ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

Evaluation of Air Exposures in Communities Adjacent to the 35th Avenue Site Birmingham, Alabama

EPA FACILITY ID: ALN000410750

APRIL 21, 2015

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 45-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Additional copies of this report are available from:

Agency for Toxic Substances and Disease Registry
Attn: Records Center
1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

PUBLIC HEALTH ASSESSMENT

Evaluation of Air Exposures in Communities Adjacent to the 35th Avenue Site Birmingham, Alabama

EPA FACILITY ID: ALN000410750

Prepared by:

Central Branch
Division of Community Health Investigations
Agency for Toxic Substances and Disease Registry

Forward

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly,

chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Agency for Toxic Substances and Disease Registry
ATTN: Records Center
1600 Clifton Road, NE (Mail Stop F-09)
Atlanta, GA 30333

Contents

Forward 2
Summary 9
Statement of Issues 13
Background 13
Sampling Strategy 16
Climate and Prevailing Winds 21
Sampling Results 22
Pathways Analysis 26
Public Health Implications 27
Acetaldehyde 27
Acetonitrile 29
Acrolein 31
Acrylonitrile 33
Arsenic 35
Benzene 37
Beryllium 40
1,3-Butadiene 43
Cadmium 44
Carbon Tetrachloride 46
Chloroform 48
Chromium 50
Ethylene Dichloride 53
Formaldehyde 55
Hexachloro-1,3-butadiene 56
Manganese 59
Naphthalene 61
Particulate Matter, $PM_{2.5}$ and PM_{10} 63
Polycyclic aromatic hydrocarbons (PAHs), Benzo(a)pyrene Toxic Equivalents (BaP-TE) 68
Trichloroethylene 71
Cumulative Cancer Risks 73
Noncancerous Health Effects From Mixtures 75
Community Concerns 77
Child Health Considerations 78

Adequacy of the Available Data 79
Conclusions, Recommendations, and Public Health Action Plan 80
References 82
Appendix A. Summary of Contaminants Exceeding Comparison Values. 93
Appendix B. Cancer Risk Estimates 111
Appendix C. ATSDR's Responses to Public Comments 116
Comments on Particulate Matter. 116
Comments on Cancer Risk 119
Comments on ATSDR's Recommendation for Additional Chemical Sampling. 121
Miscellaneous Comments 123

Table of Figures

Figure 1. Neighborhood Locations. 14
Figure 2. Demographic Information 15
Figure 3. Air Sampling Locations in 2005/2006 17
Figure 4. 35th Avenue Site and Air Monitoring Stations 18
Figure 5. Wind Rose for North Birmingham, Alabama (2002-2007) 21

List of Tables

Table 1. Summary of 2005/2006 Air Sampling for Acetaldehyde. 28
Table 2. Summary of 2005/2006 Air Sampling for Acetonitrile 30
Table 3. Summary of 2009 Air Sampling for Acetonitrile 30
Table 4. Summary of 2011/2012 Air Sampling for Acetonitrile 31
Table 5. Summary of 2005/2006 Air Sampling for Acrolein. 32
Table 6. Summary of 2005/2006 North Birmingham Air Sampling for Acrylonitrile. 33
Table 7. Summary of 2009 North Birmingham Air Sampling for Acrylonitrile. 34
Table 8. Summary of 2011/2012 North Birmingham Air Sampling for Acrylonitrile. 34
Table 9. Summary of 2005/2006 North Birmingham Air Sampling for Arsenic. 35
Table 10. Summary of 2009 North Birmingham Air Sampling for Arsenic. 36
Table 11. Summary of 2011/2012 North Birmingham Air Sampling for Arsenic. 36
Table 12. Summary of 2005/2006 North Birmingham Air Sampling for Benzene. 38
Table 13. Summary of 2009 North Birmingham Air Sampling for Benzene. 39
Table 14. Summary of 2011/2012 North Birmingham Air Sampling for Benzene. 39
Table 15. Summary of 2005/2006 North Birmingham Air Sampling for Beryllium. 41
Table 16. Summary of 2009 North Birmingham Air Sampling for Beryllium. 42
Table 17. Summary of 2011/2012 North Birmingham Air Sampling for Beryllium. 42
Table 18. Summary of 2005/2006 North Birmingham Air Sampling for 1,3-Butadiene. 43
Table 19. Summary of 2009 North Birmingham Air Sampling for 1,3-Butadiene. 43
Table 20. Summary of 2011/2012 North Birmingham Air Sampling for 1,3-Butadiene. 44
Table 21. Summary of 2005/2006 North Birmingham Air Sampling for Cadmium. 45
Table 22. Summary of 2009 North Birmingham Air Sampling for Cadmium. 45
Table 23. Summary of 2011/2012 North Birmingham Air Sampling for Cadmium. 46

Table 24. Summary of 2005/2006 North Birmingham Air Sampling for Carbon Tetrachloride. 47
Table 25. Summary of 2009 North Birmingham Air Sampling for Carbon Tetrachloride. 47
Table 26. Summary of 2011/2012 North Birmingham Air Sampling for Carbon Tetrachloride. 48
Table 27. Summary of 2005/2006 North Birmingham Air Sampling for Chloroform..... 49
Table 28. Summary of 2009 North Birmingham Air Sampling for Chloroform..... 49
Table 29. Summary of 2011/2012 North Birmingham Air Sampling for Chloroform..... 50
Table 30. Summary of 2005/2006 North Birmingham Air Sampling for Hexavalent Chromium (Chromium VI). 51
Table 31. Summary of 2005/2006 North Birmingham Air Sampling for Total Chromium..... 52
Table 32. Summary of 2009 North Birmingham Air Sampling for Total Chromium..... 52
Table 33. Summary of 2011/2012 North Birmingham Air Sampling for Total Chromium..... 53
Table 34. Summary of 2005/2006 North Birmingham Air Sampling for Ethylene Dichloride ... 53
Table 35. Summary of 2009 North Birmingham Air Sampling for Ethylene Dichloride. 54
Table 36. Summary of 2011/2012 North Birmingham Air Sampling for Ethylene Dichloride. .. 54
Table 37. Summary of 2005/2006 Air Sampling for Formaldehyde. 55
Table 38. Summary of 2005/2006 North Birmingham Air Sampling for Hexachloro-1,3-butadiene. 57
Table 39. Summary of 2009 North Birmingham Air Sampling for Hexachloro-1,3-butadiene... 57
Table 40. Summary of 2011/2012 North Birmingham Air Sampling for Hexachloro-1,3-butadiene. 58
Table 41. Summary of 2005/2006 North Birmingham Air Sampling for Manganese. 59
Table 42. Summary of 2009 North Birmingham Air Sampling for Manganese. 60
Table 43. Summary of 2011/2012 North Birmingham Air Sampling for Manganese. 60
Table 44. Summary of 2005/2006 North Birmingham Air Sampling for Naphthalene. 61
Table 45. Summary of 2009 North Birmingham Air Sampling for Naphthalene. 62
Table 46. Summary of 2011/2012 North Birmingham Air Sampling for Naphthalene. 62
Table 47 Summary of $PM_{2.5}$ Sampling Results from the North Birmingham and Providence Monitoring Stations (1999-2013). 64
Table 48 Summary of PM_{10} Sampling Results from the North Birmingham and Shuttlesworth Monitoring Stations (1999-2013) 65
Table 49.Summary of $PM_{2.5}$ Sampling Results from the Huntsville, Alabama Monitoring Station (1999-2013)..... 67
Table 50. Summary of 2005/2006 North Birmingham Air Sampling for BaP-TE..... 69
Table 51. Summary of 2009 North Birmingham Air Sampling for BaP-TE..... 70
Table 52 Summary of 2011/2012 North Birmingham Air Sampling for BaP-TE..... 70
Table 53. Summary of 2005/2006 North Birmingham Air Sampling for Trichloroethylene..... 72
Table 54. Summary of 2009 North Birmingham Air Sampling for Trichloroethylene. 72
Table 55. Summary of 2011/2012 North Birmingham Air Sampling for Trichloroethylene. 73
Table 1A. Summary of Sampling Results from the East Thomas Air Monitor Site (2005/2006) for Chemicals above Comparison Values (CVs). 95
Table 2A. Summary of Sampling Results from the North Birmingham Air Monitor (2005/2006) for Chemicals above Comparison Values (CVs). 96
Table 3A. Summary of Sampling Results from the Providence Air Monitor (2005/2006) for Chemicals above Comparison Values (CVs)..... 98
Table 4A. Summary of Sampling Results from the Shuttlesworth Air Monitor (2005/2006) for Chemicals above Comparison Values (CVs)..... 99

Table 5A. Summary of Sampling Results from the Riggins School Air Monitor (2009) for Chemicals above Comparison Values (CVs). 101
Table 6A. Summary of Sample Results from the North Birmingham Elementary School Air Monitor (2009) for Chemicals above Comparison Values (CVs). 102
Table 7A. Summary of Sampling Results from Lewis Elementary School Air Monitor (2009) for Chemicals above Comparison Values (CVs). 103
Table 8A. Summary of Sampling Results from the Hudson K-8 School Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs). 104
Table 9A. Summary of Sampling Results from the Shuttlesworth Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs). 105
Table 10A. Summary of Sampling Results from the Riggins School Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs). 106
Table 11A. Summary of Sampling Results from the Lewis Elementary School Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs). 107
Table 12A. Summary of $PM_{2.5}$ Sampling Results from the North Birmingham and Providence Air Monitors (1999-2013). 109
Table 13A. Summary of PM_{10} Sampling Results from the North Birmingham and Shuttlesworth Air Monitor (1999-2013). 110
Table 1 B. Cancer Risk Estimates for North Birmingham Using Average Detected Concentrations. 113
Table 2B. Cancer Risk Estimates for North Birmingham Air Using the 95% UCL Calculated by EPA or Jefferson County Department of Health 114

Acronyms

ATSDR = Agency for Toxic Substances and Disease Registry
AMCV = Air Monitoring Comparison Value
BaP-TE = Benzo(a)pyrene Toxic Equivalents
CREG = Carcinogenic Risk Evaluation Guide
CEL = Cancer Effect Level
CSF = Cancer Slope Factor
CV = Comparison Value
EPA = United States Environmental Protection Agency
HAP = Hazardous Air Pollutant
HEC = health equivalent concentration
IUR = Inhalation Unit Risk
JCDH = Jefferson County Department of Health
LOAEL= Lowest Observed Adverse Effect Level
MRL = Minimal Risk Level
$\mu g/m^3$ = micrograms per cubic meter of air.
NAAQS = National Ambient Air Quality Standards
NOAEL = No Observed Adverse Effect Level
PAH = Polycyclic Aromatic Hydrocarbon
$PM_{2.5}$ = Particulate matter equal to or less than 2.5 micrometers in diameter
PM_{10} = Particulate matter equal to or less than 10 micrometers in diameter
RfC = Reference Concentration
RfD = Reference Dose
RSLs = Regional Screening Levels
SVOC = Semi-Volatile Organic Compound
TCEQ = Texas Commission on Environmental Quality
TSP = Total Suspended Particulates
95% UCL = 95% Upper Confidence Limit of the Average
VOC = Volatile Organic Compound

Summary

The Public Health Issues

The United States Environmental Protection Agency (EPA) Region IV requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate environmental data collected from three communities in North Birmingham, Jefferson County, Alabama in the vicinity of the 35th Avenue Site. This area contains or has in the past contained two coking operations, pipe manufacturing facilities, asphalt batch plants, quarries, steel manufacturing facilities, and other industries. Additionally, the area features heavy rail transportation routes and rail yards, two adjacent interstate highways, and the nearby Birmingham-Shuttlesworth International Airport. The purpose of this public health assessment is to determine if exposure to air contaminants in Collegeville, Harriman Park, and Fairmont communities is a public health hazard for people who live or work in the area. Air samples were collected near these three communities in 2005/2006, 2009, and 2011/2012. In 2005/2006, the Jefferson County Department of Health collected samples from four locations and analyzed for 102 different contaminants. In 2009, the EPA collected air samples from three area schools and analyzed for 59 different contaminants. In 2011/2012, the EPA collected samples at four locations and analyzed for 91 different contaminants. The Jefferson County Department of Health implements and enforces air pollution control standards and has oversight of industries in this area.

Conclusions

ATSDR has evaluated the past and current exposures to air contaminants in the communities in the vicinity of the 35th Avenue Site. On the basis of the likely exposure pathways and the available environmental data, ATSDR concludes the following:

Conclusion 1:

Exposures to particulate matter in North Birmingham air in the past (1999-2012) could have resulted in harmful effects in sensitive individuals but not the general public. Population subgroups that may be more sensitive to the effects of particulate matter exposure include children (under 18 years of age), older adults (over 65 years old), individuals with asthma, chronic obstructive pulmonary disease (COPD), or cardiovascular disease, diabetics, lower socioeconomic status, and those with certain genetic predispositions.

Basis for Conclusion:

ATSDR reviewed sampling data from 1999-2013 for $PM_{2.5}$ and PM_{10}. In the past, short-term $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 microns or less) and PM_{10} (particulate matter with an aerodynamic diameter of 10 microns or less) levels measured at the North Birmingham, Providence, and Shuttlesworth monitoring stations have been in the range considered by the EPA (based on the Air Quality Index) to be a concern for sensitive populations, but not for the general public. However, as defined by the EPA, short-term levels of $PM_{2.5}$

measured at the North Birmingham monitoring station have been in compliance with the current standard since 2009. Short-term levels of PM_{10} in the North Birmingham area have not exceeded the current standard since 2008.

The annual average concentrations of $PM_{2.5}$ measured at the North Birmingham monitoring station in the past were above EPA's current standard of 12.0 micrograms per cubic meter and above EPA's previous annual standard of 15.0 micrograms per cubic meter.

Next Steps:

ATSDR recommends the Jefferson County Department of Health continue to monitor for particulate matter at the North Birmingham (in the Collegeville neighborhood) and Shuttlesworth (in the Harriman Park neighborhood) monitoring stations.

Conclusion 2:

Current exposures to particulate matter in North Birmingham air are unlikely to result in harmful effects in individuals.

Basis for Conclusion:

The most recent (2011-2013) annual average concentrations of $PM_{2.5}$ measured at the North Birmingham monitoring station show compliance with the EPA's annual NAAQS for $PM_{2.5}$. The most recent annual average concentrations of $PM_{2.5}$ measured at the North Birmingham monitoring station are also similar to the annual average concentrations in the recent past of other areas of Alabama. As noted above, the most recent short term concentrations of $PM_{2.5}$ and PM_{10} measured at the North Birmingham monitoring station have been in compliance with the NAAQS since 2009 and 2008, respectively.

Next Steps:

ATSDR recommends the Jefferson County Department of Health continue to monitor for particulate matter at the North Birmingham (in the Collegeville neighborhood) and Shuttlesworth (in the Harriman Park neighborhood) monitoring stations.

Conclusion 3:

Levels of air contaminants (volatile organic compounds, semi-volatile organic compounds, carbonyls, and metals) in North Birmingham air are not likely to result in harmful noncancerous health effects.

Basis for Conclusion:

The results of air contaminant sampling in 2005/2006, 2009, and 2011/2012 are below levels likely to result in harmful noncancerous health effects. ATSDR did not have air sample results for volatile organic compounds, semi-volatile organic compounds, carbonyls, and metals prior to 2005/2006.

Next Steps:

ATSDR recommends the EPA or Jefferson County Department of Health continue to manage the risk posed by air toxics by

a. Improving air quality in North Birmingham through regulation, enforcement, and collaboration with the community using approaches that go beyond regulation.
b. Resampling for air contaminants if there is a substantial increase in emissions of contaminants due to additional industry locating in the area or modification of existing industry in the area.

Conclusion 4:

The current estimated cumulative cancer risks from air contaminants in North Birmingham are within EPA's target risk range and represent a low to very low increased cancer risk. Using high-end estimates (95% upper confidence limits) of the concentrations of contaminants in North Birmingham air to estimate cancer risk, it is estimated that there may be one additional cancer out of a population of 10,000 people exposed to these contaminants over a 70-year lifetime.

Basis of Conclusion:

The EPA has a target cancer risk range of 1×10^{-6} to 1×10^{-4}. The cumulative cancer risk estimates based upon 2011/2012 sampling at all monitoring stations are 1×10^{-4} or lower even if the high end estimates (95% upper confidence limits) of the chemical concentrations in 2011/2012 are used to estimate cancer risk.

Next Steps:

ATSDR recommends the EPA or Jefferson County Department of Health continue to manage the risk posed by air toxics by

a. Improving air quality in North Birmingham through regulation, enforcement, and collaboration with the community using approaches that go beyond regulation.
b. Resampling for air contaminants if there is a substantial increase in emissions of contaminants due to additional industry locating in the area or modification of existing industry in the area.

Conclusion 5:

Past levels of air contaminants at the Riggins monitoring station (in 2009) and the Shuttlesworth monitoring station (in 2005/2006) represented an estimated cancer risk above EPA's target risk range. Using average concentrations of contaminants measured at these two stations, it is estimated that there may be two additional cancers out of a population of 10,000 people exposed to these contaminants over a 70-year lifetime.

Basis for Conclusion:

Cumulative cancer risk estimates based on the 2005/2006 (Shuttlesworth) and 2009 (Riggins) sampling results show a cumulative cancer risk of 2×10^{-4} even if the average concentrations of the air contaminants are used to estimate cancer

risk. These cancer risk estimates assume people would be exposed to the average concentrations of air contaminants at these stations every day for 70 years. It is also worth noting the 2009 sampling was completed as a part of a screening survey, and its primary goal was to determine which chemicals were at levels requiring further evaluation or follow up. Additionally, ATSDR did not have air sample results for volatile organic compounds, semi-volatile organic compounds, carbonyls, and metals prior to 2005/2006.

Next Steps:

ATSDR recommends the EPA or Jefferson County Department of Health continue to manage the risk posed by air toxics by

a. Improving air quality in North Birmingham through regulation, enforcement, and collaboration with the community using approaches that go beyond regulation.
b. Resampling for air contaminants if there is a substantial increase in emissions of contaminants due to additional industry locating in the area or modification of existing industry in the area.

For More Information

If you have concerns about your health, you should contact your health care provider. For questions or comments related to this Public Health Assessment please call ATSDR at 1-800-CDC-INFO:

Statement of Issues

The United States Environmental Protection Agency (EPA) Region IV requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate environmental data collected from three communities in the vicinity of the 35th Avenue Site in North Birmingham, Jefferson County, Alabama. The three communities are: Collegeville, Harriman Park, and Fairmont. Citizens in these three communities are concerned about whether breathing the air is safe for them and their children and grandchildren. This area contains and historically has contained two coking facilities, pipe manufacturing facilities, asphalt batch plants, quarries, steel manufacturing facilities, and other industries. Additionally, the area features heavy rail transportation routes and rail yards, two adjacent interstate highways, and the nearby Birmingham-Shuttlesworth International Airport. Air samples were collected from the area in 2005/2006 by the Jefferson County Department of Health. In 2005/2006, samples were collected at four locations and analyzed for 102 different contaminants. In 2009 and 2011/2012, air samples were collected by the Environmental Protection Agency. In 2009, samples were collected at three area schools and analyzed for 59 different contaminants. In 2011/2012, samples were collected at four locations and analyzed for 91 different contaminants.

ATSDR released a public comment version of this public health assessment (PHA) on June 26, 2014 and held several public meetings in the North Birmingham area to present the initial findings of the PHA. ATSDR received several comments during the public comment period. These comments and ATSDR's responses are summarized in Appendix C. Some of the comments warrant changes to the PHA document. Appendix C indicates how the document was revised or explains why no changes were warranted.

Background

Site Description and History

The North Birmingham area has been heavily industrialized for decades. The area under investigation is potentially affected by various industries. The Walter Coke facility has been in operation since 1919 and currently manufactures coke. Another coke oven plant is located in the adjacent city of Tarrant, Alabama. In addition to coke plants, this area includes or has previously included asphalt batch plants, pipe manufacturing facilities, steel producing facilities, quarries and other manufacturing facilities[1]. Additionally, the area features heavy rail transportation routes and rail yards, two adjacent interstate highways, and the nearby Birmingham-Shuttlesworth International Airport. Residential communities near the 35th Avenue Site include the Collegeville, Harriman Park, and Fairmont neighborhoods (Figure 1).

Demographics

According to U.S. 2010 Census data, 13,928 people live within a mile radius of the site. Approximately 10%, or 1,450 are children age 6 and under. Also, 1,904 (about 14%) are adults

[1] The Jefferson County Department of Health's website shows there are 37 major facilities that release air contaminants (i.e. facilities required to obtain a Title V air permit) located in Jefferson County (see http://www.jcdh.org/EH/AnR/AnR13.aspx).

over age 65. A total of 6,727 housing units are within a mile of the site area. Additional demographic information for the community in the vicinity of the site is presented in Figure 2. Approximately one third of North Birmingham residents live below the poverty line (EPA, 2014b).

Figure 1. Neighborhood Locations.

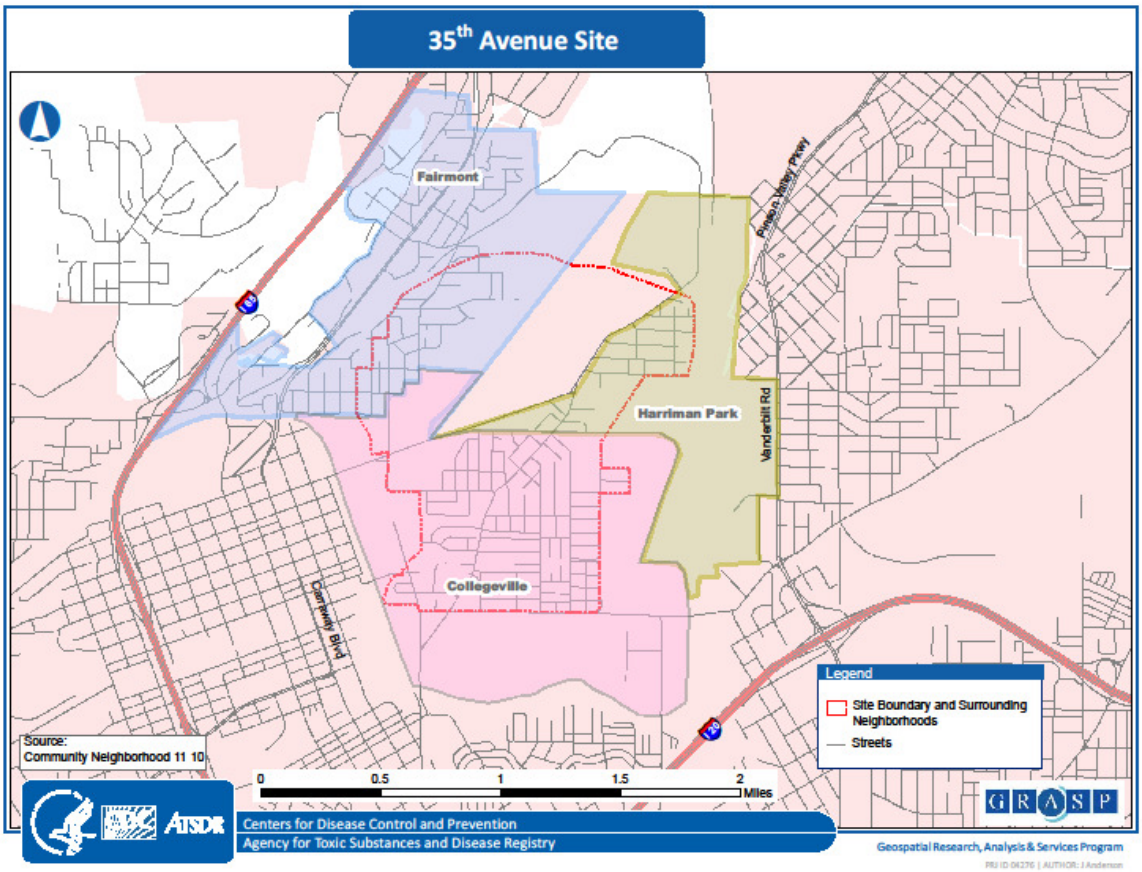
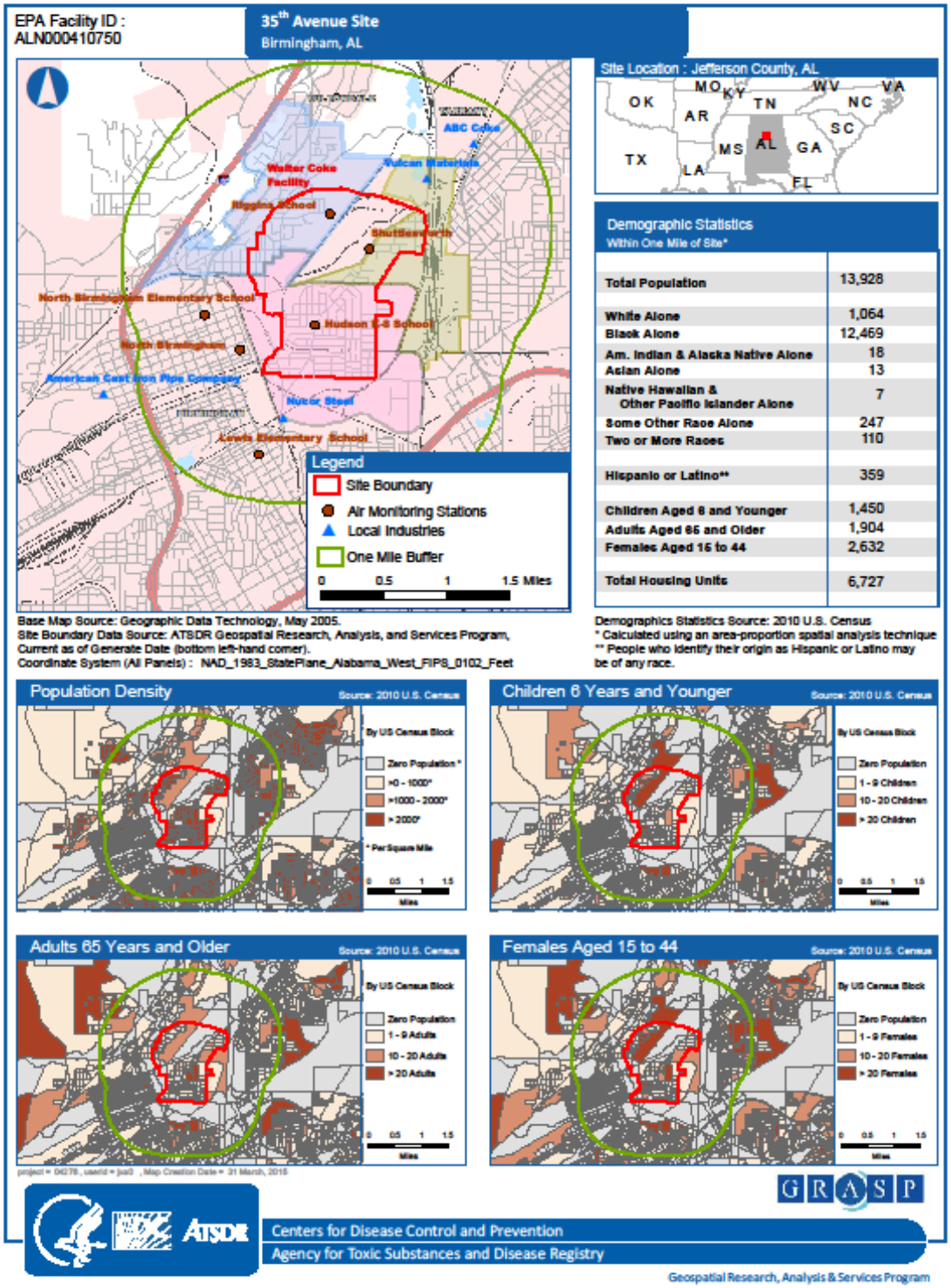


Figure 2. Demographic Information



Sampling Strategy

Sampling Strategy – 2005/2006 Birmingham Air Toxics Report

Between July 2005 and June 2006, the Jefferson County Department of Health (JCDH) sampled the air for a large number of toxic air contaminants at four locations in the Jefferson County, Alabama, area. The four sites were East Thomas, North Birmingham, Providence and Shuttlesworth (Figure 3) (JCDH, 2009). A close-up view of the East Thomas, North Birmingham, and Shuttlesworth monitors as well as the sampling stations used in the later sampling periods can be seen in Figure 4. Each of the four monitoring sites represents an area with unique pollution sources which are briefly described below along with other relevant information.

- **Shuttlesworth**. The Shuttlesworth monitoring site was located near several industrial facilities including two coke oven plants, a mineral wool production facility, pipe manufacturing facilities, asphalt batch plants, and quarries. It was also near a road with a large amount of vehicular traffic. This area was and currently is a mixture of residential and industrial properties (JCDH, 2009; EPA 2013a).
- **North Birmingham**. The North Birmingham monitoring site was located close to most of the same industrial facilities as the Shuttlesworth monitoring site. However, it was closer to the large pipe mill facility and to a highway and interstate (JCDH, 2009).
- **East Thomas**. This site was located close to railroads and highways. The East Thomas monitor was not located near any schools, day care facilities, or nursing homes (JCDH, 2009).
- **Providence**. The Providence site was located in a rural, wooded area approximately 30 miles southwest of the other monitors. JCDH selected this site as a background location (JCDH, 2009).

A total of five monitors were placed at these four locations to test for volatile organic chemicals (VOCs), semi-volatile organic compounds (SVOCs), carbonyls, and metals including hexavalent chromium (Cr+6). At the North Birmingham monitor, metals were tested for in both total suspended particles (TSP) and particulate matter equal to or smaller than 10 microns in diameter (PM_{10})[2]. Air samples were collected every twelfth day for one year (July 15, 2005 to June 26, 2006), resulting in approximately thirty sampling events at each location. Each sample was collected over a 24 hour period (from midnight to midnight).

The JCDH summarized the sampling validation methods as follows:

"All samples were validated by checking monitoring parameters, including sampling flow rates. Samples were invalidated if the samplers did not run continuously over the 24-hour monitoring period, there were equipment malfunctions, and/or the monitors did not maintain proper flows. All invalid samples, however, were rerun on a six-day schedule. Duplicate samples were completed for carbonyls, Cr+6, and VOCs at all sites. Duplicates were run randomly and were in tolerance with original samples. Sample analyses were completed by Eastern Research Group

[2] The JCDH found the sample results for PM and PM_{10} were similar and averaged both data sets for their assessment.

(ERG), an EPA contractor. Duplicate samples were all processed for sample precision"(JCDH, 2009). ATSDR used only the validated samples as a part of this public health assessment.

In 2009, the JCDH noted that," Since the monitoring time period of this study (July 2005 to June 2006), several plants around this site have installed pollution control equipment and have implemented work practice standards (2006 and 2007), in accordance with federal air toxics regulations, resulting in direct reductions in air toxics emissions and concentrations" (JCDH, 2009).

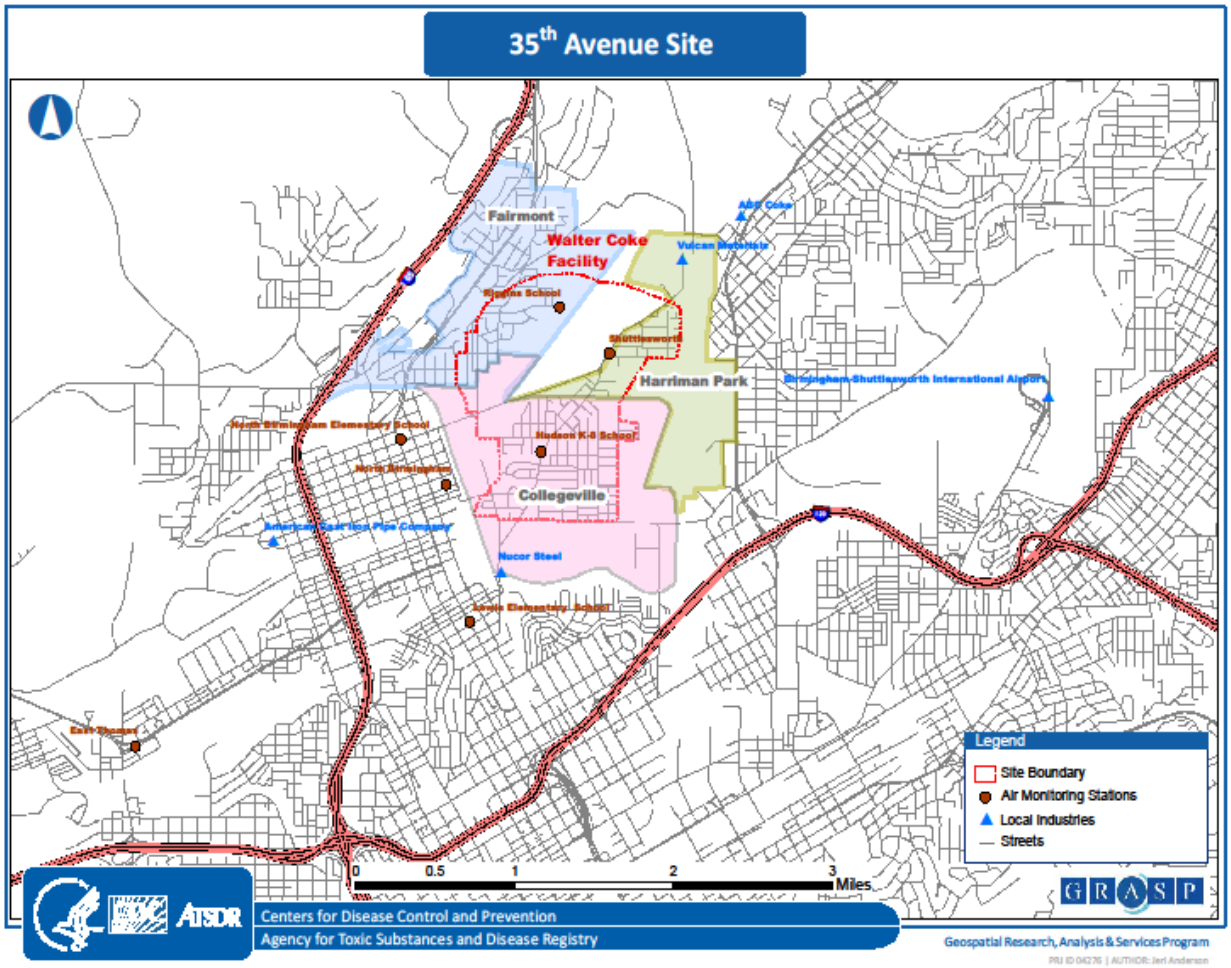
During the course of this public health assessment, it was discovered that Appendix A of JCDH's Birmingham Air Toxics Study report contained an error. The concentrations were reported in micrograms per cubic meter of air ($\mu g/m^3$)[3]. However, for metals and polycyclic aromatic hydrocarbons, the units should have been reported in nanograms per cubic meter in Appendix A of the JCDH report (Personal communication, JCDH; October 1, 2012).

