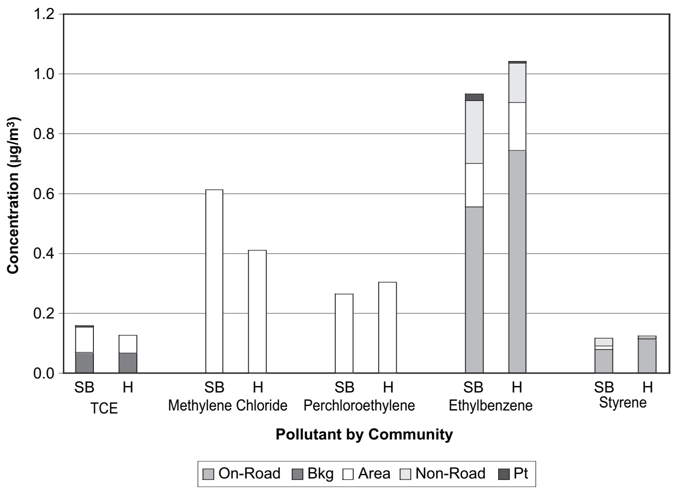

Figure 27. Average ASPEN 1996 estimates of annual ambient VOC concentration of multiple sources across Hampden (H) and South Baltimore (SB)

Results from the community-based exposure assessment indicate that both South Baltimore and Hampden residents were routinely exposed to a number of VOCs considered to be toxic air pollutants by the EPA. Findings from the current study are consistent with other VOC exposure studies with respect to both pattern and level of exposure. Table 23 shows summary results from this study and provides a comparison to other VOC exposure surveys. For example, personal exposures in South Baltimore are comparable to exposures observed in the National Human Exposure Assessment Survey (NHEXAS), a large population-based exposure study covering six Midwestern states (Clayton et al). Because smokers are included in the NHEXAS survey, comparisons between the two studies need to be made cautiously. The pattern of measured environmental concentrations is consistent with what has been previously reported, namely that for consumer-product-related VOCs, personal concentrations are greater than indoor concentrations which, in turn, are greater than outdoor concentrations. Those VOCs related solely to outdoor sources (such as carbon tetrachloride) were similarly distributed across personal, indoor, and outdoor measurements.

Measurement results from the current study are compared to annual average ambient estimates and source contributions from the Assessment System for Population Exposure Nationwide (ASPEN) for the year 1996. Figures 25, 26, and 27 show the annual ambient VOC concentrations and source contributions estimated from ASPEN for the same South Baltimore and Hampden census blocks that constitute the sampling frame of this study. Figure 25 indicates that ASPEN estimates of mobile-source-related VOC concentrations, including benzene, toluene, xylenes, and MTBE for Hampden, are higher than for South Baltimore. This is largely due to on-road mobile sources. This figure further illustrates the very small point source contribution for these pollutants. In contrast to mobile-source-related VOCs that dominate in Hampden, ASPEN indicates that those VOCs that predominate in South Baltimore come primarily from area sources (Figure 26). This includes chloroform and carbon tetrachloride. As with other mobile-source-dominated VOCs shown in Figure 21, ASPEN estimates that ethylbenzene and styrene are both higher in Hampden than in South Baltimore. The area source pollutants TCE and methylene chloride are both estimated to be higher in South Baltimore. The opposite is estimated for perchlorethylene, with higher concentrations in Hampden than in South Baltimore (Figure 27). Payne-Sturges and coworkers (2004) provide additional analysis comparing the 1996 ASPEN model estimates of indoor, outdoor, and personal measurements from this study. They also consider the risk assessment implications suggested by their estimated differences. It is difficult and complex to discern the industry contribution to community VOC exposure because those VOCs measured in this study originate from multiple source categories. These categories include many consumer products, cigarette smoke, and automobiles. When the contribution of industrial sources is small relative to other sources, a very large sample size may be required to detect relatively small differences. While the absence of a significant difference between concentration measurements in the two communities may be because no difference exists, it may alternatively be because the sample size was not large enough to detect differences. To examine this question, using the actual observed variation in measurements, sample size has been plotted against the difference to be detected with a probability of type I and type II error of 0.05 and 0.80, respectively (Rosner, 1995). Analytic results for outdoor, indoor, and personal measurements are presented in Figure 28. The analysis indicates that a relatively large sample size is required to detect the relatively subtle differences in exposure that result from point source industrial emissions. Therefore, it is not possible to conclude from this study that there was not an effect on community air pollution from industry, but rather that the effect was too small to be detected given the sample size constraints.

Overall, the MA levels measured in the South Baltimore and Hampden communities were consistent with their associated environmental benzene exposures. Few elevated MA outliers were present, suggesting that dietary restrictions to avoid ingestion of sorbate preservatives may

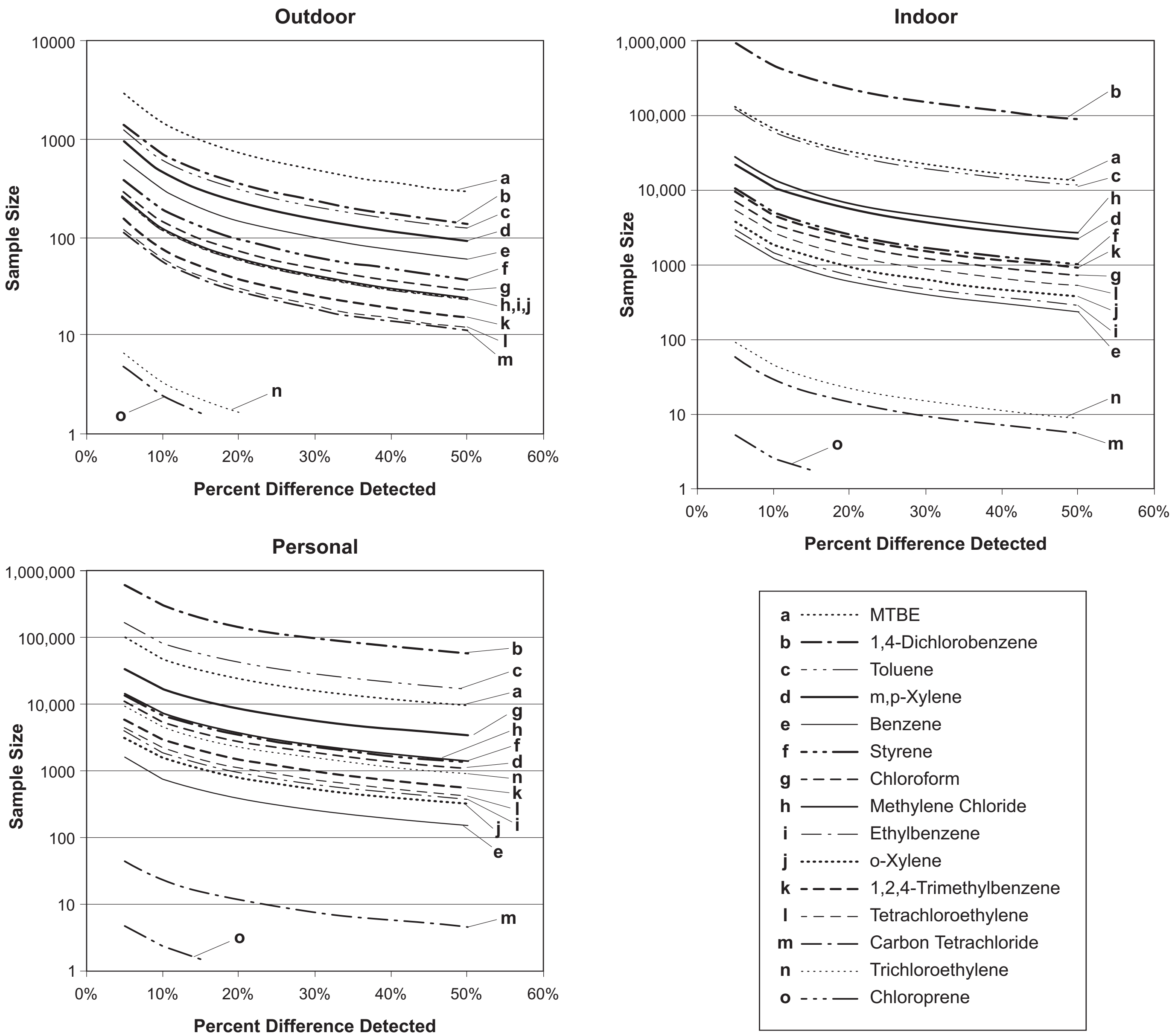

Figure 28. Sample size needed in order to detect differences between exposed populations based on measured variance

have been successful. Furthermore, the association between 24-hour personal air samples for benzene and MA also suggests that dietary restriction may increase the specificity of MA as a biomarker for environmental level benzene. However, the positive results reported here need to be interpreted cautiously because of the small sample size and influential outliers. Further study will be needed to rule out residual confounding from sorbate preservatives or chance as explanatory factors for this association.

This study was conducted in cooperation with South Baltimore community residents to address concerns about the impact of nearby industry on exposure to toxic air pollutants and possible health risks resulting from exposure. Outdoor, indoor, and personal VOC concentrations in an urban non-industry-impacted Baltimore location served as a comparison community. Residential outdoor measurements should provide the most sensitive indications of an industry effect. Only two VOCs (ethylbenzene and m-p-xylene) were measured at statistically significant higher concentrations in South Baltimore than in the community of Hampden. The 1999 toxic release inventory (U.S. EPA, Toxic Release Inventory) reports releases for both chemicals in South Baltimore and none in Hampden. For both analytes, the elevated outdoor concentrations translated into statistically significant different indoor concentrations among sampled community residents. Corresponding elevations in indoor and personal levels would indicate that elevated outdoor concentrations increase indoor and personal exposures. Therefore, an industry impact on community exposure could be inferred for a VOC with elevated outdoor, indoor, and personal exposure concentrations. The indoor difference did not translate, however, into a statistically significant difference in personal exposure. Therefore, these data suggest an industry impact on outdoor and indoor ethylbenzene and m,p-xylene exposures. Because of the large variability in personal exposure measurements, it may be that there was insufficient power to detect this difference. These results need to be interpreted in light of limitations in the study, including a low response rate (37%) and potentially important differences in education between the South Baltimore and Hampden samples.

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ABBREVIATIONS

µg	Microgram
µL	Microliter
µm	Micrometer
ANOVA	Analysis of variance
ASPEN	Assessment System for Population Exposure Nationwide
CAAA	Clean Air Act Amendments of 1990
CI	Confidence interval
CV	Coefficient of variance
EPA	U. S. Environmental Protection Agency
ETS	Environmental tobacco smoke
GC/MS	Gas chromatography/mass spectrometry
HAP	Hazardous air pollutant
HPLC	High pressure liquid chromatography
ID	Inner diameter
JHU	Johns Hopkins University
LOD	Limit of detection
m	Meter
m^3	Cubic meter
mL	Milliliter
MA	Trans,trans-muconic acid
min	Minutes
mm	Millimeter
MTBE	Methyl tertiary butyl ether
NHEXAS	National Human Exposure Assessment Survey
OR	Odds ratio
OSHA	U.S. Occupational Safety and Health Administration
OVM	Organic vapor monitor
PCB	Polychlorinated biphenyl
ppb	Parts per billion
psi	Pounds per square inch
S-PMA	S-phenyl mercapturic acid
TEAM	Total exposure assessment methodology
TRI	Toxic release inventory
TWA	Time weighted average
UTH	University of Texas at Houston
UV	Ultraviolet light
VOC	Volatile organic compound

ABOUT THE AUTHORS

Dr. Timothy J. Buckley is an Associate Professor of Environmental Health Sciences and Epidemiology at the Johns Hopkins Bloomberg School of Public Health. Dr. Buckley joined the Hopkins faculty in 1996 after five years with the U.S. EPA's National Exposure Research Lab. His research has focused on assessing total human environmental exposure through measurements in multiple environmental media and biomarkers. Dr. Buckley has been responsible for the concept, design, implementation, and management of several major studies involving human exposure to PAHs, metals, VOCs, pesticides, and PCBs through multiple environmental media. These large-scale projects complement laboratory-based studies where controlled exposures are used to more fully investigate relationships between exposure, body burden, and effects. Dr. Buckley's current research includes community-based exposure assessment, evaluation of chemical treatment to reduce lead bioavailability, the role of exposure to indoor air pollution, allergens in asthma among inner-city children, exposure and effects from mobile-source-related air pollution, improvement of methods to assess dermal exposure, and the development and evaluation of biomarkers of exposure. While with the U.S. EPA, Dr. Buckley received awards for his role and efforts in the National Human Exposure Assessment Survey (NHEXAS) and the Lower Rio Grande Environmental Exposure Study. His published research was recognized in 1996 with a U.S. EPA Scientific and Technology Achievement Award and again in 1999 by the Walter G. Berl Award given the Johns Hopkins Applied Physics Laboratory. Dr. Buckley is a certified industrial hygienist and has been elected to leadership positions among his professional associations, including chair of the American Industrial Hygiene Association's Biological Monitoring Committee and Academic Counselor of the International Society of Exposure Analysis. Dr. Buckley received his Ph.D. in Environmental Science from Rutgers University and a Masters of Health Science in Industrial Hygiene from the Johns Hopkins Bloomberg School of Public Health.

Dr. Virginia Weaver is assistant professor in the Department of Environmental Health Sciences at the Johns Hopkins Bloomberg School of Public Health. Her research interests include the use of molecular epidemiologic tools in the evaluation of populations exposed to occupational and environmental chemicals. The validation of exposure and early biological effect markers to improve risk assessment and medical surveillance is a primary focus of her research. Specific research interests include benzene and renal toxicants. Dr. Weaver seeks to include children in her studies in order to provide data on this potentially susceptible group. Current projects utilize biomarkers for benzene exposure in urban populations and renal effect biomarkers in lead-exposed workers. Medical surveillance of former Department of Energy Workers at Los Alamos National Laboratory is an additional project.

Dr. Devon Payne-Sturges is currently working as an environmental scientist for the U.S. EPA's Office of Policy, Economics and Innovation. She was formerly the Assistant Commissioner for Environmental Health for the Baltimore City Health Department. Dr. Payne-Sturges' DrPH dissertation focused on comparing measured and modeled estimates of exposure and risk.

Sung Roul Kim is a doctoral candidate within the Department of Environmental Health Sciences at the Johns Hopkins Bloomberg School of Public Health. Mr. Kim has a Masters of Science from Yeungnam University's Department of Environmental Engineering in Korea.

APPENDIX A

JHSPH / TXSPH Inter-laboratory Comparison Study Protocol

Appendix A. JHSPH / TXSPH inter-laboratory comparison study protocol

JHSPH / TXSPH Inter-laboratory Comparison Study Protocol

1. Extraction Efficiency and Precision

The UTSPH and JHSPH laboratories will each spike two sets of six 3M OVM 3500 badges in triplicate (n total = 72). Each laboratory will generate their own set of spiked samples (n=36). One set of spikes (n=18) will be retained by the spiking laboratory and the second set will be shipped to the other laboratory. The level of spikes will be identical (0, 0.1, 0.5, 1.0, 5.0, and 10.0 µg) but the spiking procedure will vary slightly (UTSPH uses a 50 µl spike while JHSPH uses 5 µl spike). Therefore, each laboratory will be analyzing their own spikes (n=18) plus a set from the other laboratory (n=18) for a total of 36 samples. Each set of 36 spiked samples will be accompanied by four field blanks (opened and closed at the time of spiking) plus two laboratory blanks (unopened). These blank samples will be evenly split between the two laboratories so that each lab will analyze one lab blank and two field blanks.

Sample Type	No. Samples	
	JHSPH	UTSPH
JHSPH Spikes (6 levels in triplicate)	18	18
UofTX Spikes (6 levels in triplicate)	18	18
Field Blanks	4	4
Lab Blanks	2	2
Total	42	42

2. Inter-laboratory Comparison

Side-by-side sampling will be conducted at a indoor and outdoor location in a JHSPH study home in order to investigate inter-laboratory variability in the extraction and analysis of 3M OVM badge samples. Four badges will be placed at each location for the standard sampling period of 3 days. Two badges will be analyzed by each laboratory for each location. In addition, two field blanks and one laboratory blank will be collected for each site so that each laboratory will have two field blanks and one laboratory blank.

Sample Type	No. Samples	
	JHSPH	UTSPH
Side-by-Side Indoor	2	2
Side-by-Side Outdoor	2	2
Field Blank (indoor and Outd)	2	2
Lab Blank	1	1
Total	7	7

Scheduling and shipping

Badge spiking, shipping, extraction, and analysis will be coordinated to occur at the same time in each laboratory. Samples will be shipped by FedEx Airborne overnight delivery in a hard plastic cooler with blue ice (kept at -20° C.).

Monday 18 September	Badges Spiked
Tuesday 19 September	Badges Shipped
Wednesday 20 September	Badges Received, Extracted and Analyzed
Thursday 21 September	Analysis Complete

APPENDIX B

Study Subject Demographics and Physical Characteristics

Table B. Study subject demographics and physical characteristics

Community	Subject ID	A/C	Sex	Age (y)	BMI (kg/m^2)	Race	Education	HH Income
Hampden	H-001	Adult	Male	37	26.9	AA	HS	$10,000 to 19,000
Hampden	H-002	Adult	Female	38	27.8	W/C	C+	$50,000 to 74,999
Hampden	H-003	Adult	Female	52	21.3	W/C	C+	$75,000 to 99,999
Hampden	H-004	Adult	Female	43	28.7	Hispanic	HS+	$20,000 to $29,999
Hampden	H-005	Adult	Female	32	21.7	Asian	C	$40,000 to 49,999
Hampden	H-006	Adult	Female	28	20.9	W/C	C+	$50,000 to 74,999
Hampden	H-007	Adult	Female	59	21.5	W/C	P/MS	refused
Hampden	H-008	Adult	Female	60	28.1	W/C	C+	$50,000 to 74,999
Hampden	H-009	Adult	Female	33	23.4	W/C	C+	$50,000 to 74,999
Hampden	H-010	Adult	Female	NA	33.1	W/C	C+	$40,000 to 49,999
Hampden	H-011	Adult	Male	73	24.7	W/C	C+	$50,000 to 74,999
Hampden	H-012	Adult	Male	41	22.4	W/C	C+	refused
Hampden	H-013	Adult	Male	48	NA	W/C	HS	$50,000 to 74,999
Hampden	H-014	Adult	Male	29	30.9	W/C	C	$40,000 to 49,999
Hampden	H-015	Adult	Male	NA	23.1	W/C	C+	$30,000 to 39,999
Hampden	H-016	Adult	Male	69	28.9	W/C	P/MS	refused
Hampden	H-017	Adult	Male	87	22.5	AA	NA	Less than $9,999
Hampden	H-018	Adult	Female	25	18.5	W/C	C	$10,000 to 19,999
Hampden	H-019	Adult	Male	27	24.2	W/C	HS+	$30,000 to 39,999
Hampden	H-020	Adult	Male	35	24.8	W/C	C+	$30,000 to 39,999
Hampden	H-021	Adult	Female	28	24.2	W/C	C+	$10,000 to 19,999
Hampden	H-022	Adult	Female	47	21.3	W/C	HS	Less than $9,999
SB	SB-001	Adult	Male	48	23.6	W/C	HS	Less than $9,999
SB	SB-002	Adult	Male	18	28.7	Asian	HS	$50,000 to 74,999
SB	SB-003	Adult	Male	39	27.0	W/C	HS	$75,000 to 99,999
SB	SB-004	Adult	Female	75	31.6	W/C	P/MS+	$10,000 to 19,000
SB	SB-005	Adult	Female	29	27.3	W/C	HS+	$50,000 to 74,999
SB	SB-006	Adult	Female	44	31.0	W/C	HS	$30,000 to 39,000
SB	SB-007	Adult	Female	57	23.4	W/C	HS	$10,000 to 19,000
SB	SB-008	Adult	Female	24	20.5	W/C	P/MS	refused
SB	SB-009	Adult	Male	73	23.3	W/C	P/MS+	$20,000 to $29,000
SB	SB-010	Adult	Male	42	35.9	W/C	HS+	$30,000 to 39,000
SB	SB-011	Adult	Female	34	50.1	AA	P/MS+	$30,000 to 39,000
SB	SB-012	Adult	Female	53	24.3	W/C	C+	refused
SB	SB-013	Adult	Female	75	34.3	W/C	HS	$20,000 to $29,000
SB	SB-014	Adult	Female	62	32.3	W/C	HS+	$10,000 to 19,000
SB	SB-015	Adult	Male	67	27.0	W/C	HS+	$75,000 to 99,999
SB	SB-016	Adult	Female	27	21.1	AA	C	$40,000 to 49,000
SB	SB-017	Adult	Female	64	25.0	W/C	HS+	$30,000 to 39,999
SB	SB-018	Adult	Male	75	24.1	AA	P/MS	Less than $9,999
SB	SB-019	Adult	Female	78	33.5	W/C	HS	refused
SB	SB-021	Adult	Female	71	31.6	W/C	P/MS	$20,000 to $29,999
SB	SB-025	Adult	Female	38	28.2	W/C	HS+	$50,000 to 74,999
SB	SB-026	Adult	Female	19	23.4	W/C	HS+	$100,000 or more
SB	SB-028	Adult	Male	59	25.8	W/C	HS	$20,000 to $29,999
SB	SB-029	Adult	Female	31	22.6	W/C	C	$20,000 to $29,999
SB	SB-031	Adult	Female	59	28.3	W/C	HS	$30,000 to 39,999
SB	SB-032	Adult	Male	67	31.6	W/C	P/MS+	$10,000 to 19,999
SB	SB-035	Adult	Female	54	26.5	W/C	HS	$30,000 to 39,999
SB	SB-036	Adult	Female	53	32.3	W/C	HS	refused
SB	SB-038	Adult	Female	43	26.2	W/C	C+	Don't know
SB	SB-039	Adult	Male	42	26.6	W/C	HS	$50,000 to 74,999
SB	SB-040	Adult	Female	53	37.9	W/C	HS	refused
SB	SB-042	Adult	Male	60	29.0	W/C	P/MS	$20,000 to $29,999

