SAT Initiative: Chicora Elementary School (North Charleston, South Carolina)

This document describes the analysis of air monitoring and other data collected under EPA's initiative to assess potentially elevated air toxics levels at some of our nation's schools. The document has been prepared for technical audiences (e.g., risk assessors, meteorologists) and their management. It is intended to describe the technical analysis of data collected for this school in clear, but generally technical terms. A summary of this analysis is presented on the page focused on this school on EPA's website (www.epa.gov/schoolair).

I. Executive Summary

- Air monitoring has been conducted at Chicora Elementary School as part of the EPA initiative to monitor specific air toxics in the outdoor air around priority schools in 22 states and 2 tribal areas.
- EPA and the South Carolina Department of Health and Environmental Control (DHEC) selected this school for monitoring based on information indicating the potential for elevated ambient concentrations of acrolein, acetaldehyde, benzene, 1,3-butadiene, manganese, nickel, and hexavalent chromium in air outside the school. The information included EPA's 2002 National-Scale Air Toxics Assessment (NATA) and air emissions inventory data. These data indicated the potential for elevated levels of acrolein, acetaldehyde, benzene, and 1,3-butadiene from sources near the school including mobile sources and waterfront activity, as well as elevated levels of manganese, nickel, and hexavalent chromium from sources supporting the nearby maritime activities and other industrial sources in the area.
- Air monitoring was performed between July 18, 2009 and March 2, 2010, for the following pollutants: acrolein, benzene, and 1,3-butadiene and other volatile organic compounds (VOCs); acetaldehyde, and other carbonyl compounds; manganese, nickel, and other metals in particulate matter less than 10 microns in diameter (PM_{10}); and hexavalent chromium.
- The concentrations of manganese and nickel measured in PM_{10}, and ambient hexavalent chromium measured in the outdoor air at this school indicate the possibility of influence from a nearby source; however, the measured concentrations and estimates of the associated longer term concentrations are below levels of concern.
- Measured levels of acetaldehyde, benzene, and 1,3-butadiene, and associated longer-term concentration estimates were lower than was suggested by the modeling information evaluated prior to monitoring. Although concentrations were below the levels of significant concern that had been suggested by the modeling information, these results indicate the influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.
- Concentrations of acetaldehyde, benzene, and 1,3-butadiene in many urban areas can be higher than in more rural areas. These pollutants are common in the outdoor air in urban areas where many sources are located near one another, particularly mobile sources such as cars, trucks, vehicles associated with maritime activities and off-road machinery.

- EPA remains concerned about mobile source emissions and continues to work to reduce those emissions across the country, through national rules and by providing information and suggestions to assist with reductions in local areas (http://www.epa.gov/schoolair/mobile.html).
- Results of a recent short-term laboratory study have raised questions about the consistency and reliability of acrolein monitoring results. As a result, EPA will not use these acrolein data in evaluating the potential for health concerns from exposure to air toxics in outdoor air as part of the School Air Toxics (SAT) monitoring project (http://www.epa.gov/schoolair/acrolein.html).
- Based on the analysis of the results described in this report, EPA will not extend air toxics monitoring at this school. However, EPA's ongoing research and national air toxics monitoring programs (e.g., the National Air Toxics Trends Stations) will continue to collect information on mobile source impacts on outdoor air nationally.
- EPA remains concerned about emissions from sources of air toxics and continues to work to reduce these emissions across the country, through national rules and by providing information and suggestions to assist with reductions in local areas (http://www.epa.gov/ttn/atw/eparules.html).
- The South Carolina Department of Health and Environmental Control (DHEC) will continue to oversee industrial facilities in the area through their air permits and other programs. DHEC will work with local governments, schools and others to implement voluntary programs for reductions in mobile source emissions.

II. Background on this Initiative

As part of an EPA initiative to implement Administrator Lisa Jackson's commitment to assess potentially elevated air toxics levels at some of our nation's schools, EPA and state and local air pollution control agencies monitored specific (key) air toxics in the outdoor air around priority schools in 22 states and 2 tribal areas (http://www.epa.gov/schoolair/schools.html).

- The schools selected for monitoring included some schools that are near large industries that are sources of air toxics, and some schools that are in urban areas, where emissions of air toxics come from a mix of large and small industries, cars, trucks, buses and other sources.
- EPA selected schools based on information available to us about air pollution in the vicinity of the school, including results of the 2002 NATA, results from a 2008 USA Today analysis on air toxics at schools, and information from state and local air agencies. The analysis by USA Today involved use of EPA's Risk Screening Environmental Indicators tool and Toxics Release Inventory (TRI) for 2005.
  - Available information had raised some questions about air quality near these schools that EPA concluded merited investigation. In many cases, the information indicated that estimated long-term average concentrations of one or more air toxics were above the upper end of the range that EPA generally considers as acceptable (e.g., above 1-in-10,000 cancer risk for carcinogens).

- Monitors were placed at each school for approximately 60 days, and took air samples on at least 10 different days during that time. The samples were analyzed for specific air toxics identified for monitoring at the school (i.e., key pollutants).[1]
- These monitoring results and other information collected at each school during this initiative allow us to:
  - assess specific air toxics levels occurring at these sites and associated estimates of longer-term concentrations in light of health risk-based criteria for long-term exposures,
  - better understand, in many cases, potential contributions from nearby sources to key air toxics concentrations at the schools,
  - consider what next steps might be appropriate to better understand and address air toxics at the school, and
  - improve the information and methods we will use in the future (e.g., NATA) for estimating air toxics concentrations in communities across the U.S.

Assessment of air quality under this initiative is specific to the air toxics identified for monitoring at each school. This initiative is being implemented in addition to ongoing state, local and national air quality monitoring and assessment activities, including those focused on criteria pollutants (e.g., ozone and particulate matter) or existing, more extensive, air toxics programs.

Several technical documents prepared for this project provide further details on aspects of monitoring and data interpretation and are available on the EPA website (e.g., www.epa.gov/schoolair/techinfo.html). The full titles of these documents are provided here:

- *School Air Toxics Ambient Monitoring Plan*
- *Quality Assurance Project Plan For the EPA School Air Toxics Monitoring Program*
- *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*

Information on health effects of air toxics being monitored[2] and educational materials describing risk concepts[3] are also available from EPA's website.

III. Basis for Selecting this School and the Air Monitoring Conducted

Chicora Elementary School was selected for monitoring as a result of consultation with the state air agency, the South Carolina Department of Health and Environmental Control (DHEC). The school is located near an urban industrial area, as well as several interstate and state highways (Figure 1). EPA and DHEC were interested in evaluating the ambient concentrations of manganese, nickel, and hexavalent chromium in air outside the school based on results from a national scale assessment of air toxics conducted by EPA in 2002 (EPA's National Air Toxics Assessment – "2002 NATA"). The assessment indicated the potential for elevated levels of these pollutants resulting from the operations of nearby industrial sources. There was also an

[1] In analyzing air samples for these key pollutants, samples are also being analyzed for some additional pollutants that are routinely included in the analytical methods for the key pollutants.
[2] For example, http://www.epa.gov/schoolair/pollutants.html, http://www.epa.gov/ttn/fera/risk_atoxic.html.
[3] For example, http://www.epa.gov/ttn/atw/3_90_022.html, http://www.epa.gov/ttn/atw/3_90_024.html.

interest in evaluating the ambient concentrations of acetaldehyde, acrolein, benzene, and 1,3-butadiene in air outside Chicora because EPA's 2002 NATA analysis also indicated the potential for elevated levels of these pollutants resulting from nearby mobile sources and maritime related activities. More information on mobile sources of air toxics can be found on EPA's website (http://www.epa.gov/schoolair/mobile.html). Additionally, there is a long-term DHEC air toxics monitoring site approximately two miles north of the school at the Jenkins Avenue Fire Station (discussed in section V) where a similar suite of air toxics were monitored during the sampling period at Chicora Elementary School.

Air sampling commenced at Chicora Elementary School on July 18, 2009 and continued through March 2, 2010. During this period, 19 PM_{10} samples (for metals analysis),[4] 16 carbonyl samples, 20 hexavalent chromium samples, and 10 VOC samples were collected using EPA approved methods. The samples were analyzed for manganese and nickel (PM_{10}), acetaldehyde, benzene, and 1,3-butadiene (VOCs), and hexavalent chromium (the key pollutants at this school) in addition to other PM_{10} metals, carbonyls, and VOCs that are routinely included in the analytical methods for the key pollutants.

Due to an issue with VOC monitoring equipment, initial VOC results were invalidated (see 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). Additional VOC samples were collected from October 10, 2009, through March 2, 2010, to ensure that a minimum of ten valid samples were available for analysis.