Figure 3. Air Sampling Locations in 2005/2006

Source: JCDH 2009.

[3] The other Appendices of the Birmingham Air Toxics Study use the correct units. Consequently, this error did not appear to affect the assessment of the potential risks of air toxics.

Figure 4. 35th Avenue Site and Air Monitoring Stations



Sampling Strategy – 2009 School Air Toxics Initiative

In 2009, the EPA began a School Air Toxic initiative to monitor air toxics in the outdoor air around schools in two tribal areas and 22 states. The School Air Toxic initiative was a screening survey (EPA, 2014d). As part of this initiative, air samples were collected from the Riggins School (Riggins), North Birmingham Elementary School (N. Birmingham), and Lewis Elementary School (Lewis) in Birmingham, Alabama (Figure 4). Most of the schools monitored as a part of this initiative were chosen based on the results of modeling of emissions from nearby facilities which showed the annual average concentration of hazardous air pollutants (HAPs)

could be of concern[4]. The nearby presence of an electric arc furnace, two coke plants, a lead-emitting source, and a chemical distribution facility led to the selection of these schools. The modeling of these and other sources in the area indicated the potential chemicals of concern at the three North Birmingham schools were lead, benzene, arsenic, and benzo(a)pyrene. Outdoor air monitoring was performed from August 5, 2009, to December 3, 2009 for the following contaminants: benzo(a)pyrene and other polycyclic aromatic hydrocarbons (PAHs); benzene and other volatile organic compounds (VOCs); arsenic and other metals in particulate matter equal to or less than 10 microns in diameter (PM_{10}); and lead in total suspended particulates (TSP). Due to an issue with VOC monitoring equipment, initial VOC results from the Riggins School were invalidated[5]. Additional VOC samples were collected at the Riggins School between November 30, 2009 and December 3, 2009 to ensure that 10 valid samples were available for analysis (EPA, 2011a). Only validated sample results were used for this public health assessment.

The EPA has published several documents describing the School Air Toxics Initiative. Those interested may consider the following:

- *School Air Toxics Ambient Monitoring Plan*. Available at http://www.epa.gov/ttnamti1/files/ambient/airtox/2009sat/SATMonitoringPlan.pdf .
- *Quality Assurance Project Plan For the EPA School Air Toxics Monitoring Program.* Available at http://www.epa.gov/ttn/amtic/files/ambient/airtox/2009sat/SATQAPP.pdf
- *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*. http://www.epa.gov/air/sat/pdfs/UsesOfHealthEffectsInfoinEvalSampleResults.pdf

These documents give further details on the sampling methods and quality control used as a part of the School Air Toxics Initiative. As indicated in these documents, samples were again collected over a 24 hour period.

The EPA noted several interesting points about the production levels of nearby facilities during the 2009 sampling period. The production of the electric arc furnace was about half of the normal production levels. Production at one of the lead emitting facilities fell over 20% in 2009, but began to recover in 2010. Since the 2009 sampling was completed, two of the lead emitting facilities have ceased production (EPA, 2011a).

The production levels of the two coke oven plants during the 2009 sampling period were approximately 58-60% of the production levels of the year prior to and the year after 2009 (2008 and 2010). The EPA noted the following:

"According to JCDH, although a lower production level might intuitively suggest a reduction in pollutant emissions, this is not necessarily the case with the coke plants in Jefferson County. Operating at lower capacity can lead to cracks and warping of the ovens, and leakage of pollutants. With decreased production there is less coke oven gas to fire boilers and generate power, possibly leading to greater HAP [hazardous air pollutant] generation during a power

[4] The results of 2002 National Scale Air Toxics Assessment (NATA) along with other sources of information were used in the selection process. More information about the 2002 NATA is available at http://www.epa.gov/nata2002/ .

[5] The problem is further discussed in EPA's technical document, Investigation and Resolution of Contamination Problems in the Collection of Volatile Organic Compounds, at http://www.epa.gov/schoolair/pdfs/VocTechdocwithappendix1209.pdf .

outage. It is difficult to predict the HAP emissions from the coke plants in Jefferson County directly from the production levels, since about half of the HAPs emitted are from coke battery leaks (e.g., through doors and lids) which are controlled by work practices. Production levels at the Jefferson County coke plants are increasing and good work practices are in place. Results from recent inspections have shown the plants to be performing well in the management of HAP emissions" (EPA, 2011a).

Sampling Strategy – 2011/2012 North Birmingham Air Toxics Risk Assessment

Because the sample results of the short-term screening in 2009 indicated data from a longer study was warranted, the EPA conducted a year-long evaluation of air toxics (EPA, 2014d). From June 2011 to August 2012, air samples were collected at four monitoring sites in North Birmingham. The Shuttlesworth, Riggins School, Lewis Elementary School locations were all sampled again in 2011/2012. The fourth monitoring site was at the Hudson K-8 School (see Figure 4). This school is located in a primarily residential area. Figure 4 shows the approximate locations of the four monitoring sites.

Samples were collected over a 24 hour period and collected every sixth day between June 2011 and June 2012. Samples collected between June 2012 and August 2012 were collected every third day. Samples were analyzed for 58 VOCs, 22 SVOCs, and 11 metals (EPA, 2013a).

The data validation procedures for this sampling are described as follows:

"All samples were validated by checking monitoring parameters, including sampling flow rates. Samples were invalidated if: 1) The samplers did not run continuously over the 24-hour period; 2) when equipment malfunctions occurred; and/or 3) when the monitors did not maintain proper flows. Whenever samples were invalided [sic], additional samples were collected on a three-day schedule beyond the 1-year sampling period to obtain at least 60 valid samples at each of the monitoring sites. Quality Assurance/Quality Control measures used in this study included collecting and analyzing duplicate samples and preparing and analyzing laboratory replicates, field blanks, and laboratory blanks." (EPA, 2013a).

Particulate Matter Sampling 1999-2013

During the course of this public health assessment, ATSDR learned some community members were concerned about exposure to particulate matter. ATSDR has learned particulate matter sampling occurred between 1999 and 2013 at three locations used by the JCDH for the 2005/2006 air toxics study. Sampling for particulate matter equal to or smaller than 2.5 microns in diameter ($PM_{2.5}$) or "fine particulate matter" took place at the North Birmingham and Providence locations with two $PM_{2.5}$ samplers operating at each location. JCDH also sampled for $PM_{2.5}$ at the Shuttlesworth location from July 2013 to late 2014. (ADEM, 2014; EPA Region 4, personal communication, February 11, 2015). Sampling for particulate matter equal to or smaller than 10 microns in diameter (PM_{10}) took place at the North Birmingham and Shuttlesworth locations. These samplers are a part of Alabama's state and local air monitoring network. Information from state and local air monitoring networks is available on EPA's website (http://www.epa.gov/airdata/). The results of the particulate matter sampling, from 1999-2013 is presented in Tables 12A and 13A of Appendix A.

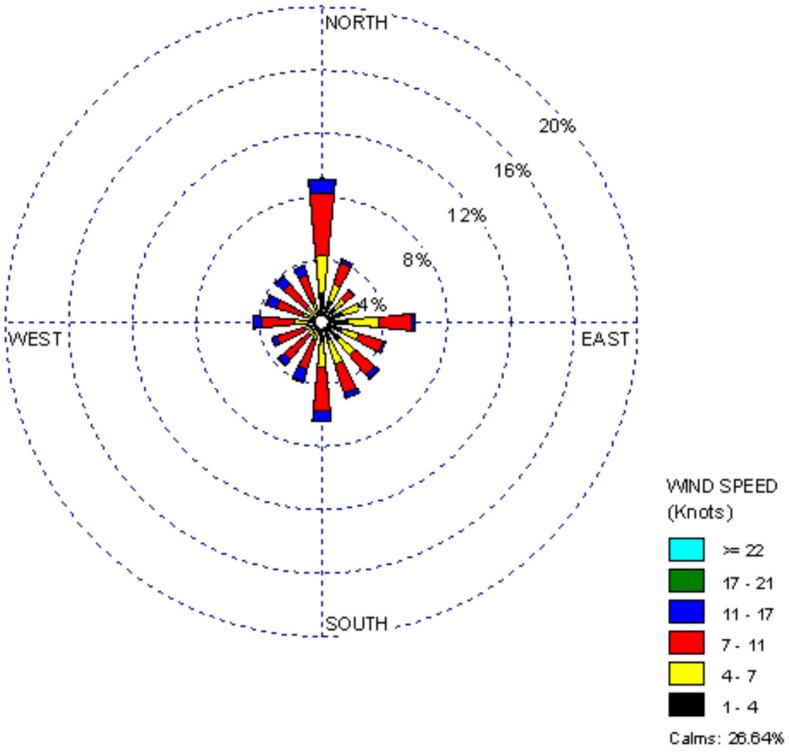
Climate and Prevailing Winds

The climate and prevailing wind patterns of a given location affect how contaminants move through the air. The average monthly temperature during the 2005/2006 sampling had a range between 44.93^0 F (in February 2006) and 81.28^0 F (in August 2005) (JCDH, 2009). The average daily temperatures during the 2009 sampling had a range between 45.5^0 F and 80.4^0 F (EPA, 2011a). The average monthly temperatures during the 2011/2012 sampling had a range between 49.6^0 F and 83.4^0 F (EPA, 2013a).

Figure 5 summarizes hourly wind speed and direction data in a format known as a wind rose. Wind roses display the statistical distribution of wind speeds and directions in a single plot. Figure 5 shows the winds primarily blew from north to south.

Figure 5. Wind Rose for North Birmingham, Alabama (2002-2007) Birmingham International Airport NWS Station

2002-2007



Source: JCDH, 2009

Sampling Results

ATSDR compared the contaminant concentrations to their respective comparison values. Comparison Values (CVs) are chemical and media-specific concentrations in air, soil, and drinking water that are used by ATSDR health assessors and others to identify environmental contaminants at hazardous waste sites that require further evaluation. CVs incorporate assumptions of daily exposure to the chemical and in the case of soil and water a standard amount that someone may likely take into their body each day. CVs are conservative and non-site specific. CVs are based on health guidelines with uncertainty or safety factors applied to ensure that they are adequately protective of public health.

The comparison of environmental data with ATSDR CVs is one of the first steps in the public health assessment process. The results of this screening step give health assessors an understanding of the priority contaminants at the site. When a contaminant is detected at a concentration less than its respective CVs, exposure is not expected to result in health effects and it is not considered further as part of the public health assessment process. It should be noted that contaminants detected at concentrations that exceed their respective CVs, do not necessarily represent a health threat. Instead, the results of the CV screening identify those contaminants that warrant a more detailed, site-specific evaluation to determine whether health effects are expected to occur. CVs are not intended to be used as environmental clean-up levels.

CVs can be based on either carcinogenic or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor (CSF) or inhalation unit risk (IUR). CVs based on cancerous effects account for a lifetime exposure (70 years) with a theoretical excess lifetime cancer risk of one extra case per one million exposed people. Non-cancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), EPA's Reference Doses (RfDs), or EPA's Reference Concentrations (RfCs).

ATSDR has developed the following types of CVs:

Cancer Risk Evaluation Guide (CREG). CREGs are media-specific comparison values that are used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population. ATSDR develops CREGs using EPA's cancer slope factor (CSF) or inhalation unit risk (IUR), a target risk level (10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents an estimated risk of one excess cancer cases in a population of one million. At this time, CREGs are available only for adult exposures—no CREGs specific to childhood exposure are available.

Minimal Risk Level (MRL). Minimal Risk Levels (MRLs) are an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during a specified duration of exposure. MRLs are based only on non-carcinogenic effects. MRLs are derived for acute (1-14 days), intermediate (15-365 days), and chronic (365 days and longer) durations for the oral and inhalation routes of exposure.

Screening levels developed by the Environmental Protection Agency (EPA) were also used in this public health assessment. The EPA has developed chronic Reference Concentrations (RfCs) for inhalation as estimates of daily exposures to a substance that are likely to be without a discernible risk of deleterious effects to the general human population (including sensitive subgroups) during a lifetime of exposure. EPA includes uncertainties sometimes spanning orders of magnitude to ensure that the potential for health effects is overestimated. RfCs are derived for the non-carcinogenic health effects of compounds that are also carcinogens. RfCs are derived assuming exposure to a single substance in a single media. In this document, if there was no MRL for a given contaminant, the EPA RfC was used.

The EPA hosts a "Regional Screening Levels for Chemical Contaminants at Superfund Sites" screening level/preliminary remediation goal website. The Regional Screening Levels (RSLs) tables provide comparison values for residential and commercial-industrial exposures to soil, air and tapwater (drinking water)[6]. In addition to ATSDR's screening levels and EPA's RfCs, this website contains the following levels.

- Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by EPA's Superfund Health Risk Technical Support Center (STSC) for the EPA Superfund program
- Chronic Reference Exposure Levels (RELS) developed by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA)
- Levels developed by the EPA's Superfund Program's Health Effects Assessment Summary (HEAST)

Since many of the contaminants detected do not have an ATSDR CV or EPA RfC, the screening levels from the remediation goal website were used for this public health assessment.

Finally, if a contaminant did not have an ATSDR MRL or CREG, or EPA RfC, or EPA RSL residential air value; ATSDR used screening levels developed by the Texas Commission on Environmental Quality (TCEQ). The TCEQ has developed air monitoring comparison values (AMCVs) and effect screening levels (ESLs). TCEQ typically derived its screening levels from occupational exposure limits (http://www.tceq.texas.gov/toxicology/AirToxics.html).

Appendix A summarizes the sampling results for contaminants with at least one sample result exceeding the respective health-based comparison value.

It can be seen from Appendix A that certain chemicals frequently exceeded a CV. Concentrations of arsenic, benzene, 1,3-butadiene, carbon tetrachloride, and chloroform exceeded comparison values at all monitoring locations in all sampling periods. These chemicals exceeded CVs even at the rural Providence location in 2005/2006.

Certain chemicals infrequently exceeded a CV. For example, chloroprene was sampled for in 2005/2006, 2009, and 2011/2012; but only detected in one sample in 2009 and two samples in 2011/2012. Additionally, 1,1,2-trichloroethane and 1,2-dibromoethane were assessed in each sampling period but only detected above their CVs once in 2011/2012. Bromodichloromethane and dibromochloromethane were assessed in 2005/2006 and 2011/2012, but only rarely detected above their CVs in 2011/2012. It should be noted the detected concentrations of these chemicals

[6] The November 2012 Regional Screening Levels were used for this health assessment.

did not exceed an acute exposure guideline or other non-cancer CV but rather their respective CREGs or California EPA's cancer target risk levels. As stated previously, CREGs are derived from the EPA's Inhalation Unit Risks which are estimated excess lifetime cancer risks from continuous exposure to an agent (EPA, 2012h). Because these chemicals exceeded their CREGs or cancer target risk levels so infrequently, ATSDR does not expect any increased cancer risks from exposure to these contaminants. Similarly, increased cancer risk from exposure to tetrachloroethylene is highly unlikely. Although tetrachloroethylene was detected much more frequently than these other chemicals, none of the sample results in 2005/2006 or 2011/2012 exceeded the CREG for tetrachloroethylene, and only one sample in 2009 slightly exceeded the CREG (the sample result was 4.32 $\mu g/m^3$ and the CREG is 3.8 $\mu g/m^3$). None of these chemicals are discussed further in this public health assessment. It should be understood that since Inhalation Unit Risks and cancer target risk levels are based upon lifetime exposures, it is most appropriate to compare these comparison values to long term concentrations such as annual averages rather than short term concentrations (24 hour).

Some of the sample results from 2011/2012 were above the National Ambient Air Quality Standard (NAAQS) for lead, 0.15 $\mu g/m^3$. However, the lead NAAQS is a standard for the 3-month average concentration and not the maximum concentration. The 3-month average lead concentrations at the Shuttlesworth, Riggins, and Lewis monitoring stations were all well below 0.15 $\mu g/m^3$. The highest 3-month average lead concentration at the Hudson K-8 station was 0.12 $\mu g/m^3$, which is approaching but still below the NAAQS. The higher 3-month average lead concentration at the Hudson K-8 station was due to two days in March 2012 with high sample results[7]. The EPA investigated but was unable to discover a reason for the increase in lead concentrations on these two days. (EPA, 2013a). In 2012, lead monitoring also took place at the same North Birmingham monitoring station used in 2005/2006[8]. The results of this monitoring were also well below the lead NAAQS (EPA, 2013a). Because the majority of the sample results from all sampling periods are well below the NAAQS for lead, lead is not discussed further in this public health assessment.

Crotonaldehyde was not evaluated further in this public health assessment. This chemical was sampled for in 2005/2006 but not in the other sampling periods. Although some of the detected concentrations of crotonaldehyde exceeded the long-term TCEQ AMCV at each sampling location, the average concentration exceeded the AMCV only at the Providence monitoring station which had the maximum detected concentration. As mentioned previously, the Providence monitor was located in a wooded, rural area about 30 miles south west of the other monitors. Moreover, the lowest average crotonaldehyde concentrations were at the two monitoring locations closest to industrial facilities (Shuttlesworth and North Birmingham). It is therefore unlikely that exposure to crotonaldehyde was primarily the result of emissions from industrial facilities in North Birmingham.

Many of the chemicals listed in Tables 1-11 belong to a group of chemicals known as polycyclic aromatic hydrocarbons (PAHs). PAHs are formed during the incomplete burning of coal, oil, gas, wood, garbage, and other organic substances. There are more than 100 different PAHs, but they are typically classified as carcinogenic PAHs or non-carcinogenic PAHs. Neither the

[7] The highest detected value (1.13 $\mu g/m^3$) is still below the previous NAAQS standard of 1.5 $\mu g/m^3$ which was the standard from 1978 until 2008.

[8] The North Birmingham monitor meets the formal criteria for definitively determining compliance with the NAAQS. The other monitors used in 2011/2012 are useful for screening purposes (EPA, 2013a).

International Agency for Research on Cancer (IARC) nor the EPA has determined that acenaphthylene, anthracene, fluoranthene, and phenanthrene are classifiable as to human carcinogenicity (ATSDR, 1995). Additionally, neither ATSDR nor the EPA have established comparison values for these chemicals. The only air comparison values specifically for these chemicals that ATSDR was able to find were TCEQ AMCVs. The TCEQ often derives its comparison values from occupational exposure limits (http://www.tceq.texas.gov/toxicology/AirToxics.html). It appears the TCEQ derived the limits for many of the PAHs from the occupational exposure limits for coal tar pitch volatiles which actually contain a mixture of PAHs[9]. The TCEQ long term AMCVs for acenaphthylene, anthracene, fluoranthene, phenanthrene, and pyrene were exceeded. However, very little information exists documenting the health effects from inhaling acenaphthylene, anthracene, fluoranthene, phenanthrene, and pyrene because most research has focused on the carcinogenic PAHs (Faust, 1993; EPA, 2012g; ATSDR, 1995). Additionally, the average concentrations for acenaphthylene, anthracene, fluoranthene, and pyrene at each monitoring station were below their respective long term AMCV. Most of the average phenanthrene concentrations were below the long term phenanthrene AMCV, except for the average concentrations at the Shuttlesworth location (0.0526 µg/m^3) and Riggins location (0.0890 µg/m^3) in 2011/2012. Consequently, acenaphthylene, anthracene, fluoranthene, phenanthrene, and pyrene are not discussed further in this public health assessment. Naphthalene is classified as a PAH and ATSDR has derived a comparison value. The chronic MRL for naphthalene was exceeded in 2009 and 2011/2012, and naphthalene is discussed further in the Public Health Implications section of this public health assessment.

Not as many PAHs were sampled for in 2009 as in 2005/2006 or 2011/2012. In 2009, the EPA sampled for naphthalene and seven other PAHs: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. The EPA has determined that these seven PAHs are probable human carcinogens (ATSDR, 1995). These PAHs are typically evaluated as benzo(a)pyrene toxic equivalents (BaP-TE). The BaP-TE concentration is the sum of seven different PAHs with their concentrations adjusted for their toxicity relative to benzo(a)pyrene. ATSDR calculated the BaP-TE for each location and sampling period and compared these results to the comparison value for benzo(a)pyrene. Those that exceed the comparison value are shown in Tables 1-11. BaP-TEs are discussed further in the Public Health Implications section of this public health assessment.

Tables 12A and 13A of Appendix A show that the NAAQS for particulate matter were frequently exceeded between 1999 and 2013; consequently, particulate matter is discussed further in the public health implications section of this document. Additionally, it is helpful to know that Jefferson County was designated by the EPA as a nonattainment county for $PM_{2.5}$ until recently (Fadlevich, 2013; EPA, 2012i). It should be understood that the EPA changed the annual $PM_{2.5}$ NAAQS in late 2012 (EPA, 2013b). The annual NAAQS for $PM_{2.5}$ was changed from 15.0 µg/m^3 to 12.0 µg/m^3. The standard was changed "to provide increased protection against health effects associated with long- and short-term exposures (including premature mortality, increased hospital admissions and emergency department visits, and development of chronic respiratory disease)" (Federal Register, 2012). On December 18, 2014, the EPA issued final area designations for the 2012 $PM_{2.5}$ standard for most areas of the country. Jefferson County,

[9] The TCEQ short term ESL for coal tar pitch volatiles is 0.5 µg/m^3 and the long term ESL is 0.05 µg/m^3. These values are the same as the AMCVs for most of the PAHs and the ESL for particulate PAHs not otherwise classified.

Alabama was designated as unclassifiable/attainment for this NAAQS (http://www.epa.gov/pmdesignations/2012standards/state.htm).

Pathways Analysis

The route of a contaminant's movement is called the exposure pathway, which has five elements:

(1) a source of contamination (the point of release),
(2) an environmental media (such as soil, water, or air),
(3) a point of exposure (place where people come into contact with the media),
(4) a route of human exposure (eating, breathing, or touching), and
(5) a receptor population (the people exposed).

Exposure to a contaminant can only occur if there is a source—a place where the contaminant comes from. A source could be a landfill, pond, creek, incinerator, tank, drum, or factory. A person could come into contact with a contaminant at its source, or the contaminant could move from its source to a place where you could come into contact with it. Contaminants can move through the air, water, and soil. They can be on plants or animals, and get into the foods you eat. The contaminant has to get into your body to make you sick, or to have an effect on your health.

When all five parts of the exposure pathway are present, the exposure pathway is termed a completed exposure pathway. A completed exposure pathway exists when information shows that people have come into contact with a contaminant in soil, air, or water. Completed exposure pathways can be either in the past, present, or possibly in the future. A potential exposure pathway occurs when one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element.

If there are potential or completed exposure pathways where people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether these contacts may result in harmful effects. Children may be more vulnerable to these effects because of their play activities and developing and growing bodies. Thus, the health impact to children is considered first when evaluating potential community health threats. The health impacts to other sensitive subpopulations within the community (such as the elderly or chronically ill) also receive special attention during the evaluation. ATSDR uses existing scientific information to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

A resident living in the North Birmingham Collegeville, Harriman Park, and Fairmont communities could be exposed to air contaminants from nearby facilities. Exposure occurred in the past, is occurring now, and will likely occur in the future.

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental Medium	Point of Exposure	Route of Exposure	Exposed Population	
Ambient Air	Nearby industrial facilities	Air	Nearby homes, schools, and businesses	Inhalation	Collegeville, Fairmont, Harriman Park residents. School children attending area schools	Past Present Future

Public Health Implications

Many different contaminants were detected at the air monitors, which is normal in an urban area. The contaminants discussed below were ones that exceeded a health based comparison value. When a contaminant exceeds a health-based comparison value it does not mean that it will cause a health effect, but it does mean that the contaminant needs to be evaluated further for adverse health effects.

For each contaminant, we include information on the contaminant's use; a summary of the concentrations detected in 2005/2006, 2009, and 2011/2012; and a comparison of the detected concentrations to levels of health concern. Additionally, we include information from other studies regarding the contaminant concentrations generally found in ambient air including the national average concentration from the EPA's 2010 National Monitoring Programs Annual Report[10].

Acetaldehyde

Acetaldehyde is a colorless, flammable liquid. It occurs naturally in certain foods, and certain plants produce acetaldehyde. Acetaldehyde evaporates when exposed to the air, and enters the body when contaminated air is inhaled or when contaminated food or water is consumed (EPA, 1994). In a pilot study of ten U.S. cities, the average concentration of acetaldehyde in urban areas was 1.62 µg/m^3 although in remote areas the average concentration is 0.16 µg/m^3 (McCarthy, 2006). The national average concentration of acetaldehyde reported in EPA's 2010 National Monitoring Programs Annual Report is 1.91 µg/m^3 (EPA, 2012j).

[10] The 2010 National Monitoring Programs Annual Report (UATMP, NATTS, CSATAM,) Volume 1: Main gives the arithmetic mean (average) of pollutants monitored at 52 sites around the country. This report contains the results from urban, suburban, and rural locations.

Table 1. Summary of 2005/2006 Air Sampling for Acetaldehyde.					
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**	
				0.45 µg/m³ (CREG)	**9.0 µg/m³ (RfC)**
Shuttlesworth	0.600–2.81	1.54	31/31	31	0
North Birmingham	0.526–3.19	1.57	29/29	29	0
East Thomas	0.849–4.29	1.99	31/31	31	0
Providence	0.299–14.1	1.49	31/31	29	1

Source: JCDH 2009
Notes:
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.

Acetaldehyde was not sampled for in 2009 or 2011/2012. In 2005/2006, the highest and lowest acetaldehyde concentrations were both found at the Providence monitor, which was located primarily in a rural, wooded area. Moreover, the average concentrations of acetaldehyde at each sampling location are similar to those in other urban areas, with only the average concentration at the East Thomas location being slightly higher than 1.62 µg/m³. Although one 24-hr sample exceeded the inhalation RfC, the average concentration—which represent long term exposures—did not. ATSDR therefore concludes that the levels of acetaldehyde in North Birmingham air are not likely to produce noncancerous harmful health effects in exposed residents.

The EPA classified acetaldehyde as a probable carcinogen, and the Department of Health and Human Services has classified it as reasonably anticipated to be a human carcinogen (EPA, 2012a; US Department of Health and Human Services, 2014). The EPA has a method for estimating the cancer risk from chemical exposure. The cancer risk is estimated by multiplying the concentration of a chemical in the air to which people may be exposed by a factor called an inhalation unit risk. The resulting number is an estimate of the number of cancers in a population over a lifetime that might result from the chemical exposure. The equation for estimating cancer risk follows:

Cancer risk = concentration of the chemical in air a person is exposed to over a lifetime x inhalation unit risk.

The additional cancer risk estimate from chemical exposures is often stated as 1×10^{-4}, 1×10^{-5}, or 1×10^{-6} (or 1E-4, 1E-5, or 1E-6). Using 1×10^{-6} (or 1E-6) as an example, it means that a population of one million people exposed to a carcinogen over a lifetime (70 years) at a specific concentration may have one additional case of cancer because of the exposure. An estimated additional cancer risk of 1×10^{-4} (or 1E-4) means that a population of 10,000 people exposed for a lifetime (70 years) at a certain chemical concentration may have one additional cancer case.

Because the average concentration of acetaldehyde at each sampling location exceeded the health-based screening value for lifetime cancer effects (CREG 0.45 µg/m^3), ATSDR calculated cancer risk estimates using the EPA's methodology described above (see Appendix B). Typically, risk assessments such as JCDH's Birmingham Air Toxics Study use high-end estimates of chemical concentrations (95% upper confidence limits) to determine whether unacceptable levels exist; ATSDR often uses average concentrations in its evaluation of potential long-term harmful health effects. ATSDR finds average concentrations more likely to represent lifetime exposure concentrations. Nevertheless, Appendix B shows cancer risk estimates using both the average concentrations of chemicals and the high end estimates of the chemical concentrations (95% upper confidence limits).

The highest estimated cancer risk for acetaldehyde (at the Providence monitoring location) is 5 x 10^{-6}. This estimate means that in addition to their baseline cancer risk, five additional people out of a million people continuously exposed to acetaldehyde at the level in Providence may develop cancer during their lifetime.

It should also be understood that the excess cancer risk is mathematically an estimate of the 95% upper confidence limit of additional cancer risk for adults or children with similar exposures. For this reason, the risk is presented as the number of cancers that might occur in a large number of people (*e.g.* 10,000; 100,000; or 1,000,000) with similar exposures. The true risk is not known, but will likely be lower. When we talk about the additional or excess cancer risk, we mean the risk above and beyond what is considered background or normal. It is important to remember that we cannot determine an individual's cancer risk but rather the estimated cancer risk refers to the risk for a population of people with similar chemical exposure.

Acetonitrile

Acetonitrile is a volatile, colorless liquid with ether-like odor. Acetonitrile has many uses, and is used as a solvent, for spinning fibers, and in lithium batteries. It is primarily found in air from automobile exhaust and manufacturing facilities (EPA, 2007). Results from 50 monitoring sites in 44 urban or rural locations in the United States detected a range from 0.017 to 520 µg/m^3 (EPA, 2008). The national average concentration of acetonitrile reported in EPA's 2010 National Monitoring Programs Annual Report is 44.2 µg/m^3 (EPA, 2012j).

Table 2. Summary of 2005/2006 Air Sampling for Acetonitrile				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				60 µg/m³ (RfC)
Shuttlesworth	ND–196	36.4	27/31	8
North Birmingham	ND–72.4	15.7	20/31	1
East Thomas	ND–250	11.3	9/31	2
Providence	ND–25.2	2.77	9/31	0
Source: JCDH 2009 Notes: In calculating the average concentration, non-detects were treated as half the detection limit. CV = Comparison Value. µg/m³ = micrograms per cubic meter of air RfC = Reference Concentration developed by the US Environmental Protection Agency. ND = Not Detected.				

Table 3. Summary of 2009 Air Sampling for Acetonitrile				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				60 µg/m³ (RfC)
Riggins	ND-0.391	0.199	9/10	0
North Birmingham	0.150-0.911	0.340	17/17	0
Lewis	0.140-0.501	0.301	14/14	0
Source: EPA 2011a Notes: In calculating the average concentration, non-detects were treated as half the detection limit. CV = Comparison Value. µg/m³ = micrograms per cubic meter of air RfC = Reference Concentration developed by the US Environmental Protection Agency. ND = Not Detected.				

Table 4. Summary of 2011/2012 Air Sampling for Acetonitrile				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV 60 µg/m³ (RfC)**
Hudson K-8	ND-3.59	0.376	58/60	0
Shuttlesworth	ND–0.606	0.262	54/60	0
Riggins	ND–9.04	0.561	62/65	0
Lewis	ND–1.45	0.310	56/61	0

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air
RfC = Reference Concentration developed by the US Environmental Protection Agency.
ND = Not Detected.

Acetonitrile was sampled for in all sampling periods but only exceeded the RfC in 2005/2006. The EPA based its RfC on a study of mice exposed for six hours a day, five days a week, for 13 weeks. The EPA determined that the human equivalent concentration (HEC) of the no observed adverse effect level (NOAEL) was 60,000 µg/m³ (EPA, 1999, 2012b). The highest detected acetonitrile concentrations at all four monitors in 2005/2006 were orders of magnitude below this NOAEL. Moreover, both the 2005/2006 average annual acetonitrile concentrations and high end estimates of the acetonitrile concentrations (95% UCL shown in Appendix A) were below the chronic RfC.

The EPA has concluded acetonitrile is a class D carcinogen, "not classifiable as to human carcinogenicity." There is an absence of human evidence and the animal evidence is not conclusive (EPA; 1999, 2012b). ATSDR concludes that exposure to acetonitrile in the North Birmingham air is unlikely to cause cancer or noncancerous, adverse health effects.

Acrolein

Acrolein is primarily used as an intermediate chemical in the synthesis of acrylic acid and as a biocide. It may be formed from the breakdown of certain contaminants in outdoor air or from the burning of organic matter including tobacco, or fuels such as gasoline or oil. The estimated half-life of acrolein in air is 15-20 hours. (ATSDR, 2007a). Data from the EPA National Air Quality System show average acrolein concentrations in ambient air in the United States ranging between 1.1 µg/m³ and 7.3 µg/m³ (ATSDR, 2007a; EPA, 2004). The national average concentration of acrolein reported in EPA's 2010 National Monitoring Programs Annual Report is 1.35 µg/m³ (EPA, 2012j).