Table B. (continued)

Community	Subject ID	A/C	Sex	Age (y)	BMI (kg/m^2)	Race	Education	HH Income
SB	SB-043	Adult	Female	54	33.7	W/C	HS	refused
SB	SB-044	Adult	Female	69	41.1	AA	P/MS+	Don't know
SB	SB-045	Adult	Female	39	25.4	W/C	HS+	$50,000 to 74,999
SB	SB-046	Adult	Female	28	16.8	W/C	P/MS+	$20,000 to $29,999
SB	SB-047	Adult	Female	58	26.1	Hispanic	P/MS	$20,000 to $29,999
SB	SB-004R	Adult-R	Female	76	31.7	W/C	P/MS+	$10,000 to 19,999
SB	SB-005R	Adult-R	Female	30	26.9	W/C	HS+	$50,000 to 74,999
SB	SB-006R	Adult-R	Female	45	33.4	W/C	HS	$40,000 to 49,999
SB	SB-007R	Adult-R	Female	58	23.3	W/C	HS	Less than $9,999
SB	SB-009R	Adult-R	Male	73	22.6	W/C	P/MS+	$20,000 to $29,000
SB	SB-010R	Adult-R	Male	43	34.2	W/C	HS	$30,000 to 39,999
SB	SB-012R	Adult-R	Female	52	24.2	W/C	C	refused
SB	SB-014R	Adult-R	Female	62	32.3	W/C	HS+	$10,000 to 19,999
SB	SB-017R	Adult-R	Female	65	24.8	W/C	HS+	$50,000 to 74,999
SB	SB-025R	Adult-R	Female	39	24.7	W/C	HS+	$50,000 to 74,999
SB	SB-005C	Child	Male	8	4.9	W/C	4	NA
SB	SB-006C	Child	Male	6	6.4	W/C	kindergarten	NA
SB	SB-008C	Child	Female	8	3.4	W/C	3	NA
SB	SB-011C	Child	Male	9	3.8	AA	4	NA
SB	SB-016C	Child	Female	8	3.9	AA	3	NA
SB	SB-029C	Child	Male	10	4.3	W/C	4	NA
SB	SB-044C	Child	Male	12	4.5	AA	6	NA
SB	SB-045C	Child	Male	12	4.7	W/C	6	NA
SB	PILOT01	Adult	Female	74	31.6	W/C	P/MS	$30,000 to 39,999
SB	PILOT02	Adult	Male	51	19.6	W/C	C	$10,000 to 19,999
SB	PILOT03	Adult	Male	50	33.0	W/C	HS+	$50,000 to 74,000
SB	PILOT03C	Child	Male	7	6.1	W/C	1	NA

APPENDIX C

Personal, Indoor, and Outdoor Air Monitoring Results

Table C. Personal, indoor, and outdoor air monitoring results

Concentration ($\mu g/m^3$) : <LOD = 0.5MDL					Methylene Chloride					
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	0.8	1.0	.	0.6	.	0.8	.		.
2	H-002	6.3	5.5	.	0.3	.	3.5	.	.	.
3	H-003	0.3	0.3	.	0.3	.	0.3	.	.	.
4	H-004	0.3	0.3	.	0.3	.	0.3	.	0.3	.
5	H-005	1.6	1.4	.	0.4	.	1.7	.	.	.
6	H-006	0.3	0.3	.	0.9	.	0.8	1.0	.	.
7	H-007	3.9	3.7	.	1.4	.	2.2	2.4	.	.
8	H-008	0.5	0.6	0.5	0.3	.	1.1	1.7	.	.
9	H-009	1.3	1.8	0.5	1.4	.	2.4	1.5	.	.
10	H-010	1.0	NA	0.3	0.5	.	2.0	4.4	.	.
11	H-011	6.0	5.6	1.5	5.7	.	1.6	NA	.	.
12	H-012	2.3	1.5	0.5	0.6	.	2.2	2.6	.	.
13	H-013	7.7	6.2	3.6	0.3	.	6.2	11.2	.	.
14	H-014	0.5	0.7	0.6	0.5	.	0.8	0.4	.	.
15	H-015	4.1	4.4	4.6	1.2	.	2.9	3.7	.	.
16	H-016	0.5	0.5	7.1	0.3	.	1.2	0.4	.	.
17	H-017	54.1	46.6	33.7	1.4	.	39.4	73.6	.	.
18	H-018	0.7	0.6	0.1	0.6	.	1.7	2.3	.	.
19	H-019	0.4	0.9	0.4	0.4	.	0.9	1.2	.	.
20	H-020	0.4	0.4	0.4	0.4	.	0.4	1.3	.	.
21	H-021	0.4	NA	.	0.4	.	0.4	1.6	.	.
22	H-022	0.4	0.4	.	NA	0.7	0.4	1.2	.	.
1	SB-001	0.1	0.1	.	0.1	.	0.1	.	.	.
2	SB-002	0.1	0.1	.	0.1	.	0.1	.	.	.
3	SB-003	1.8	2.0	.	0.1	.	0.0	.	.	.
4	SB-008	0.7	0.6	.	0.2	.	0.8	.	0.9	.
5	SB-011	7.1	7.0	.	0.1	.	5.7	.	0.1	.
6	SB-013	.	0.1	.	0.1	.	0.1	.		.
7	SB-015	0.3	0.3	.	0.3	.	0.3	.	.	.
8	SB-016	0.3	.	.	0.3	0.3	0.3	.	0.3	.
9	SB-018	0.1	0.1	.	0.1	.	2.0	.		.
10	SB-019	9.0	0.3	.	0.3	0.3	.	.	.	.
11	SB-007R	0.9	0.7	.	0.6	.	1.8	.	.	.
12	SB-021	3.0	.	.	0.5	0.5	2.3	.	.	.
13	SB-009R	28.2	32.4	.	0.6	.	23.8	21.6	.	.
14	SB-014R	5.2	4.9	2.5	1.2	.	5.6	2.5	.	.
15	SB-004R	1.9	1.7	0.3	1.2	.	2.0	2.3	.	.
16	SB-025	11.5	12.0	3.6	1.7	.	7.1	9.8	.	.
17	SB-026	.	11.3	4.8	1.2	.	.	21.8	.	.
18	SB-017R	1.1	2.4	0.3	NA	.	1.3	1.9	.	.
19	SB-028	1.1	0.9	0.6	0.5	.	0.5	1.1	.	.
20	SB-029	2.2	2.1	1.0	0.4	.	2.0	.	0.7	.
21	SB-006R	0.3	0.3	0.2	0.1	.	0.3	0.4	.	.
22	SB-031	2.5	2.6	1.4	0.8	.	1.7	3.1	.	.
23	SB-032	0.1	1.8	0.7	0.1	.	0.8	0.5	.	.
24	SB-010R	1.0	1.1	NA	0.9	.	0.8	NA	.	.
25	SB-0045R	1.2	1.2	1.0	0.7	.	1.6	2.5	.	.
26	SB-035	7.8	8.0	0.1	0.6	.	3.5	2.1	.	.
27	SB-036	0.1	0.5	0.1	0.1	.	0.7	1.5	.	.
28	SB-038	0.4	0.4	0.4	0.4	.	1.2	1.3	.	.
29	SB-039	0.4	0.4	0.4	0.4	.	4.1	5.3	.	.
30	SB-040	1.2	1.3	0.9	0.4	.	0.4	6.0	.	.
31	SB-012R	0.4	0.4	4.1	0.4	.	0.4	1.2	.	.
32	SB-042	1.7	1.6	1.6	0.4	.	1.7	0.4	.	.
33	SB-043	1.4	1.4	.	0.4	.	0.9	1.2	.	.
34	SB-044	0.4	0.4	.	0.4	.	0.4	1.5	0.4	1.0
35	SB-045	5.4	5.3	.	0.4	.	3.8	6.9	4.4	8.7
36	SB-046	0.4	0.4	.	0.4	.	0.4	1.3	.	.
37	SB-047	0.4	0.4	.	0.4	.	2.3	4.4	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL					MTBE					
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	1.9	4.6	.	3.4	.	5.8	.		.
2	H-002	2.0	1.4	.	1.3	.	3.3	.	.	.
3	H-003	6.7	6.5	.	7.4	.	10.1	.	.	.
4	H-004	5.5	4.0	.	6.1	.	5.5	.	4.3	.
5	H-005	4.1	3.4	.	7.1	.	7.9	.	.	.
6	H-006	5.6	5.7	.	6.1	.	7.0	0.9	.	.
7	H-007	61.0	54.5	.	7.4	.	40.2	32.2	.	.
8	H-008	3.8	3.8	4.0	4.7	.	5.0	4.5	.	.
9	H-009	7.5	8.9	4.9	9.6	.	8.7	8.1	.	.
10	H-010	4.6	NA	2.1	3.0	.	5.7	6.4	.	.
11	H-011	8.1	7.4	2.6	17.9	.	2.9	NA	.	.
12	H-012	4.3	2.4	1.1	2.3	.	7.2	7.1	.	.
13	H-013	4.0	2.8	2.1	3.8	.	3.2	3.7	.	.
14	H-014	2.5	3.3	3.3	4.2	.	3.5	1.5	.	.
15	H-015	2.1	2.6	2.5	4.4	.	5.4	6.3	.	.
16	H-016	4.3	4.0	3.2	4.2	.	5.0	1.7	.	.
17	H-017	90.0	71.3	64.4	5.4	.	67.1	116.6	.	.
18	H-018	4.5	3.7	4.6	5.5	.	5.1	4.8	.	.
19	H-019	5.3	5.9	2.9	5.3	.	10.8	3.1	.	.
20	H-020	4.6	4.0	5.3	3.8	.	7.7	6.1	.	.
21	H-021	1.9	NA	.	3.4	.	3.3	4.3	.	.
22	H-022	4.9	3.8	.	NA	4.6	3.6	6.0	.	.
1	SB-001	6.1	5.7	.	1.9	.	4.7	.	.	.
2	SB-002	5.2	7.9	.	3.7	.	9.4	.	.	.
3	SB-003	0.7	0.6	.	1.1	.	54.1	.	.	.
4	SB-008	4.1	3.1	.	4.1	.	3.7	.	4.1	.
5	SB-011	3.7	5.6	.	3.3	.	4.5	.	0.5	.
6	SB-013	.	1.1	.	2.3	.	1.6	.		.
7	SB-015	4.7	3.1	.	5.3	.	15.1	.	.	.
8	SB-016	9.0	.	.	6.4	5.5	26.0	.	25.6	.
9	SB-018	4.9	3.7	.	5.1	.	5.5	.		.
10	SB-019	0.3	0.3	.	0.3	0.3	.	.	.	.
11	SB-007R	6.2	5.8	.	8.6	.	7.2	.	.	.
12	SB-021	81.7	.	.	6.9	6.0	66.6	.	.	.
13	SB-009R	20.3	23.0	.	2.7	.	17.6	13.4	.	.
14	SB-014R	4.6	3.6	3.4	4.3	.	4.4	2.5	.	.
15	SB-004R	5.8	5.6	3.7	7.2	.	6.9	6.3	.	.
16	SB-025	23.3	25.5	25.4	10.4	.	23.1	16.3	.	.
17	SB-026	.	5.0	2.0	4.9	.	.	5.1	.	.
18	SB-017R	5.6	10.8	2.1	NA	.	7.1	7.2	.	.
19	SB-028	4.7	3.7	3.8	5.2	.	8.8	2.6	.	.
20	SB-029	9.2	9.0	6.8	4.3	.	9.6	.	5.4	.
21	SB-006R	4.6	4.6	4.1	1.3	.	4.2	2.8	.	.
22	SB-031	2.5	2.4	2.0	4.0	.	3.9	4.3	.	.
23	SB-032	12.6	12.1	7.7	4.4	.	7.2	9.0	.	.
24	SB-010R	5.9	7.0	NA	6.5	.	6.3	NA	.	.
25	SB-0045R	23.0	22.9	23.6	7.4	.	23.2	18.2	.	.
26	SB-035	3.6	3.6	0.6	5.2	.	3.8	1.9	.	.
27	SB-036	3.4	5.1	3.8	3.8	.	60.4	178.8	.	.
28	SB-038	5.0	5.0	5.0	5.4	.	6.2	4.9	.	.
29	SB-039	6.0	5.4	5.6	6.6	.	13.2	8.2	.	.
30	SB-040	9.0	9.3	10.3	4.5	.	1.3	30.9	.	.
31	SB-012R	4.8	5.6	4.8	5.8	.	5.2	30.5	.	.
32	SB-042	3.7	3.4	4.4	4.2	.	5.0	1.6	.	.
33	SB-043	2.9	2.9	.	1.8	.	3.1	1.5	.	.
34	SB-044	11.3	10.9	.	9.1	.	15.6	39.8	7.3	10.4
35	SB-045	71.2	73.3	.	10.4	.	68.3	66.4	57.8	80.7
36	SB-046	129.5	134.5	.	9.7	.	59.8	49.8	.	.
37	SB-047	5.1	4.2	.	4.4	.	12.9	22.4	.	.

Table C. (continued)

Concentration ($\mu g/m^3$) : <LOD = 0.5MDL					Chloroprene					
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	0.4	0.4	.	0.4	.	0.4	.		.
2	H-002	0.0	0.0	.	0.0	.	0.0	.	.	.
3	H-003	0.0	0.0	.	0.0	.	0.0	.	.	.
4	H-004	0.0	0.0	.	0.0	.	0.0	.	0.0	.
5	H-005	0.0	0.0	.	0.0	.	0.0	.	.	.
6	H-006	0.0	0.1	.	0.0	.	0.1	0.0	.	.
7	H-007	0.3	0.2	.	0.1	.	0.1	0.2	.	.
8	H-008	0.1	0.1	0.2	0.1	.	0.1	0.2	.	.
9	H-009	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
10	H-010	0.1	NA	0.1	0.1	.	0.1	0.2	.	.
11	H-011	0.1	0.1	0.2	0.2	.	0.1	NA	.	.
12	H-012	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
13	H-013	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
14	H-014	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
15	H-015	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
16	H-016	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
17	H-017	0.2	0.1	0.1	0.0	.	0.1	0.1	.	.
18	H-018	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
19	H-019	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
20	H-020	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
21	H-021	0.0	NA	.	0.0	.	0.0	0.1	.	.
22	H-022	0.0	0.0	.	NA	0.1	0.0	0.1	.	.
1	SB-001	0.4	0.4	.	0.4	.	0.4	.	.	.
2	SB-002	0.4	0.4	.	0.4	.	0.4	.	.	.
3	SB-003	0.4	0.4	.	0.4	.	0.3	.	.	.
4	SB-008	0.4	0.4	.	0.4	.	0.4	.	0.4	.
5	SB-011	0.4	0.4	.	0.4	.	0.4	.	0.4	.
6	SB-013	.	0.4	.	0.4	.	0.4	.		.
7	SB-015	0.0	0.0	.	0.0	.	0.0	.	.	.
8	SB-016	0.0	.	.	0.0	0.0	0.0	.	0.1	.
9	SB-018	0.3	0.3	.	0.3	.	0.3	.		.
10	SB-019	0.0	0.0	.	0.0	0.0	.	.	.	.
11	SB-007R	0.1	0.1	.	0.1	.	0.1	.	.	.
12	SB-021	0.3	.	.	0.1	0.1	0.3	.	.	.
13	SB-009R	0.1	0.1	.	0.1	.	0.1	0.2	.	.
14	SB-014R	0.1	0.1	0.2	0.1	.	0.1	0.1	.	.
15	SB-004R	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
16	SB-025	0.1	0.1	0.3	0.1	.	0.1	0.2	.	.
17	SB-026	.	0.1	0.1	0.1	.	.	0.2	.	.
18	SB-017R	0.1	0.1	0.1	NA	.	0.1	0.2	.	.
19	SB-028	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
20	SB-029	0.1	0.1	0.1	0.1	.	0.1	.	0.1	.
21	SB-006R	0.1	0.1	0.2	0.1	.	0.1	0.2	.	.
22	SB-031	0.1	0.1	0.2	0.1	.	0.1	0.2	.	.
23	SB-032	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
24	SB-010R	0.0	0.0	NA	0.0	.	0.0	NA	.	.
25	SB-0045R	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
26	SB-035	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
27	SB-036	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
28	SB-038	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
29	SB-039	0.2	0.2	0.0	0.0	.	0.0	0.1	.	.
30	SB-040	0.0	0.0	0.0	0.0	.	0.0	0.1	.	.
31	SB-012R	0.0	0.0	0.3	0.0	.	0.0	0.1	.	.
32	SB-042	0.0	0.0	0.0	0.0	.	0.0	0.0	.	.
33	SB-043	0.0	0.0	.	0.0	.	0.0	0.1	.	.
34	SB-044	0.0	0.0	.	0.0	.	0.0	0.1	0.0	0.1
35	SB-045	0.3	0.4	.	0.1	.	0.2	0.1	0.2	0.1
36	SB-046	0.4	0.6	.	0.0	.	0.2	0.1	.	.
37	SB-047	0.0	0.0	.	0.0	.	0.0	0.1	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL				Chloroform						
No.	Subject	Indoor	Ind_dup	Ind_tube	Outdoor	Outdoor_ duplicate	Pers_72	Pers_24	Child_72	Child_24
1	H-001	13.1	14.1	.	5.7	.	24.5	.		.
2	H-002	1.0	0.9	.	0.1	.	1.9	.	.	.
3	H-003	2.9	2.8	.	0.4	.	3.9	.	.	.
4	H-004	9.6	7.5	.	0.1	.	9.6	.	5.8	.
5	H-005	0.7	0.5	.	0.1	.	1.1	.	.	.
6	H-006	0.6	0.6	.	0.4	.	1.4	0.8	.	.
7	H-007	5.3	4.5	.	1.3	.	6.5	14.2	.	.
8	H-008	1.6	1.6	1.7	0.4	.	2.4	3.3	.	.
9	H-009	6.3	6.9	3.7	0.7	.	6.3	7.8	.	.
10	H-010	4.1	NA	1.9	0.3	.	4.4	4.7	.	.
11	H-011	2.9	2.6	0.9	1.1	.	1.3	NA	.	.
12	H-012	5.1	3.8	2.0	0.2	.	4.2	4.5	.	.
13	H-013	1.7	1.4	0.7	0.1	.	1.8	1.7	.	.
14	H-014	1.1	1.3	1.2	0.2	.	0.8	0.1	.	.
15	H-015	1.1	1.3	1.2	0.2	.	1.0	1.7	.	.
16	H-016	1.4	1.4	0.7	0.2	.	2.0	0.9	.	.
17	H-017	6.5	5.3	4.5	0.3	.	5.2	6.8	.	.
18	H-018	0.9	0.9	0.9	0.3	.	8.2	11.7	.	.
19	H-019	1.0	1.1	0.7	0.2	.	1.9	0.7	.	.
20	H-020	0.6	0.6	0.8	0.2	.	1.3	1.4	.	.
21	H-021	4.3	NA	.	0.4	.	66.4	68.5	.	.
22	H-022	0.6	0.4	.	NA	0.2	1.7	3.0	.	.
1	SB-001	1.0	0.8	.	0.2	.	0.9	.	.	.
2	SB-002	2.3	2.3	.	0.2	.	2.5	.	.	.
3	SB-003	0.2	0.2	.	0.1	.	0.3	.	.	.
4	SB-008	0.6	0.6	.	0.1	.	0.6	.	0.7	.
5	SB-011	31.0	28.8	.	0.2	.	34.4	.	0.2	.
6	SB-013	.	7.4	.	0.2	.	9.8	.		
7	SB-015	1.4	1.1	.	0.7	.	2.0	.	.	
8	SB-016	6.1	.	.	0.7	0.6	7.8	.	6.9	
9	SB-018	6.0	5.8	.	3.4	.	6.1	.		
10	SB-019	0.1	0.1	.	0.1	0.1	.	.	.	
11	SB-007R	1.8	1.7	.	0.5	.	4.6	.	.	
12	SB-021	8.0	.	.	0.5	0.6	7.6	.	.	
13	SB-009R	1.8	2.0	.	0.3	.	2.3	1.4	.	
14	SB-014R	3.7	3.4	3.8	0.3	.	3.9	0.8	.	
15	SB-004R	2.4	2.4	1.4	0.6	.	3.4	5.3	.	
16	SB-025	2.8	3.1	1.5	1.8	.	2.0	2.5	.	
17	SB-026	.	6.6	2.7	0.4	.	.	3.2	.	
18	SB-017R	3.1	5.1	1.5	NA	.	4.5	5.2	.	
19	SB-028	2.1	1.6	1.0	0.3	.	0.7	1.3	.	
20	SB-029	1.6	1.8	0.9	0.5	.	2.1	.	1.1	
21	SB-006R	2.6	2.4	1.6	0.2	.	3.0	2.4	.	
22	SB-031	2.4	2.3	1.8	0.3	.	7.2	8.4	.	
23	SB-032	1.4	1.4	1.0	0.1	.	1.6	2.2	.	
24	SB-010R	1.7	2.0	NA	0.3	.	1.5	NA	.	
25	SB-0045R	6.9	6.9	6.0	0.4	.	9.6	8.3	.	
26	SB-035	0.7	0.8	0.5	0.2	.	1.1	0.6	.	
27	SB-036	1.0	1.4	1.0	0.1	.	1.9	2.5	.	
28	SB-038	1.7	1.7	1.7	0.2	.	2.1	1.3	.	
29	SB-039	8.3	7.9	8.0	0.3	.	5.0	4.5	.	
30	SB-040	3.1	3.2	3.5	0.2	.	0.8	10.5	.	
31	SB-012R	1.8	2.0	0.6	0.3	.	0.3	5.6	.	
32	SB-042	7.4	6.5	8.2	0.3	.	6.0	2.6	.	
33	SB-043	2.2	2.3	.	0.1	.	2.0	0.7	.	
34	SB-044	3.3	3.2	.	0.3	.	2.3	3.0	2.3	1.9
35	SB-045	14.6	15.8	.	1.0	.	14.5	15.1	11.3	17.6
36	SB-046	2.0	1.9	.	0.3	.	2.3	1.5	.	
37	SB-047	5.0	4.7	.	0.1	.	6.9	8.8	.	