All VOC results, with the exception of acrolein, were evaluated for health concerns. As previously mentioned, results of a recent short-term laboratory study have raised questions about the consistency and reliability of monitoring results for acrolein. As a result, EPA will not use these acrolein data in evaluating the potential for health concerns from exposure to air toxics in outdoor air as part of the School Air Toxics Monitoring project (http://www.epa.gov/schoolair/acrolein.html). All sampling methodologies are described in EPA's schools air toxics monitoring plan (http://www.epa.gov/schoolair/techinfo.html).[5]

IV. Monitoring Results and Analysis

A. Background for the SAT Analysis

The majority of schools being monitored in this initiative were selected based on modeling analyses that indicated the potential for annual average air concentrations of some specific (key) hazardous air pollutants (HAPs or air toxics)[6] to be of particular concern based on approaches

[4] In general, this sampler collects airborne particles with a diameter of 10 microns or smaller.
[5] DHEC staff operated the monitors and sent the sample filters, cartridges, and canisters to the analytical laboratory under contract to EPA.
[6] The term hazardous air pollutants (commonly called HAPs or air toxics) refers to pollutants identified in section 112(b) of the Clean Air Act which are the focus of regulatory actions involving stationary sources described by CAA section 112 and are distinguished from the six pollutants for which criteria and national ambient air quality standards (NAAQS) are developed as described in section 108. One of the criteria pollutants, lead, is also represented, as lead compounds, on the HAP list.

that are commonly used in the air toxics program for considering potential for long-term risk. For example, such analyses suggested annual average concentrations of some air toxics were greater than long-term risk-based concentrations associated with an additional cancer risk greater than 10-in-10,000 or a hazard index on the order of or above 10. To make projections of air concentrations, the modeling analyses combined estimates of air toxics emissions from industrial, motor vehicle, and other sources, with past measurements of winds, and other meteorological factors that can influence air concentrations, from a weather station in the general area. In some cases, the weather station was very close (within a few miles), but in other cases, it was much further away (e.g., up to 60 miles), which may contribute to quite different conditions being modeled than actually exist at the school. The modeling analyses are intended to be used to prioritize locations for further investigation.

The primary objective of this initiative is to investigate - through monitoring air concentrations of key air toxics at each school over a 2-3 month period - whether levels measured and associated longer-term concentration estimates are of a magnitude, in light of health risk-based criteria, for which follow-up activities may need to be considered. To evaluate the monitoring results consistent with this objective, we developed health risk-based air concentrations (the long-term comparison levels summarized in Appendix A) for the monitored air toxics using established EPA methodology and practices for health risk assessment[7] and, in the case of cancer risk, consistent with the implied level of risk considered in identifying schools for monitoring. Consistent with the long-term or chronic focus of the modeling analyses, based on which these schools were selected for monitoring, we have analyzed the full record of concentrations of air toxics measured at this school, using routine statistical tools, to derive a 95 percent confidence interval[8] for the estimate of the longer-term average concentration of each of these pollutants. In this project, we are reporting all actual numerical values for pollutant concentrations including any values below method detection limit (MDL).[9] Additionally, a value of 0.0 is used when a measured pollutant had no value detected (ND). The projected range for the longer-term concentration estimate for each chemical (most particularly the upper end of the range) is compared to the long-term comparison levels. These long-term comparison levels conservatively presume continuous (all-day, all-year) exposure over a lifetime. The analysis of

[7] While this EPA initiative will rely on EPA methodology, practices, assessments and risk policy considerations, we recognize that individual state methods, practices and policies may differ and subsequent analyses of the monitoring data by state agencies may draw additional or varying conclusions.

[8] When data are available for only a portion of the period of interest (e.g., samples not collected on every day during this period), statisticians commonly calculate the 95% confidence interval around the dataset mean (or average) in order to have a conservative idea of how high or low the "true" mean may be. More specifically, this interval is the range in which the mean for the complete period of interest is expected to fall 95% of the time (95% probability is commonly used by statisticians). The interval includes an equal amount of quantities above and below the sample dataset mean. The interval that includes these quantities is calculated using a formula that takes into account the size of the dataset (i.e., the 'n') as well as the amount by which the individual data values vary from the dataset mean (i.e., the "standard deviation"). This calculation yields larger confidence intervals for smaller datasets as well as ones with more variable data points. For example, a dataset including {1.0, 3.0, and 5.0}, results in a mean of 3.0 and a 95% confidence interval of 3.0 +/- ~5 (or -2.0 to 8.0). For comparison purposes, a dataset including {2.5, 3 and 3.5} results in a mean of 3.0 and a 95% confidence interval of 3.0 +/- ~1.2 (or 1.8 to 4.2). The smaller variation within the data in the second set of values causes the second confidence interval to be smaller.

[9] Method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the pollutant concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the pollutant.

the air concentrations also includes a consideration of the potential for cumulative multiple pollutant impacts.[10] In general, where the monitoring results indicate estimates of longer-term average concentrations that are above the comparison levels - i.e., above the cancer-based comparison levels or notably above the non-cancer-based comparison levels - EPA considered the need for follow-up actions such as:

- → Additional monitoring of air concentrations and/or meteorology in the area,
- → Evaluation of potentially contributing sources to help us confirm their emissions and identify what options (regulatory and otherwise) may be available to us to achieve emissions reductions, and
- → Evaluation of actions being taken or planned nationally, regionally or locally that may achieve emission and/or exposure reductions. An example of this would be actions taken to address the type of ubiquitous emissions that came from mobile sources.

We have further analyzed the dataset to describe what it indicates in light of some other criteria and information commonly used in prioritizing state, local and national air toxics program activities. State, local and national programs often develop long-term monitoring datasets in order to better characterize pollutants near particular sources. The 2-3 month dataset developed under this initiative will be helpful to those programs in setting priorities for longer-term monitoring projects. The intent of this analysis is to make this 2-3 month monitoring dataset as useful as possible to state, local and national air toxics programs in their longer-term efforts to improve air quality nationally. To that end, this analysis:

- → Describes the air toxics measurements in terms of potential longer-term concentrations, and, as available, compares the measurements at this school to monitoring data from national monitoring programs.
- → Describes the meteorological data by considering conditions on sampling days as compared to those over all the days within the two to three month monitoring period and what conditions might be expected over the longer-term (as indicated, for example, by information from a nearby weather station).
- → Describes available information regarding activities and emissions at the nearby source(s) of interest, such as that obtained from public databases such as TRI and/or consultation with the local air pollution authority.

[10] As this analysis of a 2-3 month monitoring dataset is not intended to be a full risk assessment, consideration of potential multiple pollutant impacts may differ among sites. For example, in instances where no individual pollutant appears to be present above its comparison level, we will also check for the presence of multiple pollutants at levels just below their respective comparison levels (giving a higher priority to such instances).

B. Chemical Concentrations

We developed two types of long-term health risk-related comparison levels (summarized in Appendix A below) to address our primary objective. The primary objective is to investigate through the monitoring data collected for key pollutants at the school, whether pollutant levels measured and associated longer-term concentration estimates are elevated enough in comparison with health risk-based criteria to indicate that follow-up activities be considered. These comparison levels conservatively presume continuous (all-day, all-year) exposure over a lifetime.

In developing or identifying these comparison levels, we have given priority to use of relevant and appropriate air standards and EPA risk assessment guidance and precedents.[11] These levels are based upon health effects information, exposure concentrations and risk estimates developed and assessed by EPA, the U.S. Agency for Toxic Substances and Disease Registry, and the California EPA. These agencies recognize the need to account for potential differences in sensitivity or susceptibility of different groups (e.g., asthmatics) or lifestages/ages (e.g., young children or the elderly) to a particular pollutant's effects so that the resulting comparison levels are relevant for these potentially sensitive groups as well as the broader population.

In addition to evaluating individual pollutants with regard to their corresponding comparison levels, we also considered the potential for cumulative impacts from multiple pollutants in cases where individual pollutant levels fall below the comparison levels but where multiple pollutant mean concentrations are within an order of magnitude of their comparison levels.

Using the analysis approach described above, we analyzed the chemical concentration data (Table 1 and Figures 2a-2f) with regard to areas of interest identified below.

Key findings drawn from the information on chemical concentrations and the considerations discussed below include:

- The air sampling data collected over the 7-month sampling period and the related longer-term concentration estimates, while indicating possible influence from nearby sources of manganese, nickel, and hexavalent chromium, are below concentrations of significant concern. Even though the levels of acetaldehyde, 1,3-butadiene and benzene were below the levels of significant concern that had been suggested by the modeling information, these results still indicate the influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

<u>Manganese, key pollutant:</u>

- Do the monitoring data indicate influence from a nearby source?

[11] The development of long-term comparison levels, as well as of individual sample screening levels, is described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results.*

→ The monitoring data include some manganese (PM_{10}) concentrations that are higher than concentrations commonly observed in other locations nationally, indicating the possibility of influence from nearby sources.[12]

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?

  → The monitoring data for manganese do not indicate levels of health concern for long-term exposures.

    - The estimate of longer-term manganese concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is well below the long-term comparison level (Table 1).[13] This comparison level is a continuous exposure concentration (24 hours a day, all year, over a lifetime) associated with little risk of adverse effect; it is not an exposure concentration at which effects have been observed or are predicted to occur.[14]
    - Manganese has not been found to be carcinogenic, and therefore has no cancer-based comparison level.[15]

  → Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for manganese (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[11]

  → In summary, none of the individual measurements indicates concentrations of concern for short-term exposures, and the combined contributions of all individual measurements in the estimate of longer-term concentration do not indicate a level of concern for long-term exposure.

<u>Nickel, key pollutant:</u>

- Do the monitoring data indicate influence from a nearby source?

  → The monitoring data include some nickel (PM_{10}) concentrations that are higher than concentrations commonly observed in other locations nationally.[16]

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[12] For example, three of the concentrations at this site (Table 2a) were higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because these NATTS sites are generally sited so as to not be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark of indicating potential influence from a source nearby to the school.