Table 5. Summary of 2005/2006 Air Sampling for Acrolein.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV	
				0.02 µg/m^3 (RfC)	0.092 µg/m^3 (Intermediate MRL)
Shuttlesworth	ND–3.35	0.750	19/31	19	19
North Birmingham	ND–2.13	0.659	22/31	22	22
East Thomas	ND–2.61	0.577	17/30	17	17
Providence	ND–2.75	0.301	10/30	10	10

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Acrolein was sampled for in 2009 and 2011/2012, but the EPA did not use the results in evaluating potential health concerns. The results of a short term laboratory study led the EPA to question the reliability and consistency of acrolein monitoring results[11]. Consequently, the 2009 and 2011/2012 acrolein sampling results were not considered in this PHA. In 2005/2006, sample results were below ATSDR's acute MRL (6.9 µg/m^3). However, all of the detected acrolein concentrations were higher than health-based comparison values for intermediate and chronic exposures to acrolein, and we evaluated them further. ATSDR's intermediate MRL is based upon a study of rats, rabbits, and hamsters exposed to acrolein for six hours a day, five days a week, for 13 weeks. The rat was the species most sensitive to acrolein in this study, and rats exposed to 920 µg/m^3 showed structural changes in nasal epithelium and bronchial inflammation. ATSDR calculated the human equivalent concentration lowest- observed- adverse-effect level[12] (LOAEL) of this study to be 28 µg/m^3 (ATSDR, 2007a; Feron et al., 1978). This human equivalent concentration LOAEL was further divided by an uncertainty factor of 300 to derive the MRL (10 for using a LOAEL, 3 for extrapolating from rat to human, and 10 for human variability) (ATSDR, 2007a). The EPA used the results from the same study to derive the chronic RfC, but calculated a human equivalent concentration LOAEL of 20 µg/m^3. The RfC was derived by dividing 20 µg/m^3 by an uncertainty factor of 1,000 (3 for using a LOAEL, 3 for extrapolating from rat to human 10 for human variability and 10 for extrapolating from intermediate exposure to chronic exposure) (EPA, 2012c). The highest detected acrolein concentrations from each sample station site are below the human equivalent concentration LOAELs calculated by ATSDR and the EPA, and the average concentrations are more than an

[11] A fact sheet summarizing the issues with acrolein monitoring identified by the EPA is available at: http://www.epa.gov/schoolair/pdfs/acroleinupdate.pdf .
[12] The lowest-observed-adverse-effect level is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

order of magnitude below these LOAELs. Moreover, it is possible that the monitoring completed in 2005/2006 may have suffered from some of the same issues identified later by the EPA. The EPA stated in 2010 that acrolein monitoring results probably over estimate rather than under estimate acrolein concentrations in the ambient air[10]. ATSDR therefore concludes that the levels of acrolein detected in North Birmingham air during the 2005/2006 assessment are not expected to produce harmful health effects in exposed residents.

The potential carcinogenicity of acrolein cannot be determined because no data are available on the carcinogenicity in humans exposed solely to acrolein, and the two studies in animals that examined the carcinogenic potential of acrolein after inhalation exposure were not adequate to determine carcinogenicity (EPA, 2012c).

Acrylonitrile

Acrylonitrile is a colorless, liquid, man-made chemical with a sharp onion- or garlic-like odor. Acrylonitrile is used to make other chemicals such as plastics, synthetic rubber, and acrylic fibers. Because acrylonitrile evaporates easily, most of it is released to the air from facilities where it is produced and used. Acrylonitrile is broken down quickly in the air. The atmospheric half-life is estimated to be between 5 and 50 hours. Acrylonitrile is not typically detected in ambient air, but has been measured near industrial sources (ATSDR, 1990). In one study of areas near chemical plants, the median concentration of acrylonitrile was 2.1 µg/m^3 (ATSDR, 1990; Brodzinsky and Singh, 1983). The national average concentration of acrylonitrile reported in EPA's 2010 National Monitoring Programs Annual Report is 0.0369 µg/m^3 (EPA, 2012j).

Table 6. Summary of 2005/2006 North Birmingham Air Sampling for Acrylonitrile.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV
				0.015 µg/m^3 (CREG)
Shuttlesworth	ND-0.347	0.070	1/31	1
North Birmingham	ND-0.260	0.068	1/31	1
East Thomas	ND	ND	ND	ND
Providence	ND-0.109	0.063	1/31	1

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 7. Summary of 2009 North Birmingham Air Sampling for Acrylonitrile.				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.015 µg/m³ (CREG)**
Riggins	ND	ND	ND	ND
North Birmingham	ND–0.13	0.0237	2/17	2
Lewis	ND	ND	ND	ND

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 8. Summary of 2011/2012 North Birmingham Air Sampling for Acrylonitrile.				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.015 µg/m³ (CREG)**
Hudson K-8	ND-0.256	0.0235	2/60	2
Shuttlesworth	ND-1.36	0.0598	3/60	3
Riggins	ND-0.767	0.0425	5/65	5
Lewis	ND-0.313	0.0228	1/61	1

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

All detected acrylonitrile concentrations fell below the EPA's chronic RfC (2 µg/m³) and ATSDR's acute MRL (220 µg/m³). ATSDR therefore concludes that the levels of acrylonitrile in North Birmingham air are not likely to produce noncancerous, harmful health effects in exposed residents.

However, some acrylonitrile concentrations exceed the health-based screening value for lifetime cancer effects (0.015 µg/m³**,** CREG) in all sampling periods. The U.S. Department of Health and Human Services has classified acrylonitrile as reasonably anticipated to be a human carcinogen (U.S. Department of Health and Human Services, 2014). ATSDR calculated cancer risk estimates for each sampling period at each monitoring location. The highest cancer risk estimate for acrylonitrile air exposures was 5×10^{-6} (see Appendix B). This estimate means that in addition to their baseline cancer risk, five additional people out of a million continuously exposed to acrylonitrile in North Birmingham may develop cancer during their lifetime.

Arsenic

Arsenic occurs naturally in soil and minerals and may enter the air from wind-blown dust. Arsenic is associated with ores mined for metals, such as copper and lead, and may enter the environment during the mining and smelting of these ores. Coal-fired power plants and incinerators may also release small amounts of arsenic into the atmosphere because coal and waste products often contain some arsenic (ATSDR, 2007b). Mean arsenic levels in ambient air in the United States range from <0.001 to 0.003 µg/m^3 in remote areas and from 0.02 to 0.03 µg/m^3 in urban areas (ATSDR, 2007b; Davidson et al. 1985; EPA, 1982; International Agency for Research on Cancer, 1980; NAS, 1977). The national average concentration of arsenic reported in EPA's 2010 National Monitoring Programs Annual Report is 0.000588 µg/m^3 (EPA, 2012j).

Table 9. Summary of 2005/2006 North Birmingham Air Sampling for Arsenic.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.00023 µg/m^3 (CREG)
Shuttlesworth (PM_{10})	0.00047–0.0343	0.00576	31/31	31
North Birmingham (PM_{10})	0.000282–0.00470	0.00210	31/31	31
North Birmingham (TSP)	0.000404-0.00458	0.00208	31/31	31
East Thomas (PM_{10})	0.000318–0.00325	0.00156	31/31	31
Providence (PM_{10})	0.000083–0.00197	0.000804	31/31	29

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
PM_{10} = Particulate matter with a diameter equal to or less than 10 microns.
TSP = Total Suspended Particulate Matter.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Table 10. Summary of 2009 North Birmingham Air Sampling for Arsenic.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.00023 µg/m^3 (CREG)
Riggins	0.000210–0.00897	0.00272	24/24	23
North Birmingham	0.00029–0.00385	0.00156	18/18	18
Lewis	ND–0.00403	0.00143	19/20	18

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 11. Summary of 2011/2012 North Birmingham Air Sampling for Arsenic.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.00023 µg/m^3 (CREG)
Hudson K-8	0.00026-0.00400	0.00151	63/63	63
Shuttlesworth	ND-0.00745	0.00236	60/62	60
Riggins	ND–0.0108	0.00230	66/67	66
Lewis	0.00017–0.00465	0.00146	66/66	64

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Most of the samples exceeded the arsenic CREG for continuous lifetime exposure to arsenic in ambient air. No non-cancer ATSDR CVs or EPA screening levels are available for arsenic in air. Arsenic levels were similar to or lower than the arsenic levels generally found in urban areas (0.02-0.03 µg/m^3).

The lowest reported NOAEL, in ATSDR's Toxicological Profile for Arsenic, for health effects from an acute exposure, for mice exposed to arsenic for three hours, is 123 µg/m^3. The same study also reported the lowest NOAEL for health effects from an intermediate exposure to

arsenic which is 126 μg/m^3 for mice exposed to arsenic for three hours a day, five days a week, for four weeks (ATSDR, 2007b; Aranyi et al., 1985). These NOAELs for acute and intermediate exposure to arsenic are orders of magnitude above the levels of arsenic detected in North Birmingham air.

ATSDR calculated cancer risk estimates for each monitor and each sampling period. The highest estimated cancer risk from arsenic air exposures in North Birmingham is 4x 10^{-5} (see Appendix B). This means that in addition to their baseline cancer risk, four additional people out of one hundred thousand people continuously exposed to arsenic at the level at the Shuttlesworth monitor may develop cancer during their lifetime.

ATSDR's health consultation, "Assessment of Soil Exposures in Communities Adjacent to the Walter Coke, Inc. Site Birmingham, AL," also considered the potential cancer risk from the ingestion of and dermal contact with arsenic in the soil around the Walter Coke facility (ATSDR, 2013). This assessment states that if the highest property average soil arsenic concentration (41 mg/kg) was used and if 100% bioavailability of arsenic by way of ingestion was assumed, the estimated cancer risk would be 1 x 10^{-4}. If a more realistic bioavailability factor of 50% is used, the estimated cancer risk would only be 5x 10^{-5}. The highest estimated cancer risk from the inhalation of arsenic in Appendix B is 4x 10^{-5}. If this estimate was combined with the 5 x 10^{-5} estimate from the soil pathway, the estimated cancer risk would still be below 1 x 10^{-4}, which represents an additional person who may develop cancer for every ten thousand people exposed.

Benzene

Benzene is a colorless liquid with a sweet odor and comes from both industrial and natural sources. Benzene is present in crude oil, gasoline, and cigarette smoke. Benzene levels in urban areas are generally higher than those in rural areas. Once in the air, benzene reacts with other chemicals and breaks down within a few days (ATSDR, 2007c). The concentration of benzene in urban areas is between 1.0 and 60 μg/m^3, but in rural areas it is between 0.06 μg/m^3 and 2.7 μg/m^3 (EPA, 1987; Roberts, 1985; ATSDR, 2007c). As seen below, the concentrations of benzene in North Birmingham are similar to the levels found in other urban areas (1.0-60 μg/m^3). However, the national average concentration of benzene reported in EPA's 2010 National Monitoring Programs Annual Report is 0.994 μg/m^3 (EPA, 2012j).

Table 12. Summary of 2005/2006 North Birmingham Air Sampling for Benzene.						
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV**		
				0.13 µg/m^3 (CREG)	**9.6 µg/m^3 (Chronic MRL)**	**29 µg/m^3 (Acute MRL)**
Shuttlesworth	0.543–31.5	6.19	31/31	31	7	1
North Birmingham	0.543–12.8	3.17	31/31	31	3	0
East Thomas	0.543–8.50	2.90	31/31	31	0	0
Providence	0.192–1.63	0.569	31/31	31	0	0

Source: JCDH 2009
Notes:
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.

Table 13. Summary of 2009 North Birmingham Air Sampling for Benzene.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/ #Samples Collected	# of 24 Hour Samples Exceeding CV		
				0.13 µg/m^3 (CREG)	9.6 µg/m^3 (Chronic MRL)	29 µg/m^3 (Acute MRL)
Riggins	0.419–30.5	10.9	10/10	10	3	2
North Birmingham	0.26–30.1	5.50	17/17	17	2	1
Lewis	0.28–22.4	4.68	14/14	14	3	0

Source: EPA 2011a
Notes:
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.

Table 14. Summary of 2011/2012 North Birmingham Air Sampling for Benzene.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/ #Samples Collected	# of 24 Hour Samples Exceeding CV		
				0.13 µg/m^3 (CREG)	9.6 µg/m^3 (Chronic MRL)	29 µg/m^3 (Acute MRL)
Hudson K-8	0.361-21.9	3.44	60/60	60	6	0
Shuttlesworth	0.521-22.7	4.13	60/60	60	6	0
Riggins	0.351-55.11	6.10	65/65	65	12	3
Lewis	0.374-20.4	2.89	61/61	61	3	0

Source: EPA 2013a
Notes:
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.

ATSDR has derived both a chronic and acute MRL for benzene. The chronic MRL (9.6 µg/m^3) is used to evaluate non-cancer health effects from exposures one year or more. Riggins in 2009 is the only location with an average benzene concentration higher than the chronic MRL. But the chronic MRL for benzene was based on occupational studies with a LOAEL of 1,800 µg/m^3. Workers exposed to benzene at this level had reduced white blood cell and platelet counts. These workers had been employed for an average of 6.1 years (ATSDR, 2007c; Lan et al. 2004a, 2004b). In deriving the chronic MRL, ATSDR first calculated a benchmark concentration of 96 µg/m^3 from the LOAEL. At this concentration, there is an estimated 0.25% increased risks of individuals experiencing reduced white blood cell and platelet counts. The benchmark

concentration of 96 µg/m^3 was further divided by an uncertainty factor of 10 to account for human variability The maximum benzene concentrations at all locations are below the benchmark concentration and average benzene concentration at most locations during most sampling periods is an order of magnitude below the benchmark concentration.

On a few occasions, ATSDR's acute MRL for benzene (29 µg/m^3) was exceeded[13]. The acute MRL is used to evaluate exposures 14 days or less. ATSDR reviewed several studies in deriving the acute MRL. The lowest level reported in ATSDR's Toxicological Profile for Benzene at which effects from acute benzene exposure occur is 32,000 µg/m^3 (ATSDR, 2007c; Dempster and Snyder, 1991; Rozen et al. 1984). Mice exposed to benzene at this level experience hematological effects. In deriving the acute MRL, ATSDR calculated LOAEL human equivalent concentration (HEC) of 8,200 µg/m^3 which was then divided by a total uncertainty factor of 300 (10 for the use of an LOAEL, 3 for converting from animal to human, and 10 to account for human variability). The maximum benzene concentration (55 µg/m^3) is still orders of magnitude below the calculated LOAEL human equivalent concentration (8,200 µg/m^3). Therefore, acute health effects from the maximum exposure to benzene are unlikely.

Because ATSDR MRLs for benzene were exceeded at the school monitoring locations, it is worth considering whether children are more susceptible to the effects of benzene than adults. ATSDR's Toxicological Profile for Benzene documents no clear evidence of age-related differences in susceptibility (ATSDR, 2007c). Similarly, an EPA review of the studies available states there is no convincing evidence to indicate that children are more susceptible to the toxic effects of benzene (EPA, 2002).

All sample results for benzene were higher than the CREG of 0.13 µg/m^3. ATSDR calculated cancer risk estimates for the inhalation of benzene, for each monitoring location and sampling period. ATSDR's cancer risk estimates for benzene are all below 1 x 10^{-4} if the average benzene concentrations detected in the air are used to calculate the cancer risk (see Table 1B, Appendix B). However, if the high-end estimates of chemical concentrations (95% upper confidence limits) are used to estimate the cancer risks from benzene, the results from the Riggins monitoring location in 2009 show a cancer risk greater than 1 x 10^{-4}. But benzene monitoring in 2009 at the Riggins location only included 10 samples collected over a period of two months. The subsequent 65 samples collected over a 12 month period in 2011/2012 did not show a cancer risk from benzene at the Riggins location greater than 1x10^{-4} even if the 95% upper confidence limit is used. Additionally, none of the 2005/2006 benzene sampling resulted in an estimated cancer risk greater than 1x10^{-4}. The fact that the more extensive benzene sampling before and after 2009 did not result in an estimated cancer risk greater than 1x10^{-4} is of particular interest since the inhalation unit risk used to calculate cancer risk estimates assumes continuous exposure to a chemical at a given concentration for a lifetime (EPA, 2012h).

Beryllium

Beryllium is a lightweight metal found naturally in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined and purified for use in aircraft and space vehicle structures, instruments, x-ray machines, and mirrors. Beryllium alloys are used in automobiles,

[13] Although ATSDR's acute exposure guideline was exceeded, the maximum detected benzene concentration (55 µg/m^3) is below EPA's 8 hour Acute Exposure Guideline Level for benzene of 29,000 µg/m^3.

computers, sports equipment (golf clubs and bicycle frames), and dental bridges (ATSDR, 2002). The annual average concentration of beryllium in ambient air in the United States is typically below 0.00003 µg/m^3. Beryllium concentrations in urban air are usually higher due primarily to burning of coal and fuel oil; for example, the annual average concentrations in 1982–1992 ranged from 0.00002 µg/m^3 to 0.002 µg/m^3 in Detroit, Michigan (ATSDR, 2002). The national average concentration of beryllium reported in EPA's 2010 National Monitoring Programs Annual Report is 0.000003 µg/m^3 (EPA, 2012j).

Table 15. Summary of 2005/2006 North Birmingham Air Sampling for Beryllium.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV
				0.00042 µg/m^3 (CREG)
Shuttlesworth (PM_{10})	0.00003–0.00144	0.000300	31/31	6
North Birmingham (PM_{10})	0.000002–0.00007	0.0000190	31/31	0
North Birmingham (TSP)	0.000002-0.00013	0.0000330	31/31	0
East Thomas (PM_{10})	0.000008–0.00009	0.0000330	31/31	0
Providence (PM_{10})	0.0000005–0.00001	0.00000500	31/31	0

Source: JCDH 2009
Notes:
PM_{10} = Particulate matter with a diameter equal to or less than 10 microns.
TSP = Total Suspended Particulate Matter.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Table 16. Summary of 2009 North Birmingham Air Sampling for Beryllium.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/#Samples Collected**	**# 24 Hour Samples Exceeding CV 0.00042 µg/m^3 (CREG)**
Riggins	ND–0.00011	0.0000230	17/24	0
North Birmingham	ND–0.00008	0.0000123	8/19	0
Lewis	ND–0.00014	0.0000246	10/20	0
Source: EPA 2011a Notes: In calculating the average concentration, non-detects were treated as half the detection limit. CV = Comparison Value. µg/m^3 = micrograms per cubic meter of air. CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry. ND = Not Detected.				

Table 17. Summary of 2011/2012 North Birmingham Air Sampling for Beryllium.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.00042 µg/m^3 (CREG)**
Hudson K-8	ND-0.00008	0.0000174	35/63	0
Shuttlesworth	ND-0.00009	0.0000227	37/62	0
Riggins	ND–0.0000775	0.0000225	36/67	0
Lewis	ND-0.00008	0.0000178	37/66	0
Source: EPA 2013a Notes: CV = Comparison Value. µg/m^3 = micrograms per cubic meter of air. CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.				

Beryllium concentrations in the air in 2009 and 2011/2012 are well below comparison values for both cancerous and noncancerous health effects. While all of the 2005/2006 sample results were also below the beryllium comparison value for noncancerous health effects, some of the beryllium concentrations detected at the Shuttlesworth monitoring station were above the CREG in the 2005/2006 sampling period. ATSDR calculated cancer risk estimates for beryllium for each monitoring location and sampling period. ATSDR's beryllium cancer risk estimates were all less than 1 x 10^{-6} (see Appendix B). The cancer risk estimates are all less than one in a million.

1,3-Butadiene

1,3-Butadiene is a colorless gas that is widely found in urban air from various sources, including rubber and plastic production, auto exhaust, gasoline stations, and cigarette smoke. 1,3-Butadiene is widely detected at low levels in urban air samples. Reported average concentrations range from 0.1 to 2 µg/m^3 (ATSDR, 2009; Curren et al., 2006; Grant et al., 2007; Oguz et al., 2003; Reiss, 2006; Reiss and Griffin, 2004; Sax et al., 2004). The national average concentration of 1,3-butadiene reported in EPA's 2010 National Monitoring Programs Annual Report is 0.0841 µg/m^3 (EPA, 2012j).

Table 18. Summary of 2005/2006 North Birmingham Air Sampling for 1,3-Butadiene.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.033 µg/m^3 (CREG)
Shuttlesworth	ND–0.553	0.210	28/31	28
North Birmingham	ND–0.553	0.141	25/31	25
East Thomas	ND–0.642	0.246	30/31	29
Providence	ND–0.243	0.019	9/31	2

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 19. Summary of 2009 North Birmingham Air Sampling for 1,3-Butadiene.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.033 µg/m^3 (CREG)
Riggins	ND–0.458	0.162	9/10	8
North Birmingham	0.02–0.48	0.127	17/17	16
Lewis	0.024–0.297	0.110	14/14	11

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 20. Summary of 2011/2012 North Birmingham Air Sampling for 1,3-Butadiene.				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.033 µg/m³ (CREG)**
Hudson K-8	0.0266-0.642	0.139	60/60	57
Shuttlesworth	0.0310-0.493	0.149	60/60	59
Riggins	ND–0.920	0.167	63/65	58
Lewis	ND–0.606	0.152	60/61	59

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

The levels of 1,3-butadiene in North Birmingham are similar to other urban areas. The highest concentrations measured in North Birmingham air at all of the monitors in all sampling periods are below the EPA RfC (2 µg/m³). Therefore, noncancerous, adverse health effects are unlikely.

ATSDR calculated cancer risk estimates for each sampling year and each sampling location for exposure to 1,3-butadiene. The highest cancer risk estimate for exposure to 1,3-butadiene levels in North Birmingham air is 9×10^{-6} (Appendix B). This cancer risk estimate means that in addition to their baseline cancer risk, nine out of a million people exposed to this level of 1,3-butadiene over a lifetime may develop cancer during their lifetime.

Cadmium

Cadmium is an element that occurs naturally in the earth's crust. It has many uses in industry and consumer products, and is found in batteries, pigments, metal coatings, plastics, and some metal alloys. Mean levels of cadmium in ambient air range from less than 0.001 µg/m³ in remote areas to 0.002–0.015 µg/m³ in urban areas and 0.015-0.150 µg/m³ in industrialized areas (ATSDR, 2008a). The national average concentration reported in EPA's 2010 National Monitoring Programs Annual Report is 0.000164 µg/m³ (EPA, 2012j).

Table 21. Summary of 2005/2006 North Birmingham Air Sampling for Cadmium.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.00056 µg/m^3 (CREG)
Shuttlesworth (PM_{10})	0.00009–0.00148	0.000370	31/31	4
North Birmingham (PM_{10})	0.0000580–0.00281	0.000707	31/31	13
North Birmingham (TSP)	0.000129-0.00319	0.000820	31/31	15
East Thomas (PM_{10})	0.000105–0.00121	0.000456	31/31	9
Providence (PM_{10})	0.00003–0.00022	0.000112	31/31	0

Source: JCDH 2009
Notes:
PM_{10} = Particulate matter with a diameter equal to or less than 10 microns.
TSP = Total Suspended Particulate Matter.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 22. Summary of 2009 North Birmingham Air Sampling for Cadmium.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.00056 µg/m^3 (CREG)
Riggins	0.00003–0.0017	0.000303	24/24	3
North Birmingham	0.00003–0.00063	0.000220	18/18	1
Lewis	0.00003–0.00242	0.000529	20/20	5

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Table 23. Summary of 2011/2012 North Birmingham Air Sampling for Cadmium.				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV (µg/m³) 0.00056 µg/m³ (CREG)**
Hudson K-8	0.000080-0.00779	0.000894	63/63	20
Shuttlesworth	0.000020–0.00246	0.000424	62/62	12
Riggins	0.0000525–0.00274	0.000476	67/67	11
Lewis	0.000040–0.00668	0.000723	66/66	21

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Cadmium levels in North Birmingham air were not elevated compared to mean cadmium levels in ambient air in urban areas in the United States. None of the samples collected exceeded ATSDR's acute or chronic MRL (0.03 and 0.01 µg/m³, respectively).

Some cadmium concentrations in North Birmingham air were above the CREG (0.00056 µg/m³) in all sampling periods. However, the average concentrations only exceeded the CREG at the North Birmingham sampling station in 2005/2006 and at the Hudson K-8 and Lewis sampling stations in 2011/2012. As an additional measure, ATSDR calculated cancer risk estimates for each monitoring station and each sampling period for exposure to cadmium in air (see Appendix B). The highest cancer risk estimate for exposure to cadmium in North Birmingham air is 3 x 10^{-6} (see Appendix B). This estimate means that in addition to their baseline cancer risk, three additional people out of one million people exposed may develop cancer in their lifetime.

Carbon Tetrachloride

Carbon tetrachloride (CCl_4) is a clear liquid that evaporates very easily. It does not occur naturally, but was once produced in large quantities to make refrigeration fluid and propellants for aerosol cans. Since many refrigerants and aerosol propellants affect the Earth's ozone layer, the production of these chemicals (including carbon tetrachloride) is being phased out. Consequently, the manufacture and use of CCl_4 has declined and will probably continue to decline. Because of past and present releases, background levels of CCl_4 are found in air, water, and soil. Air concentrations of 0.63 µg/m³ are common around the world, with somewhat higher levels of 1.3–3.8 µg/m³ often found in cities (ATSDR, 2005b). The national average concentration of carbon tetrachloride reported in EPA's 2010 National Monitoring Programs Annual Report is 3.57 µg/m³ [14](EPA, 2012j).

[14] It is worth noting that the 2008-2009 National Monitoring Programs report stated the national average concentration was 0.69 µg/m³ (EPA, 2011e).

Table 24. Summary of 2005/2006 North Birmingham Air Sampling for Carbon Tetrachloride.

Monitor Location	Concentration Range ($\mu g/m^3$)	Average Concentration ($\mu g/m^3$)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV
				0.17 $\mu g/m^3$ (CREG)
Shuttlesworth	0.440–0.944	0.650	31/31	31
North Birmingham	0.440–1.01	0.670	31/31	31
East Thomas	0.440–1.07	0.684	31/31	31
Providence	0.315–1.01	0.651	31/31	31

Source: JCDH 2009
Notes:
CV = Comparison Value.
$\mu g/m^3$ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Table 25. Summary of 2009 North Birmingham Air Sampling for Carbon Tetrachloride.

Monitor Location	Concentration Range ($\mu g/m^3$)	Average Concentration ($\mu g/m^3$)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV
				0.17 $\mu g/m^3$ (CREG)
Riggins	0.51–0.951	0.671	10/10	10
North Birmingham	0.52–1.05	0.705	17/17	17
Lewis	0.54–1.1	0.742	14/14	14

Source: EPA 2011a
Notes:
CV = Comparison Value.
$\mu g/m^3$ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 26. Summary of 2011/2012 North Birmingham Air Sampling for Carbon Tetrachloride.				
Monitor Location	**Concentration Range ($\mu g/m^3$)**	**Average Concentration ($\mu g/m^3$)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				0.17 $\mu g/m^3$ (CREG)
Hudson K-8	0.522-0.900	0.700	60/60	60
Shuttlesworth	0.471–0.937	0.714	60/60	60
Riggins	0.530–0.966	0.693	65/65	65
Lewis	0.308–0.988	0.715	61/61	61
Source: EPA 2013a Notes: CV = Comparison Value. $\mu g/m^3$ = micrograms per cubic meter of air. CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.				

Carbon tetrachloride levels displayed little variability: concentrations across all of the monitoring stations range from 0.308–1.1 $\mu g/m^3$. Average concentrations are all close to the worldwide background levels (0.63 $\mu g/m^3$), and below the levels found in cities (1.3–3.8 $\mu g/m^3$). Therefore, it does not appear that the concentrations of carbon tetrachloride are due to any particular emission source in the North Birmingham area.

All detected concentrations are below the chronic MRL of 190 $\mu g/m^3$, and adverse, noncancerous health effects are not expected. All detected concentrations are also above the carbon tetrachloride CREG of 0.17 $\mu g/m^3$. ATSDR calculated cancer risk estimates for exposure to carbon tetrachloride for each station and each sampling period (see Appendix B). The highest cancer risk estimate for exposure to carbon tetrachloride in North Birmingham air is 5×10^{-6}, or an estimated additional five people out of a million exposed people who may develop cancer in their lifetime.

Chloroform

Chloroform is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. Most of the chloroform found in the environment comes from chemical companies and paper mills. It is also found in waste water from sewage treatment plants and drinking water (small amounts of chloroform are formed as an unwanted product during the process of adding chlorine to water). There are many ways for chloroform to enter the environment and small amounts of it are likely to be found almost everywhere. Chloroform is typically found in the air from 0.098–0.24 $\mu g/m^3$ (ATSDR, 1997a). The national average concentration of chloroform reported in EPA's 2010 National Monitoring Programs Annual Report is 0.186 $\mu g/m^3$ (EPA, 2012j).

Table 27. Summary of 2005/2006 North Birmingham Air Sampling for Chloroform.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.043 µg/m^3 (CREG)
Shuttlesworth	ND–0.293	0.090	15/31	15
North Birmingham	ND–0.244	0.071	15/31	15
East Thomas	ND–0.391	0.091	18/31	18
Providence	ND–0.0977	0.030	10/31	10

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 28. Summary of 2009 North Birmingham Air Sampling for Chloroform.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.043 µg/m^3 (CREG)
Riggins	ND–0.17	0.104	9/10	9
North Birmingham	0.088–0.18	0.131	17/17	17
Lewis	ND–0.23	0.135	13/14	13

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 29. Summary of 2011/2012 North Birmingham Air Sampling for Chloroform.				
Monitor Location	**Concentration Range ($\mu g/m^3$)**	**Average Concentration ($\mu g/m^3$)**	**# Contaminant Detected/#Samples Collected**	**# of 24 hour Samples Exceeding CV 0.043 $\mu g/m^3$ (CREG)**
Hudson K-8	ND-0.288	0.118	43/60	43
Shuttlesworth	ND–0.806	0.134	43/60	43
Riggins	ND–0.254	0.101	52/65	52
Lewis	ND–0.303	0.112	41/61	41

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
$\mu g/m^3$ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

All chloroform concentrations fall below ATSDR's chronic MRL (98 $\mu g/m^3$), and the average levels fall within the range of concentrations that are typically found in the air (ATSDR, 1997a; EPA, 2008). Chloroform levels in North Birmingham air are not likely to lead to adverse, noncancerous health effects.

Studies regarding cancer in humans after inhaling chloroform are not available (ATSDR, 1997a). However, the EPA has derived an inhalation unit risk for cancer effects from exposure to chloroform based on the results of a study of mice exposed orally to chloroform (EPA, 2012d). ATSDR used this inhalation unit risk to calculate cancer risk estimates for each monitoring station and sampling period. The highest cancer risk estimate for chloroform air exposures in North Birmingham is 5×10^{-6} (see Appendix B).

Chromium

Chromium does not usually remain in the atmosphere, but is deposited into the soil and water. Chromium is present in the environment in several different forms. The most common forms are chromium (0), chromium (III), and chromium (VI). No taste or odor is associated with chromium compounds. Chromium (III) is considered an essential nutrient, although reports of chromium (III) deficiency are rare and there is no recognized disease attributed to chromium deficiency. Chromium (VI) and chromium (0) are generally produced by industrial processes. Chromium (VI) compounds are more toxic than chromium (III) compounds. Breathing in high levels of chromium (VI) can cause irritation to the nose, and long-term exposure to chromium (VI) has been associated with lung cancer in workers (ATSDR, 2008b). In 2005/2006, the JCDH analyzed samples for both total chromium and chromium (VI). However, in 2009 and 2011/2012, the EPA only tested for total chromium. The total chromium concentrations detected are not elevated compared to typical atmospheric levels of total chromium (0.01–0.03 $\mu g/m^3$) in urban areas of the United States (ATSDR, 2008b; Fishbein, 1984; WHO, 2003). The national average concentration of total chromium reported in EPA's 2010 National Monitoring Programs Annual Report is 0.00226 $\mu g/m^3$ (EPA, 2012j).

Both ATSDR and EPA have derived comparison values for chromium compounds. The lowest MRL for chromium compounds is the intermediate and chronic MRL of 0.005 µg/m^3 for dissolved chromium (VI) aerosols and mists. By comparison, the intermediate MRL for chromium (III) soluble particulate compounds is 0.1 µg/m^3. The chromium (VI) sample results did not exceed the MRL of 0.005 µg/m^3, but some of the detected total chromium concentrations did exceed this MRL. Nevertheless, the maximum detected concentration (0.0304 µg/m^3 in 2011/2012) is still below both the MRL for chromium (VI) particulate compounds (0.3 µg/m^3) and the MRL for chromium (III) soluble particulate compounds (0.1 µg/m^3). Atmospheric chromium is present primarily in particulate form (ATSDR, 2008b). Moreover, as can be seen from the tables below, the 2005/2006 results suggest that most of the atmospheric chromium in North Birmingham is not chromium (VI). Finally, the MRL for chromium (VI) aerosols and mists of 0.005 µg/m^3 was derived from a 1983 study of workers exposed to chromic acid. The LOAEL from this study was 2 µg/m^3 (ATSDR 2008b; Lindberg and Hedenstierna, 1983), a concentration well above the levels found in North Birmingham air. Therefore, adverse, noncancerous health effects from exposure to chromium are not expected.

A CREG of 0.000083 µg/m^3 based upon EPA's inhalation unit risk has been derived for chromium (VI). However, no CREG or inhalation risk is available for total chromium. Based upon the 2005/2006 sample results, the highest cancer risk estimate for chromium (VI) air exposures in North Birmingham is 1 x 10^{-6} (see Appendix B), or out of a million people exposed, there might be one person who gets cancer.

Table 30. Summary of 2005/2006 North Birmingham Air Sampling for Hexavalent Chromium (Chromium VI).

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV (µg/m^3)
				0.000083 (CREG)
Shuttlesworth	ND–0.000166	0.0000400	23/32	5
North Birmingham	ND–0.000154	0.0000360	23/30	3
East Thomas	ND–0.000145	0.0000330	26/31	1
Providence	ND–0.0000462	0.00000900	20/31	0

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Table 31. Summary of 2005/2006 North Birmingham Air Sampling for Total Chromium.			
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/#Samples Collected**
Shuttlesworth (PM_{10})	0.00154–0.0133	0.00495	31/31
North Birmingham (PM_{10})	0.00132–0.00650	0.00346	31/31
North Birmingham (TSP)	0.00174-0.00968	0.00407	31/31
East Thomas (PM_{10})	0.00227–0.00853	0.00500	31/31
Providence (PM_{10})	0.00125–0.00425	0.00241	31/31
Source: JCDH 2009 Notes: PM_{10} = Particulate matter with a diameter equal to or less than 10 microns. TSP = Total Suspended Particulate Matter. µg/m^3 = micrograms per cubic meter of air.			

Table 32. Summary of 2009 North Birmingham Air Sampling for Total Chromium.			
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**
Riggins	0.00114–0.00655	0.00343	24/24
North Birmingham	0.00112–0.00870	0.00386	18/18
Lewis	0.00106–0.0160	0.00416	20/20
Source: EPA 2011a Notes: µg/m^3 = micrograms per cubic meter of air.			

Table 33. Summary of 2011/2012 North Birmingham Air Sampling for Total Chromium.			
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**
Hudson K-8	ND-0.0178	0.0115	18/63
Shuttlesworth	ND-0.0304	0.0115	16/62
Riggins	ND-0.0166	0.0109	14/67
Lewis	ND-0.0261	0.0113	18/66
Source: EPA 2013a Notes: In calculating the average concentration, non-detects were treated as half the detection limit. µg/m^3 = micrograms per cubic meter of air.			