Table C. (continued)

Concentration ($\mu g/m^3$) : <LOD = 0.5MDL					Carbon tetrachloride					
No.	Subject	Indoor	Ind_dup	Ind_tube	Outdoor	Outdoor_ duplicate	Pers_72	Pers_24	Child_72	Child_24
1	H-001	1.2	1.3	.	1.1	.	1.2	.		.
2	H-002	0.6	0.6	.	0.6	.	0.8	.	.	.
3	H-003	0.8	0.6	.	0.9	.	1.0	.	.	.
4	H-004	0.7	0.6	.	0.8	.	1.0	.	0.8	.
5	H-005	1.0	0.8	.	1.0	.	1.0	.	.	.
6	H-006	0.8	0.9	.	1.1	.	1.1	0.9	.	.
7	H-007	1.3	0.9	.	1.3	.	1.4	1.7	.	.
8	H-008	1.1	1.1	1.5	1.5	.	1.5	1.8	.	.
9	H-009	1.4	1.9	1.2	1.2	.	1.7	1.8	.	.
10	H-010	1.1	NA	0.9	1.4	.	1.3	2.1	.	.
11	H-011	2.2	1.7	0.9	4.2	.	0.7	NA	.	.
12	H-012	1.7	1.3	0.9	1.2	.	1.7	1.4	.	.
13	H-013	1.0	0.8	0.8	0.8	.	0.9	0.2	.	.
14	H-014	0.9	1.0	1.0	1.0	.	0.9	0.1	.	.
15	H-015	0.6	0.8	0.8	1.0	.	0.7	0.7	.	.
16	H-016	0.7	0.7	0.7	0.8	.	0.9	0.3	.	.
17	H-017	1.1	0.9	0.9	1.0	.	1.0	0.8	.	.
18	H-018	1.0	0.8	1.0	0.8	.	1.0	1.4	.	.
19	H-019	0.9	1.1	0.6	0.8	.	1.0	0.9	.	.
20	H-020	0.7	0.6	0.8	0.8	.	0.8	0.9	.	.
21	H-021	0.6	NA	.	0.6	.	0.7	0.4	.	.
22	H-022	0.9	0.7	.	NA	0.9	0.8	1.3	.	.
1	SB-001	0.7	0.5	.	0.7	.	0.6	.	.	.
2	SB-002	0.6	0.5	.	0.6	.	0.7	.	.	.
3	SB-003	0.5	0.5	.	0.6	.	0.6	.	.	.
4	SB-008	0.6	0.7	.	0.6	.	0.8	.	0.7	.
5	SB-011	1.4	1.3	.	1.3	.	1.8	.	0.1	.
6	SB-013	.	0.6	.	0.6	.	0.7	.		.
7	SB-015	0.9	0.6	.	0.9	.	0.7	.	.	.
8	SB-016	1.1	.	.	1.8	1.6	1.4	.	1.1	.
9	SB-018	1.0	0.9	.	1.1	.	1.0	.		.
10	SB-019	0.1	0.1	.	0.1	0.1	.	.	.	.
11	SB-007R	1.2	1.1	.	1.3	.	1.3	.	.	.
12	SB-021	2.7	.	.	1.4	1.4	2.1	.	.	.
13	SB-009R	1.7	1.9	.	1.7	.	1.5	1.4	.	.
14	SB-014R	1.1	1.2	1.7	1.4	.	1.2	0.5	.	.
15	SB-004R	1.2	1.1	0.9	1.4	.	1.1	1.2	.	.
16	SB-025	1.4	1.6	1.0	1.8	.	1.2	1.4	.	.
17	SB-026	.	2.5	1.6	1.7	.	.	2.5	.	.
18	SB-017R	1.8	2.7	1.0	NA	.	2.0	2.8	.	.
19	SB-028	0.9	0.8	1.0	0.9	.	0.3	0.9	.	.
20	SB-029	1.1	0.9	0.9	1.0	.	1.2	.	0.4	.
21	SB-006R	0.7	0.9	0.9	1.1	.	0.9	1.4	.	.
22	SB-031	0.7	0.6	0.9	0.8	.	0.6	1.0	.	.
23	SB-032	0.8	0.8	0.9	0.8	.	0.6	0.2	.	.
24	SB-010R	0.8	1.0	NA	1.1	.	0.9	NA	.	.
25	SB-0045R	0.7	0.8	0.7	0.9	.	1.1	0.8	.	.
26	SB-035	0.9	0.7	0.2	0.9	.	1.0	0.9	.	.
27	SB-036	0.6	0.8	0.8	0.7	.	0.8	1.1	.	.
28	SB-038	0.7	0.7	0.9	0.7	.	0.6	0.4	.	.
29	SB-039	0.8	0.8	0.9	0.9	.	0.8	1.1	.	.
30	SB-040	1.1	1.1	1.3	0.6	.	0.3	3.7	.	.
31	SB-012R	1.3	1.6	1.2	0.9	.	0.3	2.2	.	.
32	SB-042	0.9	0.9	0.9	1.0	.	0.9	0.3	.	.
33	SB-043	1.0	1.1	.	0.9	.	0.7	0.4	.	.
34	SB-044	0.9	0.9	.	0.8	.	0.7	1.4	0.6	0.6
35	SB-045	1.0	1.1	.	1.6	.	1.0	0.9	0.8	1.0
36	SB-046	0.7	0.8	.	1.1	.	0.8	0.4	.	.
37	SB-047	0.9	0.8	.	0.7	.	1.0	1.0	.	

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL					Benzene					
No.	Subject	Indoor	Ind_dup	Ind_tube	Outdoor	Outdoor_ duplicate	Pers_72	Pers_24	Child_72	Child_24
1	H-001	4.6	4.9	.	2.5	.	4.9	.		.
2	H-002	0.6	0.6	.	0.6	.	0.6	.	.	.
3	H-003	1.8	1.5	.	1.7	.	3.0	.	.	.
4	H-004	2.3	1.3	.	1.2	.	1.6	.	1.6	.
5	H-005	1.2	0.6	.	2.1	.	2.2	.	.	.
6	H-006	2.8	2.7	.	2.2	.	2.8	1.7	.	.
7	H-007	8.9	7.6	.	3.3	.	6.7	8.6	.	.
8	H-008	1.8	1.5	1.9	1.7	.	2.5	2.2	.	.
9	H-009	2.4	3.1	1.3	2.8	.	2.9	2.3	.	.
10	H-010	2.1	NA	1.0	0.8	.	1.6	2.4	.	.
11	H-011	4.1	3.5	0.8	8.4	.	0.7	NA	.	.
12	H-012	3.8	2.2	0.7	1.6	.	3.6	5.3	.	.
13	H-013	6.8	5.1	2.9	2.1	.	6.3	4.9	.	.
14	H-014	8.0	10.1	8.2	1.8	.	4.8	0.8	.	.
15	H-015	1.0	1.2	0.8	1.8	.	2.4	2.3	.	.
16	H-016	1.7	1.7	0.9	1.0	.	2.4	0.9	.	.
17	H-017	10.4	8.1	6.2	1.8	.	7.6	12.3	.	.
18	H-018	2.0	1.7	1.8	1.8	.	2.2	2.7	.	.
19	H-019	1.7	2.1	0.6	1.7	.	2.3	1.7	.	.
20	H-020	0.6	0.6	0.6	0.6	.	1.8	1.8	.	.
21	H-021	2.2	NA	.	0.6	.	1.2	2.2	.	.
22	H-022	1.3	0.6	.	NA	0.9	0.6	1.7	.	.
1	SB-001	7.7	7.5	.	2.4	.	8.4	.	.	.
2	SB-002	7.0	6.8	.	2.7	.	7.3	.	.	.
3	SB-003	3.5	4.2	.	1.8	.	6.4	.	.	.
4	SB-008	1.4	1.2	.	0.6	.	1.5	.	1.4	.
5	SB-011	2.3	2.5	.	2.3	.	3.4	.	0.2	.
6	SB-013	.	1.0	.	0.9	.	1.3	.		.
7	SB-015	1.2	0.6	.	1.5	.	2.4	.	.	.
8	SB-016	2.6	.	.	2.5	2.0	4.8	.	4.1	.
9	SB-018	5.0	5.1	.	2.8	.	6.7	.		.
10	SB-019	9.2	8.2	.	2.9	3.2	.	.	.	.
11	SB-007R	2.9	2.7	.	3.0	.	3.4	.	.	.
12	SB-021	8.8	.	.	3.4	2.9	7.3	.	.	.
13	SB-009R	7.4	8.3	.	0.8	.	6.8	6.3	.	.
14	SB-014R	3.1	2.8	3.7	0.7	.	3.0	0.7	.	.
15	SB-004R	0.8	0.8	0.4	2.1	.	2.1	2.4	.	.
16	SB-025	4.5	5.0	3.1	4.8	.	4.3	2.7	.	.
17	SB-026	.	2.4	0.4	2.3	.	.	2.4	.	.
18	SB-017R	6.4	7.5	1.1	NA	.	5.1	5.6	.	.
19	SB-028	2.8	2.1	0.9	3.2	.	0.7	2.0	.	.
20	SB-029	4.8	4.7	2.6	2.0	.	6.0	.	3.5	.
21	SB-006R	2.4	2.4	1.4	0.7	.	2.6	2.0	.	.
22	SB-031	0.7	0.7	0.4	1.6	.	2.0	2.3	.	.
23	SB-032	4.9	4.5	3.0	1.4	.	2.3	2.4	.	.
24	SB-010R	2.6	3.1	NA	2.7	.	2.8	NA	.	.
25	SB-0045R	4.0	3.9	3.3	1.9	.	5.7	2.9	.	.
26	SB-035	1.3	1.3	0.3	1.8	.	1.5	1.0	.	.
27	SB-036	0.9	1.4	0.6	0.8	.	2.9	6.7	.	.
28	SB-038	1.5	1.5	0.6	0.6	.	1.6	1.8	.	.
29	SB-039	2.9	2.6	2.8	1.6	.	2.1	1.7	.	.
30	SB-040	6.8	6.7	6.7	0.6	.	1.7	21.5	.	.
31	SB-012R	1.1	1.4	5.7	1.2	.	0.6	4.2	.	.
32	SB-042	1.6	1.2	0.7	0.6	.	1.4	0.6	.	.
33	SB-043	1.2	1.2	.	0.6	.	1.4	1.7	.	.
34	SB-044	6.3	6.0	.	1.9	.	4.4	10.4	3.8	6.0
35	SB-045	10.2	11.0	.	3.7	.	10.1	11.0	8.0	13.1
36	SB-046	12.3	12.3	.	2.8	.	8.5	10.1	.	.
37	SB-047	5.4	4.9	.	0.5	.	5.7	7.9	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL					Trichloroethylene					
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	0.1	0.1	.	0.1	.	2.3	.		.
2	H-002	0.2	0.2	.	0.2	.	0.3	.	.	.
3	H-003	0.2	0.2	.	0.2	.	0.2	.	.	.
4	H-004	0.2	0.2	.	0.2	.	0.9	.	0.2	.
5	H-005	0.2	0.2	.	0.5	.	0.2	.	.	.
6	H-006	0.2	0.2	.	0.2	.	0.6	0.5	.	.
7	H-007	0.1	0.1	.	0.1	.	0.1	0.4	.	.
8	H-008	0.1	0.1	0.4	0.3	.	0.3	0.4	.	.
9	H-009	0.1	0.6	0.3	0.1	.	0.4	1.5	.	.
10	H-010	0.1	NA	0.2	0.1	.	0.1	0.4	.	.
11	H-011	0.2	0.2	0.2	0.5	.	0.2	NA	.	.
12	H-012	0.2	0.2	0.4	0.2	.	0.2	0.5	.	.
13	H-013	0.2	0.2	0.6	0.2	.	0.2	0.5	.	.
14	H-014	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
15	H-015	0.1	0.1	0.1	0.1	.	0.2	0.3	.	.
16	H-016	0.1	0.1	0.1	0.1	.	0.1	0.3	.	.
17	H-017	0.1	0.1	0.1	0.1	.	0.2	0.3	.	.
18	H-018	0.3	0.2	0.1	0.1	.	0.3	0.7	.	.
19	H-019	0.2	0.2	0.2	0.2	.	0.2	0.7	.	.
20	H-020	0.2	0.2	0.2	0.2	.	0.2	0.7	.	.
21	H-021	0.2	NA	.	0.2	.	0.2	0.9	.	.
22	H-022	0.2	0.2	.	NA	0.4	0.2	0.7	.	.
1	SB-001	0.1	0.1	.	0.1	.	0.1	.	.	.
2	SB-002	0.1	0.1	.	0.1	.	0.1	.	.	.
3	SB-003	0.1	0.5	.	0.1	.	0.1	.	.	.
4	SB-008	0.1	0.1	.	0.1	.	0.1	.	0.1	.
5	SB-011	0.2	0.1	.	0.1	.	0.2	.	0.1	.
6	SB-013	.	0.1	.	0.1	.	0.1	.		.
7	SB-015	0.2	0.2	.	0.2	.	0.4	.	.	.
8	SB-016	0.5	.	.	0.2	0.2	0.4	.	0.4	.
9	SB-018	0.1	0.1	.	0.1	.	0.1	.		.
10	SB-019	0.2	0.2	.	0.2	0.2	.	.	.	.
11	SB-007R	0.1	0.1	.	0.1	.	0.1	.	.	.
12	SB-021	0.6	.	.	0.1	0.1	0.4	.	.	.
13	SB-009R	4.0	4.2	.	0.6	.	2.9	1.5	.	.
14	SB-014R	0.4	0.1	0.9	0.1	.	0.4	0.1	.	.
15	SB-004R	0.4	0.1	0.6	0.4	.	0.4	1.7	.	.
16	SB-025	0.1	0.1	0.4	0.3	.	0.4	0.5	.	.
17	SB-026	.	0.2	0.4	0.2	.	.	0.6	.	.
18	SB-017R	0.2	0.2	0.4	NA	.	0.2	0.5	.	.
19	SB-028	0.2	0.2	0.2	0.2	.	0.2	0.5	.	.
20	SB-029	0.2	0.2	0.2	0.2	.	0.2	.	0.2	.
21	SB-006R	0.2	0.2	0.3	0.2	.	0.2	0.5	.	.
22	SB-031	0.2	0.2	0.2	0.2	.	0.2	0.6	.	.
23	SB-032	0.2	0.2	0.7	0.2	.	0.2	0.6	.	.
24	SB-010R	0.3	0.4	NA	0.2	.	0.2	NA	.	.
25	SB-0045R	0.1	0.1	0.1	0.1	.	42.8	109.3	.	.
26	SB-035	0.1	0.1	0.1	0.1	.	0.1	0.3	.	.
27	SB-036	0.1	0.1	0.1	0.1	.	0.3	0.3	.	.
28	SB-038	0.2	0.2	0.2	0.2	.	0.2	0.7	.	.
29	SB-039	0.2	0.2	0.2	0.2	.	0.8	0.7	.	.
30	SB-040	0.2	0.2	0.2	0.2	.	0.2	0.9	.	.
31	SB-012R	0.5	0.6	2.3	0.2	.	0.2	0.7	.	.
32	SB-042	0.2	0.2	0.3	0.2	.	0.2	0.2	.	.
33	SB-043	0.2	0.2	.	0.2	.	0.8	0.7	.	.
34	SB-044	1.4	1.3	.	0.2	.	0.5	0.8	0.8	0.6
35	SB-045	1.6	2.3	.	1.0	.	1.7	1.5	1.3	2.2
36	SB-046	3.3	3.1	.	0.2	.	2.5	2.2	.	.
37	SB-047	0.2	0.2	.	0.2	.	0.2	0.6	.	.