[13] The upper end of the interval is less than 1.3 times the mean of the monitoring data and less than 19 percent of the long-term noncancer-based comparison level.

[14] The comparison level for manganese is based on the RfC. Manganese concentrations at which health effects have been observed are higher than the RfC (http://www.atsdr.cdc.gov/tfacts151.html, http://www.epa.gov/ttn/atw/hlthef/manganes.html#conversion)

[15] www.epa.gov/iris

[16] For example, two of the concentrations at this site (Table 2a) were higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because these NATTS sites are generally sited so as to not be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark of indicating potential influence from a source nearby to the school.

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?

  → The monitoring data for nickel do not indicate levels of health concern for long-term exposures.

    - The estimate of longer-term nickel concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below both of the long-term comparison levels (Table 1).[17] These comparison levels are continuous exposure concentrations (24 hours a day, all year, over a lifetime).
    - Further, the longer-term concentration estimate is more than 100-fold lower than the cancer-based comparison level, indicating the longer-term estimate is below a continuous (24 hours a day, 7 days a week) lifetime exposure concentration associated with 1-in-1-million additional cancer risk.

  → Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for nickel (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[11]

  → In summary, the individual measurements do not indicate concentrations of concern for short-term exposures and the combined contributions of all individual measurements in the estimate of longer-term concentration do not indicate a level of concern for long-term exposure.

<u>Hexavalent Chromium, key pollutant:</u>

- Do the monitoring data indicate influence from a nearby source?

  → The monitoring data include one hexavalent chromium concentration that is higher than concentrations commonly observed in other locations nationally.[18]

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?

  → The monitoring data for hexavalent chromium do not indicate levels of health concern for long-term exposures.

    - The estimate of the longer-term hexavalent chromium concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below both of the long-term comparison levels (Table 1).[19] These comparison levels are continuous exposure concentrations (24 hours a day, all year, over a lifetime).

[17] The upper end of the interval is approximately 1.3 times the mean of the monitoring data and less than 3 percent of the long-term noncancer-based comparison level.

[18] For example, one of the concentrations at this site (Table 2a) was higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because these NATTS sites are generally sited so as to not be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark of indicating potential influence from a source nearby to the school.

[19] The upper end of the interval is 1.7 times the mean of the monitoring data and less than 1 percent of the long-term cancer-based comparison level.

- Further, the longer-term concentration estimate is more than 100-fold lower than the cancer-based comparison level, indicating the longer-term estimate is below a continuous (24 hours a day, 7 days a week) lifetime exposure concentration associated with 1-in-1-million additional cancer risk.

→ Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for hexavalent chromium (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[11]

→ In summary, the individual measurements do not indicate concentrations of concern for short-term exposures and the combined contributions of all individual measurements in the estimate of longer-term concentration do not indicate a level of concern for long-term exposure.

Acetaldehyde, key pollutant:

Acetaldehyde is one of several air toxics that EPA recognizes as a key pollutant nationally. A large number of people live in areas across the U.S. with elevated ambient concentrations of this pollutant due to mobile[20] and industrial sources.

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?

  → Measured acetaldehyde levels and associated longer-term concentration estimates at Chicora were not as high as suggested by the modeling information available prior to monitoring. Although they are below the levels of significant concern that had been suggested by the modeling information, these results are consistent with the ubiquitous nature and influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

  - The estimate of the longer-term acetaldehyde concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below both of the long-term comparison levels (Table 1).[21] These comparison levels are continuous exposure concentrations (24 hours a day, all year, over a lifetime).
  - Further, the longer-term concentration estimate is more than tenfold lower than the cancer-based comparison level, indicating the longer-term estimate is below a continuous (24 hours a day, 7 days a week) lifetime exposure concentration associated with 1-in-100,000 additional cancer risk.

  → Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for acetaldehyde (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[11]

[20] Additional information on mobile sources of air toxics is available at http://www.epa.gov/schoolair/mobile.html.
[21] The upper end of the interval is nearly 1.2 times the mean of the monitoring data and less than 11% of the long-term noncancer-based comparison level.

Benzene, key pollutant:

Benzene is one of several air toxics that EPA recognizes as a key pollutant nationally. A large number of people live in areas across the U.S. with elevated ambient concentrations of this pollutant due to mobile source emissions.[20]

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?

  → Measured benzene levels and associated longer-term concentration estimates at this school were not as high as suggested by the modeling information available prior to monitoring. Although they were below the levels of significant concern that had been suggested by the modeling information, these results are consistent with the ubiquitous nature and influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

    - The estimate of the longer-term benzene concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below both of the long-term comparison levels (Table 1).[22] These comparison levels are continuous exposure concentrations (24 hours a day, all year, over a lifetime).
    - Further, the longer-term concentration estimate is approximately 12% of the cancer-based comparison level, indicating the longer-term estimate falls between continuous (24 hours a day, 7 days a week) lifetime exposure concentrations associated with 1-in-100,000 and 1-in-10,000 additional cancer risk.

  → Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for benzene (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[11]

1,3-Butadiene, key pollutant:

1,3-Butadiene is one of several air toxics that EPA recognizes as a key pollutant nationally. A large number of people live in areas across the U.S. with elevated ambient concentrations of this pollutant due to mobile sources.[20]

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?

  → Measured 1,3-butadiene levels and associated longer-term concentration estimates at this school were not as high as suggested by the modeling information available prior to monitoring. Although they were below the levels of significant concern that had been suggested by the modeling information, these results indicate the influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

    - The estimate of the longer-term 1,3-butadiene concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is

[22] The upper end of the interval is less than 1.4 times the mean of the monitoring data and less than 12% of the long-term cancer-based comparison level.

below both of the long-term comparison levels (Table 1).[23] These comparison levels are continuous exposure concentrations (24 hours a day, all year, over a lifetime).

- Further, the longer-term concentration estimate is more than tenfold lower than the cancer-based comparison level, indicating the longer-term estimate is below a continuous (24 hours a day, 7 days a week) lifetime exposure concentration associated with 1-in-100,000 additional cancer risk.

→ Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for 1,3-butadiene (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[11]

Other Air Toxics:

- Do the monitoring data indicate elevated levels of any other air toxics (or HAPs) that pose significant long-term health concerns?

  → The monitoring data show low levels of the other HAPs monitored, with longer-term concentration estimates for these HAPs below their long-term comparison levels (Appendix C). Additionally, each individual measurement for these pollutants is below the individual sample screening level[11] for that pollutant (Appendix D).

Multiple Pollutants:

- Do the data collected for the air toxics monitored indicate the potential for other monitored pollutants to be present at levels that in combination with the key pollutant levels indicate an increased potential for cumulative impacts of significant concern (e.g., that might warrant further investigation)?

  → Although the multiple air toxics monitored at this site were below the levels of significant concern for multi-pollutant cumulative risk that had been suggested by the modeling information, these results indicate the influence of multiple mobile source pollutants of concern that are the focus of EPA actions nationwide (Appendix C).[24]

C. Wind and Other Meteorological Data

At each school monitored as part of this initiative, we collected meteorological data, minimally for wind speed and direction, during the sampling period. Additionally, we identified the nearest National Weather Service (NWS) station at which a longer record is available.

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[23] The upper end of the interval is approximately 1.5 times the mean of the monitoring data and less than 8% of the long-term noncancer-based comparison level.

[24] We note that this initiative is focused on investigation for a school-specific set of key pollutants indicated by previous analyses (and a small set of others for which measurements are obtained in the same analysis). Combined impacts of pollutants or stressors other than those monitored in this project is a broader area of consideration in other EPA activities. General information on additional air pollutants is available at http://www.epa.gov/air/airpollutants.html.

In reviewing these data at each school in this initiative, we are considering if these data indicate that the general pattern of winds on our sampling dates are significantly different from those occurring across the full sampling period or from those expected over the longer-term. Additionally, we are noting, particularly for school sites where the measured chemical concentrations show little indication of influence from a nearby source, whether wind conditions on some portion of the sampling dates were indicative of a potential to capture contributions from the nearby "key" source in the air sample collected.

The meteorological station at Chicora Elementary School collected wind speed and wind direction measurements beginning on July 20, 2009, continuing through the sampling period (July 24, 2009-March 2, 2010), and ending on August 2, 2010. As a result, on-site data for these meteorological parameters are available for all dates of sample collection, and also for a period after the sampling period, producing a continuous record of over one year of on-site meteorological data. Due to instrument error, the wind data collected prior to July 20, 2009 was invalid. Thus, there is no wind data at the school to correlate with the first sampling day of July 18, 2009. There were additional days during the sampling period in which the on-site wind data could not be used due to instrument error. On these days, wind data from the nearest NWS station was used as a surrogate. The meteorological data collected on sampling days are presented in Figures 3a-3f and Tables 2a-2c.

The nearest NWS station is at Charleston Air Force Base/International Airport in Charleston, South Carolina. This station is approximately five miles northwest of the school. Measurements taken at that station include wind, temperature, and precipitation. Wind speed and direction data collected at the Charleston Air Force Base/International Airport NWS station have been summarized in Tables 2a-2c and Appendix E. The meteorological data collected for the entire period (July 20, 2009-August 2, 2010) at this school and at the nearby NWS station are also summarized in Appendix F. The windroses for the entire meteorological period are very similar to those for the sampling period which is reflected in Figures 3a-3f.