Ethylene Dichloride

Ethylene dichloride (also known as 1,2-dichloroethane) is a chemical used in the manufacture of vinyl chloride. Previously it was used to clean materials and as a de-greaser (ATSDR, 2001). One study of the outdoor concentration of ethylene dichloride in 83 urban locations across the United States found the median concentration to be 0.04 µg/m^3 (ATSDR, 2001; Kelly et al., 1994). Another study of seven urban locations in 1980-1981 found an average concentration range of 0.405 to 6.07 µg/m^3 (ATSDR, 2001; Singh et al., 1982). The national average concentration of ethylene dichloride reported in EPA's 2010 National Monitoring Programs Annual Report is 0.0121 µg/m^3 (EPA, 2012j).

Table 34. Summary of 2005/2006 North Birmingham Air Sampling for Ethylene Dichloride				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				0.038 µg/m^3 (CREG)
Shuttlesworth	ND	ND	ND	ND
North Birmingham	ND–0.121	0.033	1/31	1
East Thomas	ND	ND	ND	ND
Providence	ND	ND	ND	ND
Source: JCDH 2009 Notes: In calculating the average concentration, non-detects were treated as half the detection limit. CV = Comparison Value. ND = Not Detected. µg/m^3 = micrograms per cubic meter of air. CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.				

Table 35. Summary of 2009 North Birmingham Air Sampling for Ethylene Dichloride.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				0.038 µg/m^3 (CREG)
Riggins	ND-0.069	0.0105	1/10	1
North Birmingham	ND	ND	ND	ND
Lewis	ND	ND	ND	ND

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
ND = Not Detected.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Table 36. Summary of 2011/2012 North Birmingham Air Sampling for Ethylene Dichloride.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				0.038 µg/m^3 (CREG)
Hudson K-8	ND-0.227	0.0737	43/60	43
Shuttlesworth	ND-0.862	0.0979	48/60	48
Riggins	ND-0.137	0.0733	47/65	47
Lewis	ND-0.150	0.0818	46/61	46

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
ND = Not Detected.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.

Ethylene dichloride was detected more frequently in the 2011/2012 sampling period than in the earlier sampling periods. None of the sample results exceed the MRL of 2,400 µg/m^3. Therefore, adverse, noncancerous health effects are not expected in the North Birmingham area.

In each sampling period the CREG of 0.038 µg/m^3 was exceeded and ATSDR calculated a cancer risk estimate for monitoring stations where ethylene dichloride was detected (see Appendix B). The highest cancer risk estimate for ethylene dichloride exposure in the North Birmingham area is 4 x 10^{-6}, or an estimated four additional people out of a million exposed people who may develop cancer in their lifetime.

Formaldehyde

Formaldehyde is a colorless, flammable gas at room temperature with a pungent, distinct odor. It occurs from both natural and man-made sources. Formaldehyde is used in the production of fertilizer, paper, plywood, and cosmetics, and is used as a preservative in some foods. Automobile exhaust from cars without catalytic converters or those using oxygenated gasoline also contain formaldehyde. Formaldehyde is also formed in the atmosphere from other chemicals. In homes, cigarettes and other tobacco products, gas cookers, and open fireplaces produce formaldehyde. Formaldehyde is found in rural areas at about 0.25 µg/m^3 in outdoor air, and about 2.5–7.4 µg/m^3 in suburban areas (ATSDR, 1999). The national average concentration of formaldehyde reported in EPA's 2010 National Monitoring Programs Annual Report is 2.47 µg/m^3 (EPA, 2012j).

Table 37. Summary of 2005/2006 Air Sampling for Formaldehyde.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/ #Samples Collected	# of 24 Hour Samples Exceeding CV	
				0.077 µg/m^3 (CREG)	9.8 µg/m^3 (Chronic MRL)
Shuttlesworth	1.02–11.1	3.69	31/31	31	1
North Birmingham	0.825–10.1	3.83	29/29	29	1
East Thomas	1.73–11.6	4.90	31/31	31	1
Providence	0.472–33.9	4.14	31/31	31	2

Source: JCDH 2009
Notes:
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.

Formaldehyde is a common component of urban atmospheres. Five samples exceeded ATSDR's chronic MRL of 9.8 µg/m^3 in 2005/2006. All other samples, as well as the average concentration at each location, were below the chronic MRL. Formaldehyde was not sampled for in 2009 or 2011/2012. Four of the samples that exceeded the chronic MRL in the North Birmingham area all happened on the same day in June 2006. Because the samples exceeded the chronic MRL so infrequently, it is most appropriate to compare these sample results to short term screening levels for formaldehyde exposure. The highest detected concentration of formaldehyde is below ATSDR's intermediate MRL (37 µg/m^3) and acute MRL (49 µg/m^3). Therefore, noncancerous adverse health effects are not likely. It is also worth noting that the highest detected concentration and the second highest average concentration were at the Providence monitoring location which is a rural, wooded area. The average concentrations are within the range found in suburban areas (2.5-7.4 µg/m^3).

All of the sample results were above ATSDR's CREG for formaldehyde (0.077 µg/m^3). The animal evidence for the carcinogenicity of formaldehyde consists primarily of nasal tumors

induced in rodents chronically exposed to formaldehyde levels of 6,000–18,000 µg/m^3. Most humans would try to avoid levels this high because formaldehyde has a suffocating, highly irritating odor that humans can detect at 600–1,200 µg/m^3 (ATSDR, 1999). More than 40 epidemiologic studies have examined the potential for occupational formaldehyde exposure to cause cancer in humans (ATSDR, 1999). Although some epidemiologic studies do not support the existence of a causal link between formaldehyde exposure and human cancer, a few studies produced statistically significant results (ATSDR, 1999; McLaughlin, 1994; European Chemical Industry and Toxicology Centre, 1995). The EPA and the Chemical Industry Institute of Toxicology consider that "a weak association with nasopharyngeal cancer cannot be completely ruled out" (ATSDR, 1999; CIIT, 1998). The U.S. Department of Health and Human Services has classified formaldehyde as known to be a human carcinogen (U.S. Department of Health and Human Services, 2014). The EPA has also derived an inhalation unit risk (IUR) for cancer from formaldehyde exposure using a study of nasal tumors in the rat (Kerns et al., 1983; EPA, 2012e).

ATSDR used the EPA's IUR for formaldehyde to calculate cancer risk estimates for each station for exposure to formaldehyde in air. The highest cancer risk estimate for formaldehyde air exposures in North Birmingham is 8 x 10^{-5} (see Appendix B). This cancer risk estimate means that in addition to their baseline cancer risk, an additional eight people out of one hundred thousand people continuously exposed to formaldehyde at the level in Providence may develop cancer during their lifetime.

Hexachloro-1,3-butadiene

Hexachloro-1,3-butadiene, also known as hexachlorobutadiene, is a colorless liquid with a turpentine odor that does not evaporate or burn easily. Hexachloro-1,3-butadiene does not occur naturally in the environment. It is formed during the processing of other chemicals such as tetrachloroethylene, trichloroethylene, and carbon tetrachloride. Hexachloro-1,3-butadiene is an intermediate in the manufacture of rubber compounds and lubricants (ATSDR, 1994). The national average concentration of hexachloro-1,3-butadiene reported in EPA's 2010 National Monitoring Programs Annual Report is 0.00107 µg/m^3 (EPA, 2012j)[15].

[15] It is worth noting that the 2008-2009 National Monitoring Programs report stated the national average concentration was 0.213 µg/m^3 (EPA, 2011e).

Table 38. Summary of 2005/2006 North Birmingham Air Sampling for Hexachloro-1,3-butadiene.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.045 µg/m^3 (CREG)
Shuttlesworth	ND–0.213	0.0600	6/31	6
North Birmingham	ND–0.213	0.0940	6/31	6
East Thomas	ND–0.213	0.102	10/31	10
Providence	ND–0.213	0.0890	5/31	5

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 39. Summary of 2009 North Birmingham Air Sampling for Hexachloro-1,3-butadiene.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/#Samples Collected	# of 24 Hour Samples Exceeding CV 0.045 µg/m^3 (CREG)
Riggins	ND–0.05	0.0565	3/10	1
North Birmingham	ND	ND	ND	ND
Lewis	ND-0.07	0.0654	1/13	1

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 40. Summary of 2011/2012 North Birmingham Air Sampling for Hexachloro-1,3-butadiene.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.045 µg/m^3 (CREG)**
Hudson K-8	ND-1.16	0.169	1/60	1
Shuttlesworth	ND	ND	ND	ND
Riggins	ND	ND	ND	ND
Lewis	ND–0.437	0.157	1/61	1

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

In the United States, the reported average concentration of hexachloro-1,3-butadiene in urban and source-dominated areas (based on 72 samples) is 0.38 µg/m^3 (ATSDR, 1994; Shah and Heyerdahl, 1988; Shah and Singh, 1988). Hexachloro-1,3-butadiene levels ranging from 0.02–0.12 µg/m^3 have been reported in a number of cities (ATSDR, 1994; Pellizzari, 1978; Singh et al., 1980; Singh et al., 1982). Higher levels of hexachloro-1,3-butadiene were reported in Niagara Falls, with concentrations of up to 0.39 µg/m^3 detected in ambient air levels and up to 0.41 µg/m^3 detected in the basement air of homes near industrial and chemical waste disposal sites (ATSDR, 1994; Pellizari, 1982). The average hexachloro-1,3-butadiene concentrations in North Birmingham are similar to those typically found in urban areas of the United States (ATSDR, 1994; Shah and Heyerdahl, 1988; Shah and Singh, 1988). Additionally, the 2005/2006 sample results show that the hexachloro-1,3-butadiene levels are essentially the same in the industrial areas of the Shuttlesworth and North Birmingham monitors as the rural area of the Providence monitor.

The lowest LOAEL for hexachloro-1,3-butadiene exposure, reported in ATSDR's Toxicological Profile for Hexachlorobutadiene, from a study that examined acute effects, is 29,000 µg/m^3 (ATSDR, 1994; de Ceaurriz et al., 1988). Information on the chronic health effects from inhalation of hexachloro-1,3-butadience is very limited. One study did consider the effect of chronic exposure to hexachloro-1,3-butadiene on the livers of workers. Workers with estimated exposure levels between 53 and 210 µg/m^3 experienced an increase in serum bile acids. It should be noted that the workers were potentially exposed to other solvents. For this reason and others, the practical importance of this finding is reduced (ATSDR, 1994; Driscoll et al., 1992). Nevertheless, all of the detected hexachloro-1,3-butadiene concentrations at all air monitors are orders of magnitude below both the LOAELs, and adverse, noncancerous health effects are not expected from exposure to hexachloro-1,3-butadiene in the North Birmingham area.

No studies were located regarding cancer in humans or animals after inhalation exposure to hexachloro-1,3-butadiene. The International Agency for Research on Cancer (IARC) has

determined that hexachloro-1,3-butadiene is not classifiable as to its carcinogenicity in humans, but indicated that there was limited evidence that hexachloro-1,3-butadiene was carcinogenic in rats. The EPA has determined that hexachloro-1,3-butadiene is a possible human carcinogen and derived an inhalation unit risk based on oral exposure data (ATSDR, 1994; EPA, 2012f). ATSDR used this inhalation unit risk to calculate cancer risk estimates for hexachloro-1,3-butadiene exposures. The highest cancer risk estimate for hexachloro-1,3-butadiene was 4×10^{-6} (see Appendix B), or out of a million people exposed to the level of hexachloro-1,3-butadiene at the Hudson K-8 monitor, four might develop cancer.

Manganese

Manganese is an essential trace element and is necessary for good health. It is a naturally occurring substance found in many types of rock. Sources of airborne manganese include iron- and steel-producing plants, power plants, coke ovens, and dust from mining operations. Because manganese is a natural component of the environment, low levels are found in water, air, soil, and food. The estimated average background concentration of manganese in urban areas is approximately 0.040 µg/m^3, based on measurements obtained in 102 U.S. cities (EPA, 2003; WHO, 2004). Concentrations near source dominated areas were reported to range from 0.220 to 0.300 µg/m^3 (WHO, 2004; ATSDR, 2012). The national average concentration of manganese reported in EPA's 2010 National Monitoring Programs Annual Report is 0.00682 µg/m^3 (EPA, 2012j).

Table 41. Summary of 2005/2006 North Birmingham Air Sampling for Manganese.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/ #Samples Collected	# of 24 Hour Samples Exceeding CV
				0.3 µg/m^3 (Chronic MRL)
Shuttlesworth	0.0205–0.614	0.139	31/31	4
North Birmingham (PM_{10})	0.0139–0.104	0.0357	31/31	0
North Birmingham (TSP)	0.00735-0.229	0.0694	31/31	0
East Thomas (PM_{10})	0.0113–0.142	0.0546	31/31	0
Providence (PM_{10})	0.000848–0.0215	0.00654	31/31	0

Source: JCDH 2009
Notes:
PM_{10} = Particulate matter with an aerodynamic diameter equal to or less than 10 microns.
TSP = Total Suspended Particulate Matter.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.

Table 42. Summary of 2009 North Birmingham Air Sampling for Manganese.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				0.3 µg/m^3 (Chronic MRL)
Riggins	0.00091–0.0276	0.0119	24/24	0
North Birmingham	0.00117–0.115	0.0189	18/18	0
Lewis	0.00154–0.175	0.0416	20/20	0
Source: EPA 2011a Notes: CV = Comparison Value. µg/m^3 = micrograms per cubic meter of air. MRL = Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.				

Table 43. Summary of 2011/2012 North Birmingham Air Sampling for Manganese.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				0.3 µg/m^3 (Chronic MRL)
Hudson K-8	0.00229-0.117	0.0310	63/63	0
Shuttlesworth	0.0005-0.0607	0.0228	62/62	0
Riggins	0.00247-0.0576	0.0167	67/67	0
Lewis	0.00256-0.165	0.0342	66/66	0
Source: EPA 2013a Notes: CV = Comparison Value. µg/m^3 = micrograms per cubic meter of air. MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.				

Manganese was detected in all air samples in all sampling periods, but sample results exceeded the chronic MRL for manganese only in 2005/2006. None of the average manganese concentrations exceeded the chronic MRL. The central nervous system is the primary target of manganese toxicity. In deriving the MRL, ATSDR considered several studies and calculated there was a 10% increased risk of neurological effects (involving reaction time, eye-hand coordination, hand steadiness) for individuals exposed to a manganese concentration between 73 and 142 µg/m^3 (ATSDR, 2012). These levels are known as the benchmark concentration. ATSDR derived the chronic MRL for manganese by adjusting 142 µg/m^3 to account for continuous exposure and by dividing by an uncertainty factor of 100 (10 for human variability and 10 for limitations in the database). The maximum detected manganese concentration (0.614 µg/m^3) is orders of magnitude below the lowest benchmark concentration (73 µg/m^3). Based on the 2005/2006, 2009, and 2011/2012 air concentrations, adverse noncancerous health effects are not expected.

There is no evidence that manganese causes cancer in humans. Although no firm conclusions can be drawn from the mixed results in animal studies, there are little data to suggest that inorganic manganese is carcinogenic. The EPA has provided manganese with a weight-of-evidence classification D—not classifiable as to human carcinogenicity (ATSDR, 2012).

Naphthalene

Naphthalene is a white solid that evaporates easily. Fossil fuels, such as petroleum and coal, naturally contain naphthalene. Burning tobacco or wood produces naphthalene. The major commercial use of naphthalene is to make other chemicals used in making polyvinyl chloride (PVC) plastics. The major consumer products made from naphthalene are moth repellents, in the form of mothballs or crystals, and toilet deodorant blocks. It is also used for making dyes, resins, leather tanning agents, and the insecticide carbaryl. Most of the naphthalene entering the environment is from the burning of woods and fossil fuels in the home. The second greatest release of naphthalene is through the use of moth repellents. Only about 10% of the naphthalene entering the environment is from coal production and distillation. Typical air concentrations for naphthalene are low, 1.1 µg/m^3 or less (ATSDR, 2005c). However, the average reported concentration in one study for 67 samples (primarily from source dominated locations in the United States) was 5.19 µg/m^3 (ATSDR, 2005c; EPA, 1988). A median naphthalene level in urban air in 11 U.S. cities of 0.94 µg/m^3 has also been reported (Howard, 1989). An average naphthalene concentration of 170 µg/m^3 in outdoor air was reported in a residential area of Columbus, Ohio (ATSDR, 2005c; Chuang et al., 1991), and naphthalene was measured in ambient air in Torrance, California at a concentration of 3.3 µg/m^3 (ATSDR, 2005c; Propper, 1988). The national average concentration of naphthalene reported in EPA's 2010 National Monitoring Programs Annual Report is 0.0953 µg/m^3 (EPA, 2012j).

Table 44. Summary of 2005/2006 North Birmingham Air Sampling for Naphthalene.

Monitor Location	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	# Contaminant Detected/ #Samples Collected	# of 24 Hour Samples Exceeding CV 3.7 µg/m^3 (Chronic MRL)
Shuttlesworth	0.0234–1.22	0.490	30/30	0
North Birmingham	0.0288–1.05	0.286	31/31	0
East Thomas	0.0451–1.28	0.266	31/31	0
Providence	0.00269–0.0453	0.017	31/31	0

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.

Table 45. Summary of 2009 North Birmingham Air Sampling for Naphthalene.				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				3.7 µg/m³ (Chronic MRL)
Riggins	0.0376–5.78	1.29	24/24	3
North Birmingham	0.039–2.26	0.631	20/20	0
Lewis	0.0157–1.74	0.297	19/19	0
Source: EPA 2011a Notes: CV = Comparison Value. µg/m³ = micrograms per cubic meter of air. MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.				

Table 46. Summary of 2011/2012 North Birmingham Air Sampling for Naphthalene.				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/#Samples Collected**	**# of 24 Hour Samples Exceeding CV**
				3.7 µg/m³ (Chronic MRL)
Hudson K-8	0.0375-2.02	0.465	66/66	0
Shuttlesworth	0.0465-2.06	0.670	62/62	0
Riggins	ND-5.74	0.860	71/72	1
Lewis	0.0203-1.83	0.433	59/59	0
Source: EPA 2013a Notes: CV = Comparison Value. µg/m³ = micrograms per cubic meter of air. MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.				

The highest detected naphthalene levels are above ATSDR's chronic MRL of 3.7 µg/m³. ATSDR based the chronic MRL for naphthalene on two chronic inhalation toxicity and carcinogenicity studies with mice and rats. In one study, mice were exposed to naphthalene vapor for six hours a day, five days a week, for 104 weeks; and in the other study rats were exposed to naphthalene vapor for six hours a day, five days a week, for 105 weeks. In both studies, 52,000 µg/m³ was a LOAEL in both sexes and species for nonneoplastic lesions in nasal olfactory and respiratory epithelium (ATSDR, 2005c; Abdo et al., 2001; NTP, 2000).

In deriving the chronic MRL for naphthalene, ATSDR first determined the human equivalent concentrations of the LOAEL from the mice and rat studies. The LOAEL human equivalent concentration ($LOAEL_{HEC}$) based on the rat study was 1,100 µg/m³ and $LOAEL_{HEC}$ based on the mice study was 1600 µg/m³ (ATSDR, 2005c). The 1,100 µg/m³ concentration was divided by a total uncertainty factor of 300 (10 for using a LOAEL, 3 for extrapolation from animals to humans, and 10 for human variability) to derive the chronic MRL. The highest detected

naphthalene levels are orders of magnitude below the human equivalent concentrations, and are not expected to result in adverse health effects.

The U.S. Department of Health and Human Services has classified naphthalene as reasonably anticipated to be a human carcinogen (U.S. Department of Health and Human Services, 2014). Both the US EPA and the International Agency for Research on Cancer have determined naphthalene is a possible human carcinogen based on the animal evidence. The evidence for the carcinogenicity of naphthalene in animals consists of studies of rats and mice exposed to naphthalene at concentrations between 52,000 $\mu g/m^3$ and 157,000 $\mu g/m^3$ (ATSDR, 2005c; Abdo et al., 2001; NTP, 2000). These levels are well above the levels of naphthalene detected in North Birmingham air. Additionally, the US EPA has not developed an inhalation unit risk value for naphthalene, but the California EPA has. ATSDR used the inhalation unit risk developed by the California EPA to calculate an estimated cancer risk for naphthalene for each location for all sampling periods. The highest estimated cancer risk for exposure to naphthalene in North Birmingham air is 7×10^{-5} (see Appendix B), or an additional seven people out of one hundred thousand exposed people who may develop cancer in their lifetime.

Particulate Matter, $PM_{2.5}$ and PM_{10}

Particulate matter (PM), which refers to airborne droplets and particles, comes from many sources, both natural and manmade. As stated previously, $PM_{2.5}$ refers to particulate matter with an aerodynamic diameter 2.5 microns or less, and PM_{10} refers to particulate matter with an aerodynamic diameter 10 microns or less. Population subgroups that may be more sensitive to the effects of PM exposure include children (under 18 years of age), older adults (over 65 years old), individuals with asthma, chronic obstructive pulmonary disease (COPD), or cardiovascular disease, diabetics, lower socioeconomic status, and those with certain genetic polymorphisms. Epidemiologic studies have also examined whether additional factors, such as gender, race, or ethnicity modify the association between PM and morbidity and mortality outcomes. Gender and race do not seem to modify the association between particulate matter and morbidity and mortality outcomes. However, some evidence, although only from two studies conducted in California, suggest that Hispanic ethnicity may modify the association between PM and mortality (EPA, 2009b).

A summary of the particulate matter sampling completed between 1999 and 2013 at air monitoring stations also included in the 2005/2006 air toxics study is presented in Tables 47 and 48.

Table 47 Summary of $PM_{2.5}$ Sampling Results from the North Birmingham and Providence Monitoring Stations (1999-2013).

Years	Location	98th Percentile of 24 Hour Samples (µg/m³)	Annual Average (µg/m³)	CV (µg/m³)
1999-2001*	North Birmingham, Monitor #1	50	21.6	35. (24 Hour Sample) 12.0 (Annual Average, see notes below)
	North Birmingham, Monitor #2	53	23.2	
	Providence, Monitor #1	35	15.0	
	Providence, Monitor #2	40	15.9	
2000-2002	North Birmingham, Monitor #1	45	19.6	
	North Birmingham, Monitor #2	52	21.5	
	Providence, Monitor #1	34	14.1	
	Providence, Monitor #2	39	15.3	
2001-2003	North Birmingham, Monitor #1	40	18.0	
	North Birmingham, Monitor #2	45	20.3	
	Providence, Monitor #1	31	12.6	
	Providence, Monitor #2	37	12.7	
2002-2004	North Birmingham, Monitor #1	40	17.5	
	North Birmingham, Monitor #2	45	19.7	
	Providence, Monitor #1	32	12.3	
	Providence, Monitor #2	31	12.3	
2003-2005	North Birmingham, Monitor #1	44	18.2	
	North Birmingham, Monitor #2	49.	20.3	
	Providence, Monitor #1	34	13.0	
	Providence, Monitor #2	32.	12.3	
2004-2006	North Birmingham, Monitor #1	44.	18.6	
	North Birmingham, Monitor #2	52.	20.4	
	Providence, Monitor #1	35	13.4	
	Providence, Monitor #2	35.	13.4	
2005-2007	North Birmingham, Monitor #1	46	18.9	
	North Birmingham, Monitor #2	51	20.4	
	Providence, Monitor #1	38	14.0	
	Providence, Monitor #2	38	13.7	
2006-2008	North Birmingham, Monitor #1	41	17.6	
	North Birmingham, Monitor #2	45	18.7	
	Providence, Monitor #1	34	12.8	
	Providence, Monitor #2	34	12.9	
2007-2009	North Birmingham, Monitor #1	36	15.3	
	North Birmingham, Monitor #2	37	16.3	
	Providence, Monitor #1	30	11.5	
	Providence, Monitor #2	31	11.9	
2008-2010	North Birmingham, Monitor #1	29	13.7	
	North Birmingham, Monitor #2	32	14.3	
	Providence, Monitor #1	22	10.2	
	Providence, Monitor #2	23	10.5	
2009-2011	North Birmingham, Monitor #1	27	12.9	
	North Birmingham, Monitor #2	29	13.8	
	Providence, Monitor #1	22	10.0	
	Providence, Monitor #2	22	10.2	
2010-2012*	North Birmingham, Monitor #1	27	13.0	
	North Birmingham, Monitor #2	27	13.6	
	Providence, Monitor #1	23	10.2	
	Providence, Monitor #2	24	10.5	
2011-2013	North Birmingham, Monitor #1	24	11.9	
	North Birmingham, Monitor #2	24	12.4	
2013	Shuttlesworth	24	11.6	

Source: http://www.epa.gov/airdata/ad_rep_mon.html; EPA 2014c

Notes: EPA's National Ambient Air Quality Standards require that annual average concentrations of $PM_{2.5}$, averaged over three consecutive calendar years, do not exceed 12.0 µg/m³. Further, the 98 percentile of 24-hour average $PM_{2.5}$ concentrations, averaged over three consecutive calendar years, must not exceed 35 µg/m³. It should be understood that the EPA annual NAAQS for $PM_{2.5}$ was changed from 15.0 µg/m³ to 12.0 µg/m³ in late 2012. Consequently, the annual standard in place during most of this time period was 15.0 µg/m³.

$PM_{2.5}$ sampling began at the Shuttlesworth monitoring station in July 2013 (ADEM, 2014).

*$PM_{2.5}$ Monitoring did not start at the Providence monitoring site until the year 2000. Therefore, the averages shown are for the years 2000 and 2001. Similarly, $PM_{2.5}$ monitoring ended at the Providence site in 2011 and the averages shown are for 2010 and 2011.

µg/m³ = micrograms per cubic meter of air.

CV = Comparison Value.

The values shown above include data from exceptional events.

Table 48 Summary of PM_{10} Sampling Results from the North Birmingham and Shuttlesworth Monitoring Stations (1999-2013)

Location	Year	Maximum 24 Hour Average Concentration ($\mu g/m^3$)	Second Highest 24 Hour Average Concentration ($\mu g/m^3$)	CV ($\mu g/m^3$)
North Birmingham	1999	136	123	150 (NAAQS)
	2000	157	157	
	2001	118	117	
	2002	113	106	
	2003	136	132	
	2004	122	121	
	2005	114	112	
	2006	95	93	
	2007	103	101	
	2008	117	89	
	2009	52	49	
	2010	101	91	
	2011	65	61	
	2012	-	-	
	2013	49	48	
Shuttlesworth	1999	198	138	
	2000	153	134	
	2001	185	130	
	2002	173	160	
	2003	190	178	
	2004	218	166	
	2005	137	128	
	2006	161	152	
	2007	241	233	
	2008	146	142	
	2009	129	126	
	2010	77	73	
	2011	83	65	
	2012	97	59	
	2013	74	58	

Source: http://www.epa.gov/airdata/ad_rep_mon.html ; EPA 2014c
Notes: The EPA's National Ambient Air Quality Standards (NAAQS) state that the24-hour average PM10 concentrations are not to exceed 150 $\mu g/m^3$ more than once per year (on average) over a 3-year period.
$\mu g/m^3$ = micrograms per cubic meter of air.
CV = Comparison Value.
The values above include data from exceptional events.

The EPA's website has an online tool known as AirNow (http://www.airnow.gov/index.cfm?action=resources.conc_aqi_calc). The AQI Calculator on that site can be used to estimate potential health effects from known 24 hour concentrations of $PM_{2.5}$ and PM_{10}. If the concentrations in Table 47 are used with this calculator, the result indicates that the maximum 24 hour $PM_{2.5}$ concentrations between 1999 and 2008 at the North Birmingham

monitoring station and the maximum 24 hour $PM_{2.5}$ concentrations from 1999 to 2003 and 2005 to 2007 at the Providence monitoring station, could have resulted in an increased likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in individuals with cardiopulmonary disease, the elderly and children; but not for the general population. Similarly, the maximum 24 hour concentrations of PM_{10} from 1999 to 2004, in 2006, and 2007 (shown in Table 48) at the Shuttlesworth station and the maximum 24 hour concentrations of PM_{10} in 2000 at the North Birmingham station, would also represent an increased likelihood of respiratory and other symptoms in sensitive individuals (EPA, 2014a). If the AQI calculator and the most recent (2011-2013) 24 hour concentrations of $PM_{2.5}$ at the Shuttlesworth and North Birmingham locations and PM_{10} at the Shuttlesworth location (2013) are used, the air quality is classified as "moderate". The EPA uses this classification to describe air quality that is acceptable but may present a moderate health concern in a very small number of people (http://airnow.gov/index.cfm?action=aqibasics.index). EPA's cautionary statement for "moderate" PM2.5 days is, "Unusually sensitive people should consider reducing prolonged or heavy exertion."

It should be noted that the averages shown in Tables 47 and 48 include data from exceptional events. An exceptional event is defined in 40 CFR 50.1 as an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the EPA Administrator in accordance with 40 CFR 50.14 to be an exceptional event. Air quality data that are determined to have been affected by an exceptional event under the procedural steps, substantive criteria, and schedule specified in section 50.14 may be excluded from consideration when EPA makes a determination that an area is meeting or violating the associated NAAQS (Federal Register, 2012). If exceptional events are excluded from the 2007-2009 averages, the average 98^{th} percentile of 24 hour $PM_{2.5}$ samples for North Birmingham Monitor #1 is 33 $\mu g/m^3$ and 35 for Monitor #2. Therefore, the North Birmingham monitoring station has shown compliance with the 24 hour $PM_{2.5}$ NAAQS since 2009[16].

As mentioned previously, the EPA changed the annual $PM_{2.5}$ NAAQS from 15.0 $\mu g/m^3$ to 12.0 $\mu g/m^3$ in late 2012 (EPA, 2013b). The North Birmingham monitors have shown compliance with the 15.0 $\mu g/m^3$ annual standard since 2010, but the $PM_{2.5}$ results were above the new 12.0 $\mu g/m^3$ annual standard until only recently (2011-2013). The most recent $PM_{2.5}$ annual averages for the North Birmingham monitors are also similar to or below the past $PM_{2.5}$ annual averages of the Huntsville, Alabama monitor shown in the table below. It is worth noting that the most recent 24 hour concentrations of $PM_{2.5}$ shown in the table below would also be qualified as "moderate" if the EPA's AQI calculator is used.

[16] It is worth noting that in 2007, wildfires in Georgia and Florida had an impact on the air quality in Jefferson County (JCDH, 2007).

Table 49.Summary of $PM_{2.5}$ Sampling Results from the Huntsville, Alabama Monitoring Station (1999-2013).

Years	98th Percentile of 24 Hour Samples (µg/m³)	Annual Average (µg/m³)	CV (µg/m³)
1999-2001	34	15.5	35. (24 Hour Sample) 12.0 (Annual Average, see notes below)
2000-2002	35	14.9	
2001-2003	30	14.1	
2002-2004	31	13.7	
2003-2005	33	13.9	
2004-2006	34	13.7	
2005-2007	35	14.0	
2006-2008	31	13.3	
2007-2009	27.7	12.2	
2008-2010	23	11.3	
2009-2011	22	11.0	
2010-2012	21	10.7	
2011-2013	20	9.7	

Source: http://www.epa.gov/airdata/ad_rep_mon.html ; EPA 2014c

Notes: EPA's National Ambient Air Quality Standards require that annual average concentrations of $PM_{2.5}$, averaged over three consecutive calendar years, do not exceed 12.0 µg/m³. Further, the 98 percentile of 24-hour average $PM_{2.5}$ concentrations, averaged over three consecutive calendar years, must not exceed 35 µg/m³. It should be understood that the EPA annual NAAQS for $PM_{2.5}$ was changed from 15.0 µg/m³ to 12.0 µg/m³ in late 2012. Consequently, the annual standard in place during most of this time period was 15.0 µg/m³.

µg/m³ = micrograms per cubic meter of air.
CV = Comparison Value
The values shown above include data from exceptional events.

Several health studies have investigated potential health effects resulting from long-term exposure to particulate matter. The World Health Organization (WHO) reviewed many of these studies such as the American Cancer Society study (Pope et. al, 2002) and the Harvard Six-Cities Study (Dockery et al., 1993; HEI, 2000), and currently recommends an annual $PM_{2.5}$ concentration of 10 µg/m³. However, WHO acknowledges this guideline, "represents the lower end of the range over which significant effects on survival were observed in the American Cancer Society's (ACS) study (Pope et al., 2002)" (WHO 2006). The guideline also "places significant weight on the long-term exposure studies that use the ACS and the Harvard Six-Cities data (Dockery et al., 1993; Pope et al., 1995, 2002; HEI, 2000; Jerrett, 2005)"(WHO, 2006). Thresholds (exposure levels where health effects are first seen) are not apparent in these studies (WHO, 2006). The historical average $PM_{2.5}$ concentration was 18 µg/m³ (range 11.0 - 29.6 µg/m³) in the Six-Cities Study and 20 µg/m³ (range 9.0 – 33.5 µg/m³) in the American Cancer Society (ACS) study (WHO, 2006), annual averages above the most recent (2010-2013) annual averages at the North Birmingham monitor. In the ACS study, statistical uncertainty in the risk estimates becomes apparent at concentrations of about 13 µg/m³, below which the confidence bounds significantly widen because of the variability in the exposure concentrations. According

to the results of the Dockery et al. (1993) study, the risks are similar in the cities with the lowest long-term $PM_{2.5}$ concentrations (i.e., 11 and 12.5 $\mu g/m^3$). Increases in risk are apparent in the city with the next lowest long-term $PM_{2.5}$ average concentration (i.e., 14.9 $\mu g/m^3$), indicating that when annual mean concentrations are in the range of 11–15 $\mu g/m^3$, health effects can be expected (WHO, 2006). While the current annual $PM_{2.5}$ concentrations at the North Birmingham monitoring station are within this range (11-15 $\mu g/m^3$), so are the past annual $PM_{2.5}$ concentrations at the Providence monitor and the Huntsville monitor.