Table C. (continued)

Concentration (µg/m^3) : <LOD = 0.5MDL					Toluene					
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	5.7	6.7	.	4.3	.	7.7	.		.
2	H-002	6.2	5.9	.	2.5	.	9.8	.	.	.
3	H-003	11.6	11.2	.	2.5	.	15.7	.	.	.
4	H-004	9.5	7.8	.	2.5	.	8.0	.	5.6	.
5	H-005	2.5	2.5	.	2.5	.	7.2	.	.	.
6	H-006	2.5	2.5	.	5.2	.	8.9	7.5	.	.
7	H-007	31.4	27.6	.	4.9	.	56.3	27.4	.	.
8	H-008	4.2	4.9	13.1	2.6	.	6.8	3.3	.	.
9	H-009	5.6	9.3	10.5	4.8	.	7.7	10.7	.	.
10	H-010	4.7	NA	6.1	1.1	.	8.0	11.4	.	.
11	H-011	8.8	6.0	5.3	7.1	.	2.4	NA	.	.
12	H-012	10.4	7.8	8.2	2.4	.	12.1	18.9	.	.
13	H-013	11.1	8.1	8.5	2.4	.	8.6	7.3	.	.
14	H-014	9.2	12.8	7.1	3.1	.	10.8	2.8	.	.
15	H-015	6.9	7.7	4.5	4.4	.	71.3	46.4	.	.
16	H-016	10.9	10.9	5.7	3.7	.	33.8	3.2	.	.
17	H-017	62.1	53.1	50.1	3.4	.	59.7	70.4	.	.
18	H-018	13.8	12.2	11.4	5.8	.	14.4	15.1	.	.
19	H-019	5.7	6.6	1.7	4.1	.	12.1	5.0	.	.
20	H-020	1.7	1.7	1.7	1.7	.	9.2	5.2	.	.
21	H-021	6.1	NA	.	1.7	.	3.7	6.3	.	.
22	H-022	3.7	3.5	.	NA	2.6	3.4	5.0	.	.
1	SB-001	21.2	14.1	.	3.4	.	15.5	.	.	.
2	SB-002	13.6	16.0	.	5.9	.	20.5	.	.	.
3	SB-003	4.8	6.3	.	1.5	.	33.5	.	.	.
4	SB-008	71.1	70.8	.	3.9	.	99.0	.	35.5	.
5	SB-011	14.0	12.2	.	3.0	.	21.0	.	1.2	.
6	SB-013	.	3.7	.	3.7	.	5.6	.		.
7	SB-015	8.6	6.3	.	6.2	.	18.8	.	.	.
8	SB-016	21.6	.	.	7.3	5.4	22.1	.	21.7	.
9	SB-018	6.4	5.6	.	4.2	.	14.6	.		.
10	SB-019	12.6	14.0	.	5.8	6.1	.	.	.	.
11	SB-007R	7.4	7.5	.	4.4	.	15.8	.	.	.
12	SB-021	53.8	.	.	4.7	4.7	44.4	.	.	.
13	SB-009R	35.6	39.1	.	2.9	.	30.7	15.6	.	.
14	SB-014R	13.7	12.7	30.1	1.0	.	14.2	5.7	.	.
15	SB-004R	12.6	11.7	16.4	3.0	.	11.6	11.1	.	.
16	SB-025	22.3	23.1	27.3	7.8	.	9.6	12.1	.	.
17	SB-026	.	26.3	21.5	5.9	.	.	55.4	.	.
18	SB-017R	16.2	27.6	16.0	NA	.	16.1	17.2	.	.
19	SB-028	10.0	7.0	7.3	5.3	.	11.4	7.1	.	.
20	SB-029	9.4	9.7	9.6	2.4	.	14.1	.	8.2	.
21	SB-006R	7.0	6.6	8.4	2.4	.	10.0	7.1	.	.
22	SB-031	7.0	6.2	7.6	2.4	.	10.7	8.1	.	.
23	SB-032	7.7	6.9	7.2	2.4	.	6.3	8.3	.	.
24	SB-010R	7.9	8.7	NA	5.1	.	7.1	NA	.	.
25	SB-0045R	69.3	71.9	61.7	7.3	.	71.3	47.0	.	.
26	SB-035	8.6	8.1	1.1	4.5	.	7.7	3.7	.	.
27	SB-036	5.4	7.6	3.7	2.8	.	10.8	15.5	.	.
28	SB-038	11.6	10.8	10.3	3.3	.	14.8	12.4	.	.
29	SB-039	20.3	19.1	17.7	7.4	.	37.1	48.6	.	.
30	SB-040	14.6	13.5	14.3	1.7	.	4.2	48.3	.	.
31	SB-012R	5.6	6.2	16.5	10.7	.	1.7	19.1	.	.
32	SB-042	15.4	13.1	13.4	1.7	.	13.7	4.7	.	.
33	SB-043	11.8	12.4	.	1.7	.	17.8	5.0	.	.
34	SB-044	17.1	15.5	.	5.1	.	10.9	21.0	9.4	10.1
35	SB-045	110.1	119.5	.	8.6	.	108.0	98.6	84.5	118.4
36	SB-046	77.4	78.6	.	6.9	.	41.7	40.9	.	.
37	SB-047	36.3	34.1	.	1.6	.	41.3	29.5	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL						Tetrachloroethylene				
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	0.6	0.7	.	0.6	.	1.2	.		.
2	H-002	0.5	0.6	.	0.5	.	0.7	.	.	.
3	H-003	2.8	2.7	.	0.8	.	7.0	.	.	.
4	H-004	1.0	0.8	.	1.1	.	1.6	.	0.7	.
5	H-005	1.0	0.9	.	1.2	.	2.0	.	.	.
6	H-006	6.4	6.8	.	1.0	.	6.0	2.5	.	.
7	H-007	3.0	2.6	.	3.3	.	3.6	1.5	.	.
8	H-008	1.0	1.1	1.5	1.0	.	1.7	2.0	.	.
9	H-009	1.2	1.4	1.1	1.7	.	1.6	1.3	.	.
10	H-010	0.4	NA	0.5	0.2	.	0.8	0.6	.	.
11	H-011	1.0	0.8	0.7	1.7	.	1.0	NA	.	.
12	H-012	0.4	0.4	0.4	0.1	.	1.1	0.4	.	.
13	H-013	2.1	1.6	1.5	0.5	.	1.4	1.9	.	.
14	H-014	0.4	0.4	0.2	0.5	.	1.2	0.5	.	.
15	H-015	0.5	0.5	0.2	0.5	.	2.4	0.6	.	.
16	H-016	1.1	1.1	0.2	0.2	.	2.6	0.6	.	.
17	H-017	1.7	1.2	1.2	0.7	.	1.6	1.6	.	.
18	H-018	0.8	0.8	0.6	0.6	.	1.3	1.2	.	.
19	H-019	2.8	3.3	1.0	1.9	.	4.8	3.7	.	.
20	H-020	0.8	0.8	1.2	0.8	.	1.2	0.8	.	.
21	H-021	2.7	NA	.	0.3	.	0.9	1.0	.	.
22	H-022	0.8	0.3	.	NA	0.4	0.3	0.8	.	.
1	SB-001	0.4	0.3	.	0.4	.	0.1	.	.	.
2	SB-002	0.3	0.5	.	0.3	.	0.6	.	.	.
3	SB-003	1.0	1.3	.	0.3	.	0.2	.	.	.
4	SB-008	0.1	0.1	.	0.1	.	0.1	.	0.1	.
5	SB-011	0.1	0.1	.	0.1	.	0.3	.	0.1	.
6	SB-013	.	0.3	.	0.2	.	0.3	.		.
7	SB-015	0.8	0.6	.	0.8	.	3.4	.	.	.
8	SB-016	1.2	.	.	0.8	0.6	3.4	.	2.1	.
9	SB-018	0.2	0.1	.	0.4	.	0.1	.		.
10	SB-019	0.1	0.1	.	0.1	0.1	.	.	.	.
11	SB-007R	0.9	0.7	.	0.8	.	1.2	.	.	.
12	SB-021	21.4	.	.	1.5	1.3	15.9	.	.	.
13	SB-009R	3.6	4.0	.	0.3	.	3.0	2.4	.	.
14	SB-014R	0.5	0.4	0.8	0.6	.	0.5	0.3	.	.
15	SB-004R	3.5	3.3	1.8	0.8	.	2.4	1.9	.	.
16	SB-025	2.1	2.2	1.4	2.1	.	1.8	0.9	.	.
17	SB-026	.	10.6	6.8	0.4	.	.	8.9	.	.
18	SB-017R	0.4	0.7	0.4	NA	.	1.1	0.4	.	.
19	SB-028	0.6	0.5	0.7	0.1	.	0.7	0.4	.	.
20	SB-029	0.3	0.3	0.3	0.3	.	0.4	.	0.1	.
21	SB-006R	0.1	0.3	0.3	0.1	.	0.3	0.4	.	.
22	SB-031	0.5	0.5	0.5	0.5	.	0.6	1.1	.	.
23	SB-032	0.8	0.8	0.7	0.1	.	0.6	1.1	.	.
24	SB-010R	0.6	0.6	NA	0.4	.	0.4	NA	.	.
25	SB-0045R	0.4	0.5	0.2	0.4	.	2.8	3.5	.	.
26	SB-035	0.2	0.2	0.2	0.2	.	0.2	0.6	.	.
27	SB-036	0.2	0.4	0.2	0.2	.	1.2	2.1	.	.
28	SB-038	0.3	0.7	0.3	0.3	.	0.3	0.8	.	.
29	SB-039	1.3	1.1	0.9	0.3	.	2.3	3.5	.	.
30	SB-040	1.2	0.9	0.8	0.3	.	0.3	2.8	.	.
31	SB-012R	0.3	0.6	2.6	0.8	.	0.3	20.3	.	.
32	SB-042	0.3	0.3	0.3	0.3	.	0.3	0.3	.	.
33	SB-043	0.3	0.3	.	0.3	.	0.9	0.8	.	.
34	SB-044	0.7	0.6	.	0.3	.	0.7	1.0	0.3	0.7
35	SB-045	24.4	26.2	.	1.2	.	24.3	27.1	18.6	30.1
36	SB-046	0.3	0.3	.	0.3	.	0.3	0.8	.	.
37	SB-047	1.6	1.5	.	1.5	.	1.8	2.1	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL					p-Xylene					
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	3.5	4.0	.	3.1	.	4.4	.		.
2	H-002	1.5	1.4	.	0.6	.	2.2	.	.	.
3	H-003	2.4	2.4	.	1.9	.	4.6	.	.	.
4	H-004	3.2	2.6	.	1.4	.	3.1	.	2.5	.
5	H-005	4.6	3.9	.	2.8	.	4.2	.	.	.
6	H-006	4.8	4.8	.	2.1	.	5.3	3.0	.	.
7	H-007	21.8	19.1	.	4.2	.	16.0	16.2	.	.
8	H-008	1.6	1.7	4.0	1.8	.	3.0	2.9	.	.
9	H-009	3.8	4.4	5.5	4.2	.	4.4	3.8	.	.
10	H-010	2.3	NA	3.0	1.0	.	2.2	2.0	.	.
11	H-011	4.6	3.9	4.7	5.3	.	2.0	NA	.	.
12	H-012	1.9	1.8	2.4	1.2	.	3.5	3.8	.	.
13	H-013	4.3	3.4	4.1	2.2	.	3.7	2.9	.	.
14	H-014	2.5	3.3	2.1	1.9	.	6.5	0.8	.	.
15	H-015	2.1	2.2	1.7	2.2	.	47.3	38.5	.	.
16	H-016	8.7	8.6	3.3	1.7	.	9.1	2.3	.	.
17	H-017	17.0	14.7	15.2	2.0	.	16.3	22.9	.	.
18	H-018	3.3	2.8	3.3	3.0	.	5.7	4.3	.	.
19	H-019	3.8	4.4	0.4	2.7	.	12.3	7.0	.	.
20	H-020	1.2	1.0	1.6	1.1	.	4.6	5.0	.	.
21	H-021	11.7	NA	.	1.3	.	6.1	7.8	.	.
22	H-022	2.0	1.6	.	NA	1.5	1.5	1.3	.	.
1	SB-001	9.2	8.0	.	2.4	.	6.9	.	.	.
2	SB-002	5.3	5.1	.	5.1	.	7.3	.	.	.
3	SB-003	1.6	2.6	.	1.2	.	24.2	.	.	.
4	SB-008	8.9	7.3	.	0.6	.	9.5	.	5.3	.
5	SB-011	4.1	3.7	.	2.1	.	5.2	.	0.4	.
6	SB-013	.	1.8	.	2.2	.	2.8	.		.
7	SB-015	3.1	2.3	.	3.6	.	10.0	.	.	.
8	SB-016	7.8	.	.	5.0	4.3	10.5	.	11.1	.
9	SB-018	4.0	4.6	.	4.3	.	5.7	.		.
10	SB-019	3.8	4.0	.	2.2	2.1	.	.	.	.
11	SB-007R	7.5	6.8	.	6.5	.	6.3	.	.	.
12	SB-021	15.4	.	.	4.4	4.0	13.1	.	.	.
13	SB-009R	21.7	23.9	.	1.9	.	19.5	14.1	.	.
14	SB-014R	5.0	4.6	8.8	1.2	.	4.9	2.7	.	.
15	SB-004R	7.7	7.4	8.9	7.1	.	6.8	5.7	.	.
16	SB-025	8.5	9.1	11.8	6.6	.	5.9	5.3	.	.
17	SB-026	.	5.0	5.9	1.8	.	.	5.8	.	.
18	SB-017R	4.7	6.8	5.0	NA	.	5.0	5.5	.	.
19	SB-028	2.8	2.0	3.1	2.3	.	4.0	3.3	.	.
20	SB-029	7.7	7.9	7.7	2.7	.	8.8	.	4.7	.
21	SB-006R	2.2	2.1	3.1	0.7	.	3.1	3.5	.	.
22	SB-031	4.5	4.2	5.4	2.8	.	4.1	6.2	.	.
23	SB-032	10.6	9.7	8.4	5.3	.	8.5	7.7	.	.
24	SB-010R	4.0	4.3	NA	4.3	.	4.0	NA	.	.
25	SB-0045R	15.5	16.3	13.3	3.5	.	18.5	8.3	.	.
26	SB-035	3.5	3.6	0.3	2.4	.	3.5	1.1	.	.
27	SB-036	3.4	4.3	2.7	3.6	.	5.0	5.4	.	.
28	SB-038	3.7	3.5	3.4	3.2	.	4.6	2.9	.	.
29	SB-039	7.5	7.0	6.5	5.5	.	14.8	25.0	.	.
30	SB-040	7.8	7.8	8.8	4.1	.	1.9	28.0	.	.
31	SB-012R	4.6	5.0	4.2	9.9	.	1.2	11.9	.	.
32	SB-042	3.0	2.5	2.7	1.8	.	3.7	0.9	.	.
33	SB-043	2.4	2.6	.	0.8	.	3.1	1.3	.	.
34	SB-044	7.9	7.1	.	6.1	.	6.8	14.0	5.3	7.1
35	SB-045	60.2	65.1	.	5.5	.	58.7	56.7	46.6	66.4
36	SB-046	47.1	47.8	.	4.9	.	23.9	25.6	.	.
37	SB-047	5.7	5.5	.	2.1	.	11.1	18.6	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL						o-Xylene				
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	1.8	1.8	.	1.8	.	1.8	.		.
2	H-002	0.8	0.8	.	0.2	.	1.1	.	.	.
3	H-003	1.3	1.4	.	1.1	.	2.5	.	.	.
4	H-004	10.4	8.3	.	1.0	.	8.1	.	7.2	.
5	H-005	2.1	1.8	.	1.6	.	2.3	.	.	.
6	H-006	3.4	3.5	.	1.3	.	0.2	2.2	.	.
7	H-007	12.8	11.4	.	2.5	.	9.7	10.6	.	.
8	H-008	0.8	1.0	1.6	1.1	.	1.7	1.9	.	.
9	H-009	1.9	2.6	2.2	2.5	.	2.5	1.9	.	.
10	H-010	1.4	NA	1.4	0.5	.	1.3	1.1	.	.
11	H-011	2.4	2.0	1.7	2.8	.	0.9	NA	.	.
12	H-012	1.0	0.9	1.0	0.6	.	2.0	2.5	.	.
13	H-013	1.4	1.0	1.4	0.8	.	1.1	0.9	.	.
14	H-014	0.7	1.0	1.0	0.7	.	1.9	0.3	.	.
15	H-015	0.7	0.7	0.6	0.7	.	9.0	7.6	.	.
16	H-016	2.1	2.0	1.0	0.5	.	2.5	0.8	.	.
17	H-017	5.7	4.9	5.2	0.8	.	5.5	7.6	.	.
18	H-018	1.1	0.8	1.1	1.0	.	1.8	2.1	.	.
19	H-019	1.3	1.3	0.3	1.0	.	4.5	2.3	.	.
20	H-020	0.4	0.3	0.6	0.4	.	1.4	1.6	.	.
21	H-021	2.8	NA	.	0.4	.	1.3	1.	.	.
22	H-022	0.7	0.6	.	NA	0.5	0.5	0.4	.	.
1	SB-001	3.0	2.4	.	0.9	.	2.0	.	.	.
2	SB-002	1.6	1.6	.	1.5	.	2.2	.	.	.
3	SB-003	0.6	0.8	.	0.2	.	6.7	.	.	.
4	SB-008	2.8	2.3	.	2.2	.	3.1	.	1.6	.
5	SB-011	1.8	1.8	.	1.8	.	1.8	.	1.8	.
6	SB-013	.	1.8	.	1.8	.	1.8	.		.
7	SB-015	1.2	0.9	.	1.3	.	3.7	.	.	.
8	SB-016	4.4	.	.	2.6	2.1	7.0	.	7.6	.
9	SB-018	1.3	1.3	.	1.3	.	1.3	.		.
10	SB-019	3.5	4.0	.	0.2	0.2	.	.	.	.
11	SB-007R	4.2	4.0	.	4.4	.	3.7	.	.	.
12	SB-021	8.9	.	.	2.4	2.1	7.8	.	.	.
13	SB-009R	12.6	13.7	.	1.1	.	11.5	8.4	.	.
14	SB-014R	3.0	2.6	3.9	0.6	.	3.0	1.3	.	.
15	SB-004R	3.4	3.4	2.6	3.1	.	3.3	2.5	.	.
16	SB-025	5.8	6.3	4.8	4.2	.	3.6	2.9	.	.
17	SB-026	.	2.6	2.2	1.1	.	.	2.9	.	.
18	SB-017R	2.3	3.4	1.9	NA	.	2.6	2.9	.	.
19	SB-028	1.0	0.7	1.2	0.8	.	1.4	1.3	.	.
20	SB-029	2.2	2.1	2.7	0.9	.	2.9	.	1.4	.
21	SB-006R	0.7	0.8	1.1	0.3	.	1.0	1.0	.	.
22	SB-031	1.2	1.2	1.8	0.9	.	1.3	2.0	.	.
23	SB-032	3.0	2.9	2.9	1.3	.	2.4	2.5	.	.
24	SB-010R	1.2	1.3	NA	1.3	.	1.2	NA	.	.
25	SB-0045R	4.5	4.8	4.0	1.0	.	5.5	2.4	.	.
26	SB-035	1.1	1.0	0.1	0.7	.	1.1	0.5	.	.
27	SB-036	0.8	1.0	0.7	0.8	.	1.3	1.6	.	.
28	SB-038	1.0	1.0	1.0	0.9	.	1.3	1.0	.	.
29	SB-039	2.5	2.3	2.1	1.5	.	5.7	9.0	.	.
30	SB-040	2.4	2.2	2.9	1.2	.	0.7	8.5	.	.
31	SB-012R	1.2	1.3	1.3	2.5	.	0.4	4.2	.	.
32	SB-042	0.9	0.7	0.8	0.6	.	1.2	0.3	.	.
33	SB-043	1.0	1.1	.	0.3	.	1.1	0.4	.	.
34	SB-044	2.5	2.1	.	1.5	.	2.2	4.2	1.4	1.8
35	SB-045	17.0	18.3	.	1.6	.	16.9	18.0	13.4	20.2
36	SB-046	15.5	16.0	.	1.5	.	8.3	8.4	.	.
37	SB-047	1.9	1.8	.	0.7	.	5.4	6.0	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL					Styrene					
No.	**Subject**	**Indoor**	**Ind_dup**	**Ind_tube**	**Outdoor**	**Outdoor_ duplicate**	**Pers_72**	**Pers_24**	**Child_72**	**Child_24**
1	H-001	1.1	1.7	.	0.2	.	3.3	.		.
2	H-002	0.3	0.3	.	0.3	.	0.3	.	.	.
3	H-003	2.5	1.7	.	0.3	.	3.8	.	.	.
4	H-004	3.2	3.0	.	0.3	.	4.7	.	3.3	.
5	H-005	1.5	1.6	.	1.3	.	1.4	.	.	.
6	H-006	0.3	0.3	.	0.9	.	1.2	1.0	.	.
7	H-007	1.9	5.0	.	0.6	.	1.2	0.8	.	.
8	H-008	0.3	0.9	0.6	1.1	.	2.9	4.6	.	.
9	H-009	1.2	1.6	0.4	1.2	.	3.3	0.8	.	.
10	H-010	4.0	NA	0.3	0.9	.	4.6	3.8	.	.
11	H-011	4.9	3.6	0.3	3.7	.	0.4	NA	.	.
12	H-012	2.9	1.0	0.3	0.4	.	6.4	8.2	.	.
13	H-013	2.2	1.4	1.0	0.4	.	1.4	1.2	.	.
14	H-014	0.2	0.4	0.2	0.2	.	0.2	0.5	.	.
15	H-015	0.2	0.2	0.2	0.2	.	2.2	1.6	.	.
16	H-016	0.2	0.2	0.2	0.2	.	0.9	0.6	.	.
17	H-017	0.7	0.6	0.9	0.2	.	1.0	0.6	.	.
18	H-018	0.2	0.2	0.2	0.2	.	0.2	0.6	.	.
19	H-019	0.3	0.4	0.1	0.1	.	0.6	0.2	.	.
20	H-020	0.1	0.1	0.1	0.1	.	0.1	0.2	.	.
21	H-021	0.1	NA	.	0.1	.	0.1	0.2	.	.
22	H-022	0.1	0.1	.	NA	0.1	0.1	0.2	.	.
1	SB-001	1.8	1.7	.	0.3	.	1.4	.	.	.
2	SB-002	0.3	0.6	.	0.3	.	1.5	.	.	.
3	SB-003	0.3	0.3	.	0.3	.	1.3	.	.	.
4	SB-008	0.3	0.3	.	0.3	.	0.3	.	0.3	.
5	SB-011	2.5	1.6	.	0.2	.	4.2	.	0.5	.
6	SB-013	.	0.2	.	0.2	.	0.2	.		.
7	SB-015	2.5	2.2	.	0.3	.	4.2	.	.	.
8	SB-016	8.2	.	.	2.4	2.1	7.4	.	7.2	.
9	SB-018	0.1	0.1	.	0.1	.	6.8	.		.
10	SB-019	0.3	0.3	.	0.3	0.3	.	.	.	.
11	SB-007R	1.9	1.5	.	7.2	.	2.5	.	.	.
12	SB-021	10.2	.	.	1.7	1.2	8.9	.	.	.
13	SB-009R	43.3	50.8	.	0.8	.	51.3	27.3	.	.
14	SB-014R	4.5	3.6	1.4	0.2	.	6.5	1.7	.	.
15	SB-004R	0.7	0.8	0.4	0.3	.	1.9	0.8	.	.
16	SB-025	7.5	9.3	1.0	2.7	.	4.5	10.7	.	.
17	SB-026	.	10.3	0.8	2.6	.	.	14.6	.	.
18	SB-017R	2.6	8.0	0.3	NA	.	6.2	17.1	.	.
19	SB-028	0.4	0.8	0.4	0.4	.	1.1	2.3	.	.
20	SB-029	0.4	0.4	0.7	0.4	.	1.9	.	0.9	.
21	SB-006R	0.4	0.4	0.5	0.4	.	0.7	1.1	.	.
22	SB-031	0.4	0.4	0.5	0.4	.	0.4	1.3	.	.
23	SB-032	0.4	0.4	0.7	0.4	.	0.4	1.3	.	.
24	SB-010R	0.2	0.4	NA	0.2	.	0.7	NA	.	.
25	SB-0045R	0.7	0.8	0.2	0.2	.	1.1	0.6	.	.
26	SB-035	0.2	0.2	0.2	0.2	.	0.2	0.7	.	.
27	SB-036	0.2	0.2	0.2	0.2	.	0.2	0.6	.	.
28	SB-038	0.1	0.1	0.3	0.1	.	0.2	0.2	.	.
29	SB-039	1.1	1.0	2.7	0.1	.	1.3	0.7	.	.
30	SB-040	0.3	0.3	0.5	0.1	.	0.1	1.9	.	.
31	SB-012R	0.1	0.1	0.5	0.1	.	0.1	0.2	.	.
32	SB-042	0.1	0.1	0.1	0.1	.	0.2	0.1	.	.
33	SB-043	0.4	0.4	.	0.1	.	0.6	0.2	.	.
34	SB-044	0.2	0.1	.	0.1	.	0.2	0.2	0.1	0.1
35	SB-045	1.6	1.9	.	0.1	.	1.7	1.1	1.2	1.3
36	SB-046	1.5	1.6	.	0.1	.	1.4	1.2	.	.
37	SB-047	0.7	0.6	.	0.1	.	0.8	0.7	.	.