Key findings drawn from this information and the considerations discussed below include:

- Both the sampling results and the on-site wind data indicate that some of the air samples were collected on days when the nearby key sources were contributing to conditions at the school location. The wind patterns at the monitoring site across sampling dates are generally similar to those observed across the record of on-site meteorological data during the sampling period.
- The ability to provide a confident characterization of the wind flow patterns at the monitoring site over the long-term is limited; however, the wind flow patterns at the NWS station at Charleston Air Force Base/International Airport do appear to represent the specific wind flow patterns at the school location.
- Although long-term wind data at the monitoring site is limited, the wind pattern at the NWS station during the sampling period is similar to the historical long-term wind flow pattern at that same NWS station. This information, along with the wind flow patterns at the school suggest that, the sampling period is representative of year-round wind patterns on a regional scale.

- What are the directions of the key sources of manganese, acetaldehyde, benzene, 1,3-butadiene, nickel, and hexavalent chromium emissions in relation to the school location?
  - → The key sources were identified as a nearby industrial source to the north of the school, and on-road and non-road maritime-related activities surrounding the school and community.
  - → Considering the boundaries of the sources of interest (in lieu of information regarding the location of specific sources of manganese, acetaldehyde, benzene, 1,3-butadiene, nickel, and hexavalent chromium emissions), we have determined the range of wind directions to use in considering potential influence of the industrial and mobile sources on air concentrations at the school.
  - → The general range of wind directions, from approximately 326 to 11 degrees, is referred to here as the expected zone of source influence (ZOI) when referring to manganese, nickel, and hexavalent chromium.
  - → The key sources for acetaldehyde, benzene, and 1,3-butadiene were identified as mobile (roadway) sources surrounding the school and maritime-related sources northeast through southeast of the school. Therefore, wind from any direction may be considered as from the direction of a key source.

- On days the air samples were collected, how often did wind come from direction of the key source?
  - → For manganese and nickel sampling, there were nine out of nineteen sampling days in which a portion of the winds were from the expected ZOI (Figures 3a and 3b, Table 2a).
  - → For hexavalent chromium sampling, there were eight out of twenty sampling days in which a portion of the winds were from the expected ZOI (Figure 3c, Table 2a).
  - → For acetaldehyde sampling, since any wind direction may be considered as the direction of the source, all sixteen sampling days for which on-site wind data are available were from the direction of the key sources (Figure 3d, Table 2b).
  - → For benzene and 1,3-butadiene sampling, since any wind direction may be considered as the direction of the source, all ten sampling days for which on-site wind data are available were from the direction of the key sources (Figures 3e-3f, Table 2c).

- How do wind patterns on the air monitoring days compare to those across the complete monitoring period and what might be expected over the longer-term at the school location?
  - → Wind patterns across the air monitoring days appear similar to those observed over the record of on-site meteorological data during the sampling period.
  - → The wind patterns at the nearest NWS station (at Charleston Air Force Base/ International Airport) during the sampling period are similar to those recorded at the NWS station over the long-term (2002-2007 period; Appendix E), supporting the idea that regional meteorological patterns in the area during the sampling period were consistent with long-term patterns. The ability to provide a confident characterization of the wind flow patterns at the monitoring site over the long-term is limited; however, the wind flow patterns at the NWS station at Charleston Air Force Base/International Airport do appear to represent the specific wind flow patterns at the school location.

- How do wind patterns at the school compare to those at the Charleston Air Force Base/International Airport station, particularly with regard to prevalent wind directions and the direction of the key source?
  → During the sampling period for which data are available both at the school site and at the reference NWS station (approximately seven months), prevalent winds at the school site are predominantly from the north to northeast, while those at the NWS station are also from the north to northeast, as well as from the west. The windroses for the two sites during the sampling period (Figures 3a-3f and Appendix E) show similarities in wind flow patterns.
- Are there other meteorological patterns that may influence the measured concentrations at the school monitoring site?
  → No. We did not observe other meteorological patterns that may influence the measured concentrations at the school monitoring site.

V. Other Monitoring in This Community

As mentioned in section III above, DHEC has a monitoring site within two (2) miles of the school at the Jenkins Avenue Fire Department (Jenkins) where DHEC has been monitoring the following pollutants: metals, including chromium, manganese and nickel, in total suspended particles (TSP); sulfur dioxide, nitrogen dioxide and $PM_{10.}$ TSP samplers capture airborne particles of sizes ranging in aerodynamic diameter from about 0.1 up to about 25 to 50 microns. This size range includes particles that can be inhaled (generally of sizes ranging up to about 10 microns), including the size range sometimes termed "respirable" (generally of sizes ranging up to about 3 to 4 microns), as well as larger particles that fall onto surfaces which people may contact.

During the sampling at Chicora Elementary, DHEC added samplers at the Jenkins monitoring site for PM_{10}, carbonyls, VOCs, and hexavalent chromium. All sampling and analysis protocols were consistent with those used at the Chicora monitoring site as well as National Air Toxics Trend Sites (NATTS). The concentrations collected at the Jenkins monitoring site were compared to those collected at the Chicora monitoring site during the same sampling periods (Tables 2a-2c). Concentrations for acetaldehyde at the Jenkins monitoring site were higher than at the school. This may be an indication of the influence of the nearby industrial and mobile sources, which are closer to the Jenkins monitoring site than the school (slightly over a mile north of the Jenkins monitoring site). Additionally, concentrations of chromium (TSP), manganese (TSP), and nickel (TSP) were often higher at the Jenkins monitoring site than the concentrations of hexavalent chromium, manganese (PM_{10}), and nickel (PM_{10}) taken at the school during the same sampling period. Concentrations of benzene were generally lower at the Jenkins monitoring site than at the school for the few dates when samples were collected at both locations, whereas there were no 1,3-butadiene detections at the Jenkins monitoring site. The method detection limit for benzene at this monitoring site is 0.166 ppbv, which equates to 0.53 $\mu g/m^3$.

In addition, DHEC operated a PM_{10} high volume sampler collocated at Chicora Elementary School and at the Howard Heights site approximately 1.6 miles southeast of the school.

VI. Key Source Information

- Were the industrial sources operating as usual during the monitoring period?
  - The nearby sources of manganese, acetaldehyde, nickel, and hexavalent chromium (described in section III above) have Title V air permits or conditional major source permits issued by DHEC that include operating requirements.[25]
  - Information from the nearby sources of manganese, nickel, and hexavalent chromium indicates that the facilities were operating at a rate of 60-80% of their production capacity during the sampling period.
  - The most recently available manganese, nickel, and chromium TRI emissions data (2008 TRI) for one of the maritime support facilities (marine containers) are lower than the 2005 TRI emissions.
- Was mobile source activity typical during the monitoring period?
  - The most recent emissions from the other facility supporting the maritime activities (shipyard) (2005 NATA) have remained the same.
  - The most recently available county-level acetaldehyde, benzene, and 1,3-butadiene emissions for on-road and non-road mobile sources (2005 NATA) are lower than those relied upon previous modeling analysis for this area (2002 NATA).

VII. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What are the key HAPs for this school?
   → Manganese, nickel, acetaldehyde, benzene, 1,3-butadiene, and hexavalent chromium are the key HAPs for this school, identified based on emissions information considered in identifying the school for monitoring. The ambient air concentrations of several pollutants during the monitoring period indicate contributions from sources in the area.

2. Do the data collected at this school indicate an elevated level of concern, as implied by information that led to identifying this school for monitoring?
   → The levels measured and associated longer-term concentration estimates for all of the key HAPs for this school are not as high as suggested by the modeling information available prior to monitoring. Levels and associated longer-term concentration estimates for manganese, nickel and hexavalent chromium are below levels of concern. Although acetaldehyde, 1,3-butadiene and benzene were below the levels of significant concern that had been suggested by the modeling information, these results indicate the influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

[25] Operating permits, which are issued to air pollution sources under the Clean Air Act, are described at: http://www.epa.gov/air/oaqps/permits/

3. Are there indications, e.g., from the meteorological or other data, that the sample set may not be indicative of longer-term air concentrations? Would we expect higher (or lower) concentrations at other times of year?
   → The data collected appear to reflect air concentrations during the entire monitoring period, with no indications from the on-site meteorological data that the sampling day conditions were inconsistent with conditions overall during this period.
   → Among the data collected for this site, none indicate generally higher (or lower) concentrations during other times of year. Although long-term wind data at the monitoring site is limited, the wind pattern at the NWS station during the sampling period is similar to the historical long-term wind flow pattern at that same NWS station. This information, along with the wind flow patterns at the school suggest that, the sampling period is representative of year-round wind patterns on a regional scale.

B. Next Steps for Key Pollutants

1. Based on the analysis described here, EPA will not extend air toxics monitoring at this school. EPA's ongoing research and national air toxics monitoring programs (e.g., the National Air Toxics Trends Stations) will continue to collect information on mobile source impacts on outdoor air nationally. EPA will also continue to work toward reductions in mobile source emissions nationally and to facilitate reductions in local areas (http://www.epa.gov/schoolair/mobile.html).
2. EPA remains concerned about emissions from all sources of air toxics and continues to work to reduce these emissions across the country, by developing national rules and providing information and suggestions to assist with reductions in local areas (http://www.epa.gov/ttn/atw/eparules.html).
3. The South Carolina Department of Health and Environmental Control (DHEC) will continue to oversee industrial facilities in the area through their air permits and other programs. DHEC will work with local governments, schools and others to implement voluntary programs for reductions in mobile source emissions.