In considering the potential health effects from $PM_{2.5}$, it would have been helpful to have more $PM_{2.5}$ data from the Shuttlesworth monitoring location. The results in Table 48 show compliance with PM_{10} standard at the Shuttlesworth monitoring location since 2008, but the only $PM_{2.5}$ data available for this location is for some of the year 2013 and most of 2014.

Polycyclic aromatic hydrocarbons (PAHs), Benzo(a)pyrene Toxic Equivalents (BaP-TE)
Polycyclic aromatic hydrocarbons (PAHs) are present throughout the environment, and people may be exposed to these substances at home, outside, or at the workplace. Typically, people will not be exposed to an individual PAH, but to a mixture of PAHs. In the environment, people are most likely to be exposed to PAH vapors or PAHs that are attached to dust and other particles in the air. Sources include cigarette smoke, vehicle exhausts, asphalt roads, coal, coal tar, wildfires, agricultural burning, residential wood burning, municipal and industrial waste incineration, and hazardous waste sites. Background levels of some representative PAHs in the air are reported to be 0.00015–0.0193 $\mu g/m^3$ in urban areas. The national average concentration of BaP-TE from EPA's 2010 National Monitoring Programs Annual Report is 0.000198 $\mu g/m^3$ (EPA, 2012j).

People may be exposed to PAHs in soil near areas where coal, wood, gasoline, or other products have been burned. People may be exposed to PAHs in the soil at or near hazardous waste sites, such as former manufactured-gas factory sites and wood-preserving facilities (ATSDR, 1995).

As mentioned previously PAHs are typically classified as carcinogenic or noncarcinogenic. Several of the PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene, have caused tumors in laboratory animals when they breathed these substances in the air, when they ate them, or when they had long periods of skin contact with them. Studies of people show that individuals exposed for long periods to mixtures that contain PAHs and other compounds can also develop cancer (ATSDR, 1995). Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene are also often evaluated as benzo(a)pyrene toxic equivalents (BaP-TE). The BaP-TE concentration is the sum of these seven different PAHs with their concentrations adjusted for their toxicity relative to benzo(a)pyrene. ATSDR calculated the BaP-TE for each location in 2005/2006 and 2009 using the following toxic equivalence factors.

PAH compound	TEF
Benzo(a)pyrene	1
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(ah)anthracene	1
Indeno(123-cd)pyrene	0.1

Source: EPA 1993

Table 50. Summary of 2005/2006 North Birmingham Air Sampling for BaP-TE.

Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**
Shuttlesworth	0.000140-0.0236	0.00328	30/30
North Birmingham	0.0000765-0.0217	0.00288	31/31
East Thomas	0.0000736--0.00608	0.000769	31/31
Providence	0.0000733-0.000429	0.000034	27/31

Source: JCDH 2009
Notes:
Concentration range calculated using detected values reported in JCDH 2009.
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.

Table 51. Summary of 2009 North Birmingham Air Sampling for BaP-TE.			
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**
Riggins	0.0000754-0.0465	0.00562	24/24
North Birmingham	0.0000753-0.00297	0.000688	20/20
Lewis	0.0000713-0.00134	0.000517	19/19
Source: EPA 2011a Notes: Concentration range calculated using detected values reported in EPA 2011a. In calculating the average concentration, non-detects were treated as half the detection limit. CV = Comparison Value. µg/m^3 = micrograms per cubic meter of air. BaP-TE = Benzo(a)pyrene toxic equivalents.			

Table 52 Summary of 2011/2012 North Birmingham Air Sampling for BaP-TE.			
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**
Hudson K-8	0.000138-0.0161	0.00183	68/68
Shuttlesworth	0.000321-0.0128	0.00270	68/68
Riggins	0.000139-0.0365	0.00603	70/71
Lewis	0.000118-0.0261	0.00235	62/62
Source: EPA 2013a Notes: Concentration range calculated using minimum and maximum values reported in EPA 2013a. In calculating the average concentration, non-detects were treated as half the detection limit. CV = Comparison Value. µg/m^3 = micrograms per cubic meter of air. BaP-TE = Benzo(a)pyrene toxic equivalents.			

The US EPA has not developed a comparison value or inhalation unit risk value for benzo(a)pyrene, but the California EPA has. ATSDR used the inhalation unit risk developed by the California EPA to calculate an estimated cancer risk for each location for all sampling periods. The results suggest no increased cancer risk (see Appendix B).

ATSDR's health consultation, "Assessment of Soil Exposures in Communities Adjacent to the Walter Coke, Inc. Site Birmingham, AL," also considered the potential cancer risk from the ingestion of and dermal contact with BaP-TE in the soil around the Walter Coke facility (ATSDR, 2013). This health consultation states if the highest property soil BaP-TE concentration was used and if 100% bioavailability of BaP-TE by way of ingestion was assumed, the estimated cancer risk would be 1×10^{-4}. If a more realistic bioavailability factor of 50% is used the estimated cancer risk based upon the maximum exposure concentration would only be 9×10^{-5}. The highest cancer risk estimate for BaP-TE in air shown in Appendix B is 1×10^{-5}. If this estimate is combined with the 9×10^{-5} estimated cancer risk from the soil pathway, the results would still be within EPA's target risk range of 1×10^{-4}, which represents one additional person who may develop cancer for every ten thousand people exposed.

Trichloroethylene

Trichloroethylene has been used as a metal degreaser, but has also been used in several consumer products. It is also known as TCE. It evaporates easily but can stay in the soil and in groundwater. Once it is in the air, about half will be broken down within a week (ATSDR, 1997b). A review of the sampling results of 115 monitors in the United States that collected TCE data in 1998 found the concentration of TCE in the ambient air had a range between 0.01 $\mu g/m^3$ and 3.9 $\mu g/m^3$ (Wu and Schaum, 2000). The national average concentration of trichloroethylene reported in EPA's 2010 National Monitoring Programs Annual Report is 0.0591 $\mu g/m^3$ (EPA, 2012j).

Table 53. Summary of 2005/2006 North Birmingham Air Sampling for Trichloroethylene				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.24 µg/m³ (CREG)**
Shuttlesworth	ND–0.215	0.070	12/31	0
North Birmingham	ND–0.645	0.101	14/31	3
East Thomas	ND–0.376	0.107	16/31	3
Providence	ND–0.108	0.034	6/31	0

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 54. Summary of 2009 North Birmingham Air Sampling for Trichloroethylene.				
Monitor Location	**Concentration Range (µg/m³)**	**Average Concentration (µg/m³)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.24 µg/m³ (CREG)**
Riggins	ND–0.054	0.016	3/10	0
North Birmingham	ND–0.17	0.0328	6/17	0
Lewis	ND–0.13	0.0427	6/14	0

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m³ = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Table 55. Summary of 2011/2012 North Birmingham Air Sampling for Trichloroethylene.				
Monitor Location	**Concentration Range (µg/m^3)**	**Average Concentration (µg/m^3)**	**# Contaminant Detected/ #Samples Collected**	**# of 24 Hour Samples Exceeding CV 0.24 µg/m^3 (CREG)**
Hudson K-8	ND-0.247	0.0734	6/60	1
Shuttlesworth	ND–0.226	0.0678	2/60	0
Riggins	ND–0.532	0.0739	3/65	1
Lewis	ND-0.279	0.0786	8/61	2

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
ND = Not Detected.

Trichloroethylene was detected in each sampling period. All detected concentrations were below the ATSDR's MRL for trichloroethylene of 2 µg/m^3. Therefore, adverse, noncancerous health effects are not expected.

Most of the trichloroethylene sample results in all sampling periods were below the CREG (0.24 µg/m^3). Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of trichloroethylene in workplace air have found evidence of increased cancer. The National Toxicology Program (NTP) determined that trichloroethylene is "reasonably anticipated to be a human carcinogen." The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is "probably carcinogenic to humans" (ATSDR, 2003).

ATSDR calculated an estimated cancer risk for each monitoring location for trichloroethylene. The estimated cancer risks for exposure to trichloroethylene in North Birmingham air are all below 1 x 10^{-6} (see Appendix B).

Cumulative Cancer Risks

While the estimated cancer risk from any individual carcinogen detected does not represent an apparent increased cancer risk, the total estimated cancer risk from all carcinogens approaches or slightly exceeds 1 x 10^{-4} (JCDH, 2009; EPA, 2013a). Appendix B shows the total estimated cancer risk from exposure to all carcinogens (using both the average concentrations of the carcinogens and the 95% upper confidence limit of the concentrations to calculate cancer risks). If the average concentrations are used to calculate the cancer risks, the only monitoring stations with results showing a total estimated cancer risk from all carcinogens greater than 1 x 10^{-4} are the Shuttlesworth station in 2005/2006 and the Riggins monitoring site in 2009. Even the total estimated cancer risks were less than 1 x 10^{-4} in the later sampling rounds at most sites when the average concentrations were used to calculate cancer risks. Typically, the individual chemical representing the highest cancer risk was benzene.

If the high-end estimates of the chemical concentrations (95% upper confidence limits) are used to calculate the total cumulative cancer risks from all carcinogens, all of the monitoring stations in 2005/2006 and 2009 were at or above 1×10^{-4}. Even the results from the Providence monitoring site (a rural area) show a cumulative cancer risk of 1×10^{-4}. At the Providence site, the individual chemical representing the highest cancer risk was formaldehyde. However, cancer risk estimates are based upon EPA's inhalation unit risks which assume a person is continually exposed to the same concentration of a carcinogen for an entire lifetime. Consequently, the 2009 cancer risk estimates are less reliable than the cancer risk estimates for 2005/2006 and 2011/2012 because the 2009 cancer risk estimates are based upon only two months of sampling. The primary goal of the 2009 sampling was to determine which chemicals were at levels requiring further evaluation or follow up (EPA, 2011a).

The cumulative cancer effects were estimated by adding together the estimated cancer risks from each individual carcinogen. While this approach does not account for possible interactions of chemicals such as synergistic or antagonistic effects, it is often used in the assessment of air toxics (EPA, 2009a; JCDH, 2009, California Environmental Protection Agency, 2003). Often information on the interactions of different carcinogens is not available, but the uncertainty from assuming cumulative cancer risks can be estimated by simply adding together the individual cancer risk from each carcinogen may be less than other sources of uncertainty (California Environmental Protection Agency,2003; JCDH 2009). To gain extra perspective on the cumulative cancer risks from air toxics in North Birmingham, it is helpful to consider other cancer risk estimates that use a simple additive approach such as those calculated by the EPA as a part of EPA's 2005 National Air Toxics Assessment. The 2005 National Air Toxics Assessment is a tool used to prioritize and characterize public health risk from air toxics including both cancer and non-cancer. The EPA used emission inventories and modeling to characterize these risks for all counties in the United States (EPA 2011b, 2011c). EPA strongly cautions that these estimates should not be used to compare risks between neighborhoods or to pinpoint the risk from specific sources in a census tract (EPA, 2011d). Nevertheless, the 2005 National Air Toxics Assessment does estimate that the nationwide total cancer risk from inhalation of air toxics is 5×10^{-5}, or five in one hundred thousand. The National Air Toxic Assessment's estimated total cancer risk for the state of Alabama is 5×10^{-5} and the estimated total cancer risk for Jefferson County is 7×10^{-5}.

Because the NATA estimates were based upon modeled data, it can also be helpful to consider cumulative cancer risk estimates from air toxics studies of other cities in the United States that used sample results from air monitoring. A recent study of air toxics in Gary, Indiana also found the cumulative cancer risk was 1×10^{-4} (IDEM, 2013). A study of nine, mostly urban, monitoring sites in Michigan (Detroit) found the estimated cumulative cancer risks (based upon the average concentrations of air toxics) to be between 3×10^{-5} and 5×10^{-4} (Michigan Department of Environmental Quality, 2005). A study of four monitoring sites in Tonawanda, New York found the estimated cancer risk to be between 9×10^{-5} and 7×10^{-4} (New York State Department of Environmental Conservation, 2009) Therefore, the cumulative cancer risk estimates based upon

sampling data from North Birmingham appear consistent with cumulative cancer risk estimates based upon sampling data from other urban areas in the United States with similar industries[17].

In determining the potential cumulative cancer risks from air contaminants for residents near the 35th Avenue Site, it is worth considering two recently released reports. The first report is EPA's analysis of the releases and pollution prevention activities of 15 industries in the North Birmingham area[18]. This report focused on carcinogens and compared the information contained in Toxic Release Inventory reporting forms from 2005-2011 with 2012 Toxic Release Inventory reporting forms. This EPA report states the following conclusions.

- In 2012, three North Birmingham facilities reported implementing pollution prevention related activities at their facilities.
- This reporting rate (3 of 15 facilities) is higher than the national average for 2012.
- It (2012) was the first year any North Birmingham facility reported implementing a pollution prevention activity for a carcinogen.
- Several North Birmingham facilities also reported using preferred waste management practices, like recycling and energy recovery, to manage their chemicals. Such activities play an important role in minimizing releases of carcinogens to air and land (EPA, 2014b).

The second recently released report is JCDH's review of health data from 2000-2009. JCDH compared the rates of death from cancer for residents living in the 35207 zip code and the rest of Jefferson County. The JCDH found no statistically significant difference in the death rate from all cancers combined (Oliver, 2014). While consistent with ATSDR's conclusions based on the air monitoring data, this study does have some limitations. The Jefferson County Department of Health's study involved data from 2000-2009; consequently, it does not address earlier time periods. It should also be noted that the statistical analysis by the Jefferson County Department of Health was based on a small sample size (Oliver, 2014; Collins, 2014). Another limitation of cancer incidence studies is that cancer is a chronic disease that takes many years after exposure to reveal itself as a clinical disease. The information supplied by cancer registries typically involves only an address at time of diagnosis for each case. No information is available on length of time an individual may have lived at the address before diagnosis. It is possible that some cases are new, short-term residents with little or no exposure to the contaminants in North Birmingham. Furthermore, former residents who moved out of the study area before diagnosis are not available for analysis. Population mobility cannot typically be accounted for in these types of studies.

Noncancerous Health Effects from Mixtures

Throughout this health assessment, the health evaluations have primarily focused on individual contaminants. This analysis is consistent with the toxicological literature, which focuses on health effects following single pollutant exposures. In the North Birmingham area, however, as with many industrial areas, real-world environmental exposures occur simultaneously and involve multiple contaminants. Many gaps exist in our understanding of the full range of health

[17] All of these studies included areas with coke oven and steel manufacturing facilities as well as mobile sources - and other industries. -

[18] The 15 industries were located within a 3 mile radius of the Hudson K-8 School. -

impacts of air pollution (i.e., the mixture of contaminants) and scientific and regulatory communities are at least 10 years away from being able to implement changes to address these issues (Mauderly et al., 2010). A series of important studies on the toxicity of low dose chemical mixtures was conducted by the TNO Nutritional and Food Research Institute in the Netherlands (ATSDR, 2005a; Jonker et al., 1990; Jonker et al., 1993). In these experiments, rats were dosed with mixtures of chemicals at doses near their individual NOAELs and LOAELs. The results of these experiments indicated that there was no discernable toxic response until the dose levels of the individual chemicals approached or exceeded their individual thresholds. Other studies have provided evidence that exposure to chemical mixtures, in which the chemicals were administered at doses that were near their individual thresholds, can produce additive toxic effects. However, there is no evidence of additive toxicity from exposure to chemical mixtures when the individual chemicals are administered at doses that are well below individual thresholds (ATSDR, 2005a; Seed et al., 1995; Wade et al., 2002).

Particulate matter is a mixture of different particles from different sources and the effects of this mixture have been discussed already (EPA, 2009b). In considering the potential health effects from multiple contaminants in North Birmingham, it is worth noting that most of the contaminants discussed in this document exceeded cancer evaluation guidelines and not screening levels for noncancerous, adverse health effects. Of the chemicals sampled for in North Birmingham, only acetaldehyde, acetonitrile, acrolein, benzene, formaldehyde, manganese, and naphthalene, had a 24 hour sample result that exceeded a screening level for noncancerous health effects. The average concentrations of acetonitrile and acrolein, and most of the average concentrations of acetaldehyde, in North Birmingham were all below the national average concentrations of these chemicals reported in EPA's 2010 National Monitoring Programs Annual Report (EPA, 2012j). As mentioned previously, 24 hour concentrations of acetaldehyde and formaldehyde infrequently exceeded a chronic MRL or RfC in 2005/2006 and the maximum concentration for both chemicals was at the Providence location (a rural area). Only one acetaldehyde sample exceeded the RfC. Four of the formaldehyde samples that exceeded the chronic MRL in the North Birmingham area all happened on the same day in June 2006. However, the maximum formaldehyde concentration did not exceed short term (acute or intermediate) MRL's for formaldehyde.

The primary target of manganese is the central nervous system (ATSDR, 2012). Both benzene and acetonitrile have also been shown to affect the central nervous system if inhaled, but only at levels at least an order of magnitude above the concentrations detected in North Birmingham air. The lowest level reported in ATSDR's Toxicological Profile for Benzene at which central nervous system effects occur from breathing benzene is 2500 $\mu g/m^3$ (ATSDR, 2007c). This level is more than an order of magnitude above the maximum detected concentration of benzene in North Birmingham air (55.11 $\mu g/m^3$). Similarly, the level at which nervous system effects occur from acetonitrile inhalation were seen in rats was 1,300,000 $\mu g/m^3$ and above. In humans, symptoms that could be related to the nervous system (chest tightness and flushing of face) were observed in subjects exposed to acetonitrile levels of 67,000 $\mu g/m^3$ and above for four hours (NTP, 1996; EPA, 1999, 2012b). The levels in these studies are well above the maximum acetonitrile concentration detected in North Birmingham (196 $\mu g/m^3$). Since, as stated previously, even the maximum concentration of manganese is also orders of magnitude below

the benchmark concentration, cumulative, adverse central nervous system effects do not seem likely.

The nose is the most sensitive target organ for both naphthalene and acrolein (ATSDR; 2005c, 2007a). However, as stated previously, the highest detected naphthalene levels in North Birmingham are orders of magnitude below the human equivalent concentrations used to derive the chronic MRL. The highest detected acrolein concentrations from each sample station site are below the human equivalent concentration LOAELs calculated by ATSDR and the EPA to derive comparison values, and the average concentrations are more than an order of magnitude below these LOAELs. Moreover, as stated previously, it is possible that the monitoring completed in 2005/2006 may overestimate the acrolein concentration.

When considering the potential noncancerous health effects from exposure to more than one chemical in North Birmingham air, it is worth giving particular attention to the most recent round of sampling (2011/2012). Only two chemicals in 2011/2012, benzene and naphthalene, had a 24 hour sample result that exceeded a CV for noncancerous health effects and these exceedances occurred at the Riggins location. However, only one sample result was above the chronic MRL for naphthalene in 2011/2012; and the average naphthalene concentrations in 2011/2012 were all below the chronic MRL[19]. The chronic MRL for naphthalene was based upon its effect on nasal tissue. Benzene has been shown to cause nasal as well as throat irritation but at levels of 110,000 $\mu g/m^3$ and above (ATSDR, 2007c). These levels are orders of magnitude above the maximum benzene concentration detected in North Birmingham (55.11 $\mu g/m^3$). Sufficient data are available to show that the hematopoietic system is a critical target for benzene toxicity (ATSDR, 2007c). Both benzene and naphthalene have been shown to cause anemia. However, anemia has been documented in humans exposed to benzene at levels of 9,600 $\mu g/m^3$ and above (ATSDR; 2007c, 2005c). The levels of naphthalene in air that cause anemia in humans are not as well documented. However, one study involving people that developed anemia from exposure to naphthalene in air showed a level of 100 $\mu g/m^3$ (ATSDR, 2005c). This level is more than an order of magnitude above the maximum level of naphthalene detected in North Birmingham (5.74 $\mu g/m^3$). Consequently, it is unlikely that combined effect of benzene and naphthalene would result in anemia or other noncancerous health effects.

ATSDR notes that a limitation inherent in the public health assessment process is that scientists do not have a complete understanding how simultaneous exposures to several environmental contaminants may cause health effects.

Community Concerns

Since the summer of 2011, ATSDR has attended several public meetings in North Birmingham. ATSDR has learned some community members are concerned about exposure to particulate matter. Specifically, community members have stated that black dust settles in attics, on clothing drying outside, and on cars. Consequently, ATSDR reviewed the particulate matter data available on EPA's website for the Collegeville (North Birmingham station) and Harriman Park

[19] It is worth noting that the maximum detected naphthalene level in 2011/2012 (5.74 $\mu g/m^3$) is below the California EPA's chronic reference exposure level for naphthalene of 9 $\mu g/m^3$. http://www.oehha.ca.gov/air/allrels.html

(Shuttlesworth station) neighborhoods from 1999 to 2013. ATSDR has concluded that exposures to particulate matter in the past could have caused adverse health effects in sensitive individuals. Community members have also told ATSDR that a number of people living in neighborhoods adjacent to Walter Coke have respiratory problems including asthma. Individuals with respiratory conditions such as asthma may have adverse reactions if they inhale particulate matter, due to its physical nature.

There was also concern about odors. Odors in the environment can come from many sources. It is important to note that not all odors are toxic. Toxicity depends on the substance giving off the odor, the amount of the substance (concentration) in the air that people are breathing, how often (frequency) they are breathing that air, and how much time (duration) they spend breathing that air. If the right conditions exist such as concentration, frequency, and duration, the odor can be toxic and cause adverse health effects. If those conditions do not exist, odors are generally not toxic. The chemical sampling which is discussed in this assessment characterizes those conditions (concentration, frequency, etc.).

Some community members were also concerned about air emissions that took place at night, particularly emissions from the Walter Coke plant. The chemical sampling (for metals, carbonyls, volatile organic compounds, and semi-volatile organic compounds) that took place involved 24 hour samples which would include sampling during the night time hours. Community members also noted the earliest chemical sampling data available was for 2005/2006. Because some community members had lived in the North Birmingham neighborhoods for decades before that time, sample results would not be a complete representation of their exposures.

Child Health Considerations

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

Some studies have shown a link between exposure to particulate matter and low birth weight and infant mortality. However, there is great variability in the outcomes of these studies which are influenced by the particle size, duration of exposure, and time during pregnancy when the mother is exposed (EPA, 2010). The EPA has concluded the evidence only suggests a causal relationship between long-term exposures to $PM_{2.5}$ and reproductive and developmental outcomes, with effects becoming more precise and consistent in locations with an average $PM_{2.5}$ concentration of 15 $\mu g/m^3$ and above (EPA, 2009b) As discussed previously, The long term concentrations of $PM_{2.5}$ in North Birmingham have been below this level since 2008. It is also worth noting that

the literature does not consistently report associations between long term exposure to particulate matter and preterm birth and birth defects (EPA, 2009b). In revising the annual $PM_{2.5}$ standard the EPA did conclude children were a susceptible population (Federal Register, 2012).

Adequacy of the Available Data

The air data underlying this assessment appear to be an adequate basis for the following public health determinations. Sample location, collection, and quality assurance procedures that were established (and apparently implemented) resulted in consistent, well-documented data sets. The 2005/2006 and 2011/2012 data sets cover an entire year and therefore account for any seasonal variations in the concentrations of contaminants. Furthermore, particulate matter data is available for the Collegeville and Harriman Park neighborhoods (the North Birmingham and Shuttlesworth monitoring stations, respectively). Acetaldehyde and formaldehyde concentrations exceeded comparison values in 2005/2006 but were not sampled for in the later sampling periods. However, as noted previously, the highest detected concentrations for these chemicals were at the Providence monitoring location which was located in a rural, wooded area approximately 30 miles southwest of the other monitors.

Conclusions, Recommendations, and Public Health Action Plan

Conclusions

ATSDR has evaluated the past and current exposures to air contaminants in the communities adjacent to the 35th Avenue site. On the basis of the likely exposure pathways and the available environmental data, ATSDR concludes the following:

1. Exposures to particulate matter in North Birmingham air in the past (1999-2012) could have resulted in harmful effects in sensitive individuals but not the general public. Population subgroups that may be more sensitive to the effects of particulate matter exposure include children (under 18 years of age), older adults (over 65 years old), individuals with asthma, chronic obstructive pulmonary disease (COPD), or cardiovascular disease, diabetics, lower socioeconomic status, and those with certain genetic predispositions.
2. Current exposures to particulate matter in North Birmingham air are unlikely to result in harmful effects in individuals.
3. Levels of air contaminants (volatile organic compounds, semi-volatile organic compounds, carbonyls, and metals) in North Birmingham air are not likely to result in harmful noncancerous health effects.
4. The current estimated cumulative cancer risks from air contaminants in North Birmingham are within EPA's target risk range and represent a low to very low increased cancer risk. Using high-end estimates (95% upper confidence limits) of the concentrations of contaminants in North Birmingham air to estimate cancer risk, it is estimated that there may be one additional cancer out of a population of 10,000 people exposed to these contaminants over a 70-year lifetime.
5. Past levels of air contaminants at the Riggins monitoring station (in 2009) and the Shuttlesworth monitoring station (in 2005/2006) represented an estimated cancer risk above EPA's target risk range. Using average concentrations of contaminants measured at these two stations, it is estimated that there may be two additional cancers out of a population of 10,000 people exposed to these contaminants over a 70-year lifetime.

Recommendations

ATSDR makes the following recommendations:

1. ATSDR recommends the Jefferson County Department of Health continue to monitor for particulate matter at the North Birmingham (in the Collegeville neighborhood) and Shuttlesworth (in the Harriman Park neighborhood) monitoring stations.
2. ATSDR recommends the EPA or Jefferson County Department of Health continue to manage the risk posed by air toxics by
    a. Improving air quality in North Birmingham through regulation, enforcement, and collaboration with the community using approaches that go beyond regulation.

b. Resampling for air contaminants if there is a substantial increase in emissions of contaminants due to additional industry locating in the area or modification of existing industry in the area.

Public Health Action Plan

ATSDR will continue to work with EPA and the Jefferson County Department of Health to address environmental public health concerns in North Birmingham during EPA's site activities. ATSDR will also continue to work with the North Birmingham, Collegeville, Fairmont, and Harriman Park community and neighborhood groups to address their health concerns related to site contaminants.

References

Abdo KM, Grumbein S, Chou BJ, et al. 2001. Toxicity and carcinogenicity study in F344 rats following 2 years of whole-body exposure to naphthalene vapors. Inhal Toxicol 13:931-950.

[ADEM] Alabama Department of Environmental Management. 2014. State of Alabama Ambient Air Monitoring 2014 Consolidated Network Review. June. Available at: http://adem.alabama.gov/programs/air/airquality/2014AmbientAirPlan.pdf Last accessed: November 12, 2014.

Aranyi C, Bradof JN, O'Shea WJ, et al. 1985. Effects of arsenic trioxide inhalation exposure on pulmonary antibacterial defenses in mice. J Toxicol Environ Health 15:163-172.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1990. Toxicological profile for Acrylonitrile. Atlanta: US Department of Health and Human Services. December.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1994. Toxicological profile for Hexachlorobutadiene. Atlanta: US Department of Health and Human Services. May.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs); U.S. Department of Health and Human Services. August.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1997a. Toxicological profile for Chloroform (update). Atlanta: US Department of Health and Human Services. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1997b. Toxicological profile for Trichloroethylene. Atlanta: US Department of Health and Human Services, Public Health Service. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1999. Toxicological profile for Formaldehyde. Atlanta: US Department of Health and Human Services. July.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2001. Toxicological Profile for 1,2-Dichloroethane. Atlanta: US Department of Health and Human Services. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2002. Toxicological Profile for Beryllium. Atlanta: US Department of Health and Human Services. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2003. Trichloroethylene, ToxFAQs. July.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2005a.Public health assessment guidance manual. Atlanta: US Department of Health and Human Services. January.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2005b. Toxicological profile for Carbon Tetrachloride (update) draft for public comment. Atlanta: US Department of Health and Human Services. August.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2005c. Toxicological Profile for Naphthalene. Department of Health and Human Services. August.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2007a. Toxicological Profile for Acrolein. Atlanta: US Department of Health and Human Services. August.

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

[ATSDR] Agency for Toxic Substances and Disease Registry. 2007c. Toxicological profile for Benzene (update). Atlanta: US Department of Health and Human Services. August.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2008a. Toxicological profile for Cadmium (update). Atlanta: US Department of Health and Human Services. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2008b. Toxicological profile for Chromium (draft). Atlanta: US Department of Health and Human Services. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2009. Toxicological profile for 1,3-Butadiene. Atlanta: US Department of Health and Human Services. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2012. Toxicological profile for Manganese (draft). Atlanta: US Department of Health and Human Services. September.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2013. Assessment of Soil Exposures in Communities Adjacent to the Walter Coke, Inc. Site, Birmingham, AL

Brodzinky R, Singh HB. 1983. Volatile organic chemicals in the atmosphere: An assessment of available data. Research Triangle Park, NC: U.S. Environmental Protection Agency, Office of Research and Development. EPA-600/3-83-027(A).

California Environmental Protection Agency. 2003. Air Toxics Hot Spots, Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. August.

Chuang JC, Mack GA, Kuhlman MR, et al. 1991. Polycyclic aromatic hydrocarbons and their derivatives in indoor and outdoor air in an eight-home study. Atmos Environ 25B(3):369-380.

[CIIT] Chemical Industry Institute of Toxicology. 1998. Formaldehyde risk assessment meeting. November 14, 1997. Research Triangle Park, NC.

Collins, Alan. 2014. Health official says no apparent health risk to those living in north Birmingham. July. Fox 6. Available at: http://www.myfoxal.com/story/26155445/health-official-says-no-apparent-health-risk-to-those-living-in-north-birmingham Last accessed: November 7, 2014.

Curren KC, Dann TF, Wang DK. 2006. Ambient air 1,3-butadiene concentrations in Canada (19952003): Seasonal, day of week variations, trends, and source influences. Atmos Environ 40:170-181.

Davidson CI, Goold WD, Mathison TP, et al. 1985. Airborne trace elements in Great Smoky Mountains, Olympic, and Glacier National Parks. Environ Sci Technol 19:27-35.

de Ceaurriz J, Gagnaire F, Ban M, et al. 1988. Assessment of the relative hazard involved with airborne irritants with additional hepatotoxic or nephrotoxic properties in mice. J Appl Toxicol 8:417-422.

Dempster AM, Snyder CA. 1991. Kinetics of granulocytic and erythroid progenitor cells are affected differently by short-term, low-level benzene exposure. Arch Toxicol 65(7):556-561.

Dockery DW, et al. 1993. An association between air pollution and mortality in six U.S. cities. N Engl J Med 329:1753–59.

Driscoll TR, Hamdan HH, Wang G, et al. 1992. Concentrations of individual serum or plasma bile acids in workers exposed to chlorinated aliphatic hydrocarbons. Br J Ind Med 49:700-705.

[EPA] US Environmental Protection Agency. 1982. Inductively coupled plasma-atomic emission spectrometric method for trace element analysis of water and wastes - method 200.7. Cincinnati, OH: U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory.

[EPA] US Environmental Protection Agency. 1987. June-September, 6-9 AM, ambient air benzene concentrations in 39 U.S. cities, 19841986. Research Triangle Park, NC: U.S. Environmental Protection Agency, Atmospheric Sciences Research Lab. EPA600D87160.

[EPA] US Environmental Protection Agency. 1988. National ambient volatile organic compounds (VOCs) data base update. Research Triangle Park, NC: U.S. Environmental Protection Agency, Atmospheric Sciences Research Laboratory, Office of Research and Development. EPA600388010a. PB88195631.

[EPA] US Environmental Protection Agency. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, US Environmental Protection Agency, EPA 540-R-04-004, July.

[EPA] US Environmental Protection Agency. 1994. Office of Pollution Prevention and Toxics Chemical Fact Sheet. Chemicals in the Environment: Acetaldehyde (CAS No. 75-07-0). August. Available at: http://www.epa.gov/chemfact/f_acetal.txt . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 1999. Toxicological Review of Acetonitrile: In Support of Summary Information on the Integrated Risk Information System (IRIS). January. Available at: http://www.epa.gov/iris/toxreviews/0205tr.pdf . Last accessed September 11, 2014.

[EPA] US Environmental Protection Agency. 2002. Toxicological Review of Benzene (Noncancer Effects): In Support of Summary Information on the Integrated Risk Information System (IRIS). October. Available at: http://www.epa.gov/iris/toxreviews/0276tr.pdf . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2003. Health effects support document for manganese. U.S. Environmental Protection Agency. EPA822R03003. Available at; http://www.epa.gov/safewater/ccl/pdfs/reg_determine1/support_cc1_magnese_healtheffects.pdf . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2004. AIRData. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.

[EPA] US Environmental Protection Agency. 2007. Technology Transfer Network Air Toxics Web Site. Acetonitrile. Last updated November 6, 2007. Available at: http://www.epa.gov/ttn/atw/hlthef/acetonit.html Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2008. 2007 National Monitoring Programs (UATMP and NATTS), Volume 1: Main Content. Prepared for the U.S. Environmental Protection Agency by Eastern Research Group, Inc. December.

[EPA] US Environmental Protection Agency. 2009a. Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final. January.

[EPA] US Environmental Protection Agency. 2009b. Integrated Science Assessment for Particulate Matter. U.S. Environmental Protection Agency. EPA/ 600/R-08/139F. December, 2009. Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=216546. Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2010. Promoting Good Prenatal Health: Air Pollution and Pregnancy. U.S. Environmental Protection Agency. Office of Children's Health Protection and Environmental Education, Child and Aging Health Protection Division . EPA-1F-09-020, January 2010.

[EPA] US Environmental Protection Agency. 2011a. SAT Initiative: Riggins School, North Birmingham Elementary School, and Lewis Elementary School in Birmingham, Alabama. June.

Available at: http://www.epa.gov/air/sat/pdfs/BirminghamTechReport.pdf . Last accessed November 6, 2014.

[EPA] United States Environmental Protection Agency. 2011b. Summary of Results for the 2005 National-Scale Assessment. February 17. Available at: http://www.epa.gov/ttn/atw/nata2005/05pdf/sum_results.pdf. Last accessed November 6, 2014.

[EPA] United States Environmental Protection Agency. 2011c. An Overview of Methods for EPA's National-Scale Air Toxics Assessment. January 31. Available at: http://www.epa.gov/ttn/atw/nata2005/05pdf/nata_tmd.pdf. Last accessed November 6, 2014.