Table C. (continued)

Concentration (g/m^3) : <LOD = 0.5MDL						1,4-Dichlorobenzene						
No.	Subject	Indoor	Ind_dup	Ind_tube	Outdoor	Outdoor_ duplicate	Pers_72	Pers_24	Child_72	Child_24	T	Child_24
1	H-001	24.1	25.7		3.0	.	26.6	.		.	.	
2	H-002	0.3	0.3		0.3	.	1.5	.	.	.	.	
3	H-003	1.8	1.7		0.3	.	3.0	.	.	.	.	
4	H-004	2.7	1.9		0.3	.	2.8	.	1.9	.	.	
5	H-005	3.0	2.5		0.8	.	3.2	.	.	.	.	
6	H-006	0.3	0.3		0.3	.	0.3	1.0	.	.	.	
7	H-007	0.4	0.4		0.6	.	1.4	0.4	.	.	.	
8	H-008	0.5	0.8	1.6	0.5	.	1.6	1.3	.	.	1.6	
9	H-009	0.5	1.1	1.7	0.9	.	0.7	1.1	.	.	1.7	
10	H-010	2.0	NA	1.8	0.1	.	4.6	0.9	.	.	1.8	
11	H-011	1.0	0.2	0.5	0.5	.	0.2	NA	.	.	0.5	
12	H-012	0.2	0.2	0.5	0.2	.	0.2	0.5	.	.	0.5	
13	H-013	0.2	0.2	0.6	0.2	.	0.2	0.5	.	.	0.6	
14	H-014	2.0	2.9	1.6	0.4	.	2.4	1.0	.	.	1.6	
15	H-015	0.4	0.4	0.4	0.4	.	0.4	1.2	.	.	0.4	
16	H-016	0.4	0.4	0.4	0.4	.	0.4	1.1	.	.	0.4	
17	H-017	4.4	4.1	4.6	0.4	.	4.6	6.2	.	.	4.6	
18	H-018	4.8	4.1	4.8	0.9	.	6.1	7.2	.	.	4.8	
19	H-019	1.3	1.5	0.4	0.4	.	1.4	1.3	.	.	0.4	
20	H-020	0.4	0.4	0.4	0.4	.	1.1	1.4	.	.	0.4	
21	H-021	64.0	NA		1.5	.	19.9	20.3	.	.	.	
22	H-022	0.4	0.4		NA	0.7	0.4	1.3	.	.	.	
1	SB-001	0.4	0.4		0.4	.	0.4	.	.	.	.	
2	SB-002	0.4	0.4		0.4	.	0.4	.	.	.	.	
3	SB-003	1.4	1.1		0.4	.	0.3	.	.	.	.	
4	SB-008	158.7	145.0		1.3	.	150.0	.	134.3	.	.	
5	SB-011	3.6	3.0		0.7	.	6.4	.	0.2	.	.	
6	SB-013	.	0.2		1.0	.	1.1	.		.	.	
7	SB-015	0.3	0.3		0.3	.	0.7	.	.	.	.	
8	SB-016	15.7	.		1.4	0.9	16.1	.	13.5	.	.	
9	SB-018	119.3	119.3		17.3	.	66.4	.		.	.	
10	SB-019	3.6	4.2		3.3	3.4	.	.	.	.	.	
11	SB-007R	0.9	0.7		0.7	.	0.7	.	.	.	.	
12	SB-021	3.5	.		0.8	0.5	3.2	.	.	.	.	
13	SB-009R	0.5	0.3		0.7	.	0.5	0.4	.	.	.	
14	SB-014R	0.7	0.7	1.1	0.1	.	1.4	0.4	.	.	1.1	
15	SB-004R	9.6	9.6	9.1	0.5	.	9.6	11.0	.	.	9.1	
16	SB-025	1.0	1.4	1.3	1.0	.	0.5	1.1	.	.	1.3	
17	SB-026	.	13.3	13.0	0.2	.	.	14.8	.	.	13.0	
18	SB-017R	3.7	6.1	3.7	NA	.	3.8	4.0	.	.	3.7	
19	SB-028	11.5	8.9	16.3	0.4	.	12.7	14.8	.	.	16.3	
20	SB-029	0.4	0.4	1.1	0.2	.	1.5	.	0.4	.	1.1	
21	SB-006R	0.2	0.2	0.5	0.2	.	2.2	7.9	.	.	0.5	
22	SB-031	0.2	0.2	0.7	0.2	.	0.6	0.6	.	.	0.7	
23	SB-032	0.2	0.2	0.6	0.2	.	0.4	0.6	.	.	0.6	
24	SB-010R	0.4	0.4	NA	0.4	.	0.8	NA	.	.	NA	
25	SB-0045R	0.4	0.4	0.4	0.4	.	0.4	1.2	.	.	0.4	
26	SB-035	0.4	0.4	0.4	0.4	.	1.1	1.3	.	.	0.4	
27	SB-036	0.4	0.4	0.4	0.4	.	0.4	1.1	.	.	0.4	
28	SB-038	0.4	0.4	0.4	0.4	.	1.5	3.1	.	.	0.4	
29	SB-039	19.6	18.7	17.0	0.9	.	18.3	31.2	.	.	17.0	
30	SB-040	1.0	0.4	0.4	0.4	.	0.4	5.9	.	.	0.4	
31	SB-012R	0.4	0.4	4.3	0.4	.	0.4	1.3	.	.	4.3	
32	SB-042	384.4	354.7		4.7	.	313.3	88.0	.	.	442.1	
33	SB-043	3.2	3.5		0.4	.	29.9	1.3	.	.	.	
34	SB-044	3.2	2.5		0.5	.	2.4	1.6	2.9	2.9	.	2.9
35	SB-045	0.4	0.4		0.4	.	0.4	1.4	0.4	1.4	.	1.4
36	SB-046	1.0	1.1		0.4	.	0.4	1.3	.	.	.	
37	SB-047	1.6	1.3		0.4	.	12.3	8.1	.	.	.	

APPENDIX D

South Baltimore Outdoor Fixed Site Air Monitoring Results

Table D. South Baltimore outdoor fixed site air monitoring results (P=Potapsco Ave., W=Wagner's Point)

Sample		Duration	Methylene Chloride		MTBE		Chloroprene	
P	W	Weeks	P	W	P	W	P	W
SB-A-017	SB-A-017-2	1	0.9	0.2	4.3	69.9	0.07	0.18
SB-A-117	SB-A-016	1	0.6	0.7	6.9	14.5	0.04	0.04
SB-A-039	SB-A-028	1	0.5	0.2	7.2	22.4	0.03	0.09
SB-A-023	SB-A-032-b	1	0.1	0.1	3.1	13.5	0.03	0.03
SB-A-031-2	SB-A-036-b	1	0.1	0.1	1.8	2.5	0.03	0.03
SB-A-151	SB-A-037-b	1	0.5	0.5	7.7	12.7	0.01	0.01
SB-A-237	SB-A-045	1	0.1	0.3	6.8	35.8	0.01	0.01
SB-A-215	SB-A-047	1	0.2	0.5	6.4	32.6	0.01	0.04
SB-A-062	SB-A-049	1	0.4	0.1	10.2	43.2	0.03	0.15
SB-A-205	SB-A-051	1	0.4	0.7	5.5	41.4	0.01	0.09
SB-A-226	SB-A-055	1	0.1	0.1	6.4	31.8	0.01	0.01
SB-A-173	SB-A-061	1	0.4	0.4	6.1	19.1	0.01	0.01
SB-A-083	SB-A-065	1	0.4	0.3	16.9	51.5	0.09	0.14
SB-A-152	SB-A-066	1	0.5	0.4	9.1	17.9	0.01	0.01
SB-A-128	SB-A-067	1	0.5	0.6	4.6	15.4	0.03	0.03
SB-A-060-b	SB-A-068	1	0.6	0.4	25.3	31.8	0.22	0.11
SB-A-189	SB-A-070	1	0.7	0.4	10	58.9	0.01	0.05
SB-A-183	SB-A-071	1	0.5	0.4	7	26.6	0.01	0.01
SB-A-075	SB-A-076	1	0.5	0.1	9.4	0.5	0.03	0.03
SB-A-079	SB-A-077	1	0.9	0.9	10.4	29	0.08	0.08
SB-A-161	SB-A-078	1	0.6	0.5	7.6	19.4	0.01	0.01
SB-A-056-b	SB-A-082	1	0.1	0.1	3.2	10.5	0.03	0.03
SB-A-090	SB-A-088	1	0.1	0.8	6.3	27.2	0.03	0.12
SB-A-199	SB-A-093	1	0.4	0.2	7.8	37.6	0.01	0.01
SB-A-232	SB-A-095	1	0.1	0.1	5.3	22.3	0.01	0.01
SB-A-242	SB-A-096	1	0.1	0.1	6.9	38.5	0.01	0.01
SB-A-069	SB-A-099	1	0.4	0.6	8.9	26.3	0.03	0.09
SB-A-194	SB-A-100	1	0.3	0.3	7.8	55.3	0.01	0.08
SB-A-145	SB-A-105	1	0.6	.	10	.	0.01	.
SB-A-054	SB-A-106	1	0.1	0.1	5.9	16.3	0.03	0.03
SB-A-210	SB-A-109	1	0.1	0.1	6.6	23.6	0.01	0.01
SB-A-112	SB-A-115	1	0.1	0.1	7.1	25.6	0.03	0.09
SB-A-166	SB-A-116	1	0.4	0.4	4.3	9.4	0.01	0.01
SB-A-132	SB-A-120	1	0.2	0.3	2.8	15	0.03	0.09
SB-A-220	SB-A-121	1	0.2	0.1	6.6	29.1	0.01	0.04
SB-A-124	SB-A-126	1	0.3	0.8	5.9	16.7	0.03	0.07
SB-A-243	SB-A-130	2	0.1	0.1	5.1	48.2	0.01	0.06
SB-A-153	SB-A-134	2	0.3	0.4	5.4	20.5	0.01	0.05
SB-A-200	SB-A-136	2	0.2	0.2	6.9	36.3	0.01	0.05
SB-A-113	SB-A-137	2	0.2	0.4	7.1	19.1	0.03	0.08
SB-A-178	SB-A-142	2	0.3	0.2	9.7	30.1	0.01	0.05
SB-A-233	SB-A-148	2	0	0.2	6	30.1	0.01	0.05
SB-A-072	SB-A-155	2	0.3	0.4	3.3	18.5	0.02	0.05
SB-A-042	SB-A-156	2	0	0.1	3.9	11	0.02	0.02
SB-A-057	SB-A-158	2	0	0	3.5	12.7	0.02	0.02
SB-A-063	SB-A-164	2	0.3	0.2	8.2	29.3	0.04	0.09
SB-A-035-b	SB-A-170	2	0	0	2.1	11.2	0.02	0.02
SB-A-094	SB-A-174	2	0.4	0.4	6.2	20	0.04	0.06
SB-A-001	SB-A-175	2	0	0.1	2.8	7.5	0.02	0.02
SB-A-211	SB-A-177	2	0.2	0.2	7.5	23.3	0.01	0.04
SB-A-190	SB-A-180	2	0.3	0.2	9.4	52.6	0.01	0.06
SB-A-123	SB-A-181	2	0.2	0.3	4.5	16.4	0.01	0.03
SB-A-167	SB-A-186	2	0.2	0.2	5	13.1	0.01	0.01
SB-A-221	SB-A-187	2	0	0	6.6	30.5	0.01	0.04
SB-A-019-b	SB-A-202	4	0	0	2.8	10.4	0.01	0.02
SB-A-140	SB-A-203	4	0.1	0.1	0.4	4.8	0.01	0.01
SB-A-064	SB-A-213	4	0.2	0.3	11	42.9	0.07	0.13
SB-A-044	SB-A-218	4	0	0	3.1	12.5	0.01	0.02
SB-A-026-b	SB-A-229	4	0	0	2.5	10.4	0.01	0.02
SB-A-103	SB-A-230	4	0.1	0	5.4	14.4	0.03	0.05
SB-A-227	SB-A-235	4	0	0	5.4	28.8	0	0.04
SB-A-118	SB-A-239	4	0.1	0	6.2	15.4	0.02	0.04
SB-A-108	SB-A-240	4	0.1	0	5.5	16.5	0.04	0.05
SB-A-206	SB-A-245	4	0	0	6.6	23.9	0.01	0.04

Table D. (continued)

Sample		Duration	Chloroform		Carbon Tetrachloride		Benzene	
P	**W**	**Weeks**	**P**	**W**	**P**	**W**	**P**	**W**
SB-A-017	SB-A-017-2	1	0.82	1	1.16	2.53	0.75	8.64
SB-A-117	SB-A-016	1	0.58	0.4	1.44	0.95	3.43	2.91
SB-A-039	SB-A-028	1	0.51	0.47	1.32	1.09	2.12	1.98
SB-A-023	SB-A-032-b	1	0.25	0.44	0.38	0.4	0.96	1.05
SB-A-031-2	SB-A-036-b	1	0.11	0.13	0.35	0.35	0.34	0.71
SB-A-151	SB-A-037-b	1	0.37	0.48	1.67	1.54	4.11	2.39
SB-A-237	SB-A-045	1	0.47	0.35	0.95	0.97	1.44	2.18
SB-A-215	SB-A-047	1	0.36	0.44	1.01	1.03	2.13	1.73
SB-A-062	SB-A-049	1	0.52	0.99	1.09	1.32	3.43	5.85
SB-A-205	SB-A-051	1	0.31	0.51	0.93	1.94	1.94	5.15
SB-A-226	SB-A-055	1	0.36	0.32	0.78	0.97	2.01	1.66
SB-A-173	SB-A-061	1	0.29	0.41	0.99	0.84	2.38	2.49
SB-A-083	SB-A-065	1	1.62	1.5	2.25	2.02	5.56	8.01
SB-A-152	SB-A-066	1	0.38	0.35	1.85	1.51	4.47	2.45
SB-A-128	SB-A-067	1	0.34	0.49	1.02	2.04	2.5	2.07
SB-A-060-b	SB-A-068	1	1.55	0.49	3.67	1.2	126.24	42.68
SB-A-189	SB-A-070	1	0.42	0.39	1.27	1.28	2.78	3.78
SB-A-183	SB-A-071	1	0.32	0.38	0.92	1.44	2.13	2.55
SB-A-075	SB-A-076	1	0.6	0.03	1.57	0.05	3.28	0.35
SB-A-079	SB-A-077	1	1.3	0.86	1.35	1.32	3.23	3.72
SB-A-161	SB-A-078	1	0.52	0.54	0.98	0.76	2.73	2.62
SB-A-056-b	SB-A-082	1	0.16	0.4	0.55	0.46	1.32	1.28
SB-A-090	SB-A-088	1	0.49	0.54	1.2	2.13	2.66	2.46
SB-A-199	SB-A-093	1	0.33	0.38	1.47	1.05	1.53	1.65
SB-A-232	SB-A-095	1	0.32	0.38	1.29	0.79	1.5	2.28
SB-A-242	SB-A-096	1	0.42	0.48	0.97	0.84	1.53	1.9
SB-A-069	SB-A-099	1	0.43	0.92	1.3	1.28	2.89	3.29
SB-A-194	SB-A-100	1	0.34	0.33	1.26	1.24	1.98	2.76
SB-A-145	SB-A-105	1	0.41	.	1.68	.	4.99	.
SB-A-054	SB-A-106	1	0.34	0.34	0.77	0.55	1.98	1.44
SB-A-210	SB-A-109	1	0.26	0.32	0.91	0.99	2.01	1.58
SB-A-112	SB-A-115	1	0.36	0.67	1.21	1.83	3.27	3.89
SB-A-166	SB-A-116	1	0.18	0.4	0.91	1.06	1.69	1.67
SB-A-132	SB-A-120	1	0.17	0.52	0.5	1.44	1.09	3.1
SB-A-220	SB-A-121	1	0.33	0.32	0.99	1.3	1.5	2.52
SB-A-124	SB-A-126	1	0.33	0.74	0.88	1.32	2.77	2.38
SB-A-243	SB-A-130	2	0.19	0.37	0.78	1.07	1.27	2.91
SB-A-153	SB-A-134	2	0.22	0.49	0.88	1.23	2.2	2.84
SB-A-200	SB-A-136	2	0.22	0.32	1.21	1.28	1.72	3.01
SB-A-113	SB-A-137	2	0.32	0.48	1.06	1.19	3.21	3.13
SB-A-178	SB-A-142	2	0.28	0.36	1.18	1.33	2.88	2.91
SB-A-233	SB-A-148	2	0.2	0.29	1.16	0.9	1.29	2.69
SB-A-072	SB-A-155	2	0.18	0.68	0.51	1.71	1.47	2.65
SB-A-042	SB-A-156	2	0.18	0.17	0.5	0.39	1.06	0.93
SB-A-057	SB-A-158	2	0.15	0.2	0.48	0.46	8.94	11.21
SB-A-063	SB-A-164	2	0.34	0.65	0.93	0.96	2.67	3.79
SB-A-035-b	SB-A-170	2	0.1	0.28	0.28	0.52	0.74	1.58
SB-A-094	SB-A-174	2	0.28	0.78	1.06	1.26	3	2.95
SB-A-001	SB-A-175	2	0.13	0.19	0.57	0.55	0.93	0.97
SB-A-211	SB-A-177	2	0.22	0.2	1.08	0.77	1.78	1.47
SB-A-190	SB-A-180	2	0.27	0.32	1.29	1.12	2.85	3.36
SB-A-123	SB-A-181	2	0.23	0.64	0.75	1.51	2.28	2.43
SB-A-167	SB-A-186	2	0.16	0.29	0.87	0.87	1.95	1.94
SB-A-221	SB-A-187	2	0.2	0.33	0.81	1.14	1.59	2.54
SB-A-019-b	SB-A-202	4	0.09	0.15	0.35	0.39	0.91	1.12
SB-A-140	SB-A-203	4	0.03	0.15	0.13	0.49	0.2	0.72
SB-A-064	SB-A-213	4	0.42	0.57	1.07	0.95	3.73	4.48
SB-A-044	SB-A-218	4	0.08	0.19	0.39	0.39	4.81	5.67
SB-A-026-b	SB-A-229	4	0.11	0.18	0.3	0.37	0.84	1.15
SB-A-103	SB-A-230	4	0.22	0.4	0.89	1.15	2.69	2.51
SB-A-227	SB-A-235	4	0.17	0.22	0.54	0.51	1.43	2.39
SB-A-118	SB-A-239	4	0.25	0.4	0.83	1.05	2.88	2.42
SB-A-108	SB-A-240	4	0.25	0.39	0.88	1.2	2.82	2.7
SB-A-206	SB-A-245	4	0.18	0.2	0.66	0.68	1.76	2.19