VIII. Figures and Tables

A. Tables

1. Chicora Elementary School – Key Pollutant Analysis.

2a. Chicora Elementary School Key Pollutant Concentrations (Manganese (PM_{10}), Nickel (PM_{10}) and Hexavalent Chromium) and Meteorological Data.

2b. Chicora Elementary School Key Pollutant Concentrations (Acetaldehyde) and Meteorological Data.

2c. Chicora Elementary School Key Pollutant Concentrations (Benzene and 1,3-Butadiene) and Meteorological Data.

B. Figures

1. Chicora Elementary School, Jenkins Avenue Monitoring Site, and Sources of Interest.

2a. Chicora Elementary School – Key Pollutant (Manganese (PM_{10})) Analysis.

2b. Chicora Elementary School – Key Pollutant (Nickel (PM_{10})) Analysis.

2c. Chicora Elementary School – Key Pollutant (Hexavalent Chromium) Analysis.

2d. Chicora Elementary School – Key Pollutant (Acetaldehyde) Analysis.

2e. Chicora Elementary School – Key Pollutant (Benzene) Analysis.

2f. Chicora Elementary School – Key Pollutant (1,3-Butadiene) Analysis.

3a. Chicora Elementary School (North Charleston, SC) Manganese (PM_{10}) Concentration and Wind Information.

3b. Chicora Elementary School (North Charleston, SC) Nickel (PM_{10}) Concentration and Wind Information.

3c. Chicora Elementary School (North Charleston, SC) Hexavalent Chromium Concentration and Wind Information.

3d. Chicora Elementary School (North Charleston, SC) Acetaldehyde Concentration and Wind Information.

3e. Chicora Elementary School (North Charleston, SC) Benzene Concentration and Wind Information.

3f. Chicora Elementary School (North Charleston, SC) 1,3-Butadiene Concentration and Wind Information.

IX. Appendices

A. Summary Description of Long-term Comparison Levels.

B. National Air Toxics Trends Stations Measurements (2004-2008).

C. Analysis of Other (non-key) Air Toxics Monitored at the School and Multiple-pollutant Considerations.

D. Chicora Elementary School Pollutant Concentrations.

E. Windroses for Charleston Air Force Base/International Airport NWS Station.

F. Windroses Comparison, Entire Meteorological Period.

Figure 1. Chicora Elementary School, Jenkins Fire Station, and Sources of Interest.

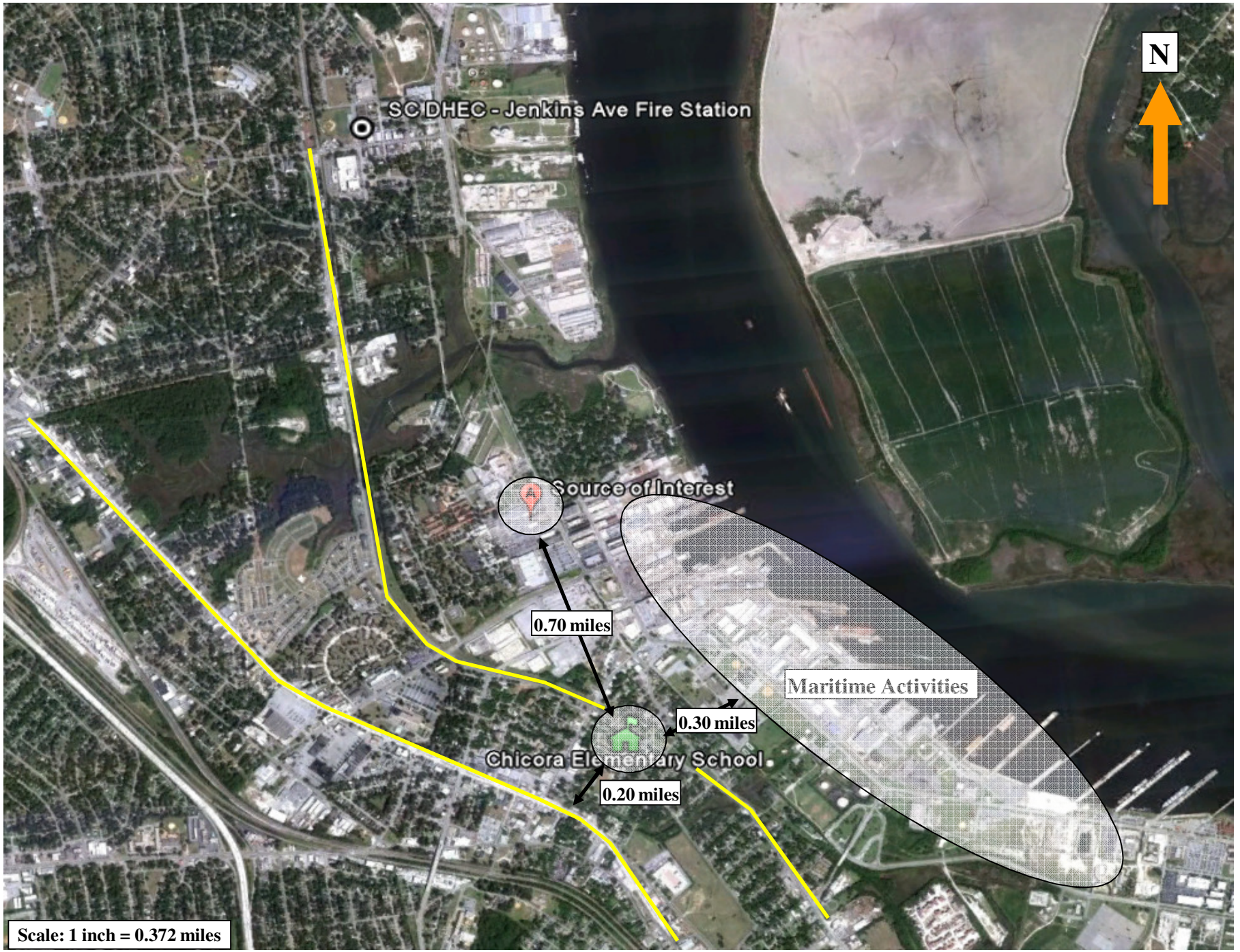


Table 1. Chicora Elementary School - Key Pollutant Analysis.

Parameter	Units	Mean of Measurements	95% Confidence Interval on the Mean	Long-term Comparison Level[a]	
				Cancer-Based[b]	Noncancer-Based[c]
Manganese (PM_{10})	ng/m^3	7.60 [d]	5.85 - 9.35	NA	50
Nickel (PM_{10})	ng/m^3	1.73 [e]	1.20 - 2.26	420	90
Hexavalent Chromium	ng/m^3	0.010 [f]	0.003 - 0.016	8.3	100
Acetaldehyde	$\mu g/m^3$	0.80 [g]	0.65 - 0.95	45	9
Benzene	$\mu g/m^3$	1.10 [h]	0.68 - 1.52	13	30
Butadiene, 1,3-	$\mu g/m^3$	0.11 [i]	0.06 - 0.16	3.3	2

ng/m^3 nanograms per cubic meter

$\mu g/m^3$ micrograms per cubic meter

NA Not applicable

[a] Details regarding these values are in the technical report, Schools Air Toxics Monitoring Activity (2009) Uses of Health Effects Information.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration is above this level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[c] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

[d] The mean of measurements for manganese (PM_{10}) is the average of all sample results, which include nineteen detections that ranged from 1.55 to 16.2 ng/m^3.

[e] The mean of measurements for nickel (PM_{10}) is the average of all sample results, which include nineteen detections that ranged from 0.31 to 5.29 ng/m^3.