[EPA] United States Environmental Protection Agency. 2011d. 2005 NATA Results. Technology Transfer Network Air Toxics.2005 National-Scale Air Toxics Assessment. Available at: http://www.epa.gov/ttn/atw/nata2005/tables.html. Last accessed November 6, 2014. Last updated February, 24 2011.

[EPA] US Environmental Protection Agency.2011e. 2008-2009 National Monitoring Programs (UATMP and NATTS), Volume 1: Main Content. Prepared for the U.S. Environmental Protection Agency by Eastern Research Group, Inc. December.

[EPA] US Environmental Protection Agency. 2012a. Integrated risk information system database. Acetaldehyde (CASRN 75-07-0). Last updated August 9, 2012. Available at: http://www.epa.gov/iris/subst/0290.htm . Last accessed September 11, 2014.

[EPA] US Environmental Protection Agency. 2012b. Integrated risk information system database. Acetonitrile (CASRN 75-05-8). Last updated August 9, 2012. Available at: http://www.epa.gov/iris/subst/0205.htm . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2012c. Integrated risk information system database. Acrolein (CASRN 107-02-8). Last updated August 9, 2012. Available at: http://www.epa.gov/iris/subst/0364.htm . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2012d. Integrated risk information system database. Chloroform (CASRN 67-66-3). Last updated August 9, 2012. Available at: http://www.epa.gov/iris/subst/0025.htm . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2012e. Integrated risk information system database. Formaldehyde (CASRN 50-00-0). Available at: http://www.epa.gov/iris/subst/0419.htm . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2012f. Integrated risk information system. Hexachlorobutadiene. (CASRN 85-01-8). Available at: http://www.epa.gov/iris/subst/0058.htm. Last accessed November 6, 2014.

[EPA] U.S. Environmental Protection Agency.2012g. Integrated risk information system, Phenanthrene (CASRN 85-01-8). Available at: http://www.epa.gov/iris/subst/0459.htm. Last accessed November 6, 2014.

[EPA] United States Environmental Protection Agency. 2012h. Integrative Risk Information System (IRIS) Glossary. Last updated November 9, 2012, US Environmental Protection Agency. Available at http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=IRIS%20Glossary . Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency2012i. Fine Particle ($PM_{2.5}$) Designations. Available at: http://www.epa.gov/airquality/particlepollution/designations/index.htm Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2012j. 2010 National Monitoring Programs Annual Report (UATMP and NATTS), Volume 1: Main Content. Prepared for the U.S. Environmental Protection Agency by Eastern Research Group, Inc. November.

[EPA] US Environmental Protection Agency. 2013a. North Birmingham Air Toxics Risk Assessment. March.

[EPA] US Environmental Protection Agency. 2013b. Particulate Matter (PM) Standards-Table of Historical PM NAAQS. Available at: http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_history.html Last updated June 11,2013. Last accessed November 6, 2014

[EPA] US Environmental Protection Agency. 2014a. AirNow AQI Calculator. Retrieved from: http://www.airnow.gov/index.cfm?action=resources.conc_aqi_calc Last accessed November 12, 2014

[EPA] US Environmental Protection Agency. 2014b. Toxics Release Inventory Analysis of Community-Scale Pollution Prevention Activities: North Birmingham, Alabama. U.S. Environmental Protection Agency Toxic Release Inventory Program. August. Available at: http://www2.epa.gov/sites/production/files/2014-08/documents/north_birmingham_p2_analysis_final.pdf Last accessed November 12, 2014.

[EPA] US Environmental Protection Agency. 2014c. AirData: County monitor values report – PM2.5 and PM10. Geographic area: Jefferson County, Alabama: 1999 to 2013. Last updated October 8, 2014. Available at: http://www.epa.gov/airdata/ad_rep_mon.html .Last accessed November 7, 2014.

[EPA] US Environmental Protection Agency. 2014d. Cleanup Process in the North Birmingham Environmental Collaboration Project. Last Updated October 15, 2014. Available at: http://www2.epa.gov/north-birmingham-project/cleanup-process-north-birmingham-environmental-collaboration-project . Last accessed November 12, 2014.

European Chemical Industry Ecology and Toxicology Centre. 1995. Technical report No. 65. Formaldehyde and human cancer risk. Brussels: European Chemical Industry Ecology and Toxicology Centre.

Faust, RA. 1993. Toxicity Summary for Phenanthrene. Health Sciences Research Division, Oak Ridge National Laboratory. August. Available at: http://rais.ornl.gov/tox/profiles/phenanthrene_f_V1.html Last accessed November 6, 2014.

Federal Register. 2012. Environmental Protection Agency, 40 CFR Parts 50, 51, 52, 53, and 58,[EPA–HQ–OAR–2007–0492; FRL–9682–9]RIN 2060–AO47,National Ambient Air Quality Standards for Particulate Matter. Volume 77. No. 126. June

Feron, VJ; Kryusse, A; Til, HP; et al. 1978. Repeated exposure to acrolein vapor: subacute studies in hamsters, rats and rabbits. Toxicology 9:47-57.

Fishbein L. 1984. Overview of analysis of carcinogenic and/or mutagenic metals in biological and environmental samples. I. Arsenic, beryllium, cadmium, chromium and selenium. Int J Environ Anal Chem 17:113–70.

Fadlevich, Jessica. 2013. Birmingham meets federal air quality standards for first time in 30 years.Regional Planning Commission of Greater Birmingham. January. Available at: http://www.rpcgb.org/news/apca/ Last accessed November 6, 2014.

Grant RL, Leopold V, McCant D, et al. 2007. Spatial and temporal trend evaluation of ambient concentrations of 1,3-butadiene and chloroprene in Texas. Chem Biol Interact 166(1-3):44-51.

[HEI] Health Effects Institute. 2000. A reanalysis of the Harvard six-cities study and the American Cancer Society study of particulate air pollution and mortality. Cambridge, MA: A Special Report of the Institute's Particle Epidemiology Reanalysis Project.

Howard PH. 1989. Handbook of environmental fate and exposure data for organic chemicals. Vol. 1. Lewis Publishers, 408-421.

[IDEM] Indiana Department of Environmental Management. 2013. Lakeshore Air Toxics Study Report. June. Available at: http://www.in.gov/idem/toxic/2342.htm Last accessed December 15, 2014.

International Agency for Research on Cancer. 1980. Arsenic and arsenic compounds. IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans. Vol. 23. Some metals and metallic compounds. Lyon, France: International Agency for Research on Cancer, 39-141.

[JCDH] Jefferson County Department of Health. 2007. Air Quality Report 2007. Available at: http://www.jcdh.org/misc/ViewBLOB.aspx?BLOBId=313 . Last accessed November 6, 2014.

[JCDH] Jefferson County Department of Health. 2009. Birmingham Air Toxics Study. February. Available at: http://www.jcdh.org/misc/ViewBLOB.aspx?BLOBId=182 . Last accessed November 6, 2014.

Jerrett M. 2005. Spatial analysis of air pollution and mortality in Los Angeles. Epidemiol 16:727–36.

Jonker D, Woutersen RA, van Bladeren PJ, Til HP, and Feron VJ. 1990. 4-week toxicity study of a combination of eight chemicals in rats: Comparison with the toxicity of the individual compounds. Food Chem Toxicol 28(9): 623-631.

Jonker D, Woutersen RA, van Bladeren PJ, Til HP, and Feron VJ. 1993. Subacute (4-week) oral toxicity of a combination of four nephrotoxins in rats: Comparison with the toxicity of the individual compounds. Food Chem Toxicol 31(2): 125-136.

Kelly TJ, Mukund R, Spicer CW, et al. 1994. Concentrations and transformations of hazardous air pollutants. Environ Sci Technol 28:378A-387A.

Kerns WD, Pavkov KL, Donofrio DJ, Gralla EJ, Swenberg JA. 1983. Carcinogenicity of formaldehyde in rats and mice after long-term inhalation exposure. Cancer Res 43: 4382–92.

Lan Q, Zhang L, Li G, et al. 2004a. Hematotoxicity in workers exposed to low levels of benzene. Science 306:1774-1776.

Lan Q, Zhang L, Li G, et al. 2004b. Hematotoxicity in workers exposed to low levels of benzene: Supporting online material. Science 306:1774-1776. Available at: http://www.sciencemag.org/cgi/data/306/5702/1774/DC1/1. August 2, 2005. Last accessed November 6, 2014.

Lindberg E, Hedenstierna G. 1983. Chrome plating: Symptoms, findings in the upper airways, and effects on lung function. Arch Environ Health 38:367-374.

Mauderly, J.L., Burnett, R.T., Castillejos, M., Ozkaynak, H., Samat, J.M., Stieb, D.M., Vedal, S., and Wyzga, R.E. 2010. Commentary: Is the air pollution health research community prepared to support a multipollutant air quality management framework? Inhal Toxicol 22(S1): 1-19.

McCarthy, MC; Hafner, HR; Montzka, SA. 2006. Background Concentration of 18 Air Toxics for North America. Air & Waste Management Association 56:3-11. Available at: http://www.environmental-expert.com/Files%5C6477%5Carticles%5C5985%5Cmccarthy.pdf . Last accessed November 6, 2014.

McLaughlin JK. 1994. Formaldehyde and cancer: a critical review. Int Arch Occup Environ Health 66:295–301.

Michigan Department of Environmental Quality. 2005. Detroit Air Toxics Initiative, Risk Assessment Report. November. Available at:

http://www.michigan.gov/documents/DATI_-_COMPLETE_FINAL_REPORT_11-9-05_142053_7.pdf Last accessed November 6, 2014.

NAS. 1977. Medical and biologic effects of environmental pollutants: Arsenic. Washington, DC: National Academy of Sciences. Available at: http://www.nap.edu/books/0309026040/html/index.html. Last accessed November 6, 2014.

New York State Department of Environmental Conservation. 2009. Tonawanda Community Air Quality Study. October. Available at: http://www.dec.ny.gov/chemical/59447.html Last accessed December 16, 2014.

[NTP] National Toxicology Program. 1996. Toxicology and carcinogenesis studies of acetonitrile (CAS No. 75-05-8) in F344/N rats and B6C3F$_1$ mice (inhalation studies). National Toxicology Program. NTP TR 447, NIH Publ. No. 96-3363. April.

[NTP] National Toxicology Program. 2000. Toxicology and carcinogenesis studies of naphthalene (CAS No. 91-20-3) in F344/N rats (inhalation studies). National Toxicology Program. NTP TR 500, NIH Publ. No. 01-4434.

Oliver, Mike. 2014. Birmingham's 'toxic city' neighborhoods show no excess cancer due to pollution, study finds. August, 06. Available at: http://www.al.com/news/index.ssf/2014/08/birminghams_toxic_city_neighbo.html Last accessed: November 7, 2014.

Oguz O, Karman D, Tuncel G. 2003. Measurement of traffic related toxic air pollutants in an urban atmosphere. Water Air Soil Pollut Focus. 3:175-192.

Pellizzari ED. 1978. Quantification of chlorinated hydrocarbons in previously collected air samples. EPA-450/3-78-112.

Pellizzari ED. 1982. Analysis for organic vapor emissions near industrial and chemical waste disposal sites. Environ Sci Technol 16:781-785.

Pope CA III, Thun MJ, Namboodiri MM, et al. 1995. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. Am J Respir Crit Care Med 151:669–74.

Pope CA III, Burnett RT, Goldberg MS, et al. 2002. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. JAMA 287:1132–41.

Propper R. 1988. Polycyclic aromatic hydrocarbons (PAH): A candidate toxic air contaminant. Air Resources Board. Springfield, VA: National Technical Information Service. TR SS-88-01.

Reiss R. 2006. Temporal trends and weekend-weekday differences for benzene and 1,3-butadiene in Houston, Texas. Atmos Environ 40(25):4711-4724.

Reiss R, Griffin J. 2004. Exploratory data analysis of benzene and 1,3-butadiene measurements for air toxics risk assessment in Houston. Alpharetta, GA: Coordinating Research Council.

Roberts JM, Hutte RS, Fehsenfeld FC, et al. 1985. Measurements of anthropogenic hydrocarbon concentration ratios in the rural troposphere: Discrimination between background and urban sources. Atmos Environ 19:1945-1950.

Rozen MG, Snyder CA, Albert RE. 1984. Depression in B- and T-lymphocyte mitogen-induced blastogenesis in mice exposed to low concentrations of benzene. Toxicol Lett 20:343-349.

Sax Sl, Bennett DH, Chillrud SN, et al. 2004. Differences in source emission rates of volatile organic compounds in inner-city residences of New York City and Los Angeles. J Expo Anal Environ Epidemiol 14(Suppl 1):S95-S109.

Seed J, Brown R, Olin SS, Foran JA. 1995. Chemical mixtures: current risk assessment methodologies and future directions. Regul Toxicol Pharmacol 22:76-94.

Shah JJ, Heyerdahl EK. 1988. National ambient volatile organic compounds (VOCs) data base update. EPA/600/3-38/010a.

Shah JJ, Singh HB. 1988. Distribution of volatile organic chemicals in outdoor and indoor air. Environ Sci Technol 22: 1381-1388.

Singh HB, Sales LJ, Smith A, et al. 1980. Atmospheric measurements of selected hazardous organic chemicals. Menlo Park, CA: SRI International. Project No. 7774:6.

Singh HB, Sales LJ, Stiles RE. 1982. Distribution of selected gaseous organic mutagens and suspect carcinogens in ambient air. Environ Sci Technol 16:872-880.

US Department of Health and Human Services. 2014. Report on Carcinogens, Thirteenth edition. Available at: http://ntp.niehs.nih.gov/?objectid=03C9AF75-E1BF-FF40-DBA9EC0928DF8B15 . Last accessed November 12, 2014.

Wade MG, Foster WG, Younglai EV, McMahon A, Leingartner K et al. 2002. Effects of subchronic exposure to a complex mixture of persistent contaminants in male rats: systemic, immune and reproductive effects. Toxicol Sci 67:131-43.

[WHO] World Health Organization. 2003. Chromium in drinking water. Background document for development of WHO guidelines for drinking water quality. Geneva: World Health Organization.

[WHO] World Health Organization. 2004. Manganese in drinking-water. Background document for development of WHO guidelines for drinking-water quality. World Health Organization. WHO/SDE/WSH/03.04/104. Available at:

http://www.who.int/water_sanitation_health/dwq/chemicals/manganese.pdf. Last accessed November 6, 2014.

[WHO] World Health Organization 2006. WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide, and Sulfur Dioxide. Global Update: 2005. 2006. Available at: http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf. Last accessed November 6, 2014.

Wu C and Schaum J. 2000. Exposure Assessment of Trichloroethylene. Environmental Health Perspectives, Vol 108, Supplement 2. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1637751/pdf/envhper00311-0209.pdf Last accessed November 6, 2014.

Appendix A. Summary of Contaminants Exceeding Comparison Values.

The United States Environmental Protection Agency (EPA) Region IV requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate environmental data collected from three communities in the vicinity of the 35th Avenue Site in North Birmingham, Jefferson County, Alabama. The three communities are: Collegeville, Harriman Park, and Fairmont. Citizens in these three communities are concerned about whether breathing the air is safe for them and their children and grandchildren. Air samples were collected from the area in 2005/2006 by the Jefferson County Department of Health. In 2009 and 2011/2012, air samples were collected by the Environmental Protection Agency. In 2005/2006, samples were collected at four locations and analyzed for 102 different contaminants. In 2009, samples were collected at three area schools and analyzed for 59 different contaminants. In 2011/2012, samples were collected at four locations and analyzed for 91 different contaminants.

ATSDR compared the contaminant concentrations to their respective health-based comparison values. Comparison Values (CVs) are chemical and media-specific concentrations in air, soil, and drinking water that are used by ATSDR health assessors and others to identify environmental contaminants at hazardous waste sites that require further evaluation. CVs incorporate assumptions of daily exposure to the chemical and in the case of soil and water a standard amount that someone may likely take into their body each day. CVs are conservative and non-site specific. CVs are based on health guidelines with uncertainty or safety factors applied to ensure that they are adequately protective of public health.

The comparison of environmental data with ATSDR CVs is one of the first steps in the public health assessment process. The results of this screening step give health assessors an understanding of the priority contaminants at the site. When a contaminant is detected at a concentration less than its respective CVs, exposure is not expected to result in health effects and it is not considered further as part of the public health assessment process. It should be noted that contaminants detected at concentrations that exceed their respective CVs, do not necessarily represent a health threat. Instead, the results of the CV screening identify those contaminants that warrant a more detailed, site-specific evaluation to determine whether health effects are expected to occur. CVs are not intended to be used as environmental clean-up levels.

CVs can be based on either carcinogenic or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor (CSF) or inhalation unit risk (IUR). CVs based on cancerous effects account for a lifetime exposure (70 years) with a theoretical excess lifetime cancer risk of one extra case per one million exposed people. Non-cancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), EPA's Reference Doses (RfDs), or EPA's Reference Concentrations (RfCs).

ATSDR has developed the following types of CVs:

> Cancer Risk Evaluation Guide (CREG). CREGs are media-specific comparison values that are used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population. ATSDR develops CREGs using EPA's cancer slope factor (CSF) or inhalation unit risk (IUR), a target risk level

(10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents an estimated risk of one excess cancer cases in a population of one million. At this time, CREGs are available only for adult exposures—no CREGs specific to childhood exposure are available.

Minimal Risk Level (MRL). Minimal Risk Levels (MRLs) are an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during a specified duration of exposure. MRLs are based only on non-carcinogenic effects. MRLs are derived for acute (1-14 days), intermediate (15-365 days), and chronic (365 days and longer) durations for the oral and inhalation routes of exposure.

Screening levels developed by the Environmental Protection Agency (EPA) were also used in this public health assessment. The EPA has developed chronic Reference Concentrations (RfCs) for inhalation as estimates of daily exposures to a substance that are likely to be without a discernible risk of deleterious effects to the general human population (including sensitive subgroups) during a lifetime of exposure. EPA includes uncertainties sometimes spanning orders of magnitude to ensure that the potential for health effects is overestimated. RfCs are derived for the non-carcinogenic health effects of compounds that are also carcinogens. RfCs are derived assuming exposure to a single substance in a single media. In this document, if there was no MRL for a given contaminant, the EPA RfC was used.

The EPA hosts a "Regional Screening Levels for Chemical Contaminants at Superfund Sites" screening level/preliminary remediation goal website. The Regional Screening Levels (RSLs) tables provide comparison values for residential and commercial industrial exposures to soil, air, and tapwater (drinking water)[20]. This EPA RSL table for air is available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm . In addition to ATSDR's screening levels and EPA's RfCs, this website contains the following levels.

- Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by EPA's Superfund Health Risk Technical Support Center (STSC) for the EPA Superfund program
- Chronic Reference Exposure Levels (RELS) developed by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA)
- Levels developed by the EPA's Superfund Program's Health Effects Assessment Summary (HEAST)

Since many of the contaminants detected do not have an ATSDR CV or EPA RfC, the screening levels from the remediation goal website were used for this public health assessment.

Finally, if a contaminant did not have an ATSDR MRL or CREG, or EPA RfC, or EPA RSL residential air value; ATSDR used screening levels developed by the Texas Commission on Environmental Quality (TCEQ). The TCEQ has developed air monitoring comparison values (AMCVs) and effect screening levels (ESLs).

[20] The November 2012 Regional Screening Levels were used for this health assessment.

The contaminants with at least one sample result that exceeded its respective health-based comparison value in 2005/2006 are broken down by sampling location in Tables 1A–4A.

Table 1A. Summary of Sampling Results from the East Thomas Air Monitor Site (2005/2006) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95 % UCL (µg/m^3)	# Contaminant Detected/ #Samples Collected	CV (µg/m^3)	Number of 24 hour samples that exceed CV
Acetaldehyde	0.849–4.29	1.99	2.10	31/31	0.45 (CREG)	31
Acetonitrile	ND–250	11.3	33.36	9/31	60 (RfC)	2
Acrolein	ND–2.61	0.577	0.799	17/30	0.02 (RfC) 0.092 (Intermediate MRL)	17 17
Anthracene	ND-0.0872	0.00612	0.0131	27/31	0.05 (Long term, Interim AMCV)	1
Arsenic	0.000318–0.00325	0.00156	0.0017	31/31	0.00023 (CREG)	31
Benzene	0.543–8.5	2.90	3.34	31/31	0.13 (CREG)	31
Benzo(a)pyrene	ND-0.00353	0.000407	0.0007	26/31	0.00087 (Cal EPA TR)	4
BaP-TE	0.0000736-0.00608	0.000769	0.00109	31/31	0.00087 (Cal EPA TR)	-
1,3-Butadiene	ND–0.642	0.246	0.285	30/31	0.033 (CREG)	29
Cadmium	0.000105–0.00121	0.000456	0.0005	31/31	0.00056 (CREG)	9
Carbon Tetrachloride	0.440–1.07	0.684	0.691	31/31	0.17 (CREG)	31
Chloroform	ND–0.391	0.091	0.123	18/31	0.043 (CREG)	18
Crotonaldehyde	0.0889-3.44	0.802	1.06	31/31	0.86 (Long term, Interim AMCV)	11
Formaldehyde	1.73–11.6	4.90	5.28	31/31	0.077 (CREG) 9.8 (Chronic MRL)	31 1
Hexachloro-1,3-butadiene	ND–0.213	0.102	0.114	10/31	0.045 (CREG)	10
Hexavalent Chromium	ND–0.000145	0.000033	0.0000	26/31	0.000083 (CREG)	1
Phenanthrene	0.00464-0.0647	0.0238	0.0283	31/31	0.05(Long term, Interim AMCV)	4
Trichloroethylene	ND-0.376	0.107	0.137	16/31	0.24 (CREG)	3

Source: JCDH 2009
Notes:
In calculating the average concentration, , non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the Jefferson County Department of Health using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using detected values reported in JCDH 2009.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Table 2A. Summary of Sampling Results from the North Birmingham Air Monitor (2005/2006) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/ #Samples Collected	CV (µg/m^3)	Number of 24 hour samples that Exceed CV
Acenapthylene	ND-0.124	0.0140	0.0240	30/31	0.1 (Long term, Interim AMCV)	1
Acetaldehyde	0.526–3.19	1.57	1.68	29/29	0.45 (CREG)	29
Acetonitrile	ND–72.4	15.7	22.5	20/31	60 (RfC)	1
Acrolein	ND–2.13	0.659	0.824	22/31	0.02 (RfC) 0.092 (Intermediate MRL)	22 22
Acrylonitrile	ND-0.260	0.068	--	1/31	0.015 (CREG)	1
Arsenic (PM_{10})	0.000282–0.0047	0.00210	0.0024	31/31	0.00023 (CREG)	31
Arsenic (TSP)	0.000404-0.00458	0.00208		31/31	0.00023 (CREG)	31
Benzene	0.543–12.8	3.17	4.24	31/31	0.13 (CREG) 9.6 (Chronic MRL)	31 3
Benzo(a)anthracene	ND-0.0193	0.00320	0.0052	30/31	0.0087 (Cal EPA TR)	5
Benzo(a)pyrene	ND-0.0136	0.00177	0.0031	23/31	0.00087 (Cal EPA TR)	9
Benzo(b)fluoranthene	ND-0.0156	0.00229	0.0038	28/31	0.0087 (Cal EPA TR)	3
Benzo(k)fluoranthene	ND-0.0159	0.00208	0.0035	29/31	0.0087 (Cal EPA TR)	3
BaP-TE	0.0000765-0.0217	0.00288	0.00498	31/31	0.00087 (Cal EPA TR)	-
1,3-Butadiene	ND–0.553	0.141	0.182	25/31	0.033 (CREG)	25
Cadmium(PM_{10})	0.000058–0.00281	0.000707	0.0010	31/31	0.00056 (CREG)	13
Cadmium (TSP)	0.000129-0.00319	0.000820		31/31	0.00056 (CREG)	15
Carbon Tetrachloride	0.440–1.01	0.670	0.678	31/31	0.17 (CREG)	31
Chloroform	ND–0.244	0.071	0.0947	15/31	0.043 (CREG)	15
Crotonaldehyde	0.0287-3.27	0.672	0.961	29/29	0.86 (Long term, Interim AMCV)	9
Dibenz(a,h)anthracene	ND-0.00338	0.000390	0.0007	13/31	0.0008 (Cal EPA TR)	4
Ethylene Dichloride	ND-0.121	0.033	--	1/31	0.038 (CREG)	1
Fluoranthene	0.000505-0.0623	0.0123	0.0171	31/31	0.05 (Long term, Interim AMCV)	1
Formaldehyde	0.825–10.1	3.83	4.33	29/29	0.077 (CREG) 9.8 (Chronic MRL)	29 1
Hexachloro-1,3-butadiene	ND–0.213	0.094	0.105	6/31	0.045 (CREG)	6
Hexavalent Chromium	ND–0.000154	0.000036	0.0000	23/30	0.000083 (CREG)	3
Indeno(1,2,3-cd) pyrene	ND-0.0107	0.00142	0.0024	22/31	0.0087 (Cal EPA TR)	1

Table 2A. Summary of Sampling Results from the North Birmingham Monitor (2005/2006) for Chemicals above Comparison Values (CVs) (Continued).

Contaminant	Concentration Range ($\mu g/m^3$)	Average Concentration ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	# Contaminant Detected/ #Samples Collected	CV ($\mu g/m^3$)	Number of 24 hour samples that Exceed CV
Phenanthrene	0.00177-0.186	0.0407	0.0554	31/31	0.05 (Long term, Interim AMCV)	9
Trichloroethylene	ND–0.645	0.101	0.152	14/31	0.24 (CREG)	3

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the Jefferson County Department of Health using ProUCL.
CV = Comparison Value.
$\mu g/m^3$ = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using detected values reported in JCDH 2009.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Table 3A. Summary of Sampling Results from the Providence Air Monitor (2005/2006) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range ($\mu g/m^3$)	Average Concentration ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	# Contaminant Detected/ #Samples Collected	CV ($\mu g/m^3$)	Number of 24 hour samples that Exceed CV
Acetaldehyde	0.299–14.1	1.49	2.38	31/31	0.45 (CREG) 9 (RfC)	29 1
Acrolein	ND–2.75	0.301	0.499	10/30	0.02 (RfC) 0.092 (Intermediate MRL)	10 10
Acrylonitrile	ND-0.109	0.0630	--	1/31	0.015 (CREG)	1
Arsenic	0.000083–0.00197	0.000804	0.0009	31/31	0.00023 (CREG)	29
Benzene	0.192–1.63	0.569	0.624	31/31	0.13 (CREG)	31
1,3-Butadiene	ND–0.243	0.019	0.0366	9/31	0.033 (CREG)	2
Carbon Tetrachloride	0.315–1.01	0.651	0.662	31/31	0.17 (CREG)	31
Chloroform	ND–0.0977	0.030	0.0409	10/31	0.043 (CREG)	10
Crotonaldehyde	ND-7.94	1.10	1.71	30/31	0.86 (Long term, Interim AMCV)	12
Formaldehyde	0.472–33.9	4.14	6.29	31/31	0.077 (CREG) 9.8 (Chronic MRL)	31 2
Hexachloro-1,3-butadiene	ND–0.213	0.089	0.0992	5/31	0.045 (CREG)	5

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the Jefferson County Department of Health using ProUCL.
$\mu g/m^3$ = micrograms per cubic meter of air.
CV = Comparison Value.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Table 4A. Summary of Sampling Results from the Shuttlesworth Air Monitor (2005/2006) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	Number of 24 hour samples that Exceed CV
Acetaldehyde	0.600–2.81	1.54	1.62	31/31	0.45 (CREG)	31
Acetonitrile	ND–196	36.4	58.2	27/31	60 (RfC)	8
Acrolein	ND–3.35	0.750	1.06	19/31	0.02 (RfC) 0.092 (Intermediate MRL)	19 19
Acrylonitrile	ND-0.347	0.070	--	1/31	0.015 (CREG)	1
Arsenic	0.00047–0.0343	0.00576	0.0081	31/31	0.00023 (CREG)	31
Benzene	0.543–31.5	6.19	7.99	31/31	0.13 (CREG) 9.6 (Chronic MRL) 29 (Acute MRL)	31 7 1
Benzo(a)anthracene	0.0000462-0.0219	0.00315	0.0046	30/30	0.0087 (Cal EPA TR)	1
Benzo(a)pyrene	ND-0.0153	0.00199	0.0030	26/30	0.00087 (Cal EPA TR)	16
Benzo(b)fluoranthene	ND-0.0221	0.00314	0.0046	28/30	0.0087 (Cal EPA TR)	2
Benzo(k)fluoranthene	ND-0.016	0.00258	0.0036	29/30	0.0087 (Cal EPA TR)	1
BaP-TE	0.000140-0.0236	0.00328	0.00484	30/30	0.00087 (Cal EPA TR)	-
Beryllium	0.00003–0.00144	0.00030	0.0004	31/31	0.00042 (CREG)	6
1,3-Butadiene	ND–0.553	0.210	0.245	28/31	0.033 (CREG)	28
Cadmium	0.00009–0.00148	0.00037	0.0004	31/31	0.00056 (CREG)	4
Carbon Tetrachloride	0.440–0.944	0.650	0.654	31/31	0.17 (CREG)	31
Chloroform	ND–0.293	0.090	0.122	15/31	0.043 (CREG)	15
Crotonaldehyde	0.0487-2.66	0.67	0.909	31/31	0.86 (Long term, Interim AMCV)	10
Dibenz(a,h)anthracene	ND-0.00245	0.00044	0.006	20/30	0.0008 (Cal EPA TR)	6
Fluoranthene	0.00236-0.0731	0.0165	0.0203	30/30	0.05 (Long term, interim AMCV)	1
Formaldehyde	1.02–11.1	3.69	4.11	31/31	0.077 (CREG) 9.8 (Chronic MRL)	31 1
Hexachloro-1,3-butadiene	ND–0.213	0.060	0.0772	6/31	0.045 (CREG)	6
Hexavalent Chromium	ND–0.000166	0.000040	0.0001	23/32	0.000083 (CREG)	5

Table 4A. Summary of Sampling Results from the Shuttlesworth Air Monitor (2005/2006) for Chemicals above Comparison Values (CVs) (Continued).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	Number of 24 hour samples that Exceed CV
Indeno (1,2,3-cd) pyrene	ND-0.0131	0.00190	0.0028	24/30	0.0087 (Cal EPA TR)	1
Manganese	0.0205–0.614	0.139	0.189	31/31	0.3 (Chronic MRL)	4
Phenanthrene	0.00809-0.157	0.0440	0.0518	30/30	0.05 (Long term, Interim AMCV)	10

Source: JCDH 2009
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the Jefferson County Department of Health using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using detected values reported in JCDH 2009.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

The contaminants with at least one sample result in 2009 that exceeded its respective health-based comparison value are broken down by sampling location in Tables 5A-7A.

Table 5A. Summary of Sampling Results from the Riggins School Air Monitor (2009) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	# of 24 hour samples that exceed CV
Arsenic	0.00021-0.00897	0.00272	0.00372	24/24	0.00023 (CREG)	23
Benzene	0.419–30.5	10.9	19.8	10/10	0.13 (CREG) 9.6 (Chronic MRL) 29 (Acute MRL)	10 3 2
Benzo(a) anthracene	0.00003-0.0525	0.00709	0.0124	24/24	0.0087 (Cal EPA TR)	6
Benzo(a) pyrene	ND-0.0264	0.00295	0.00544	21/24	0.00087 (Cal EPA TR)	9
Benzo(b) fluoranthene	0.00008-0.0610	0.00837	0.0146	24/24	0.0087 (Cal EPA TR)	6
Benzo(k) fluoranthene	0.00003-0.0203	0.00261	0.00462	24/24	0.0087 (Cal EPA TR)	3
BaP-TE	0.0000754-0.0465	0.00562	0.0101	24/24	0.00087 (Cal EPA TR)	-
1,3-Butadiene	ND–0.458	0.162	0.28	9/10	0.033 (CREG)	8
Cadmium	0.00003–0.0017	0.000303	0.00045	24/24	0.00056 (CREG)	3
Carbon Tetrachloride	0.51–0.951	0.671	0.77	10/10	0.17 (CREG)	10
Chloroform	ND–0.17	0.104	0.13	9/10	0.043 (CREG)	9
Chloroprene	ND–0.036	0.0086	-	1/10	0.0033 (CREG)	1
Dibenz(a,h) anthracene	ND-0.00582	0.000769	0.00136	14/24	0.0008 (Cal EPA TR)	6
Ethylene dichloride	ND–0.069	0.0105	--	1/10	0.038 (CREG)	1
Hexachloro-1,3-butadiene	ND-0.05	0.0565	--	3/10	0.045 (CREG)	1
Indeno(1,2,3-cd)pyrene	ND–0.0264	0.00317	0.00573	20/24	0.0087 (Cal EPA TR)	3
Naphthalene	0.0376–5.78	1.29	1.96	24/24	3.7 (Chronic MRL)	3
Tetrachloro-ethylene	ND-4.32	0.566	1.50	9/10	3.8(CREG)	1

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the EPA using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using detected values reported in EPA 2011a.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Table 6A. Summary of Sample Results from the North Birmingham Elementary School Air Monitor (2009) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	# of 24 hour samples that exceed CV
Acrylonitrile	ND–0.13	0.0237	--	2/17	0.015 (CREG)	2
Arsenic	0.00029-0.00385	0.00156	0.00215	18/18	0.00023 (CREG)	18
Benzene	0.26–30.1	5.50	9.88	17/17	0.13 (CREG) 9.6 (Chronic MRL) 29 (Acute MRL)	17 2 1
Benzo(a)pyrene	ND-0.00144	0.000350	0.00055	17/20	0.00087 (Cal EPA TR)	4
BaP-TE	0.0000753-0.00297	0.000688	0.000982	20/20	0.00087 (Cal EPA TR)	-
1,3-Butadiene	0.02–0.48	0.127	0.15	17/17	0.033 (CREG)	16
Cadmium	0.00003–0.00063	0.000220	0.00026	18/18	0.00056 (CREG)	1
Carbon Tetrachloride	0.52–1.05	0.705	0.80	17/17	0.17 (CREG)	17
Chloroform	0.088–0.18	0.131	0.15	17/17	0.043 (CREG)	17

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the EPA using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using detected values reported in EPA 2011a.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.