Table D. (continued)

Sample		Duration	Trichloroethylene		Toluene		Tetrachloroethylene	
P	W	Weeks	P	W	P	W	P	W
SB-A-017	SB-A-017-2	1	0.15	0.56	3.05	25.06	0.92	2.76
SB-A-117	SB-A-016	1	0.36	0.21	6.87	4.76	0.99	1.05
SB-A-039	SB-A-028	1	0.07	0.23	4.66	10.98	0.53	0.68
SB-A-023	SB-A-032-b	1	0.07	0.07	1.43	6.2	0.44	0.53
SB-A-031-2	SB-A-036-b	1	0.07	0.07	1.37	1.43	0.26	0.43
SB-A-151	SB-A-037-b	1	0.16	0.1	5.92	3.42	0.42	0.57
SB-A-237	SB-A-045	1	0.13	0.25	5.3	5.92	0.39	0.55
SB-A-215	SB-A-047	1	0.15	0.14	5.98	7.26	0.44	0.93
SB-A-062	SB-A-049	1	0.47	0.39	6.14	9.17	0.8	1.44
SB-A-205	SB-A-051	1	0.12	0.24	4.06	10.48	0.57	0.89
SB-A-226	SB-A-055	1	0.06	0.09	5.92	7.65	0.41	0.69
SB-A-173	SB-A-061	1	0.08	0.1	4.29	3.83	0.44	0.41
SB-A-083	SB-A-065	1	0.58	0.58	16.56	14.77	1.55	2.07
SB-A-152	SB-A-066	1	0.18	0.11	8.09	4.65	0.44	0.5
SB-A-128	SB-A-067	1	0.2	0.07	4.6	4.81	0.61	0.94
SB-A-060-b	SB-A-068	1	0.48	0.23	9.78	5.3	3.49	0.91
SB-A-189	SB-A-070	1	0.05	0.08	8.08	9.98	0.41	0.59
SB-A-183	SB-A-071	1	0.06	0.12	4.4	5.91	0.45	1.27
SB-A-075	SB-A-076	1	0.42	0.07	7.9	1.4	0.85	0.03
SB-A-079	SB-A-077	1	0.45	0.38	9.24	7.34	1.4	1.41
SB-A-161	SB-A-078	1	0.13	0.1	5.12	4.34	0.56	0.54
SB-A-056-b	SB-A-082	1	0.07	0.07	2.92	4.15	0.41	0.5
SB-A-090	SB-A-088	1	0.07	0.18	4.91	8.45	0.54	1.28
SB-A-199	SB-A-093	1	0.06	0.05	7.67	6.63	0.56	0.4
SB-A-232	SB-A-095	1	0.02	0.02	4.88	4.03	0.33	0.47
SB-A-242	SB-A-096	1	0.09	0.14	4.81	9.37	0.5	1.57
SB-A-069	SB-A-099	1	0.21	0.16	5.26	5.97	0.75	0.98
SB-A-194	SB-A-100	1	0.11	0.16	13.73	11.21	0.56	0.75
SB-A-145	SB-A-105	1	0.18	.	7.95	.	0.53	.
SB-A-054	SB-A-106	1	0.07	0.16	4.87	6.77	0.45	0.4
SB-A-210	SB-A-109	1	0.08	0.03	5.47	3.13	0.41	0.41
SB-A-112	SB-A-115	1	0.2	0.34	6.74	10.8	0.88	2.76
SB-A-166	SB-A-116	1	0.05	0.06	2.19	2.57	0.28	0.37
SB-A-132	SB-A-120	1	0.06	0.26	1.21	3.68	0.35	0.93
SB-A-220	SB-A-121	1	0.14	0.11	5.39	6.96	0.59	0.58
SB-A-124	SB-A-126	1	0.2	0.19	5.6	4.66	0.8	0.9
SB-A-243	SB-A-130	2	0.07	0.1	3.91	13.08	0.29	1.38
SB-A-153	SB-A-134	2	0.1	0.14	4.22	5.6	0.25	0.44
SB-A-200	SB-A-136	2	0.1	0.1	6.83	7.62	0.45	0.55
SB-A-113	SB-A-137	2	0.24	0.31	6.23	7.99	0.77	1.75
SB-A-178	SB-A-142	2	0.11	0.13	8.12	8.22	0.39	0.99
SB-A-233	SB-A-148	2	0.08	0.09	5.54	6.4	0.33	0.53
SB-A-072	SB-A-155	2	0.13	0.22	3.24	6.06	0.5	1
SB-A-042	SB-A-156	2	0.03	0.03	3.51	5.48	0.23	0.31
SB-A-057	SB-A-158	2	0.13	0.09	2.71	4.26	0.28	0.41
SB-A-063	SB-A-164	2	0.23	0.26	5.64	7.05	0.73	0.93
SB-A-035-b	SB-A-170	2	0.03	0.08	2.29	8.55	0.23	0.53
SB-A-094	SB-A-174	2	0.2	0.21	5.39	7.24	0.78	1.05
SB-A-001	SB-A-175	2	0.03	0.03	2.04	1.73	0.23	0.35
SB-A-211	SB-A-177	2	0.1	0.06	6.87	4.38	0.45	0.52
SB-A-190	SB-A-180	2	0.08	0.1	10.75	9.36	0.38	0.53
SB-A-123	SB-A-181	2	0.15	0.17	4.48	5.57	0.63	0.9
SB-A-167	SB-A-186	2	0.08	0.09	3.13	3.24	0.27	0.35
SB-A-221	SB-A-187	2	0.1	0.11	5.69	8.16	0.45	0.63
SB-A-019-b	SB-A-202	4	0.06	0.07	2.42	3.39	0.25	0.36
SB-A-140	SB-A-203	4	0.02	0.04	0.36	1.61	0.06	0.18
SB-A-064	SB-A-213	4	0.26	0.32	7.82	10.12	0.72	1.09
SB-A-044	SB-A-218	4	0.08	0.11	3.12	5.4	0.26	0.35
SB-A-026-b	SB-A-229	4	0.05	0.05	2.36	5.86	0.25	0.55
SB-A-103	SB-A-230	4	0.16	0.17	4.98	5.04	0.48	0.78
SB-A-227	SB-A-235	4	0.07	0.09	5.39	7.83	0.34	0.62
SB-A-118	SB-A-239	4	0.21	0.19	5.78	4.83	0.65	0.72
SB-A-108	SB-A-240	4	0.2	0.19	5.76	6.04	0.58	1.17
SB-A-206	SB-A-245	4	0.11	0.09	5.85	5.58	0.43	0.47

Table D. (continued)

Sample		Duration	Ethylbenzene		m,p-Xylene		o-Xylene	
P	W	Weeks	P	W	P	W	P	W
SB-A-017	SB-A-017-2	1	1.56	7.65	2.85	20.69	0.92	6.33
SB-A-117	SB-A-016	1	2.11	1.83	5.15	4.37	2.1	1.76
SB-A-039	SB-A-028	1	2.72	2.88	6.87	10.07	2.1	2.58
SB-A-023	SB-A-032-b	1	0.63	1.34	1.56	3.29	0.59	1.03
SB-A-031-2	SB-A-036-b	1	0.53	0.56	1.49	1.47	0.51	0.57
SB-A-151	SB-A-037-b	1	1.86	2.26	5.13	5.77	1.53	1.28
SB-A-237	SB-A-045	1	2.1	2.37	4.91	8.61	1.65	2.32
SB-A-215	SB-A-047	1	3.97	2.2	12.62	8.01	2.24	2.18
SB-A-062	SB-A-049	1	2.17	2.96	5.2	7.59	2.01	2.59
SB-A-205	SB-A-051	1	1.45	3.14	3.1	10.1	1.21	2.2
SB-A-226	SB-A-055	1	2.21	2.8	8.32	9.92	2.31	2.64
SB-A-173	SB-A-061	1	1.88	1.06	5.25	2.86	1.39	0.95
SB-A-083	SB-A-065	1	5.01	4.19	13.61	11.16	4.43	3.96
SB-A-152	SB-A-066	1	3.1	2.19	8.09	5.67	2.15	1.35
SB-A-128	SB-A-067	1	1.49	2.52	3.53	6.1	1.53	1.9
SB-A-060-b	SB-A-068	1	6.74	1.94	13.34	4.29	5.27	1.72
SB-A-189	SB-A-070	1	1.98	3.24	5.49	8.9	1.52	2.33
SB-A-183	SB-A-071	1	1.84	2.2	5.23	6.2	1.38	1.61
SB-A-075	SB-A-076	1	5.85	0.08	14.43	0.16	3.58	0.07
SB-A-079	SB-A-077	1	2.98	2.21	7.24	5.62	2.66	2.31
SB-A-161	SB-A-078	1	1.74	1.2	4.49	3.18	1.25	1.02
SB-A-056-b	SB-A-082	1	0.79	1.15	1.96	3.89	0.78	1.22
SB-A-090	SB-A-088	1	1.57	4.47	3.47	11.72	1.54	3.09
SB-A-199	SB-A-093	1	3.2	1.88	10.54	4.22	2.06	1.52
SB-A-232	SB-A-095	1	2.72	1.59	6.89	3.58	1.92	1.3
SB-A-242	SB-A-096	1	1.95	5.67	4.43	18.16	1.56	3.4
SB-A-069	SB-A-099	1	2.03	2.86	4.86	6.91	1.77	2.08
SB-A-194	SB-A-100	1	3.26	2.45	10.55	5.74	2.18	2
SB-A-145	SB-A-105	1	2.62	.	7.3	.	2.14	.
SB-A-054	SB-A-106	1	1.34	1.68	3.3	6.3	1.26	1.77
SB-A-210	SB-A-109	1	2.27	1.08	7.96	2.01	2.1	0.85
SB-A-112	SB-A-115	1	7.25	6.63	19.05	18.24	4.49	4.71
SB-A-166	SB-A-116	1	0.7	1.32	1.88	3.56	0.59	0.82
SB-A-132	SB-A-120	1	0.87	1.88	2.19	4.45	0.75	1.55
SB-A-220	SB-A-121	1	1.71	2.82	6.55	9.85	2.01	1.94
SB-A-124	SB-A-126	1	1.82	1.74	4.5	4.22	1.8	1.46
SB-A-243	SB-A-130	2	1.36	6.59	3.27	20.45	1.15	4.27
SB-A-153	SB-A-134	2	1.71	1.93	4.46	5.02	1.19	1.33
SB-A-200	SB-A-136	2	2.44	2.01	7.68	6.31	1.73	1.47
SB-A-113	SB-A-137	2	4.79	3.99	12.72	11.11	3.16	3.04
SB-A-178	SB-A-142	2	4.54	3.67	13.08	10.21	3.01	2.34
SB-A-233	SB-A-148	2	1.81	2.16	6.19	7.15	1.36	1.61
SB-A-072	SB-A-155	2	1.04	2.4	2.58	6.2	1.04	1.82
SB-A-042	SB-A-156	2	1.24	1.37	3.31	5.14	1.05	1.28
SB-A-057	SB-A-158	2	0.8	1.1	1.92	3.45	0.77	1.08
SB-A-063	SB-A-164	2	1.75	2.46	4.53	6.49	1.56	1.97
SB-A-035-b	SB-A-170	2	0.85	1.83	2.2	5.97	0.73	1.61
SB-A-094	SB-A-174	2	1.53	2.58	3.9	6.92	1.5	1.89
SB-A-001	SB-A-175	2	0.93	0.49	2.4	1.19	0.74	0.43
SB-A-211	SB-A-177	2	3.92	1.14	11.65	4.11	2.36	1.19
SB-A-190	SB-A-180	2	2.81	2.39	7.67	6.63	1.97	1.79
SB-A-123	SB-A-181	2	1.37	2.23	3.59	5.77	1.38	1.68
SB-A-167	SB-A-186	2	1.2	1.15	3.28	3.14	0.91	0.83
SB-A-221	SB-A-187	2	2.24	3.38	7.48	10.69	1.7	2.29
SB-A-019-b	SB-A-202	4	0.8	1.01	2.11	2.75	0.7	0.83
SB-A-140	SB-A-203	4	0.24	0.79	0.58	2.09	0.17	0.56
SB-A-064	SB-A-213	4	2.99	3.48	7.78	9.44	2.24	2.64
SB-A-044	SB-A-218	4	0.94	1.29	2.54	4.58	0.84	1.14
SB-A-026-b	SB-A-229	4	0.76	1.31	2.04	3.99	0.67	1.05
SB-A-103	SB-A-230	4	1.53	1.87	4.18	5.02	1.42	1.45
SB-A-227	SB-A-235	4	1.94	3.66	6.2	11.1	1.48	2.43
SB-A-118	SB-A-239	4	1.69	1.75	4.72	4.67	1.61	1.38
SB-A-108	SB-A-240	4	3.47	2.68	9.43	7.46	2.45	2.02
SB-A-206	SB-A-245	4	2.78	2.02	8.28	6.2	1.87	1.43

Table D. (continued)

Sample		Duration	Styrene		1,2,4-Trimethylbenzene		1,4-Dichlorobenzene	
P	W	Weeks	P	W	P	W	P	W
SB-A-017	SB-A-017-2	1	1.05	3.89	0.91	4.97	0.51	1.35
SB-A-117	SB-A-016	1	1.32	0.23	2.01	1.63	0.27	0.27
SB-A-039	SB-A-028	1	0.2	0.2	1.4	1.08	0.24	0.24
SB-A-023	SB-A-032-b	1	0.2	0.2	0.68	0.62	0.24	0.24
SB-A-031-2	SB-A-036-b	1	0.19	0.2	0.41	0.66	0.23	0.24
SB-A-151	SB-A-037-b	1	0.7	0.01	1.2	0.46	0.15	0.04
SB-A-237	SB-A-045	1	0.51	0.02	1.22	1.16	0.24	0.24
SB-A-215	SB-A-047	1	0.97	0.59	1.15	1.24	0.24	0.24
SB-A-062	SB-A-049	1	0.79	0.87	1.92	2.15	0.54	0.24
SB-A-205	SB-A-051	1	0.44	0.77	1.11	2.22	0.24	0.24
SB-A-226	SB-A-055	1	0.02	0.28	1.17	1.23	0.24	0.24
SB-A-173	SB-A-061	1	0.56	0.36	0.7	0.59	0.16	0.04
SB-A-083	SB-A-065	1	0.74	0.47	3.66	3.97	0.87	0.7
SB-A-152	SB-A-066	1	1.42	0.52	1.32	0.54	0.29	0.04
SB-A-128	SB-A-067	1	0.78	0.73	1.41	1.24	0.48	0.23
SB-A-060-b	SB-A-068	1	1.37	0.2	5.78	1.47	1.63	0.23
SB-A-189	SB-A-070	1	0.77	0.01	0.93	1.16	0.25	0.04
SB-A-183	SB-A-071	1	0.22	0.01	0.69	0.97	0.14	0.04
SB-A-075	SB-A-076	1	0.87	0.2	2.24	0.12	0.63	0.23
SB-A-079	SB-A-077	1	0.58	0.2	2.52	2.41	0.83	0.48
SB-A-161	SB-A-078	1	0.84	0.53	0.73	0.93	0.2	0.09
SB-A-056-b	SB-A-082	1	0.2	0.2	0.81	0.76	0.23	0.23
SB-A-090	SB-A-088	1	1.18	1.48	1.59	1.61	0.23	0.6
SB-A-199	SB-A-093	1	0.14	0.01	1.23	1.1	0.24	0.23
SB-A-232	SB-A-095	1	0.1	0.01	0.68	1.04	0.23	0.23
SB-A-242	SB-A-096	1	0.06	0.5	1.25	1.09	0.23	0.23
SB-A-069	SB-A-099	1	0.19	0.19	1.51	1.49	0.23	0.23
SB-A-194	SB-A-100	1	1.48	0.54	1.53	1.6	0.5	0.23
SB-A-145	SB-A-105	1	1.66	.	1.57	.	0.17	.
SB-A-054	SB-A-106	1	1.02	0.92	1.3	0.92	0.51	0.23
SB-A-210	SB-A-109	1	0.8	0.24	0.93	0.69	0.23	0.23
SB-A-112	SB-A-115	1	0.17	0.38	1.96	2.37	0.49	0.21
SB-A-166	SB-A-116	1	0.34	0.17	0.4	0.32	0.03	0.03
SB-A-132	SB-A-120	1	0.17	0.17	0.62	1.18	0.2	0.2
SB-A-220	SB-A-121	1	0.73	0.48	1.51	1.17	0.51	0.2
SB-A-124	SB-A-126	1	1.34	1.54	1.75	1.2	0.21	0.4
SB-A-243	SB-A-130	2	0.31	0.82	1.02	1.49	0.28	0.13
SB-A-153	SB-A-134	2	0.9	0.94	0.72	0.94	0.13	0.14
SB-A-200	SB-A-136	2	0.7	0.59	1.24	1.34	0.28	0.27
SB-A-113	SB-A-137	2	0.4	0.44	1.64	1.79	0.27	0.32
SB-A-178	SB-A-142	2	0.2	0.76	1.16	1.08	0.29	0.16
SB-A-233	SB-A-148	2	0.58	0.16	0.92	1.22	0.24	0.12
SB-A-072	SB-A-155	2	0.85	1.75	0.97	1.29	0.12	0.27
SB-A-042	SB-A-156	2	0.67	0.34	0.85	0.48	0.12	0.12
SB-A-057	SB-A-158	2	0.64	0.1	0.81	0.79	0.31	0.24
SB-A-063	SB-A-164	2	0.44	0.25	1.42	1.49	0.44	0.12
SB-A-035-b	SB-A-170	2	0.1	0.62	0.61	0.9	0.12	0.31
SB-A-094	SB-A-174	2	0.36	0.24	1.53	1.23	0.28	0.27
SB-A-001	SB-A-175	2	0.41	0.27	0.61	0.43	0.12	0.12
SB-A-211	SB-A-177	2	1.06	0.4	1.14	0.78	0.24	0.12
SB-A-190	SB-A-180	2	0.2	0.12	1.13	1.09	0.28	0.09
SB-A-123	SB-A-181	2	0.24	1.47	1.3	1.23	0.24	0.29
SB-A-167	SB-A-186	2	0.58	0.36	0.57	0.5	0.08	0.07
SB-A-221	SB-A-187	2	0.69	0.57	1.3	1.25	0.23	0.27
SB-A-019-b	SB-A-202	4	0.51	0.36	0.61	0.65	0.17	0.16
SB-A-140	SB-A-203	4	0.05	0.37	0.11	0.38	0.06	0.06
SB-A-064	SB-A-213	4	0.34	0.35	1.84	1.95	0.5	0.33
SB-A-044	SB-A-218	4	0.5	0.24	0.76	0.62	0.2	0.06
SB-A-026-b	SB-A-229	4	0.46	0.3	0.58	0.62	0.15	0.06
SB-A-103	SB-A-230	4	0.32	0.19	1.3	1.03	0.17	0.2
SB-A-227	SB-A-235	4	0.1	0.11	0.72	0.92	0.6	0.57
SB-A-118	SB-A-239	4	0.31	0.85	1.47	1.04	0.26	0.17
SB-A-108	SB-A-240	4	0.35	0.27	1.48	1.24	0.26	0.23
SB-A-206	SB-A-245	4	0.15	0.1	0.92	0.75	0.2	0.12

APPENDIX E

Laboratory Intercomparison Study Results

Table E. Laboratory intercomparison study results

Badge ID	SPK	Anal	Spike level	Methylene Chloride ng/badge	MTBE ng/badge	Chloroprene ng/badge	Chloroform ng/badge	Carbon Tetrachloride ng/badge	Benzene ng/badge	Trichloro-ethylene ng/badge
4223	TX	JHU	Field Blank	0	0	0	171	0	246	0
4224	TX	JHU	Field Blank	0	0	0	0	0	298	0
4227	TX	JHU	Lab blank	0	0	0	0	0	115	0
4190	TX	JHU	solvent	0	0	0	0	0	245	0
4191	TX	JHU	solvent	0	0	0	0	0	273	0
4192	TX	JHU	solvent	0	0	0	189	0	257	0
ST 4187	TX	TX	solvent	32	0	0	0	0	286	15
ST 4188	TX	TX	solvent	25	0	0	0	0	223	9
ST 4189	TX	TX	solvent	35	0	0	0	0	251	20
H6.1	JHU	JHU	solvent	0	0	0	260	0	197	0
H6.2	JHU	JHU	solvent	0	0	0	0	0	276	0
H6.3	JHU	JHU	solvent	0	0	0	0	0	235	0