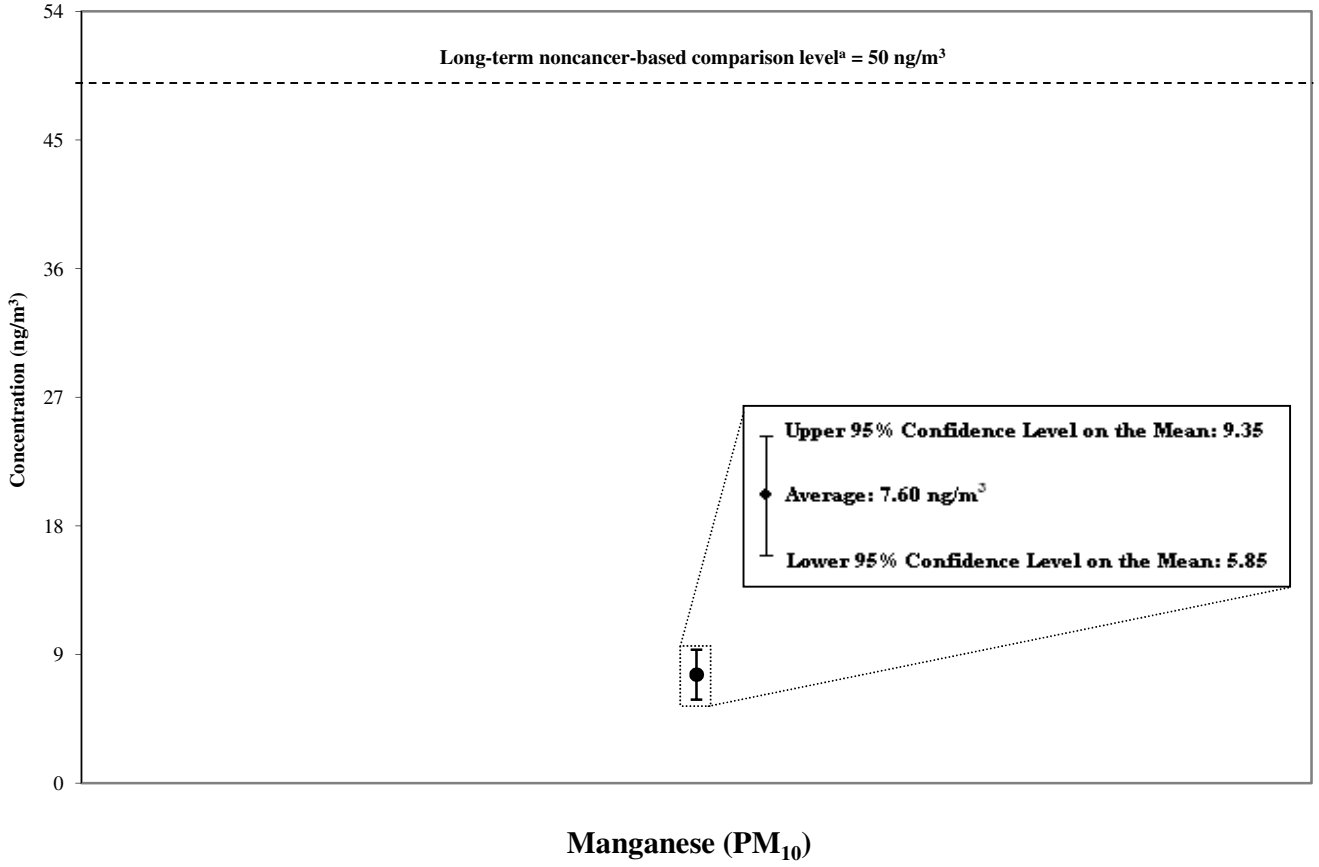
[f] The mean of measurements for hexavalent chromium is the average of all sample results, which include ten detections that ranged from 0.0064 to 0.0544 ng/m^3. There were, as well, ten samples in which no chemical was registered by the laboratory analytical equipment. For these samples, a value of zero was used when calculating the mean.

[g] The mean of measurements for acetaldehyde is the average of all sample results, which include sixteen detections that ranged from 0.418 to 1.39 $\mu g/m^3$.

[h] The mean of measurements for benzene is the average of all sample results, which include ten detections that ranged from 0.467 to 2.17 $\mu g/m^3$.

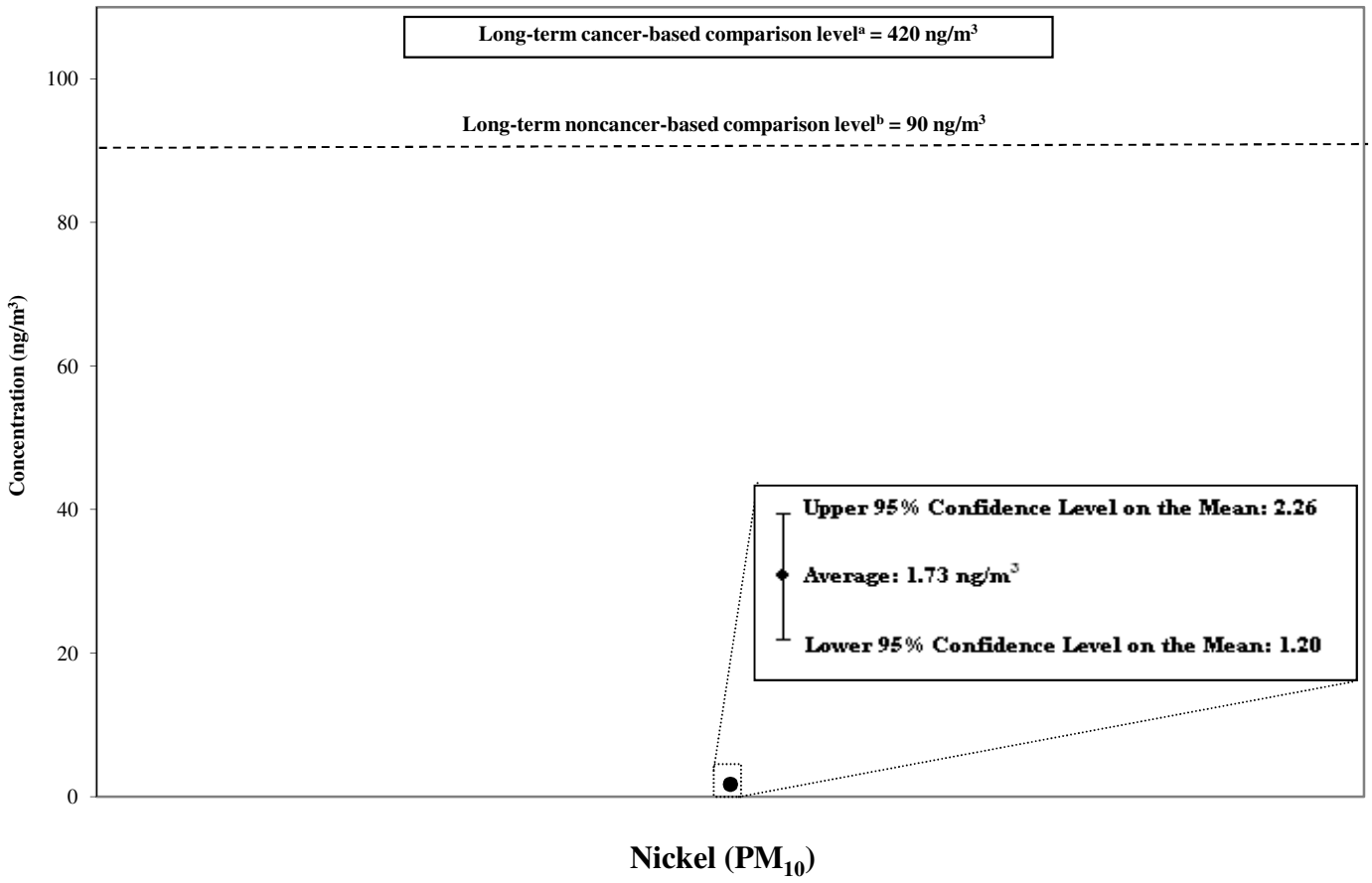
[i] The mean of measurements for 1,3-butadiene is the average of all sample results, which include ten detections that ranged from 0.031 to 0.246 $\mu g/m^3$.

Figure 2a. Chicora Elementary School - Key Pollutant (Manganese (PM_{10})) Analysis.



[a] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

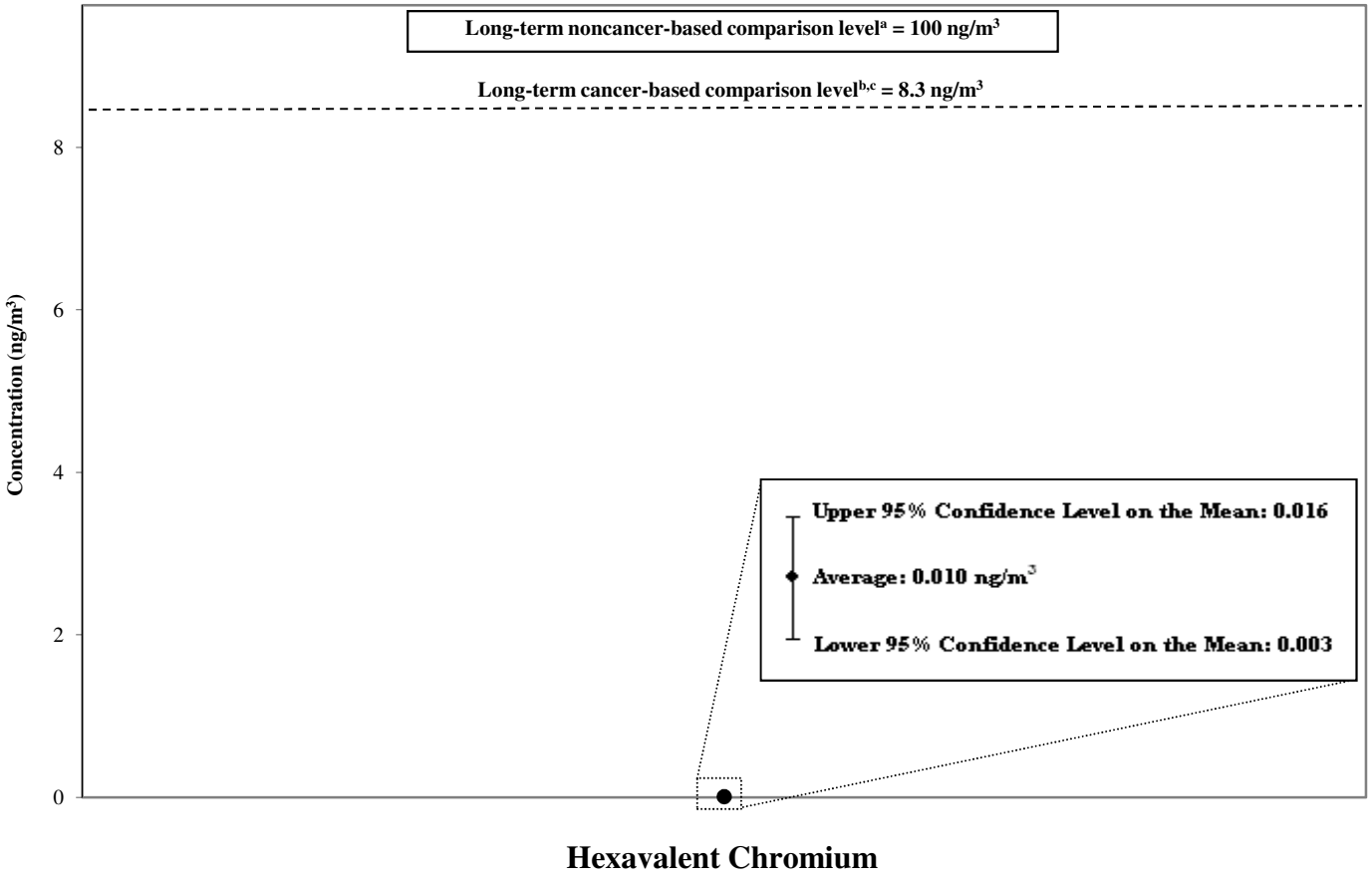
Figure 2b. Chicora Elementary School - Key Pollutant (Nickel (PM_{10})) Analysis.