Table 7A. Summary of Sampling Results from Lewis Elementary School Air Monitor (2009) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	# of 24 hour samples that exceed CV.
Arsenic	ND-0.00403	0.00143	0.00203	19/20	0.00023 (CREG)	18
Benzene	0.28–22.4	4.68	8.92	14/14	0.13 (CREG) 9.6 (Chronic MRL)	14 3
1,3-Butadiene	0.024–0.297	0.110	0.17	14/14	0.033 (CREG)	11
Cadmium	0.00003–0.00242	0.000529	0.00082	20/20	0.00056 (CREG)	5
Carbon Tetrachloride	0.54–1.1	0.742	0.85	14/14	0.17 (CREG)	14
Chloroform	ND–0.23	0.135	0.16	13/14	0.043 (CREG)	13
Hexachloro-1,3-butadiene	ND–0.07	0.0654	--	1/13	0.045 (CREG)	1

Source: EPA 2011a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the EPA using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

The contaminants with at least one sample result that exceeded its respective health-based comparison value in 2011/2012 are broken down by sampling location in Tables 8A–11A.

Table 8A. Summary of Sampling Results from the Hudson K-8 School Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	# of 24 hour samples that Exceed CV
Acrylonitrile	ND-0.256	0.0235	--	2/60	0.015 (CREG)	2
Arsenic	0.00026-0.00400	0.00151	0.00177	63/63	0.00023 (CREG)	63
Benzene	0.361-21.9	3.44	6.43	60/60	0.13 (CREG) 9.6 (Chronic MRL)	60 6
Benzo(a)anthracene	ND-0.0161	0.00199	0.00576	60/66	0.0087 (Cal EPA TR)	4
Benzo(a)pyrene	ND-0.00955	0.00101	0.00202	44/66	0.00087 (Cal EPA TR)	17
Benzo(b)fluoranthene	0.000062-0.0193	0.00266	0.00493	66/66	0.0087 (Cal EPA TR)	8
BaP-TE	0.000138-0.0161	0.00183	0.00378	68/68	0.00087 (Cal EPA TR)	-
Bromodichloromethane	ND-0.301	0.0798	--	1/60	0.066 (Cal EPA TR)	1
1,3-Butadiene	0.0266-0.642	0.139	0.167	60/60	0.033 (CREG)	57
Cadmium	0.00008-0.00779	0.000894	0.00174	63/63	0.00056 (CREG)	20
Carbon Tetrachloride	0.522-0.900	0.700	0.72	60/60	0.17 (CREG)	60
Chloroform	ND–0.288	0.118	0.158	43/60	0.043 (CREG)	43
Chloroprene	ND-0.145	0.0208	--	1/60	0.0033 (CREG)	1
Dibenz(a,h)anthracene	ND-0.00225	0.000255	0.000495	49/66	0.0008 (Cal EPA TR)	8
Dibromochloromethane	ND-0.409	0.0875	--	1/60	0.09 (Cal EPA TR)	1
1,2-Dibromoethane	ND-0.384	0.0732	--	1/60	0.0017 (CREG)	1
Ethylene Dichloride	ND-0.227	0.0737	0.0968	43/60	0.038 (CREG)	43
Hexachloro-1,3-butadiene	ND–1.16	0.169	--	1/60	0.045 (CREG)	1
Lead	0.00189-1.13	0.0529	0.14	63/63	0.15 (NAAQS)	5
Phenanthrene	0.00306-0.158	0.0371	--	66/66	0.05 (Long term, Interim AMCV)	20
1,1,2-Trichloroethane	ND-0.229	0.0647	-	1/60	0.063 (CREG)	1
Trichloroethylene	ND-0.247	0.0734	0.0814	6/60	0.24 (CREG)	1

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the EPA using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using minimum and maximum values reported in EPA 2013a.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Table 9A. Summary of Sampling Results from the Shuttlesworth Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	Number of 24 hour samples that Exceed CV
Acrylonitrile	ND-1.36	0.0598	-	3/60	0.015 (CREG)	3
Arsenic	ND-0.00745	0.00236	0.0027	60/62	0.00023 (CREG)	60
Benzene	0.521-22.7	4.13	5.13	60/60	0.13 (CREG) 9.6 (Chronic MRL)	60 6
Benzo(a)anthracene	0.000623-0.0137	0.00317	0.00422	62/62	0.0087 (Cal EPA TR)	6
Benzo(a)pyrene	ND-0.00753	0.00147	0.00203	56/62	0.00087 (Cal EPA TR)	32
Benzo(b)fluoranthene	0.0000977-0.0153	0.00381	0.00506	62/62	0.0087 (Cal EPA TR)	7
BaP-TE	0.000321-0.0128	0.00270	0.00375	68/68	0.00087 (Cal EPA TR)	--
Bromodichloro-methane	ND-0.174	0.0779	-	1/60	0.066 (Cal EPA TR)	1
1,3-Butadiene	0.0310-0.493	0.149	0.174	60/60	0.033 (CREG)	59
Cadmium	0.000020-0.00246	0.000424	0.000666	62/62	0.00056 (CREG)	12
Carbon Tetrachloride	0.472-0.937	0.714	0.736	60/60	0.17 (CREG)	60
Chloroform	ND–0.806	0.134	0.198	43/60	0.043 (CREG)	43
Chloroprene	ND-0.264	0.0226	-	1/60	0.0033 (CREG)	1
Dibenz(a,h)anthracene	ND-0.00176	0.000361	0.000599	47/62	0.0008 (Cal EPA TR)	7
Dibromochloromethane	ND-0.153	0.0835	-	1/60	0.09 (Cal EPA TR)	1
Ethylene Dichloride	ND-0.862	0.0979	0.158	48/60	0.038 (CREG)	48
Fluoranthene	0.00223-0.0713	0.0180	--	62/62	0.05 (Long term, interim AMCV)	1
Phenanthrene	0.0018-0.180	0.0526	--	62/62	0.05 (Long term, Interim AMCV)	29

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the EPA using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using minimum and maximum values reported in EPA 2013a.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Table 10A. Summary of Sampling Results from the Riggins School Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	# of 24 hour samples that Exceed CV
Acrylonitrile	ND-0.767	0.0425	-	5/65	0.015 (CREG)	5
Anthracene	ND-0.0607	0.0106	-	71/72	0.05 (Long term, Interim AMCV)	2
Arsenic	ND-0.0108	0.00230	0.0027	66/67	0.00023 (CREG)	66
Benzene	0.351-55.1	6.10	8.60	65/65	0.13 (CREG) 9.6 (Chronic /MRL) 29 (Acute MRL)	65 12 3
Benzo(a)anthracene	ND-0.0385	0.00682	0.0092	71/72	0.0087 (Cal EPA TR)	19
Benzo(a)pyrene	ND-0.0215	0.00342	0.0048	58/72	0.00087 (Cal EPA TR)	43
Benzo(b)fluoranthene	ND-0.0471	0.00817	0.0110	71/72	0.0087 (Cal EPA TR)	20
Benzo(k)fluoranthene	ND-0.0132	0.00246	0.0033	63/72	0.0087 (Cal EPA TR)	6
BaP-TE	0.000139-0.0365	0.00603	0.00863	70/71	0.00087 (Cal EPA TR)	--
1,3-Butadiene	ND–0.920	0.167	0.203	63/65	0.033 (CREG)	58
Cadmium	0.0000525–0.00274	0.000475	0.0006	67/67	0.00056 (CREG)	11
Carbon Tetrachloride	0.530-0.966	0.693	0.713	65/65	0.17 (CREG)	65
Chloroform	ND–0.254	0.101	0.142	52/65	0.043 (CREG)	52
Dibenz(a,h)-anthracene	ND-0.00469	0.000801	0.0014	55/72	0.0008 (Cal EPA TR)	21
Ethylene Dichloride	ND-0.137	0.0733	0.0953	47/65	0.038 (CREG)	47
Fluoranthene	0.0000395-0.125	0.0320	-	71/72	0.05 (Long term, interim AMCV)	17
Indeno (1,2,3-cd) pyrene	ND-0.0157	0.00273	0.0037	63/72	0.0087 (Cal EPA TR)	8
Naphthalene	ND-5.74	0.860	1.08	71/72	3.7 (Chronic MRL)	1
Phenanthrene	0.0000208-0.329	0.0890	-	71/72	0.05 (Long term, Interim AMCV)	42
Pyrene	0.0000388-0.0787	0.0194	-	72/72	0.05 (Long term, interim AMCV)	9
Trichloroethylene	ND-0.532	0.0739	-	3/65	0.24 (CREG)	1

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the EPA using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using minimum and maximum values reported in EPA 2013a.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Table 11A. Summary of Sampling Results from the Lewis Elementary School Air Monitor (2011/2012) for Chemicals above Comparison Values (CVs).

Contaminant	Concentration Range (µg/m^3)	Average Concentration (µg/m^3)	95% UCL (µg/m^3)	# Contaminant Detected/# Samples Collected	CV (µg/m^3)	# of 24 hour samples that Exceed CV
Acrylonitrile	ND-0.313	0.0228	--	1/61	0.015 (CREG)	1
Arsenic	0.00017-0.00465	0.00146	0.00178	66/66	0.00023 (CREG)	64
Benzene	0.374-20.4	2.89	5.064	61/61	0.13 (CREG) 9.6 (Chronic MRL)	61 3
Benzo(a)anthracene	ND-0.0301	0.00254	0.00594	53/59	0.0087 (Cal EPA TR)	6
Benzo(a)pyrene	ND-0.0153	0.00135	0.0032	39/59	0.00087 (Cal EPA TR)	15
Benzo(b)fluoranthene	ND-0.0319	0.00312	0.00694	58/59	0.0087 (Cal EPA TR)	7
Benzo(k)fluoranthene	ND-0.0106	0.000979	0.00222	42/59	0.0087 (Cal EPA TR)	2
BaP-TE	0.000118-0.0261	0.00235	0.00548	62/62	0.00087 (Cal EPA TR)	-
1,3-Butadiene	ND–0.606	0.152	0.194	60/61	0.033 (CREG)	59
Cadmium	0.000040–0.00668	0.000723	0.000921	66/66	0.00056 (CREG)	21
Carbon Tetrachloride	0.308-0.988	0.715	0.739	61/61	0.17 (CREG)	61
Chloroform	ND–0.303	0.112	0.153	41/61	0.043 (CREG)	41
Dibenz(a,h)anthracene	ND-0.00349	0.000316	0.000729	25/59	0.0008 (Cal EPA TR)	7
Ethylene Dichloride	ND-0.150	0.0818	0.104	46/61	0.038 (CREG)	46
Fluoranthene	0.00104-0.0978	0.0148	--	59/59	0.05 (Long term, interim AMCV)	2
Hexachloro-1,3-butadiene	ND–0.437	0.157	--	1/61	0.045 (CREG)	1
Indeno (1,2,3-cd) pyrene	ND-0.00987	0.00104	0.0023	44/59	0.0087 (Cal EPA TR)	2
Lead	0.00096-0.835	0.0276	0.0826	66/66	0.15 (NAAQS)	1
Phenanthrene	0.00342-0.377	0.0497	--	59/59	0.05 (Long term, Interim AMCV)	23
Pyrene	0.000678-0.0571	0.00857	--	59/59	0.05 (Long term, interim AMCV)	1
Trichloroethylene	ND-0.279	0.0786	0.0887	8/61	0.24 (CREG)	2

Source: EPA 2013a
Notes:
In calculating the average concentration, non-detects were treated as half the detection limit.
95 % UCL refers to the 95% upper confidence limit of the mean. The 95% UCL values shown were calculated by the EPA using ProUCL.
CV = Comparison Value.
µg/m^3 = micrograms per cubic meter of air.
BaP-TE = Benzo(a)pyrene toxic equivalents.
BaP-TE concentration range calculated using minimum and maximum values reported in EPA 2013a.
CREG = Cancer Risk Evaluation Guide developed by the Agency for Toxic Substances and Disease Registry.
MRL =Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry.
RfC = Reference Concentration developed by the US Environmental Protection Agency.
AMCV=Air Monitoring Comparison Value developed by the Texas Commission on Environmental Quality.
Cal EPA TR = Cancer target risk concentration developed by the California Environmental Protection Agency.
ND = Not Detected.

Since the summer of 2011, ATSDR has attended several public meetings in North Birmingham. ATSDR has learned some community members are concerned about exposure to particulate matter. Consequently, particulate matter was considered as a part of this Public Health Assessment. A summary of the particulate matter sampling completed between 1999 and 2013 at air monitoring stations that also participated in the 2005/2006 air toxics study is presented in Tables 12A and 13A.

Table 12A. Summary of $PM_{2.5}$ Sampling Results from the North Birmingham and Providence Air Monitors (1999-2013).

Years	Location	98th Percentile of 24 Hour Samples (µg/m³)	Annual Average (µg/m³)	CV (µg/m³)
1999-2001*	North Birmingham, Monitor #1	50	21.6	35. (24 Hour Sample) 12.0 (Annual Average, see notes below)
	North Birmingham, Monitor #2	53	23.2	
	Providence, Monitor #1	35	15.0	
	Providence, Monitor #2	40	15.9	
2000-2002	North Birmingham, Monitor #1	45	19.6	
	North Birmingham, Monitor #2	52	21.5	
	Providence, Monitor #1	34	14.1	
	Providence, Monitor #2	39	15.3	
2001-2003	North Birmingham, Monitor #1	40	18.0	
	North Birmingham, Monitor #2	45	20.3	
	Providence, Monitor #1	31	12.6	
	Providence, Monitor #2	37	12.7	
2002-2004	North Birmingham, Monitor #1	40	17.5	
	North Birmingham, Monitor #2	45	19.7	
	Providence, Monitor #1	32	12.3	
	Providence, Monitor #2	31	12.3	
2003-2005	North Birmingham, Monitor #1	44	18.2	
	North Birmingham, Monitor #2	49.	20.3	
	Providence, Monitor #1	34	13.0	
	Providence, Monitor #2	32.	12.3	
2004-2006	North Birmingham, Monitor #1	44.	18.6	
	North Birmingham, Monitor #2	52.	20.4	
	Providence, Monitor #1	35	13.4	
	Providence, Monitor #2	35.	13.4	
2005-2007	North Birmingham, Monitor #1	46	18.9	
	North Birmingham, Monitor #2	51	20.4	
	Providence, Monitor #1	38	14.0	
	Providence, Monitor #2	38	13.7	
2006-2008	North Birmingham, Monitor #1	41	17.6	
	North Birmingham, Monitor #2	45	18.7	
	Providence, Monitor #1	34	12.8	
	Providence, Monitor #2	34	12.9	
2007-2009	North Birmingham, Monitor #1	36	15.3	
	North Birmingham, Monitor #2	37	16.3	
	Providence, Monitor #1	30	11.5	
	Providence, Monitor #2	31	11.9	
2008-2010	North Birmingham, Monitor #1	29	13.7	
	North Birmingham, Monitor #2	32	14.3	
	Providence, Monitor #1	22	10.2	
	Providence, Monitor #2	23	10.5	
2009-2011	North Birmingham, Monitor #1	27	12.9	
	North Birmingham, Monitor #2	29	13.8	
	Providence, Monitor #1	22	10.0	
	Providence, Monitor #2	22	10.2	
2010-2012*	North Birmingham, Monitor #1	27	13.0	
	North Birmingham, Monitor #2	27	13.6	
	Providence, Monitor #1	23	10.2	
	Providence, Monitor #2	24	10.5	
2011-2013	North Birmingham, Monitor #1	24	11.9	
	North Birmingham, Monitor #2	24	12.4	
2013	Shuttlesworth	24	11.6	

Source: http://www.epa.gov/airdata/ad_rep_mon.html; EPA 2014c

Notes: EPA's National Ambient Air Quality Standards require that annual average concentrations of $PM_{2.5}$, averaged over three consecutive calendar years, do not exceed 12.0 µg/m³. Further, the 98 percentile of 24-hour average $PM_{2.5}$ concentrations, averaged over three consecutive calendar years, must not exceed 35 µg/m³. It should be understood that the EPA annual NAAQS for $PM_{2.5}$ was changed from 15.0 µg/m³ to 12.0 µg/m³ in late 2012. Consequently, the annual standard in place during most of this time period was 15.0 µg/m³.

$PM_{2.5}$ sampling began at the Shuttlesworth monitoring station in July 2013 (ADEM, 2014).

*$PM_{2.5}$ Monitoring did not start at the Providence monitoring site until the year 2000. Therefore, the averages shown are for the years 2000 and 2001. Similarly, $PM_{2.5}$ monitoring ended at the Providence site in 2011 and the averages shown are for 2010 and 2011.

µg/m³ = micrograms per cubic meter of air.

CV = Comparison Value.

The values shown above include data from exceptional events.

Table 13A. Summary of PM_{10} Sampling Results from the North Birmingham and Shuttlesworth Air Monitor (1999-2013).

Location	Year	Maximum 24 Hour Average Concentration ($\mu g/m^3$)	Second Highest 24 Hour Average Concentration ($\mu g/m^3$)	CV ($\mu g/m^3$)
North Birmingham	1999	136	123	150 (NAAQS)
	2000	157	157	
	2001	118	117	
	2002	113	106	
	2003	136	132	
	2004	122	121	
	2005	114	112	
	2006	95	93	
	2007	103	101	
	2008	117	89	
	2009	52	49	
	2010	101	91	
	2011	65	61	
	2012	-	-	
	2013	49	48	
Shuttlesworth	1999	198	138	
	2000	153	134	
	2001	185	130	
	2002	173	160	
	2003	190	178	
	2004	218	166	
	2005	137	128	
	2006	161	152	
	2007	241	233	
	2008	146	142	
	2009	129	126	
	2010	77	73	
	2011	83	65	
	2012	97	59	
	2013	74	58	

Source: http://www.epa.gov/airdata/ad_rep_mon.html ; EPA 2014c
Notes: The EPA's National Ambient Air Quality Standards (NAAQS) state that the24-hour average PM10 concentrations are not to exceed 150 $\mu g/m^3$ more than once per year (on average) over a 3-year period.
$\mu g/m^3$ = micrograms per cubic meter of air.
CV = Comparison Value.
The values shown above include data from exceptional events.

Appendix B. Cancer Risk Estimates

The United States Environmental Protection Agency (EPA) Region IV requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate environmental data collected from three communities in the vicinity of the 35th Avenue Site in North Birmingham, Jefferson County, Alabama. The three communities are: Collegeville, Harriman Park, and Fairmont. Citizens in these three communities are concerned about whether breathing the air is safe for them and their children and grandchildren. This area contains and historically has contained two coking facilities, pipe manufacturing facilities, asphalt batch plants, quarries, steel manufacturing facilities, and other industries. Additionally, the area features heavy rail transportation routes and rail yards, two adjacent interstate highways, and the nearby Brimingham-Shuttlesworth International Airport. Air samples were collected from the area in 2005/2006 by the Jefferson County Department of Health. In 2005/2006, samples were collected at four locations and analyzed for 102 different contaminants. In 2009 and 2011/2012, air samples were collected by the Environmental Protection Agency. In 2009, samples were collected at three area schools and analyzed for 59 different contaminants. In 2011/2012, samples were collected at four locations and analyzed for 91 different contaminants.

The EPA has a method for estimating the cancer risk from chemical exposure. The cancer risk is estimated by multiplying the concentration of a chemical in the air to which people may be exposed to a factor called an inhalation unit risk. The resulting number is an estimate of the number of cancers in a population over a lifetime that might result from the chemical exposure. The equation for estimating cancer risk follows:

Cancer risk = concentration of the chemical in air a person is exposed to over a lifetime x inhalation unit risk.

The additional cancer risk estimate from chemical exposures is often stated as 1 x 10^{-4}, 1 x 10^{-5}, or 1 x 10^{-6} (or 1E-4, 1E-5, or 1E-6)[21]. Using 1 x 10^{-6} (or 1E-6) as an example, it means that a population of one million people exposed to a carcinogen over a lifetime (70 years) at a specific concentration may have one additional case of cancer because of the exposure. An estimated additional cancer risk of 1 x 10^{-4} (or 1E-4) means that a population of 10,000 people exposed for a lifetime (70 years) at a certain chemical concentration may have one additional cancer case. ATSDR calculated cancer risk estimates using the methodology above and both the average concentration and the 95% upper confidence limit as the chemical concentrations people may be exposed to over a lifetime.

It should also be understood that the excess cancer risk is mathematically an estimate of the 95% upper confidence limit of additional cancer risk for adults or children with similar exposures. For

[21] "EPA uses the general 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1,000,000) risk range as a "target range" within which the Agency strives to manage risks as part of a Superfund cleanup.… A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks. Therefore, in certain cases EPA may consider risk estimates slightly greater than 1 x 10-4 to be protective" EPA. 1991. OSWER Directive 9355.0-30. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. http://www.epa.gov/oswer/riskassessment/baseline.htm

this reason, the risk is presented as the number of cancers that might occur in a large number of people (*e.g.* 10,000; 100,000; or 1,000,000) with similar exposures. The true risk is not known, but will likely be lower. When we talk about the additional or excess cancer risk, we mean the risk above and beyond what is considered background or normal. It is important to remember that we cannot determine an individual's cancer risk but rather the estimated cancer risk refers to the risk for a population of people with similar chemical exposure.

Table 1 B. Cancer Risk Estimates for North Birmingham Using Average Detected Concentrations.

	2005/2006				2009			2011/2012			
	Shuttlesworth	North Birmingham	East Thomas	Providence	Riggins	North Birmingham Elementary	Lewis	Hudson K-8	Shuttles-worth	Riggins	Lewis
Acetaldehyde	3.39×10^{-6}	3.45×10^{-6}	4.38×10^{-6}	3.28×10^{-6}	--	--	--	--	--	--	--
Acrylonitrile	4.76×10^{-6}	4.62×10^{-6}	ND	4.28×10^{-6}	ND	1.61×10^{-6}	ND	1.60×10^{-6}	4.07×10^{-6}	2.89×10^{-6}	1.55×10^{-6}
Arsenic	2.48×10^{-5}	9.03×10^{-6} (PM10) 8.90×10^{-6} (TSP)	6.71×10^{-6}	3.46×10^{-6}	1.17×10^{-5}	6.71×10^{-6}	6.15×10^{-6}	6.49×10^{-6}	1.01×10^{-5}	9.89×10^{-6}	6.28×10^{-6}
Benzene	4.83×10^{-5}	2.47×10^{-5}	2.26×10^{-5}	4.44×10^{-6}	8.50×10^{-5}	4.29×10^{-5}	3.65×10^{-5}	2.68×10^{-5}	3.22×10^{-5}	4.76×10^{-5}	2.25×10^{-5}
BaP-TE	3.61×10^{-6}	3.17×10^{-6}	8.46×10^{-7}	3.74×10^{-8}	6.18×10^{-6}	7.57×10^{-7}	5.69×10^{-7}	2.01×10^{-6}	2.97×10^{-6}	6.63×10^{-6}	2.59×10^{-6}
Beryllium	7.20×10^{-7}	4.56×10^{-8} (PM10) 7.92×10^{-8} (TSP)	7.92×10^{-8}	1.20×10^{-8}	5.52×10^{-8}	2.93×10^{-8}	5.90×10^{-8}	4.18×10^{-8}	5.45×10^{-8}	5.38×10^{-8}	4.27×10^{-8}
1,3-Butadiene	6.30×10^{-6}	4.23×10^{-6}	7.38×10^{-6}	5.70×10^{-7}	4.86×10^{-6}	3.81×10^{-6}	3.30×10^{-6}	4.17×10^{-6}	4.47×10^{-6}	5.01×10^{-6}	4.56×10^{-6}
Cadmium	6.66×10^{-7}	1.27×10^{-6} (PM10) 1.48×10^{-6} (TSP)	8.21×10^{-7}	2.02×10^{-7}	5.45×10^{-7}	3.96×10^{-7}	9.52×10^{-7}	1.61×10^{-6}	7.63×10^{-7}	8.57×10^{-7}	1.30×10^{-6}
Carbon Tetrachloride	3.90×10^{-6}	4.02×10^{-6}	4.10×10^{-6}	3.91×10^{-6}	4.03×10^{-6}	4.23×10^{-6}	4.45×10^{-6}	4.20×10^{-6}	4.28×10^{-6}	4.16×10^{-6}	4.29×10^{-6}
Chloroform	2.07×10^{-6}	1.63×10^{-6}	2.09×10^{-6}	6.90×10^{-7}	2.39×10^{-6}	3.01×10^{-6}	3.11×10^{-6}	2.71×10^{-6}	3.08×10^{-6}	2.32×10^{-6}	2.58×10^{-6}
Chromium, hexavalent	4.80×10^{-7}	4.32×10^{-7}	3.96×10^{-7}	1.08×10^{-7}	--	--	--	--	--	--	--
Ethylene Dichloride	ND	8.58×10^{-7}	ND	ND	2.73×10^{-7}	ND	ND	1.92×10^{-6}	2.55×10^{-6}	1.91×10^{-6}	2.13×10^{-6}
Formaldehyde	4.80×10^{-5}	4.98×10^{-5}	6.37×10^{-5}	5.38×10^{-5}	--	--	--	--	--	--	--
Hexachloro-1,3-butadiene	1.32×10^{-6}	2.07×10^{-6}	2.24×10^{-6}	1.96×10^{-6}	1.24×10^{-6}	ND	1.44×10^{-6}	3.72×10^{-6}	ND	ND	3.45×10^{-6}
Napthalene	1.67×10^{-5}	9.74×10^{-6}	9.03×10^{-6}	5.79×10^{-7}	4.39×10^{-5}	2.15×10^{-5}	1.01×10^{-5}	1.58×10^{-5}	2.28×10^{-5}	2.92×10^{-5}	1.47×10^{-5}
TCE	2.87×10^{-7}	4.14×10^{-7}	4.39×10^{-7}	1.39×10^{-7}	6.56×10^{-8}	1.34×10^{-7}	1.75×10^{-7}	3.01×10^{-7}	2.78×10^{-7}	3.03×10^{-7}	3.22×10^{-7}
Total	2×10^{-4}	1×10^{-4}	1×10^{-4}	8×10^{-5}	2×10^{-4}	9×10^{-5}	7×10^{-5}	7×10^{-5}	9×10^{-5}	1×10^{-4}	7×10^{-5}

TCE=Trichloroethylene

For the North Birmingham total, the higher value (PM10 or TSP) was used.

The estimated cancer risks in this table were calculated by multiplying the average concentration of the chemicals by the inhalation unit risk of the chemical.

The average contaminant levels used for these cancer risk estimates can be found in Tables 1-11 of Appendix A

Table 2B. Cancer Risk Estimates for North Birmingham Air Using the 95% UCL Calculated by EPA or Jefferson County Department of Health

	2005/2006				2009			2011/2012			
	Shuttlesworth	North Birmingham	East Thomas	Providence	Riggins	North Birmingham Elementary	Lewis	Hudson K-8	Shuttles-worth	Riggins	Lewis
Acetaldehyde	3.56×10^{-6}	3.70×10^{-6}	4.62×10^{-6}	5.24×10^{-6}	--	--	--	--	--	--	--
Arsenic	3.48×10^{-5}	1.03×10^{-5}	7.31×10^{-6}	3.87×10^{-6}	1.60×10^{-5}	9.25×10^{-6}	8.73×10^{-6}	7.61×10^{-6}	1.16×10^{-5}	1.16×10^{-5}	7.65×10^{-6}
Benzene	6.23×10^{-5}	3.31×10^{-5}	2.61×10^{-5}	4.87×10^{-6}	1.54×10^{-4}	7.71×10^{-5}	6.96×10^{-5}	5.01×10^{-5}	4.00×10^{-5}	6.71×10^{-5}	3.95×10^{-5}
BaP-TE	5.32×10^{-6}	5.48×10^{-6}	1.20×10^{-6}	1.11×10^{-7}	1.11×10^{-5}	1.08×10^{-6}	3.95×10^{-7}	4.16×10^{-6}	4.13×10^{-6}	9.50×10^{-6}	6.03×10^{-6}
Beryllium	9.60×10^{-7}	--	--	--	9.6×10^{-8}	--	9.6×10^{-8}	4.80×10^{-8}	7.20×10^{-8}	7.20×10^{-8}	7.20×10^{-8}
1,3-Butadiene	7.35×10^{-6}	5.46×10^{-6}	8.55×10^{-6}	1.10×10^{-6}	8.4×10^{-6}	4.50×10^{-6}	5.10×10^{-6}	5.01×10^{-6}	5.22×10^{-6}	6.09×10^{-6}	5.82×10^{-6}
Cadmium	7.20×10^{-7}	1.8×10^{-6}	9.0×10^{-7}	1.8×10^{-7}	8.10×10^{-7}	4.68×10^{-7}	1.48×10^{-6}	3.13×10^{-6}	1.20×10^{-6}	1.08×10^{-6}	1.66×10^{-6}
Carbon Tetrachloride	3.92×10^{-6}	4.07×10^{-6}	4.15×10^{-6}	3.97×10^{-6}	4.62×10^{-6}	4.80×10^{-6}	5.10×10^{-6}	4.32×10^{-6}	4.42×10^{-6}	4.28×10^{-6}	4.43×10^{-6}
Chloroform	2.81×10^{-6}	2.18×10^{-6}	2.83×10^{-6}	9.41×10^{-7}	2.99×10^{-6}	3.45×10^{-6}	3.68×10^{-6}	3.63×10^{-6}	4.55×10^{-6}	3.27×10^{-6}	3.52×10^{-6}
Chromium, hexavalent	1.2×10^{-6}	--	--	--	--	--	--	--	--	--	--
Ethylene Dichloride	ND	--	ND	ND	-	ND	ND	2.52×10^{-6}	4.11×10^{-6}	2.48×10^{-6}	2.70×10^{-6}
Formaldehyde	5.34×10^{-5}	5.63×10^{-5}	6.86×10^{-5}	8.18×10^{-5}	--	--	--	--	--	--	--
Hexachloro-1,3-butadiene	1.70×10^{-6}	2.31×10^{-6}	2.51×10^{-6}	2.18×10^{-6}	--	ND	--		ND	ND	--
Napthalene	1.94×10^{-5}	1.23×10^{-5}	1.16×10^{-5}	6.66×10^{-7}	6.66×10^{-5}	3.74×10^{-5}	1.77×10^{-5}	2.00×10^{-5}	2.81×10^{-5}	3.67×10^{-5}	2.24×10^{-5}
TCE	3.42×10^{-7}	6.23×10^{-7}	5.62×10^{-7}	1.52×10^{-7}	--	--	--	3.34×10^{-7}	--	--	3.64×10^{-7}
Total	2×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	3×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	9×10^{-5}

TCE=Trichloroethylene

The estimated cancer risks in this table were calculated by multiplying the 95% upper confidence limit of the average of the chemicals by the inhalation unit risk of the chemical. The 95% upper confidence limits used for these cancer risk estimates can be found in Tables 1-11 of Appendix A

Prepared by:

Timothy R. Pettifor
Environmental Health Scientist
Central Branch
Division of Community Health Investigations

Dana Robison
Environmental Health Scientist
Washington DC Office
Division of Community Health Investigations

Appendix C. ATSDR's Responses to Public Comments

ATSDR released the *Evaluation of Air Exposures in Communities Adjacent to the 35th Avenue Site* Public Health Assessment (PHA) for public review and comment on June 26, 2014. The public comment period, which ended August 11, 2014, was announced in a press release on June 26, 2014. The document was made available for public comment on ATSDR's website (http://www.atsdr.cdc.gov/HAC/pha/NorthBirminghamAirSite/35th%20Avenue%20Site_PHA_PC_06-26-2014_508.pdf) and at the following locations:

Harriman Park Recreation Center
4347 F.L. Shuttlesworth Drive
Birmingham, AL 35207

North Birmingham Regional Branch Library
2501 31st Avenue North
Birmingham, AL 35207-4423

ATSDR thanks all individuals and agencies who took the time to comment. For those comments that questioned the factual validity of a statement made in the PHA, ATSDR verified and, when appropriate, corrected any errors. This appendix includes a summary of these comments and ATSDR's responses. If two or more comments pertain to similar issues and require the same response, they will be described under one comment and corresponding response. Editorial comments such as word spelling or sentence syntax and the commenter's statement of opinion about the agency or PHA process, *in general*, without pertaining to the factual accuracy of specific portions of the document are not included in this appendix.

Comments on Particulate Matter.
Comment: The North Birmingham monitor has been in compliance with EPA's National Ambient Air Quality Standard (NAAQS) for 24-hour $PM_{2.5}$ since 2009, which is based on data for 2007-2009. The basis [of Conclusion 1] should be amended to reflect the proper years of attainment with EPA's current 24-hour NAAQS for $PM_{2.5}$.

ATSDR Response: The basis of Conclusion 1 has been modified to state short-term levels of $PM_{2.5}$ measured at the North Birmingham monitoring station have been in compliance with the NAAQS since 2009. However, it is important to note the 2007-2009 average 24-hour $PM_{2.5}$ concentration measured at the North Birmingham monitoring station is below the NAAQS only when the exceptional events in 2007 are excluded. An exceptional event is defined in 40 CFR 50.1 as an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the EPA Administrator in accordance with 40 CFR 50.14 to be an exceptional event. Air quality data that are determined to have been affected by an exceptional event under the procedural steps, substantive criteria, and schedule specified in section 50.14 may be excluded from consideration when EPA makes a determination that an area is meeting or violating the associated NAAQS (Federal Register, 2012). Information about the 2007-2009 average has been added to the particulate matter section of the document.

Comment: The most recent 3-year annual average of $PM_{2.5}$ at the North Birmingham monitor is already BELOW EPA's new annual NAAQS for $PM_{2.5}$. The most recent 3-year average (2011-2013) at the North Birmingham monitor is 11.9 $\mu g/m^3$, which is below the standard set at 12 $\mu g/m^3$. The conclusion that the North Birmingham monitoring station is currently above the new annual NAAQS for $PM_{2.5}$ throughout the document should be changed to read "Past long-term exposures" as well as the basis [of Conclusion 2] should reflect the correct monitoring data. Like all other monitors throughout Jefferson County, the monitored concentrations for $PM_{2.5}$ at the North Birmingham monitor are currently BELOW the new annual $PM_{2.5}$ NAAQS for the most recent monitoring period (2011-2013). Therefore, these statements should be amended or deleted altogether.