Badge ID	SPK	Anal	Spike level	Toluene ng/badge	Tetrachloro-ethylene ng/badge	Ethyl-benzene ng/badge	m,p-Xylene ng/badge	o-Xylene ng/badge	Styrene ng/badge	1,4-Dichloro-benzene ng/badge
4223	TX	JHU	Field Blank	329	0	0	0	0	0	0
4224	TX	JHU	Field Blank	333	0	0	0	0	0	181
4227	TX	JHU	Lab blank	NA	0	0	0	154	0	0
4190	TX	JHU	solvent	251	0	0	0	0	0	181
4191	TX	JHU	solvent	280	0	0	0	0	0	0
4192	TX	JHU	solvent	277	0	168	169	0	0	0
ST 4187	TX	TX	solvent	143	0	10	29	0	11	0
ST 4188	TX	TX	solvent	100	0	7	16	0	9	0
ST 4189	TX	TX	solvent	196	NF	11	28	NF	10	0
H6.1	JHU	JHU	solvent	502	0	150	155	222	0	200
H6.2	JHU	JHU	solvent	478	0	0	0	0	0	0
H6.3	JHU	JHU	solvent	553	0	140	195	0	0	187

Badge ID	SPK	Anal	Spike level	Methylene Chloride ng/badge	MTBE ng/badge	Chloroprene ng/badge	Chloroform ng/badge	Carbon Tetrachloride ng/badge	Benzene ng/badge	Trichloro-ethylene ng/badge
ST 4193	TX	TX	0.1 ug	107	107	0	100	90	56	85
ST 4194	TX	TX	0.1 ug	196	162	0	153	131	227	134
ST 4195	TX	TX	0.1 ug	138	130	0	119	106	128	100
T5.1	JH	TX	0.1 ug	27	0	0	37	36	0	31
T5.2	JH	TX	0.1 ug	30	37	29	38	38	6	29
T5.3	JH	TX	0.1 ug	36	0	26	45	41	23	41
4196	TX	JHU	0.1 ug	NF	NF	NF	NF	NF	272	398
4197	TX	JHU	0.1 ug	NF	NF	NF	NF	NF	135	NF
4198	TX	JHU	0.1 ug	NF	NF	NF	NF	NF	151	NF
H5.1	JHU	JHU	0.1 ug	NF	NF	NF	NF	NF	24	259
H5.2	JHU	JHU	0.1 ug	NF	NF	NF	NF	NF	64	NF
H5.3	JHU	JHU	0.1 ug	NF	NF	NF	NF	NF	22	NF

Badge ID	SPK	Anal	Spike level	Toluene ng/badge	Tetrachloro-ethylene ng/badge	Ethyl-benzene ng/badge	m,p-Xylene ng/badge	o-Xylene ng/badge	Styrene ng/badge	1,4-Dichloro-benzene ng/badge
ST 4193	TX	TX	0.1 ug	66	82	87	162	NA	74	21
ST 4194	TX	TX	0.1 ug	93	113	133	263	18	113	40
ST 4195	TX	TX	0.1 ug	123	96	103	209	NA	92	29
T5.1	JH	TX	0.1 ug	0	33	30	21	32	16	23
T5.2	JH	TX	0.1 ug	0	37	32	17	30	19	16
T5.3	JH	TX	0.1 ug	0	40	40	34	35	22	38
4196	TX	JHU	0.1 ug	461	NF	225	243	307	NF	264
4197	TX	JHU	0.1 ug	249	NF	167	185	NF	NF	205
4198	TX	JHU	0.1 ug	237	NF	174	193	266	NF	214
H5.1	JHU	JHU	0.1 ug	NF	NF	55	54	NF	NF	91
H5.2	JHU	JHU	0.1 ug	200	NF	93	92	143	NF	112
H5.3	JHU	JHU	0.1 ug	80	NF	NF	NF	NF	216	116

Table E. (continued)

Badge ID	SPK	Anal	Spike level	Methylene Chloride ng/badge	MTBE ng/badge	Chloroprene ng/badge	Chloroform ng/badge	Carbon Tetrachloride ng/badge	Benzene ng/badge	Trichloro-ethylene ng/badge
ST 4199-1	TX	TX	0.5 ug	335	576	241	463	477	517	513
ST 4200	TX	TX	0.5 ug	840	700	216	692	582	673	614
ST 4201	TX	TX	0.5 ug	808	690	193	651	579	656	596
T4.1	JH	TX	0.5 ug	529	409	335	460	410	400	410
T4.2	JH	TX	0.5 ug	428	349	283	370	321	288	354
T4.3	JH	TX	0.5 ug	470	369	314	406	349	340	382
4202	TX	JHU	0.5 ug	NF	NF	NF	635	614	509	730
4203	TX	JHU	0.5 ug	825	898	NF	639	619	501	731
4204	TX	JHU	0.5 ug	805	NF	NF	616	587	446	703
H4.1	JHU	JHU	0.5 ug	687	NF	NF	476	NF	370	574
H4.2	JHU	JHU	0.5 ug	661	NF	NF	429	444	275	524
H4.3	JHU	JHU	0.5 ug	667	NF	NF	444	455	268	537

Badge ID	SPK	Anal	Spike level	Toluene ng/badge	Tetrachloro-ethylene ng/badge	Ethyl-benzene ng/badge	m,p-Xylene ng/badge	o-Xylene ng/badge	Styrene ng/badge	1,4-Dichloro-benzene ng/badge
ST 4199-1	TX	TX	0.5 ug	437	435	497	943	15	419	214
ST 4200	TX	TX	0.5 ug	518	520	591	1111	NA	500	250
ST 4201	TX	TX	0.5 ug	524	517	592	1128	49	505	233
T4.1	JH	TX	0.5 ug	344	374	422	410	367	259	320
T4.2	JH	TX	0.5 ug	219	303	360	338	298	214	245
T4.3	JH	TX	0.5 ug	226	339	373	363	321	240	286
4202	TX	JHU	0.5 ug	525	659	574	593	620	367	519
4203	TX	JHU	0.5 ug	475	660	583	601	616	363	513
4204	TX	JHU	0.5 ug	478	634	543	561	586	336	490
H4.1	JHU	JHU	0.5 ug	183	507	396	394	415	351	335
H4.2	JHU	JHU	0.5 ug	244	473	339	338	369	370	298
H4.3	JHU	JHU	0.5 ug	271	472	350	349	379	383	310

Badge ID	SPK	Anal	Spike level	Methylene Chloride ng/badge	MTBE ng/badge	Chloroprene ng/badge	Chloroform ng/badge	Carbon Tetrachloride ng/badge	Benzene ng/badge	Trichloro-ethylene ng/badge
T3.1	JH	TX	1.0 ug	1149	886	750	951	838	841	911
T3.2	JH	TX	1.0 ug	1543	1200	1025	1274	1114	1118	1129
T3.3	JH	TX	1.0 ug	1264	1002	852	1067	927	919	984
4208	TX	JHU	1.0 ug	1212	1342	730	1107	1058	944	1169
4209	TX	JHU	1.0 ug	1174	1261	872	1045	989	832	1079
4210	TX	JHU	1.0 ug	1243	NF	702	1110	1061	950	1174
H3.1	JHU	JHU	1.0 ug	1289	1319	1083	1177	1091	926	1188
H3.2	JHU	JHU	1.0 ug	1276	1334	1102	1182	1121	960	1188
H3.3	JHU	JHU	1.0 ug	1213	NF	1025	1148	1077	895	1175

Badge ID	SPK	Anal	Spike level	Toluene ng/badge	Tetrachloro-ethylene ng/badge	Ethyl-benzene ng/badge	m,p-Xylene ng/badge	o-Xylene ng/badge	Styrene ng/badge	1,4-Dichloro-benzene ng/badge
T3.1	JH	TX	1.0 ug	941	757	898	882	748	459	628
T3.2	JH	TX	1.0 ug	1047	971	1133	1096	971	727	836
T3.3	JH	TX	1.0 ug	804	836	969	938	839	633	721
4208	TX	JHU	1.0 ug	966	1070	1036	1054	1008	604	849
4209	TX	JHU	1.0 ug	838	965	958	977	944	542	804
4210	TX	JHU	1.0 ug	1021	1075	1032	1050	999	627	857
H3.1	JHU	JHU	1.0 ug	1110	1078	1075	1074	977	830	838
H3.2	JHU	JHU	1.0 ug	1045	1089	1022	1101	1019	856	887
H3.3	JHU	JHU	1.0 ug	1110	1068	1009	1007	948	795	842

Table E. (continued)

Badge ID	SPK	Anal	Spike level	Methylene Chloride ng/badge	MTBE ng/badge	Chloroprene ng/badge	Chloroform ng/badge	Carbon Tetrachloride ng/badge	Benzene ng/badge	Trichloro-ethylene ng/badge
ST 4211	TX	TX	5.0 ug	6090	5121	3213	5028	4617	4456	4567
ST 4212	TX	TX	5.0 ug	6632	6115	4356	5775	5530	5265	5500
ST 4213	TX	TX	5.0 ug	7396	6249	4002	6128	5683	5452	5543
T2.1	JH	TX	5.0 ug	6263	5066	4982	5380	5060	4815	4990
T2.2	JH	TX	5.0 ug	6159	5021	4975	5339	5021	4846	4992
T2.3	JH	TX	5.0 ug	6645	5439	5267	5810	5382	5146	5373
4214	TX	JHU	5.0 ug	NA	NA	NA	NA	NA	NA	NA
4215	TX	JHU	5.0 ug	4705	5085	3254	5079	4805	4475	4687
4216	TX	JHU	5.0 ug	4537	4857	3108	4898	4545	4283	4524
H2.1	JHU	JHU	5.0 ug	3881	4143	3646	4473	4170	3865	4016
H2.2	JHU	JHU	5.0 ug	4506	4788	4307	5109	4859	4559	4646
H2.3	JHU	JHU	5.0 ug	4576	4675	4408	5500	5143	4665	5087
Badge ID	**SPK**	**Anal**	**Spike level**	**Toluene ng/badge**	**Tetrachloro-ethylene ng/badge**	**Ethyl-benzene ng/badge**	**m,p-Xylene ng/badge**	**o-Xylene ng/badge**	**Styrene ng/badge**	**1,4-Dichloro-benzene ng/badge**
ST 4211	TX	TX	5.0 ug	4178	3954	4532	8760	110	3915	2637
ST 4212	TX	TX	5.0 ug	5021	4704	5353	10239	992	4630	3279
ST 4213	TX	TX	5.0 ug	5035	4719	5347	10219	NA	4543	3086
T2.1	JH	TX	5.0 ug	4540	4383	4894	4787	4269	3222	3664
T2.2	JH	TX	5.0 ug	4602	4392	4946	4840	4320	3602	3755
T2.3	JH	TX	5.0 ug	4904	4643	5187	5093	4566	3722	3941
4214	TX	JHU	5.0 ug	NA	NA	NA	NA	NA	NA	NA
4215	TX	JHU	5.0 ug	4421	4357	4681	4697	4195	2751	3646
4216	TX	JHU	5.0 ug	4259	4221	4575	4591	4067	2656	3583
H2.1	JHU	JHU	5.0 ug	3767	3715	4032	4028	3535	2550	3015
H2.2	JHU	JHU	5.0 ug	4393	4301	4811	4808	4354	3540	3698
H2.3	JHU	JHU	5.0 ug	4670	4772	5166	5162	4514	3660	3986

Badge ID	SPK	Anal	Spike level	Methylene Chloride ng/badge	MTBE ng/badge	Chloroprene ng/badge	Chloroform ng/badge	Carbon Tetrachloride ng/badge	Benzene ng/badge	Trichloro-ethylene ng/badge
4220	TX	JHU	10 ug	9158	9882	7003	10233	9776	8979	9387
4221	TX	JHU	10 ug	8613	8959	6300	9741	9085	8184	8683
4222	TX	JHU	10 ug	8562	9379	6666	9520	9042	8422	8597
H1.1	JHU	JHU	10 ug	8076	8413	7669	8965	8489	7859	7915
H1.2	JHU	JHU	10 ug	7814	8189	7633	8702	8474	7702	7913
H1.3	JHU	JHU	10 ug	9376	9490	8747	10338	9950	8823	9238
ST 4217	TX	TX	10 ug	12326	10243	7404	10082	9417	8735	9161
ST 4218	TX	TX	10 ug	15266	12631	9452	12378	11656	10958	11422
ST 4219	TX	TX	10 ug	11884	9798	7409	9648	9031	8413	8848
T1.1	JH	TX	10 ug	12965	10397	10208	10680	10164	9393	9798
T1.2	JH	TX	10 ug	13947	11193	10985	11467	10908	10136	10605
T1.3	JH	TX	10 ug	12877	10361	10212	10505	10165	9498	9804
Badge ID	**SPK**	**Anal**	**Spike level**	**Toluene ng/badge**	**Tetrachloro-ethylene ng/badge**	**Ethyl-benzene ng/badge**	**m,p-Xylene ng/badge**	**o-Xylene ng/badge**	**Styrene ng/badge**	**1,4-Dichloro-benzene ng/badge**
4220	TX	JHU	10 ug	8988	8735	9495	9508	8358	5947	7465
4221	TX	JHU	10 ug	8214	8021	8764	8778	7640	5098	6468
4222	TX	JHU	10 ug	8219	7976	8868	8882	7844	5688	6978
H1.1	JHU	JHU	10 ug	7661	7279	8007	8001	6979	5293	5992
H1.2	JHU	JHU	10 ug	7437	7202	8096	8090	7170	5915	6289
H1.3	JHU	JHU	10 ug	8869	8607	9381	9374	8221	6744	7187
ST 4217	TX	TX	10 ug	8191	7829	8606	16382	477	7523	5665
ST 4218	TX	TX	10 ug	10273	9859	10897	20736	1152	9406	7027
ST 4219	TX	TX	10 ug	8033	7745	8514	16316	973	7346	5473
T1.1	JH	TX	10 ug	8671	8443	9139	8978	7895	6609	6935
T1.2	JH	TX	10 ug	9455	9233	10016	9754	8612	7069	7531
T1.3	JH	TX	10 ug	8876	8680	9328	9171	8184	7078	7373

APPENDIX F

Survey Forms

Form F-1. Initial contact recruitment form

Initial Contact Recruitment Form

Block:_______________

Street Address:____________________________/Apt.:_______________

City: Baltimore / Zip Code:_______________

GPS Reading: Latitude:__________________; Longitude:________________;

Interviewer / Technician:_________________; Date Completed:____/___/___;

Hello. I'm (NAME) with the Johns Hopkins University School of Public Health. We are conducting a study to address community concerns over exposure to air toxins. Your home is one of 40 in Brooklyn and Curtis Bay that has been randomly selected to be in the study. Do you have a few minutes now, or can we schedule a time at your convenience to tell you more about the study?

Is the respondent a permanent resident of the household? YES NO

Does anyone within the household smoke within the home? YES NO

Number of persons who live in the residence?

Is this home rented or owned? Rent Owned

List persons who live in residence by first name. Co mment:

First Name	Sex	DOB

What is (NAME's) race? (READ CHOICES AND CIRCLE ONE NUMBER IN COLUMN E.)

White	1
Black or African-American	2
American Indian	3
Eskimo or Aleut	4
Asian or Pacific Islander	5
Some other race (Specify:____________)	6
DON'T KNOW	DK
REFUSED	RE

What is the telephone number, starting with the area code?

(______)-______-________ SSN: ___-___-___ (this needed for incentive payment)

Form F-1. (continued)

Initial Contact Letter

Dear Brooklyn / Curtis Bay Resident:

The Johns Hopkins University School of Public Health is conducting a study to address community concerns over exposure to air toxins. Your home is one of forty in Brooklyn and Curtis Bay that has been randomly selected to be a part of this important study. Participation in the study is easy and we will give you $25 for helping us. If you agree, we will conduct air sampling for three days. During this time, you will be asked to wear a small air sampling badge, complete a couple of short questionnaires, and provide a couple of urine samples each day.

I hope that you can work with us to help address your community's concern over toxins in the air. If you have any questions or concerns, I can be reached at (410) 614-5750 or email Tbuckley@jhsph.edu.

Sincerely,

Timothy J. Buckley, Ph.D.
Assistant Professor

Form F-2. Instruction for participants

Instructions for Participants

Diet

We are trying to avoid one type of food preservative called **sorbic acid** or **potassium sorbate**. It is not dangerous, but it affects the urine test we do. Therefore, during the study we would like you to try to avoid the following 3 food types:

1. **fruit punch drinks** that come refrigerated such as Sunny Delight™, and store brand fruit drinks;
2. **baked sweets/snacks** such as Hostess Cupcakes™, Little Debbie™, grocery store cakes, and soft packaged cookies like Snack Wells™ and Fig Newtons;
3. **soft cheeses** including **processed cheese slices**, cottage cheese, cheese spreads, Velveeta™, cheese dips, low fat cream cheese and low fat shredded cheese.

Some other foods, such as salad dressings and mayonnaise, also have this preservative in them. We would like you to pick one day on the study, tomorrow or the next day, to be very careful about avoiding all packaged foods that might have this preservative in it. To make it easier, we are giving you a log that lists food to avoid and sample labels from foods with this preservative in them. **On the day you pick to avoid all sorbic preservatives**, please don't eat anything that comes in a package unless you read the ingredients label and don't see the words **"sorbic acid"** or **"potassium sorbate"**. Labels usually note when substances are added as preservatives and so you can look for the words "preservative", "to protect flavor", and "to retain freshness".

Urine Collection

Some of the chemicals in air pollution that you breathe in are changed by your body so that you can get rid of them in your urine. We collect samples of urine to test for the breakdown product from benzene, which is one of these air pollutants. Starting tomorrow morning, please collect three samples each day : 1) the first void of the morning; 2) a late afternoon void when you come home from school or work or around 4-5 pm; and 3) the last void of the day before you go to bed at night. Please do not fill the container completely since the sample will expand when we freeze it. Put a label on the container with the time, and date of the sample (press hard when you write out the label to make the carbon copy). Place the sample in the cooler that we have provided.

Daily Time /Activity and Food Questionnaires

A questionnaire has been provided to keep track of the time that you spend indoors, outdoors, and around air pollution sources. A food log will be used to keep track of all packaged food you eat. These forms should be filled out over the course of each day or at the end of each day so that you can remember everything.

In Case of Trouble or Questions

If you have any questions or trouble do not hesitate to give us a call, day or night. We will especially want to know if an air sampler should stop working so that we can repair or replace

Form F-3. Technician walk-through questionnaire

Mickey Leland National Urban Air Toxics Research Center
VOC Exposure in an Industry Impacted Community

TECHNICIAN WALK-THROUGH QUESTIONNAIRE

Participant Identification Number

[Place Label Here]

TECHNICIAN WALK-THROUGH QUESTIONNAIRE

==

LOCATION DATA (Technician Completed--address/ID label)

Street Address____/ Apt./Space #________

City, Zip____/ Zip code____________

==

INTERVIEWER/TECHNICIAN ID: Date Completed: _____/_____/_____

Form F-3. (continued)

TECHNICIAN WALK-THROUGH QUESTIONNAIRE

COMPLETE THIS QUESTIONNAIRE BY OBSERVATION. YOU MAY ASK PARTICIPANT ANY QUESTIONS THAT ARE NOT APPARENT.

T1. How many stories (floors) are in this building? (COUNT ONLY FLOORS WITH FINISHED ROOMS FOR LIVING PURPOSES OR FINISHED BASEMENTS.)

_____ Floors

IF MULTI-FAMILY BUILDING , CONTINUE. ELSE, GO TO QUESTION T3.

T2. Which floor(s) do respondents live on? ________ floor(s).

T3. Of these rooms, how many are carpeted or have rugs covering most (>50%) of their surface?

_____ Rooms

T4. Using the following statements, how would you rate the overall dust level within the residence? (CIRCLE ONE.)

Very Dusty --	1
Some Dust -- obvious efforts to control dust	2
"No" Dust -- extreme dust control, very clean	3

T5. Indicate nearest major intersection:

EXTERIOR AND INTERIOR RESIDENTIAL CHARACTERISTICS

T6. Distance to street (MEASURE THE DISTANCE FROM THE CURB TO THE PRIMARY ENTRANCE TO THE RESIDENCE OR CHECK BOX IF DISTANCE IS ESTIMATED TO BE GREATER THAN 300 FEET.):

_____ Feet

_____ >300 feet

T7. Number of cars parked on the street outside of the front of the home (COUNT THE CARS ON BOTH SIDES OF THE STREET THAT ARE PARKED ON THE SAME BLOCK AS THE RESIDENCE)

_____ Cars

T8. Number of cars parked in the back of the home.

_____ Cars

Form F-4. Time/activity questionnaire

TIME DIARY AND ACTIVITY QUESTIONNAIRE

==

DESIGNATED PARTICIPANT

(If the participant is less than 10 years old, what is the name of the individual who is providing the answers for the designated respondent?)