[a] Air toxics for which the upper 95% confidence limit on the mean concentration is above this cancer-based comparison level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

Figure 2c. Chicora Elementary School - Key Pollutant (Hexavalent Chromium) Analysis.

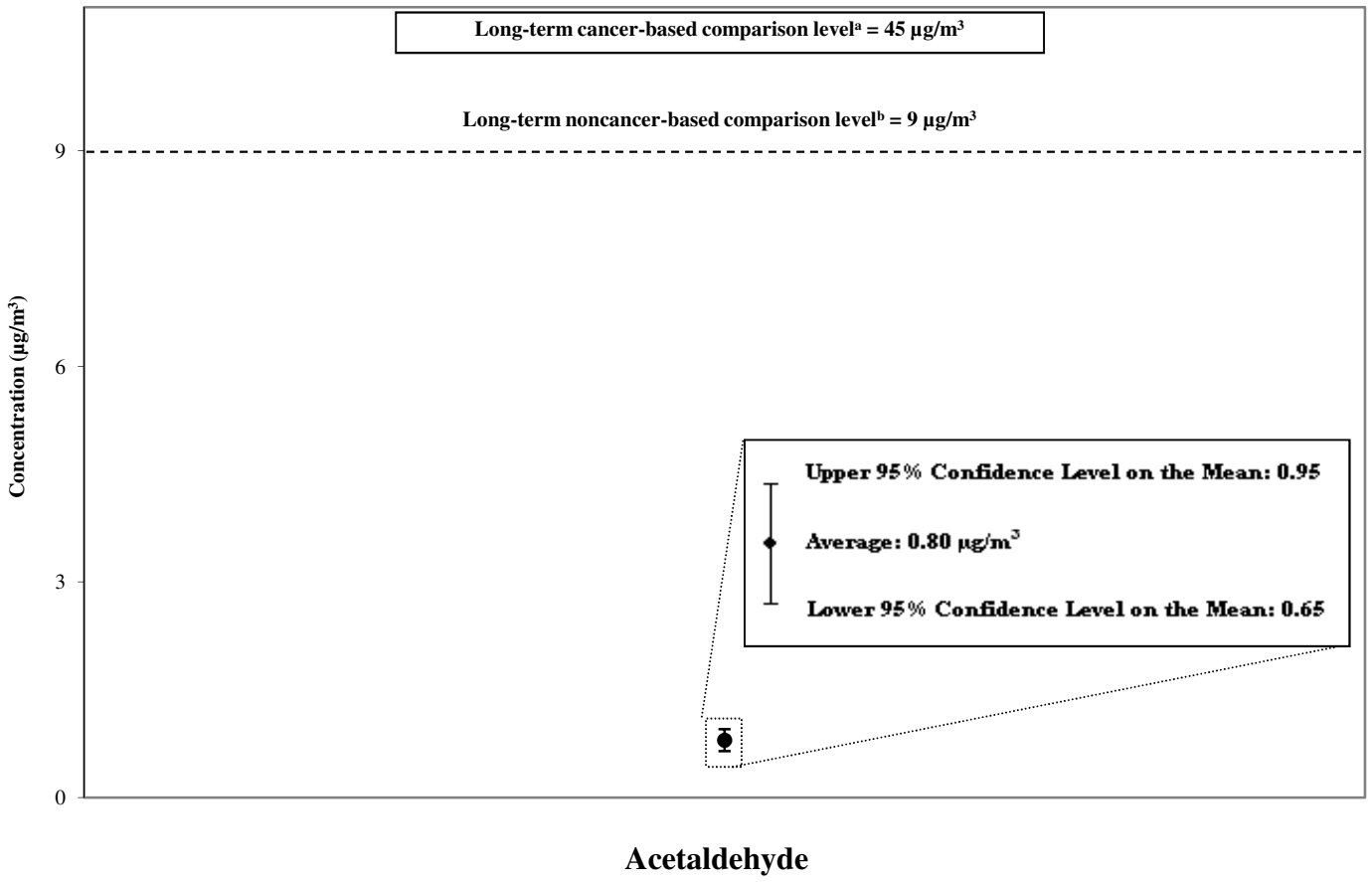


[a] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration is above this cancer-based comparison level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[c] This comparison value is based on the EPA IRIS cancer assessment. It is noted that the EPA is currently updating this assessment with regard to the mode of action. If the update were to conclude that this chemical is carcinogenic by a mutagenic mode of action, this comparison level would be revised to a slightly lower value of 5.2 ng/m^3, consistent with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life exposure.

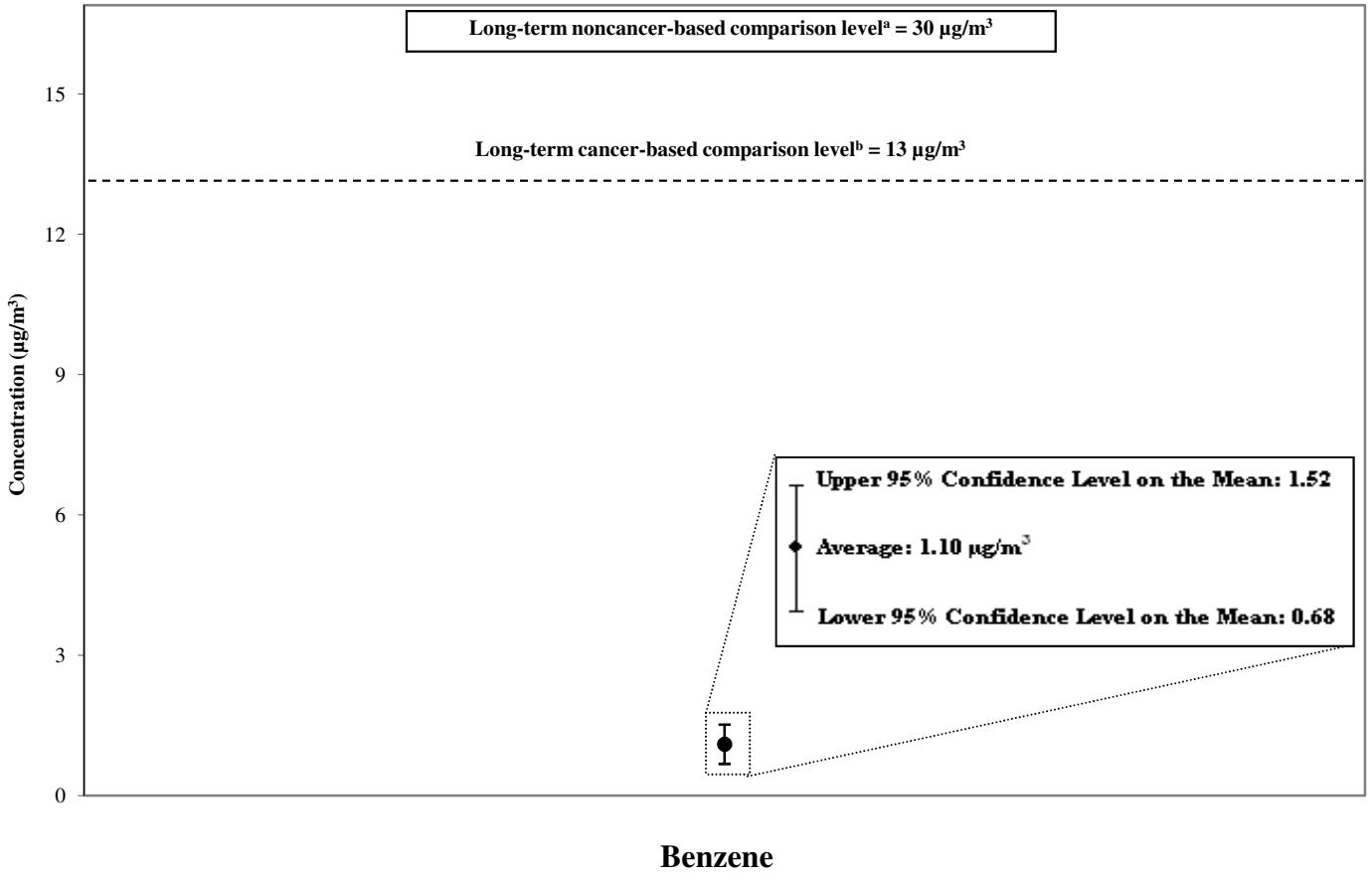
Figure 2d. Chicora Elementary School - Key Pollutant (Acetaldehyde) Analysis.