Finally, the Department has been monitoring for $PM_{2.5}$ at Shuttlesworth site and the values through the end of March [2014] show that the concentrations are below 12.0 micrograms per cubic meter. The Next Steps should be changed to reflect that "JCDH is currently monitoring at Shuttlesworth for $PM_{2.5}$ and the resulting air monitoring data reflects values below 12.0 micrograms per cubic meter.

ATSDR Response: The annual statistics for 2013 were finalized shortly before the release of the public comment version of the health assessment. ATSDR has included the 2011-2013 three year average in the final version and modified the text and conclusions as needed. The recommendations and particulate matter discussion have also been modified to reflect the fact that $PM_{2.5}$ sampling has taken place at the Shuttlesworth site.

Comment: As shown in the two points above, both the short-term and long-term NAAQS for $PM_{2.5}$ are presently being met in the Birmingham area. By definition, meeting a NAAQS signifies that an area has healthy air for all people, with an adequate margin of safety. The report should say that all residents of the area breathe healthy air with respect to $PM_{2.5}$.

ATSDR Response: The Clean Air Act (CAA) does require the EPA to develop NAAQS necessary to protect public health with an adequate margin of safety. The requirement was intended to address uncertainties associated with inconclusive scientific and technical information available at the time of standard setting. It was also intended to provide a reasonable degree of protection against hazards that research has not yet identified. However, the CAA does not require the EPA to establish a NAAQS at a zero-risk level or at background concentration levels (Federal Register, 2012). Nevertheless, Conclusion 2 has been modified to reflect the fact that current levels of particulate matter are in compliance with the NAAQS.

Comment: EPA changed the annual $PM_{2.5}$ NAAQS from 15.0 $\mu g/m^3$ to 12.0 $\mu g/m^3$ in late 2012 for use in future attainment/non-attainment designations. This standard was not intended to apply retroactively to previous years. It is not consistent with EPA's approach to state that past data was not in compliance with the new lower standard. The most recent annual 3-year $PM_{2.5}$

average concentration (2011-2013) at the North Birmingham monitor is 11.9 µg/m^3, which is below the standard recently set at 12 µg/m^3.

ATSDR Response: ATSDR has revised the public comment version of the public health assessment where applicable to state that past levels of $PM_{2.5}$ were above the current standard rather than not being in compliance with the current standard.

Comment: ATSDR did not adequately define "sensitive" populations in conclusions #1 and #2. According to ATSDR's own definition, "sensitive" populations include children, the elderly and the chronically ill. Both conclusion statements should be rewritten to accurately state who is at risk from exposure to particulate matter pollution. What percentage of the population in the communities is considered to be a part of the "sensitive" individuals compared to the "general public?"

ATSDR Response: Conclusion 1 has been modified to include all population subgroups that may be more sensitive to particulate matter. Conclusion 2 has been modified to reflect the most recent sampling data (2011-2013) which show compliance with the NAAQS. More information about sensitive populations has also been added to the discussion of particulate matter. Additionally, a section describing the demographics of individuals living near the 35th Avenue Site has also been added to the document.

Comment: ATSDR's recommendation for conclusions #1 and #2, for the Jefferson County Health Department (JCDH) to continue to monitor for particulate matter, is inadequate for addressing the concerns of exposed residents who routinely wash the black soot off their homes and bodies. Aggressive air monitoring of particulate pollution utilizing real time technologies should be established (as EPA's National Environmental Justice Advisory Committee has recommended) to provide residents with complete transparency and access to data regarding their exposure to particulate matter.

ATSDR Response: Real time air monitoring data, including particulate matter data, for the North Birmingham area may be viewed at the EMPACT-Birmingham website (http://vortex.nsstc.uah.edu/empact_bhm/index.html) and the Birmingham Air Quality website (http://bhamaq.nsstc.uah.edu/index.html). EMPACT (Environmental Monitoring for Public Access and Community Tracking) is an EPA program to assist local agencies to improve environmental monitoring and assessment and, especially, outreach to the public. EMPACT-Birmingham is an EMPACT-funded program under the overall management of the Jefferson County Department of Health (JCDH), and in partnership with the Alabama Department of Environmental Management (ADEM), The University of Alabama in Huntsville (UAH), and Microelectronics Center of North Carolina (MCNC) Environment Program (http://vortex.nsstc.uah.edu/empact_bhm/index.html). Residents may also choose to subscribe to EnviroFlash at http://birmingham.enviroflash.info/. EnviroFlash provides air quality information such as alert day notifications and forecasts by means of email or text message for the area around Birmingham, AL. For those without computer access, air quality forecasts for the Birmingham area may also be obtained by calling 205-933-0583 (http://www.jcdh.org/EH/AnR/AnR06.aspx?TabCntl=0).

It should also be understood that the particulate matter levels in the North Birmingham area have dropped over the last several years. The final version of the public health assessment includes data from 2013 which shows compliance with the 2012 National Ambient Air Quality Standards. However, ATSDR recommends continued particulate matter monitoring to determine if this trend will continue.

Comments on Cancer Risk

Comment: While cumulative cancer risk estimates at the Shuttlesworth site, based on 2005/2006 monitoring data, did show a cumulative cancer risk of 2×10^{-4}, more recent monitoring completed in 2011/2012 indicated that the risk had fallen at the Shuttlesworth to a cumulative cancer risk of 1×10^{-4}, within the USEPA acceptable range. As part of the same study, similarly, cumulative risk estimates, based on 2011/2012 monitoring data at Riggins Elementary, did show a cumulative cancer risk of 1×10^{-4}, also within the USEPA acceptable range.

Regarding the results of the 2009 monitoring at Riggins, where monitoring occurred for approximately three to four months, this was not long enough nor were results intended for a cancer risk estimate (which usually uses data for at least one year). The results were only to be utilized as a screening tool to determine whether further/additional monitoring is needed. Based on these preliminary 2009 monitored concentrations, it was decided to follow-up with more comprehensive monitoring, which was the 2011/2012 monitoring campaign.

ATSDR Response: ATSDR's public comment version public health assessment (PHA) did acknowledge the primary goal of the 2009 sampling was to determine which chemicals were at levels requiring further evaluation or follow up. Additional language has been added to the final version to clarify this point. The public comment version also acknowledged the 2009 cancer risk estimates are less reliable than the cancer risk estimates for 2005/2006 and 2011/2012. Both the public comment and final version of this PHA conclude the current estimated cumulative cancer risks from air contaminants in North Birmingham are within EPA's target risk range and represent a low to very low increased risk.

Comment: We recommend that the ATSDR avoid comparing results of the School Air Toxics (SAT) study with those from the Birmingham Air Toxics Study (BATS) and 2013 EPA risk assessments since the purpose of the SAT was different and clarify that conclusions related to health are based on these long term studies only. The SAT air monitoring at Riggins site occurred for approximately four months and is an insufficient length of time to perform a risk assessment. The SAT results were not intended to be cancer risks and can only be used as a screening tool to determine whether further/additional monitoring is needed. Based on the preliminary SAT monitored concentrations, EPA decided to conduct a more comprehensive monitoring campaign. Conclusions related to health should be based only on the two most recent studies.

ATSDR Response: Additional language has been added to the final version of the PHA to clarify the School Air Toxics study was a screening survey. The conclusions concerning cancer risk in both the public comment and final version of the PHA were based primarily on the long term studies. Nevertheless, the 2009 sample results are still helpful in understanding the potential cancer risks from air toxics in North Birmingham. Both the results from the Shuttlesworth monitoring station in 2005/2006 and the Riggins monitoring station in 2009 showed an estimated

target risk above EPA's target range. Additionally, although it is most appropriate to compare cancer comparison values to long term concentrations such as annual averages rather than short term concentrations (24 hour); it is worth noting some carcinogens did not have any of the 24 hour sample results in 2009 exceed their cancer comparison values (*e.g.* beryllium). Furthermore, the EPA guidance for the SAT did contain screening levels for cancer as well as noncancer health effects.[22]

Comment: An important conclusion providing helpful context to a layperson is stated on page 73-74, as follows: "Therefore, the cumulative cancer risk estimates based upon sampling data from North Birmingham appear consistent with cumulative cancer risk estimates based upon sampling data from other areas in the United States." Similar language should be folded into conclusions 4 and/or 5 in the Summary on pages 9-11.

ATSDR Response: Pages 73-74 have several statements useful for providing context to a layperson. ATSDR has chosen to describe the potential cancer risk as low to very low in the conclusions to make the conclusions more understandable to the layperson. Pages 73-74 have also been modified to compare the cumulative cancer risk estimates from the North Birmingham sampling results to cumulative cancer risk estimates based upon sampling data from other urban areas in the United States with similar industries.

Comment: On page 38 of the 35th Ave north Birmingham air toxics risk assessment is the following:
"All sample results for benzene were higher than the CREG of 0.13 µg/m^3. ATSDR calculated cancer risk estimates for the inhalation of benzene, for each monitoring location and sampling period. ATSDR's cancer risk estimates for benzene are all below 1 x 10^{-4} if the average benzene concentrations detected in the air are used to calculate the cancer risk (see Table 1B, Appendix B). However, if the high-end estimates of chemical concentrations (95% upper confidence limits) are used to estimate the cancer risks from benzene, the results from the Riggins monitoring location in 2009 show a cancer risk greater than 1 x 10^{-4}. But benzene monitoring in 2009 at the Riggins location only included 10 samples collected over a period of two months. The subsequent 65 samples collected over a 12 month period in 2011/2012 did not show a cancer risk from benzene at the Riggins location greater than 1x10^{-4} even if the 95% upper confidence limit is used. Additionally, none of the 2005/2006 benzene sampling resulted in an estimated cancer risk greater than 1x10^{-4}. The fact that the more extensive benzene sampling before and after 2009 did not result in an estimated cancer risk greater than 1x10^{-4} is of particular interest since the inhalation unit risk used to calculate cancer risk estimates assumes continuous exposure to a chemical at a given concentration for a lifetime (EPA, 2012h)."

With the statements above are you suggesting you are not considering life exposure with Benzene in the north Birmingham area considering sample years 2005/6 and 2011/12 were much lower than 2009? If so would this mean that 70 years prior had similar amounts of air emissions including years before and immediately after the Clean Air Act or its 1990 amendments (i.e. the 1960's, 70's, 80's, early 1990's)? Isn't the 70 years assumption a standard?

[22] The interested reader should consult the EPA's document, Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results.
http://www.epa.gov/air/sat/pdfs/UsesOfHealthEffectsInfoinEvalSampleResults.pdf

I just don't think this is a fair assumption to say that the very low standard of 1/10000 at this school and in this area has been maintained for the past 70 years.

ATSDR Response: ATSDR does not have results for samples collected near the 35th Avenue Site from earlier time periods such as the 1960's, 1970's and 1980's for metals, carbonyls, volatile organic compounds and semi-volatile organic compounds. Statements have been added to the final version of the PHA to clarify this point. Because sampling results are not available, cancer risk estimates cannot be calculated for these time periods.

Comment: Is it okay that Fairmont/Riggins had a 3/10,000 cumulative cancer risk from 2009? Does this average out to an acceptable risk somehow? If this excessive risk of 3 times the acceptable limit is not okay, then why is this area not one that you recommended more air monitoring?

ATSDR Response: It is important to remember that cancer risk estimates are based upon EPA's inhalation unit risks which assume a person is continually exposed to the same concentration of a carcinogen for an entire lifetime (70 years). The 2009 cancer risk estimates were based on only a few months of sampling. The primary goal of the 2009 sampling was to determine which chemicals were at levels requiring further evaluation or follow up. The 2011/2012 sampling is considered a follow up to the 2009 sampling. Additional language has been added to the final version of the public health assessment to clarify this point. If the 2011/2012 sampling had not occurred, further air sampling at the Riggins location would have been warranted. It should be noted the cumulative cancer risk estimate for the Riggins location based on the 2011/2012 sample results were within EPA's target risk range.

Comment: Conclusion 5, Page 77 should be changed to reflect the findings of the EPA Risk assessment. The assessment indicates that 1 in 10,000 people are at an elevated risk of getting cancer and this is fundamentally different than indication that they may get cancer. We recommend replacing "….may get cancer" by "are at an elevated risk of getting cancer" whenever the former statement appears in the report.

ATSDR Response: Conclusions 4 and 5 have been rewritten for clarity.

Comments on ATSDR's Recommendation for Additional Chemical Sampling.
Comment: ATSDR's recommendation for conclusions #4 and #5 is for, "the JCDH to resample for air contaminants if there is an increase in emissions of contaminants due to additional industry locating in the area or modification of existing industry in the area."

This recommendation is does [sic] not adequately address the health concerns of the 35th Avenue communities. The cancer risk is above EPA's lowest target risk range and well above the local governing authority's acceptable risk (the Jefferson County Board of Health has declared that the incremental cancer risk from exposure to any individual carcinogen shall not exceed 1 in 100,000). The recommendation should address the current exceedance of acceptable cancer risk. Why wait to resample when additional pollution is emitted due to new industry or modification when the data shows there is a problem with existing emissions?

ATSDR Response: The EPA uses the general 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1,000,000) risk range as a "target range" within which the Agency strives to manage risks as part of a Superfund

cleanup (EPA. 1991. OSWER Directive 9355.0-30, http://www.epa.gov/oswer/riskassessment/baseline.htm). The EPA used this same risk range in evaluating the results of the National-Scale Air Toxics Assessment (NATA). ATSDR acknowledges some other agencies may adopt a different target risk range such as 1 in 100,000 or less.

NATA is EPA's ongoing evaluation of air toxics in the United States. EPA developed the NATA as a state-of-the-science screening tool to prioritize emission sources, pollutants, and locations of interest for further study in order to gain a better understanding of risks. These assessments input emissions data for a single year into models which will yield concentration and risk estimates (EPA, 2013). The results of the most recent assessment are instructive. The EPA estimated the average, national, cancer risk, based upon 2005 data, to be 5 in 100,000. This means that, on average, approximately 1 in every 20,000 people have an increased likelihood of contracting cancer as a result of breathing air toxics from outdoor sources if they were exposed to 2005 emission levels over the course of their lifetime (EPA, 2011).

To gain additional perspective on the estimated cancer risks in North Birmingham, it is also helpful to consider estimates by the American Cancer Society. The American Cancer Society estimates that one in two men and one in three women in the United States will be diagnosed with some form of cancer during their lifetime (American Cancer Society, 2013).

Comment: In both the Summary Section (pages 9-11) of the report and recommendations (page 77), ATSDR recommends that "EPA or Jefferson County resample for contaminants if there is an increase of contaminants due to industry locating in the area or modification of existing industry in the area." We recommend that this be clarified to include health related thresholds which might trigger the need for resampling or removed from the recommendation.

ATSDR Response: This recommendation has been reworded to allow the EPA and the Jefferson County Department of Health greater flexibility in managing the potential impact from increased emissions of air contaminants.

Comment: Jefferson County's preconstruction program addresses the air quality impacts of new and modified sources. The program requires new industrial sources and existing sources which undergo modifications to use the Best Available Control Technology to ensure the source is well controlled and causes minimal impact on the air quality of the region. We recommend that this information be included in the report to demonstrate that there are effective approaches in place to minimize this risk when industry locates in the N. Birmingham area. A more detailed description of this type of program can be found at http://www.epa.gov/nsr/psd.html.

ATSDR Response: The Jefferson County Department of Health (JCDH) requires emissions-limiting permits for most air pollution sources in Jefferson County. It also requires any person constructing, erecting, altering, or replacing any air pollution source to submit an application for an air permit at least ten days prior to construction. Additionally, the JCDH periodically inspects local industrial facilities and other air pollution sources to determine compliance with applicable regulations. The Jefferson County Board of Health adopts regulations that meet all Federal Clean Air Act requirements and those requirements mandated through the Alabama Department of Environmental Management (http://www.jcdh.org/EH/AnR/AnR06.aspx). A full discussion of

the permitting process is beyond the scope of the public health assessment. However, the recommendation for additional chemical sampling has been modified.

Miscellaneous Comments

Comment: We appreciate the opportunity to offer comments. In general, we concur with ATSDR's central conclusions, specifically that the "current estimated cumulative cancer risks from air contaminants in North Birmingham are within EPA's target risk range" and "levels of air contaminants in North Birmingham air are not likely to result in harmful noncancerous effects." Based on the entirety of the Assessment, it appears that levels of contaminants found in the air in North Birmingham are similar to, or in some cases lower than, average levels in other urban areas across the United States. We appreciate ATSDR's science-based efforts in reaching these conclusions.

Notably, these conclusions are consistent with a recently released study by the Jefferson County Department of Health finding that death rates for residents of the three relevant North Birmingham neighborhoods are statistically equal to death rates for Jefferson County residents at large with respect to (a) all causes of death combined, (b) all cancers combined, and (c) a number of individually reviewed cancers. Similarly, death rates from asthma and COPD were found to be statistically the same as between the neighborhood residents and residents of the rest of Jefferson County. Likewise, rates of infant mortality, stillbirths, and birth defects were found to be statistically equal. Thus, evaluating scientifically whether presumed exposures to identified contaminant levels are likely to cause adverse health effects leads to essentially the same conclusion as evaluating whether adverse health effects in a presumptively exposed population have in fact occurred: such adverse health effects are not present.

ATSDR Response: ATSDR is aware of the recent findings of the Jefferson County Department of Health. While there is agreement between these findings and ATSDR's public health assessment both have some limitations, ATSDR did not have air sampling data available for earlier time periods such as the 1960's, 1970's, and 1980's. Similarly, the Jefferson County Department of Health's study involved data from 2000-2009 (Oliver, 2014). It should also be noted that the statistical analysis by the Jefferson County Department of Health was based on a small sample size.

Comment: The draft public health assessment appropriately indicates that the North Birmingham area has a long history of heavy industrialization and that a number of industrial and transportation features of the area are relevant to the consideration of any environmental impacts. The particular history of how investigations in North Birmingham have unfolded has in part been a function of efforts by Walter Coke to cooperate with EPA on various issues. An artifact of that history is that past documents have tended to highlight the presence of the Walter Coke facility within the 35th Avenue Site, with the misleading implication that Walter Coke is uniquely relevant as a focus of inquiry. Several portions of the assessment that have retained this misplaced emphasis and that should be revised to be more accurate and balanced have been identified. Nothing in the suggested revisions should be construed as criticism of ATSDR's central conclusions; instead, the revisions are intended to assist ATSDR in presenting those conclusions in an appropriate context and as clearly as possible.

ATSDR Response: ATSDR reviewed the suggested revisions provided by the commenter and made changes to the document as appropriate.

Comment: The EPA Facility ID number referenced was initially issued to Sloss Industries, (now known as Walter Coke) as an operations-related number. Its use in connection with the entirety of the 35th Avenue Superfund Site is inappropriate and misleading. We have previously requested that EPA discontinue that practice. We request that ATSDR remove the ID number as it is unnecessary given the identification of the Superfund Site by name.

ATSDR Response: ATSDR verified the EPA Facility ID number. This number has been used by the EPA for the entire 35th Avenue Site (http://www.epa.gov/superfund/sites/docrec/pdoc1897.pdf).

Comment: Conclusion 5 is slightly erroneous as stated, and is otherwise susceptible to being misconstrued. We thus request consideration of the revision we have provided.

ATSDR Response: The wording of this conclusion has been revised. Additional information has been added to the basis of this conclusion as well.

Comment: The draft assessment notes reduced production levels at the two coke plants during sampling efforts. To ensure proper context is provided for that statement, the national economic crisis that was underway at that time should be referred to.

ATSDR Response: The draft assessment notes the lower production levels of other nearby facilities in addition to the two coke plants. Information on the production levels of nearby facilities during the 2009 sampling was taken from the EPA's 2011 report. This report did not mention the national economic issues that the United States was facing at the time. The EPA's 2011 report does state that it is difficult to predict the hazardous air pollutant emissions from the coke plants in Jefferson County directly from the production levels. Because this point is somewhat counterintuitive and important to consider, ATSDR has included it in both the public comment and final version of the public health assessment.

Comment: The discussion of arsenic would be more accurate if revised as follows:

> Most of the samples exceeded the arsenic CREG for continuous lifetime exposure to arsenic in ambient air. No non-cancer ATSDR CVs or EPA screening levels are available for arsenic in air. Arsenic levels were lower than, by approximately an order of magnitude, the typical arsenic levels found in urban areas (0.02-0.03 $\mu g/m^3$).

ATSDR Response: Although most of the arsenic levels were below 0.02-0.03 $\mu g/m^3$, the maximum detected arsenic concentration at the Shuttlesworth location during the 2005/2006 sampling period was 0.0343 $\mu g/m^3$. The last sentence of the quoted section has been revised as follows: "Arsenic levels were similar to or lower than the arsenic levels generally found in urban areas (0.02-0.03 $\mu g/m^3$)".

Comment: The residents of the communities affected by the ongoing contamination around the 35th Avenue Superfund Site continue to suffer from soot covered homes, excessive unhealthy

odors and clear increased risk of cancer from air toxic exposure. Aggressive and timely actions are past due to address their exposure to polluted air.

ATSDR Response: Because the black dust (soot) was identified as a community concern, ATSDR evaluated particulate matter sampling data available from the North Birmingham area from 1999-2012 in the public comment version. The final version also includes particulate matter sampling data from 2013. It is worth noting the most recent (2011-2013) particulate matter monitoring data for North Birmingham show compliance with the 2012 National Ambient Air Quality Standards.

Information about odors has been added to the community concerns section of the document. It is important to note that not all odors are toxic. Toxicity depends on the substance giving off the odor, the amount of the substance (concentration) in the air that people are breathing, how often (frequency) they are breathing that air, and how much time (duration) they spend breathing that air. If the right conditions exist such as concentration, frequency, and duration, the odor can be toxic and cause adverse health effects. If those conditions do not exist, odors are generally not toxic.

Comment: Why isn't the precautionary principle used considering school children are being exposed?

ATSDR Response: The use of good science and the precautionary principle by ATSDR and other agencies can be seen when examining many programs. In the public comment and final version of the health assessment, ATSDR used methods that tend to overestimate rather than underestimate risk. For example, in comparing sample results to screening levels, ATSDR compared the maximum detected concentration for each chemical to screening levels developed for chronic exposures and cancer. This approach was used even though the maximum detected concentrations were obtained from samples taken over a 24 hour period and the screening levels for chronic exposures and cancer are based on much longer time frames. Additionally, ATSDR calculated cancer risk estimates using not only average concentrations of chemicals but also high-end estimates of the chemical concentrations (95% upper confidence limits). The inhalation unit risks developed by the EPA and used by ATSDR to estimate cancer risks also represent high-end estimates of the additional cancer risks.

Comment: Since the EPA has developed awareness of and tools for cumulative risk assessments and since there is national academic interest in cumulative risk and numerous tools, why is there not consideration of multiple exposures and the actual reports of known human health issues in the area? The EPA had a workshop in 2002 on the societal, cultural and economic effects of contamination. Shouldn't similar factors be considered since this is an environmental justice area?

ATSDR Response: While the EPA and others have made some progress in understanding the factors that likely contribute to disproportionate environmental health impacts and in developing conceptual frameworks and analytical tools for informing policy and decision making in environmental justice communities, it is still an area of ongoing research and development (Nweke, et. al, 2011; EPA, 2014**).** Scientific research and development activities at EPA include: (1) developing tools, methods and guidance for conducting cumulative risk assessments,

(2) identifying and better understanding of susceptible and vulnerable population groups for risk assessments and to help determine the underlying causes of health disparities and (3) identifying and developing technical approaches for reducing the burden of exposure to a wide variety of contaminants (EPA, 2014).

Comment: Is there political pressure to not protect the citizens near a school that was closed in the Fairmont area (Riggins school) due to contamination where these monitors were set next to where many children still reside in government housing because there is an environmental justice group meeting in that area with whom local EPA officials have treated unfairly (ignoring calls and emails and reporting they cannot meet with local North Birmingham Renewal Group)?

ATSDR Response: ATSDR uses a scientific process for evaluating available data to assess environmental exposures and associated public health impact.

Comment: Why does ATSDR not consider cumulative non-cancer risk?

ATSDR Response: There is some discussion of cumulative non-cancer risk in the report. However, many gaps still exist in our understanding of the full range of health impacts from mixtures of contaminants. The scientific community is at least 10 years away from being able to implement changes to address this issue (Mauderly et al., 2010). It is also worth noting that most of the contaminants discussed in the report exceeded cancer evaluation guidelines, and not the screening levels for non-cancer health effects. The possible cumulative effect for those chemicals that exceeded non-cancer screening levels was discussed in the public comment version of the health assessment and further discussion has been added to the final version (see Noncancerous Health Effects from Mixtures).

Comment: Why are non-chemical stressors not considered since they disproportionately burden this population?

ATSDR Response: While the EPA and others have made some progress on evaluating cumulative risks, these methods are still unable to assess and account for the combined impacts of exposure to chemical and non-chemical stressors (Nweke et. al., 2011). The EPA acknowledges additional information on methods is still needed for assessing combinations of non-chemical and chemical stressors before cumulative risk assessment guidelines can be completed (EPA, 2014). Similarly, a 2011 Society of Toxicology workshop noted methods are not available for assessing the additional risk (if any) that may be imposed on segments of the population due to the cumulative impacts of non-chemical and chemical stressors (Ryder et al., 2012).

Comment: Will ATSDR or the EPA look at the acute effects of discharges such as occurred with Benzene in the Fairmont area and with Lead and Manganese in March 2012 at Hudson K-8 School while children were in session?

ATSDR Response: ATSDR has not derived comparison values for acute exposures to lead or manganese. The U.S. EPA also has not derived an acute reference dose or reference concentration for lead or manganese. There are relatively few data available for acute exposures to lead in humans and most are derived from cases of accidental or intentional ingestion of lead-

containing dirt or lead-based paint in adults and children (ATSDR, 2007b). ATSDR considered the available data on the toxicity of inhaled manganese inadequate for derivation of acute- or intermediate-duration inhalation comparison values (ATSDR, 2012). It is worth noting the highest measured level of manganese in air at the Hudson K-8 School was below ATSDR's comparison value for chronic exposures.

The occasional exceedances of ATSDR's acute comparison value for benzene at the Riggins School (in Fairmont) is discussed in the public comment and final version of the public health assessment. As stated in the public health assessment, the maximum measured concentration of benzene at the Riggins School was orders of magnitude below the lowest observed adverse effect level human equivalent concentration used to derive the acute comparison value. The scientific and medical literature does not provide any clear evidence of age-related differences in susceptibility to benzene toxicity (ATSDR, 2007a).

Comment: Thanks for your report and thanks for including all recent years of air data as well as the cumulative cancer risk.

ATSDR Response: Thank you for the comment.

Comment: The EPA SAT was a screening tool to make determinations regarding the need for future monitoring and analysis. Since EPA and JCDH conducted more robust monitoring based on the findings in the screening samples, we recommend that ATSDR avoid using this study to base conclusions related to health risk.

ATSDR Response: While ATSDR based its conclusions primarily on the longer term studies, the SAT still is useful in understanding the potential health risks from air contaminants in North Birmingham. It is appropriate to compare the results of the SAT to short term health based screening values such as ATSDR's Acute Minimal Risk Levels. It is also helpful to note those occasions when the long term health based screening levels for a particular chemical were not exceeded by any of the sample results in 2009. Nevertheless, additional language has been added to the final version of the public health assessment stating the SAT was a screening survey.

Comment: The first sentence of Paragraph 1 on Page 64 should read: The EPA website has an online tool known as AirNow. The AQI Calculator on that site can be used to … show the likelihood for individuals to experience health effects associated with particulate matter.

ATSDR Response: This suggested change has been adopted.

Note: The next four comments all came from the same commenter.

Comment: I moved near the Walter Coke Plant in the 1980's. I started noticing funny odors in the air in the early evening and at night. In 2007, I started coughing and gagging and having headaches. I don't smoke or drink and don't allow it in my home. Also, my workplace is and has been a nonsmoking workplace.

ATSDR Response: The Community Concerns section of the document has been modified to include two issues referred to both in this comment and during public meetings, namely odors and the emission of air pollutants during the night. Additionally, ATSDR does not have results

for samples collected near the 35th Avenue Site from earlier time periods such as the 1980's for metals, carbonyls, volatile organic compounds and semi-volatile organic compounds. Statements have been added to the public health assessment to clarify this point.

Comment: I have been diagnosed with hypertension, chronic bronchitis, chronic sinusitis, and hyperlipidemia.

ATSDR Response: ATSDR recommends you continue to work with your health care provider to determine the best treatment for these conditions. Although ATSDR does not provide medical care, it does work with medical groups who study how exposures to hazardous substances where people live or work can affect their health. These groups are the Pediatric Environmental Health Specialty Units (PEHSU) and the Association of Occupational and Environmental Clinics (AOEC). These groups can talk to you about how breathing chemicals in air can affect your health. You can make an appointment with physicians in these groups to talk about your health concerns. You will have to pay the cost of these appointments. ATSDR can give you or your health care provider the information to contact the groups that provide these services.

Comment: Recently, I was admitted to the hospital for an asthma attack and diagnosed with adult-onset asthma. On my discharge papers it has asthma attack from second hand smoke.

ATSDR Response: ATSDR recommends that people with asthma work with their health care providers to determine what triggers their asthma attacks and what medicine should be taken. Once a person has this information from their health care provider, they can work with their health care provider to develop an asthma action plan. This plan should list asthma triggers, warning signs, names of medications, emergency numbers, and steps to take if you have an asthma attack. Anyone with persistent or uncontrolled symptoms should see their health care provider or asthma specialist. People who believe they are experiencing side effects from their asthma medication should also consult their health care provider or asthma specialist.
For more information on managing asthma visit:

- http://www.cdc.gov/asthma/default.htm
- http://www.epa.gov/asthma/about.html
- http://www.noattacks.org

For a list of asthma triggers and actions you can take visit:
http://www.epa.gov/asthma/triggers.html. A copy of an asthma action plan can downloaded at:
http://www.epa.gov/asthma/pdfs/asthma_action_plan.pdf .

Comment: Everyone in Collegeville, Fairmont, North Birmingham, and Harriman Park are suffering or dead from the same health issues (even babies).

Response: There has been limited evaluation of health issues in the North Birmingham area. Recently, the Jefferson County Department of Health released the findings of its study which concluded the overall death rate for all causes of death and for all cancer deaths were statistically the same between residents of North Birmingham neighborhoods and the rest of Jefferson County. The death rates from asthma and chronic obstructive pulmonary disease were also statistically the same. The rates of infant mortality, still births, and birth defects also did not show a statistically significant difference between residents in North Birmingham neighborhoods and the rest of Jefferson County (Oliver, 2014).

ATSDR does acknowledge this study had some limitations. The Jefferson County Department of Health's study involved data from 2000-2009; consequently, does not address earlier time periods such as the 1980's. It should also be noted that the statistical analysis by the Jefferson County Department of Health was based on a small sample size (Oliver, 2014; Collins, 2014). Officials with the Jefferson County Department of Health also acknowledged the need for more information, particular information about asthma (Collins, 2014)

References:

American Cancer Society. 2013. Lifetime Risk of Developing or Dying From Cancer. September. Available at: http://www.cancer.org/cancer/cancerbasics/lifetime-probability-of-developing-or-dying-from-cancer Last accessed November 6, 2014.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2007a. Toxicological profile for Benzene (update). Atlanta: US Department of Health and Human Services. August.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2007b. Toxicological profile for Lead. Atlanta: US Department of Health and Human Services. August.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2012. Toxicological profile for Manganese. Atlanta: US Department of Health and Human Services. September

Collins, Alan. 2014. Health official says no apparent health risk to those living in north Birmingham. July. Fox 6. Available at: http://www.myfoxal.com/story/26155445/health-official-says-no-apparent-health-risk-to-those-living-in-north-birmingham Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2011. Summary of Results for the 2005 National-Scale Assessment. February. Available at: http://www.epa.gov/ttn/atw/nata2005/05pdf/sum_results.pdf Last accessed November 6, 2014.

[EPA] US Environmental Protection Agency. 2013. National Air Toxics Assessments. February. Available at: http://www.epa.gov/ttn/atw/natamain/index.html Last Accessed: November 6, 2014

[EPA] US Environmental Protection Agency. 2014. Plan EJ 2014 Progress Report. February. Available at: http://epa.gov/environmentaljustice/resources/policy/plan-ej-2014/plan-ej-progress-report-2014.pdf Last Accessed: November 6, 2014.

Federal Register. 2012. Environmental Protection Agency, 40 CFR Parts 50, 51, 52, 53, and 58,[EPA–HQ–OAR–2007–0492; FRL–9682–9]RIN 2060–AO47,National Ambient Air Quality Standards for Particulate Matter. Volume 77. No. 126. June.

Mauderly, J.L., Burnett, R.T., Castillejos, M., Ozkaynak, H., Samat, J.M., Stieb, D.M., Vedal, S., and Wyzga, R.E. 2010. Commentary: Is the air pollution health research community prepared to support a multipollutant air quality management framework? Inhal Toxicol 22(S1): 1-19.

Nweke, O.C.; Payne-Sturges, D; Garcia, L; Lee,C; Zenick,H,; Grevatt, P; Sanders,W,H; Case,H; and Dankwa-Mullan, I.2011. Symposium on Integrating the Science of Environmental Justice into Decision-Making at the Environmental Protection Agency: An Overview. American Journal of Public Health. 101: S19-S26. Available at: http://ajph.aphapublications.org/doi/pdfplus/10.2105/AJPH.2011.300368 Last accessed November 6, 2014.

Oliver, Mike. 2014. Birmingham's 'toxic city' neighborhoods show no excess cancer due to pollution, study finds. August, 06. Available at: http://www.al.com/news/index.ssf/2014/08/birminghams_toxic_city_neighbo.html Last accessed November 6, 2014.

Ryder, C.; Dourson, M.L.; Hertzberg, R.C.; Mumtaz, M.M.; Price, P.S.; and Simmons, J.E. 2012. Incorporating Nonchemical Stressors Into Cumulative Risk Assessments. Toxicological Sciences. 127(1): 10-17. February. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3469279/pdf/kfs088.pdf Last accessed November 6, 2014.