Name of Participant______________________________________

Completed by____ (if other than participant)

Relation to participant___________________________________

Home Phone ____ Date: _____/_____/_____

==

LOCATION DATA (Technician Completed--address/ID label)

Street Address____/ Apt./Space #________________

City, Zip____/ Zip code____________________

Study Block # _________ Block Group #_________________ Census Tract #_______________

==

INTERVIEWER/TECHNICIAN ID:________________________________ Date Completed: _____/_____/_____

==

Form F-4. (continued)

TIME DIARY AND ACTIVITY QUESTIONNAIRE

At the end of each day, take a few minutes to record the time (you/your child) spent in each of the seven listed locations. There is one box for each day of the study. The numbers in the box stand for hours of the day. For example, 5 in the morning is 5:00 a.m. to 5:59 a.m. For each hour of the day, place an X through the number for each location where (you/your child) spent any time during the hour. Make sure there is at least one X for each hour of the day.

The terms used in the time diary are defined as follows:

- Home: The house or apartment where (you live/your child lives); the location where we are collecting samples.
- School: A place away from home where (you attend/your child attends) school.
- Transit: Any travel from one location to another, including all travel between such places as home, school, and shopping centers, as well as all other travel on roads, paths, or trails.
- Other: All other places (you spend/your child spends) time besides home, work, school, and in transit between locations.

Form F-4. (continued)

Day 1 Day of Week_______	Location	Morning	Afternoon	Evening	Early Morning (Night time)
DATE__/__/__	In Transit Refueling Smoker Nearby	5 6 7 8 9 10 11 5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4 12 1 2 3 4
	Inside at Home Inside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4
	Outside at Home Outside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4

Day 2 Day of Week_______	Location	Morning	Afternoon	Evening	Early Morning (Night time)
DATE__/__/__	In Transit Refueling Smoker Nearby	5 6 7 8 9 10 11 5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4 12 1 2 3 4
	Inside at Home Inside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4
	Outside at Home Outside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4

Day 3 Day of Week_______	Location	Morning	Afternoon	Evening	Early Morning (Night time)
DATE__/__/__	In Transit Refueling Smoker Nearby	5 6 7 8 9 10 11 5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4 12 1 2 3 4
	Inside at Home Inside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4
	Outside at Home Outside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4

Day 4 Day of Week_______	Location	Morning	Afternoon	Evening	Early Morning (Night time)
DATE__/__/__	In Transit Refueling Smoker Nearby	5 6 7 8 9 10 11 5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4 12 1 2 3 4
	Inside at Home Inside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4
	Outside at Home Outside at Other	5 6 7 8 9 10 11 5 6 7 8 9 10 11	12 1 2 3 4 5 12 1 2 3 4 5	6 7 8 9 10 11 6 7 8 9 10 11	12 1 2 3 4 12 1 2 3 4

Form F-4. (continued)

DIALY ACTIVITY INFORMATION

	1	2	3	4
	Day ____ Date / /	Day ____ Date / /	Day ____ Date / /	Day ____ Date / /

Questions A1-A3: Please circle "Y" for Yes or "N" for No.

		1	2	3	4
A1.	Did (you/your child) start or tend a fire in a fireplace or wood stove today?	Y N	Y N	Y N	Y N
A2.	Did (you/your child) use an outdoor grill or burn wood, leaves, or trash today?	Y N	Y N	Y N	Y N
A3.	Were any tobacco products smoked in the home today?	Y N	Y N	Y N	Y N
A4.	Did you burn candles or incense today?	Y N	Y N	Y N	Y N
A5.	Did you visit hair or nail salon today?	Y N	Y N	Y N	Y N
A6.	Did you pump gas today? Was you child with you?	Y N Y N	Y N Y N	Y N Y N	Y N Y N
A7.	Did you visit a dry-cleaning store today Was you child with you?	Y N Y N	Y N Y N	Y N Y N	Y N Y N
A8.	Did you bring dry cleaned clothes home today?	Y N	Y N	Y N	Y N

Questions A9-A13: Please enter time spent. If the time was less than 1 hour, enter 15 min, 30 min, 45 min, or 1 hr, whichever is closest to time actually spent. If time was greater than 1 hour, round to the nearest hour. Circle either min. or hr.

		1	2	3	4
A9.	(You/your child) traveled on roadways or highways today?	____min or hr	____min or hr	____min or hr	____min or hr
A10.	(You/your child) use any chemicals today in hobbies, home repair or car repair (e.g. paints, paint stripper, glues, gasoline)	____min or hr	____min or hr	____min or hr	____min or hr
A11.	(You/your child) spent in a vehicle with someone who was smoking?	____min or hr	____min or hr	____min or hr	____min or hr
A12.	(You/your child) spent in an enclosed workshop or garage used as a workshop today?	____min or hr	____min or hr	____min or hr	____min or hr
A13.	Doors and windows **at your house** were left open for ventilation today?	____min or hr	____min or hr	____min or hr	____min or hr

For Technician Use Only	Comp. [ ] Asst. [ ] Do [ ]	Comp. [ ] Asst. [ ] Do [ ]	Comp. [ ] Asst. [ ] Do [ ]	Comp. [ ] Asst. [ ] Do [ ]

Form F-5. Baseline questionnaire

BASELINE QUESTIONNAIRE

==

DESIGNATED PARTICIPANT

(If the participant is less than 10 years old, what is the name of the individual who is providing the answers for the designated respondent?)

Name of Participant______________________________________

Completed by____ (if other than participant)

Relation to participant___________________________________

Home Phone ____ Date: _____/_____/_____

==

LOCATION DATA (Technician Completed--address/ID label)

Street Address____/ Apt./Space #________________

City, Zip____/ Zip code____________________

Study Block # __________ Block Group #_________________ Census Tract #_______________

==

INTERVIEWER/TECHNICIAN ID:________________________________ Date Completed: _____/_____/_____

==

NOTE: For children participants (less than 16 years of age), only answer Question numbers 59 - 65.

Form F-5. (continued)

DEMOGRAPHICS

1. What is the highest level of school (you have/this child has) completed? (READ CHOICES AND CIRCLE ONE.) IF CURRENTLY ENROLLED, MARK THE LEVEL OF PREVIOUS GRADE ATTENDED OR HIGHEST DEGREE RECEIVED.

No school completed or Kindergarten only	1
Primary or middle school (Grade 1-8)	2
Some high school (Grade 9-11)	3
High school graduate (Grade 12 or GED)	4
Some college or technical school	5
College graduate	6
Some post college	7

2. CIRCLE SEX OF PARTICIPANT.

MALE	1
FEMALE	2

3. What is (your/his/her) date of birth? _________/______/_______
   Month Day Year

4. How tall (are you/is he/she) without shoes? _____ft _____inches

5. How much (do you/does he/she) weigh? _____ pounds

6. What is (your/his/her) racial/ethnic background? (READ CHOICED AND CIRCLE RESPONSE)

BLACK/AFRICAN AMERICAN	1
WHITE/CAUCASIAN AMERICAN	2
HISPANIC	3
ASIAN	4

Form F-5. (continued)

PERSONAL EXPOSURE ACTIVITIES

7. Do you currently work full time or part time at any location away from your home? (CIRCLE "Y" OR "N." INCLUDE WORKING FOR OTHERS, SELF-EMPLOYED, AND VOLUNTEER WORK. INCLUDE THOSE WHO WORK OUT OF A HOME OFFICE IF THEY WORK PART OF THE TIME AWAY FROM HOME.)

YES	Y → CONTINUE
NO	N → GO TO 26

8. On average for the past month, how many hours per week did (you/he/she) work at (your/his/her) primary job? (INCLUDE WEEKS WHERE TIME WAS TAKEN OFF FOR VACATION, SICKNESS, ETC. IF LESS THAN 10 HOURS, ROUND TO THE NEAREST HOUR; IF GREATER THAN 10 HOURS, ROUND TO THE NEAREST 10 HOURS; e.g., 10, 20, 30, 40, 50 HOURS).

    ______ hours/week

    i. On average, how many of these hours were spent working at home?
    ______ hours/week

9. What kind of business or industry is this? (For example, manufacturing, retail store, government, farm, school.)

    ____

10. Is the business or industry located in the South Baltimore community? (Curtis Bay, Brooklyn, Wagner's Point, Hawkins Point, or Fairfield)

    YES
    NO

11. What is (your/his/her) job title? (For example, electrical engineer, stock clerk, typist)

    ____

12. What activities (do you/does he/she) perform most often as part of (your/his/her) duties at that job? (For example, typing, keeping account books, filing, selling cars, operating printing press, finishing concrete.)

    ____

13. (Do you/Does he/she) wear protective clothing while at (your/his/her) primary job? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 15

14. Which types of protective clothing (do you/does he/she) wear while at (your/his/her) primary job? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Gloves	1
Overalls	2
Overcoat (e.g. lab coat; smock)	3
Respirator	4
Other (Specify:______________________)	5
DON'T KNOW	DK

Form F-5. (continued)

15. While at (your/his/her) primary job, (do you/does he/she) come into contact at least once a week with? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Welding fumes	1
Solder or flux fumes	2
Plastic fumes	3
Paint fumes (include varnish, shellac, etc.)	4
Gasoline or diesel fumes	5
Other known type of fumes, smoke, gas, or vapors (Specify:___________________________)	6
Unknown type of fumes, smoke, gas, or vapors	7
No contact with fumes, smoke, gas, or vapors	8

16. Do you have a second job? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 26

17. On average for the ***past month***, how many hours ***per week*** did (you he/she) work at (your/his/her) second job? (INCLUDE WEEKS WHERE TIME WAS TAKEN OFF FOR VACATION, SICKNESS, ETC. IF LESS THAN 10 HOURS, ROUND TO THE NEAREST HOUR; IF GREATER THAN 10 HOURS, ROUND TO THE NEAREST 10 HOURS; e.g., 10, 20, 30, 40, 50 HOURS).

_______ hours/week

i. On average, how many of these hours were spent working at home?
______ hours/week

18. What kind of business or industry is this? (For example, manufacturing, retail store, government, farm, school.)

____

19. Is the business or industry located in the South Baltimore community? (Curtis Bay, Brooklyn, Wagner's Point, Hawkins Point, or Fairfield)

YES
NO

20. What is (your/his/her) job title? (For example, electrical engineer, stock clerk, typist)

____

21. What activities (do you/does he/she) perform most often as part of (your/his/her) duties at that job? (For example, typing, keeping account books, filing, selling cars, operating printing press, finishing concrete.)

____

22. (Do you/Does he/she) regularly wear protective clothing while at (your/his/her) second job? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 24

Form F-5. (continued)

23. Which types of protective clothing (do you/does he/she) wear while at (your/his/her) second job? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Gloves	1
Overalls	2
Overcoat (e.g., lab coat; smock)	3
Respirator	4
Other (Specify:________________________)	5
Don't know	DK

24. While at (your/his/her) second job, (do you/does he/she) come into contact at least once a week with? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Welding fumes	1
Solder or flux fumes	2
Plastic fumes	3
Paint fumes (include varnish, shellac, etc.)	4
Gasoline or diesel fumes	5
Other known type of fumes, smoke, gas, or vapors (Specify:__________________________)	6
Unknown type of fumes, smoke, gas, or vapors	7
No contact with fumes, smoke, gas, or vapors	8

25. What methods of transportation did you use to go to work, school, shopping, etc in the ***past six months***? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Car, truck, van, or taxi cab	1
Bus, trolley bus, or trolley car	2
Train, subway or elevated train	3
Motorcycle	4
Bicycle	5
Walk	6
Other method (Specify: __________________)	

BASIC HOUSING CHARACTERISTICS

These next questions are about your (house/apartment). Please feel free to ask another member of your household for assistance if necessary.

26. About when was this building first built? (READ CHOICES AND CIRCLE ONE.)

1990 TO PRESENT	1
1985 TO 1989	2
1980 TO 1984	3
1970 TO 1979	4
1960 TO 1969	5
1950 TO 1959	6
1940 TO 1949	7
1939 OR EARLIER	8
DON'T KNOW	DK

27. When did (you/he/she) move into this (house/apartment)? (READ CHOICES AND CIRCLE ONE.)

Month:________ Year ________

Form F-5. (continued)

28. In the last week, have any of the following been performed in this home? (CIRCLE "Y" OR "N.")

	YES	NO
Adding a room	Y	N
Putting up or taking down a wall	Y	N
Replacing windows	Y	N
Refinishing floors	Y	N
Exterior painting	Y	N
Interior painting	Y	N

29. What is the source of the running water in your house/apartment? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Public or commercial water system NAME______________________	1
Private well	2
Cistern	3
Some other source _________________	4
DON'T KNOW	DK

30. Do you use any of the following to treat your water at home? (CIRCLE "Y" or "N" FOR EACH TREATMENT TYPE OR "DK" FOR DON'T KNOW.)

		YES	NO	DON'T KNOW
i.	Water Softener	Y	N	DK
ii.	Charcoal Filter	Y	N	DK
iii.	Reverse Osmosis	Y	N	DK
iv.	Distillation	Y	N	DK
v.	Other (Specify:______________________)	Y	N	DK

31. Is there an enclosed garage attached to this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 35

32. Where is the attached garage? (READ CHOICES AND CIRCLE ONE.)

Underneath the main living quarters	1
Same level as the main living quarters	2
Somewhere else; Specify: ______________	3

33. Is there a doorway leading directly from the garage into the living quarters? (CIRCLE "Y" OR "N.")

YES	Y
NO	N

34. Are automobiles, vans, trucks or other motor vehicles parked in this attached garage? (CIRCLE "Y" OR "N".)

YES	Y
NO	N

35. Are any gas powered devices stored in any room, basement, or attached garage in this (house/apartment)? (CIRCLE ONE. DO NOT INCLUDE CARS, VANS, OR TRUCKS. DO INCLUDE MOTORCYCLES, GAS-POWERED LAWN MOWERS, TRIMMERS OR BLOWERS, BOAT ENGINES, ETC.)

YES	Y
NO	N
DON'T KNOW	DK

Form F-5. (continued)

36. Is air conditioning (refrigeration) used to cool this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 38

37. Which types of air conditioning units do you use? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Central unit/units	1
Window or wall unit/units	2
Portable unit/units	3

38. Which fuels are used for heating this (house/apartment)? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Gas: from underground pipes serving the neighborhood	1
Gas: bottled, tank, or LP	2
Electricity	3
Fuel oil, kerosene, etc.	4
Coal or coke	5
Wood	6
Solar energy	7
Other fuel (Specify: ____________________)	8
No fuel used	9
Don't know	DK

39. Does this (house/apartment) have a central heating system with ducts that blow air into most rooms? (CIRCLE "Y" OR "N.")

YES	Y
NO	N

40. Do you use portable kerosene heaters in this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 42

41. How often do you use your kerosene heater during the heating season? (READ CHOICES AND CIRCLE ONE.)

Less than one day a month	1
One to three days per month	2
One or two days a week	3
3-5 days a week	4
More than 5 days a week	5

42. During the heating season, is a portable or nonvented gas heater used in this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 45

43. How many gas heaters? _________

Form F-5. (continued)

44. How often is a portable or nonvented gas heater used? (READ CHOICES AND CIRCLE ONE.)

Less than one day a month	1
One to three days per month	2
One or two days a week	3
3-5 days a week	4
More than 5 days a week	5

45. During the heating season, is a wood-burning or coal-burning stove used in this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 49

46. How many wood or coal-burning stoves? ___________

47. How often is a wood-burning or coal-burning stove used during the heating season? (READ CHOICES AND CIRCLE ONE.)

Less than one day a month	1
One to three days per month	2
One or two days a week	3
3-5 days a week	4
More than 5 days a week	5

48. What is burned in the stove? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Wood	1
Coal	2
Other: (Specify: ____________________)	3

49. During the heating season, is a fireplace used in this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y → CONTINUE
NO	N → GO TO 53

50. How many fireplaces? _________

51. How often is a fireplace used during the heating season? (READ CHOICES AND CIRCLE ONE.)

Less than one day a month	1
One to three days per month	2
One or two days a week	3
3-5 days a week	4
More than 5 days a week	5

52. What is burned in the fireplace? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Wood	1
Artificial logs	2
Gas fire	3
Other (Specify: ____________)	4

53. Are mothballs used in this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y
NO	N

Form F-5. (continued)

54. Are room deodorizers being currently used in this (house/apartment)? (CIRCLE "Y" OR "N.")

YES	Y
NO	N

55. Do you have your clothes dry cleaned?

YES	Y
NO	N

56. Have you brought clothes home from the dry cleaner in the last week?

YES	Y
NO	N

57. Have you cleaned your carpets in the last week?

YES	Y
NO	N

FAMILY INCOME

58. Family income is often used in scientific studies to compare groups of people who are similar. We do some analysis of the data using these groups. Please remember that all the data you provide is held in strict confidence.

Approximately what is the gross annual income for all family members in this household? (HAND CARD, PENCIL, AND ENVELOPE TO RESPONDENT.) Please circle the number on this card and put the card in the envelope. Seal the envelope and return it to me. (IF RESPONDENT PROVIDES ANSWER DIRECTLY, CIRCLE NUMBER BELOW. IF RESPONDENT SEALS RESPONSE IN ENVELOPE, CIRCLE "EN." IF RESPONDENT DOES BOTH, CIRCLE BOTH NUMBER AND "EN.")

Less than $9,999	1
$ 10,000 - $ 19,999	2
$ 20,000 - $ 29,999	3
$ 30,000 - $ 39,999	4
$ 40,000 - $ 49,999	5
$ 50,000 - $ 74,999	6
$ 75,000 - $ 99,999	7
$100,000 or more	8
ANSWER IN ENVELOPE	EN
DON'T KNOW	DK
REFUSE	RE

Form F-5. (continued)

Children Participant Questions
Ages less than 16 years old

DEMOGRAPHICS

59. What is the highest level of school (you have/this child has) completed?
(READ CHOICES AND CIRCLE ONE.) IF CURRENTLY ENROLLED, MARK THE LEVEL OF PREVIOUS GRADE ATTENDED OR HIGHEST DEGREE RECEIVED.

No school completed or Kindergarten only	1
Primary or middle school (Grade 1-8)	2
Some high school (Grade 9-11)	3
High school graduate (Grade 12 or GED)	4
Some college or technical school	5
College graduate	6
Some post college	7

60. CIRCLE SEX OF PARTICIPANT.

MALE	1
FEMALE	2

61. What is (your/his/her) date of birth? _________/______/_______
Month Day Year

62. How tall (are you/is he/she) without shoes? _____ft _____inches

63. How much (do you/does he/she) weigh? _____ pounds

64. What is (your/his/her) racial/ethnic background? (READ CHOICED AND CIRCLE RESPONSE)

BLACK/AFRICAN AMERICAN	1
WHITE/CAUCASIAN AMERICAN	2
HISPANIC	3
ASIAN	4

65. Do you/does he/she work? If so where? ______________________________

66. What methods of transportation did you/he/she use to go to work, school, or daycare in the past six months? (READ CHOICES AND CIRCLE ALL THAT APPLY.)

Car, truck, van, or taxi cab	1
Bus, trolley bus, or trolley car	2
Train, subway or elevated train	3
Motorcycle	4
Bicycle	5
Walk	6

Other method (Specify: __________________)

Form F-6. Daily food diary

Date: __ __-__ __-00

M M D D

SBCS STUDY DAILY FOOD LOG - DAY ___
ID # __ __

Please try not to eat the following foods during the entire study:

1. **soft cheeses** including **processed cheese slices,** cottage cheese, cheese spreads, Velveeta, cheese dips, low fat cream cheese and low fat shredded cheese.
2. **fruit punch drinks that come refrigerated** (Sunny Delight, store brands)
3. **baked sweets/snacks** (Hostess cupcakes, Little Debbie, grocery store cakes). Packaged cookies OK except soft ones like Snack Wells and Fig Newtons.

On the day you pick to avoid all sorbic preservatives, don't eat anything that comes in a package unless you read the ingredients label and don't see the words **"sorbic acid"** or **"potassium sorbate"**. Labels usually note when substances are added as preservative and so you can look for the words "preservative", "to protect flavor", and "to retain freshness", then see what is listed by it. The sample labels you have been given for the study will also help with this. Please avoid fast or restaurant food on this day also. Foods that often have these preservatives are:

1. salad dressings
2. mayonnaise
3. prepared dips such as humus or for vegetables
4. possibly wine
5. margarine, frosting, syrup
6. sometimes in ice cream (Jack & Jill)

In order to help us get the best test results, please **list all packaged or processed foods or drinks** that you eat at each meal or snack. Include amount and brand name from package.

Time	Food/Drink	Brand Name	How Many/much
11 am	Example: fruit punch	Giant	16 oz

MICKEY LELAND NATIONAL URBAN AIR TOXICS RESEARCH CENTER

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