[a] Air toxics for which the upper 95% confidence limit on the mean concentration is above this cancer-based comparison level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

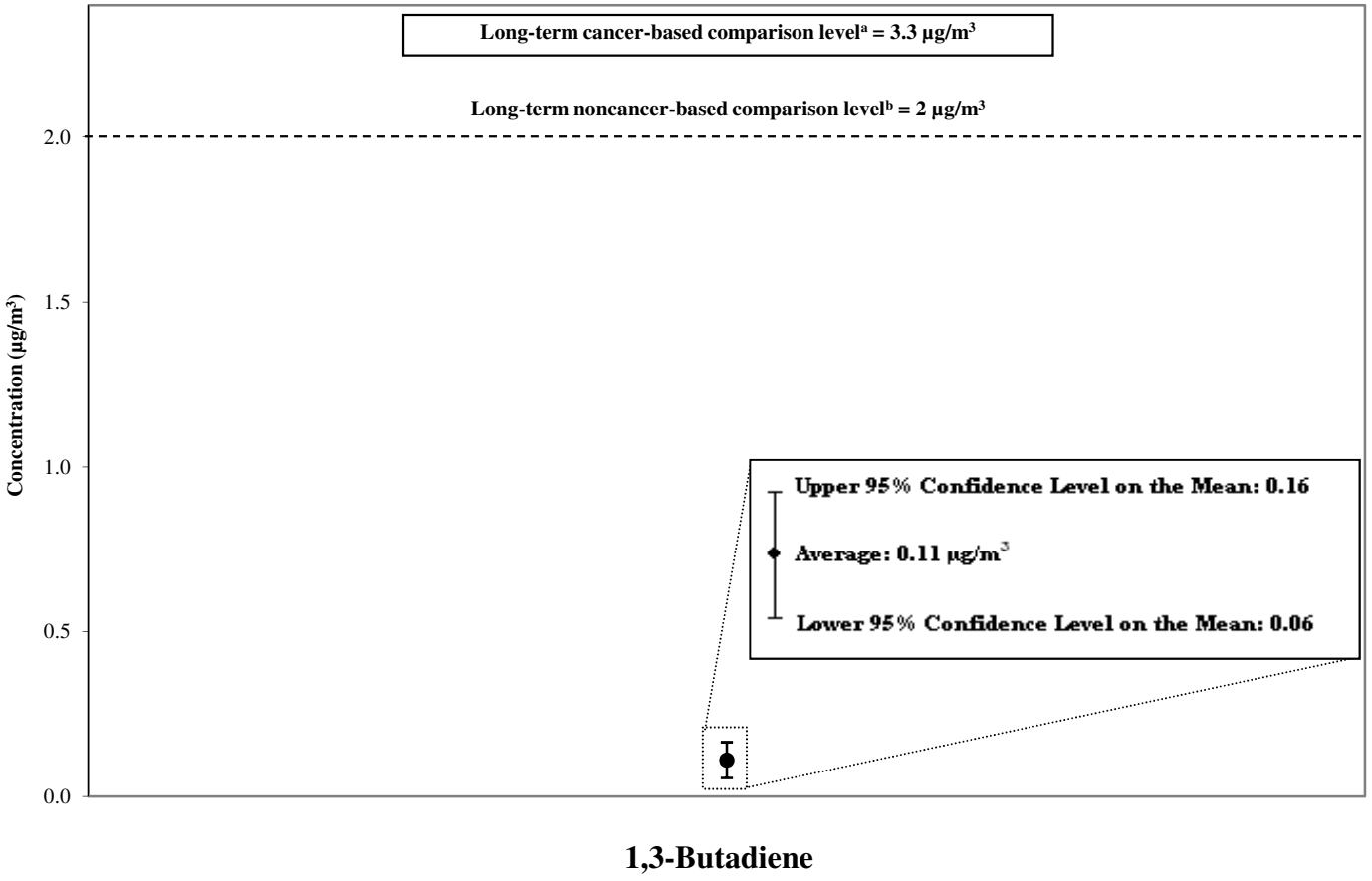
Figure 2e. Chicora Elementary School - Key Pollutant (Benzene) Analysis.



[a] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration is above this cancer-based comparison level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

Figure 2f. Chicora Elementary School - Key Pollutant (1,3-Butadiene) Analysis.



1,3-Butadiene

[a] Air toxics for which the upper 95% confidence limit on the mean concentration is above this cancer-based comparison level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

Table 2a. Chicora Elementary School Key Pollutant Concentrations (Manganese (PM_{10}), Nickel (PM_{10}), and Hexavalent Chromium) and Meteorological Data. (Includes Jenkins Avenue Fire Department, Operated by SC DHEC)

Parameter	Units	7/18/2009	7/24/2009	7/30/2009	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/29/2009	9/1/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/1/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009
Manganese (PM_{10})	ng/m^3	--	9.66	9.01	6.07	4.93	7.03	--	5	9.11	7.99	10.2	7.59	13.7	3.32	16.2	7.96	1.68	6.86	9.92	1.55	6.61
Nickel (PM_{10})	ng/m^3	--	2.26	0.88	0.85	0.87	1.36	--	0.59	1.69	1.64	2.19	2.40	2.50	0.31	2.05	1.00	1.14	1.71	2.70	1.44	5.29
Hexavalent Chromium	ng/m^3	ND	0.0199	0.0158	0.0135	ND	--	ND	ND	ND	ND	0.0241	ND	0.0544	ND	0.0087	0.0064	0.0152	0.0147	ND	ND	0.0177
% Hours w/Wind Direction from Expected ZOI[a]	%	0.0	0.0	0.0	12.5	0.0	12.5	0.0	0.0	0.0	0.0	4.2	16.7	0.0	0.0	20.8	20.8	0.0	58.3	0.0	25.0	16.7
Wind Speed (avg. of hourly speeds)	mph	7.3	3.7	4.7	3.6	3.5	3.2	3.3	4.4	6.3	4.2	4.4	2.8	4.8	4.4	2.8	2.3	3.5	4.2	3.3	3.8	3.2
Wind Direction (avg. of unitized vector)[b]	deg.	249.3	207.2	225.8	214.6	216.9	75.2	237.4	266.7	31.7	47.4	44.0	83.2	39.5	250.0	55.4	36.0	255.0	8.9	73.3	275.7	43.9
% of Hours with Speed below 2 knots	%	0.0	8.3	4.2	29.2	25.0	12.5	29.2	0.0	0.0	20.8	20.8	37.5	0.0	25.0	45.8	58.3	33.3	4.2	25.0	20.8	25.0
Daily Average Temperature	° F	80.1	80.4	79.5	81.4	82.0	81.4	79.5	78.8	73.5	75.2	75.0	78.2	76.8	77.3	66.1	68.7	79.4	60.9	68.2	74.8	57.7
Daily Precipitation	inches	0.00	0.01	0.77	0.02	0.59	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.01	0.03	0.41	0.00	0.00	0.00
Jenkins Avenue FD: Manganese (TSP)	ng/m^3	7	13	12	11	11	5	5	8	--	20	25	10	22	7	--	16	5	6	8	3	11
Jenkins Avenue FD: Nickel (TSP)	ng/m^3	14	7	6	9	18	7	6	20	--	11	13	5	7	0	--	0	0	0	2	3	0
Jenkins Avenue FD: Chromium (TSP)	ng/m^3	ND	ND	2	ND	ND	ND	ND	ND	--	1	2	ND	1	ND	--	2	2	ND	ND	ND	ND

All precipitation and temperature data were from the Charleston Air Force Base/International Airport NWS Station.

Due to instrument error, wind data for some hours were not collected at the school. Thus, wind data from the Charleston Air Force Base/International Airport NWS Station were retrieved for these hours and used as a surrogate.

Data taken from the Jenkins Avenue Fire Department, which is approximately 2 miles north of the school. This station is operated by the South Carolina Department of Health and Environmental Control.

[a] Based on count of hours for which vector wind direction is from expected zone of influence (ZOI). For these pollutants, the ZOI is 326°-11°.

[b] Wind direction for each day is represented by values derived by scalar averaging of hourly estimates that were produced (by wind instrumentation's logger) as unitized vectors (specified as degrees from due north).

-- No sample was collected for this pollutant on this day or the sample was invalid.

ND No detection of this chemical was registered by the laboratory analytical equipment.

Table 2b. Chicora Elementary School Key Pollutant Concentrations (Acetaldehyde) and Meteorological Data.
(Includes Jenkins Avenue Fire Department, Operated by SC DHEC)

Parameter	Units	8/17/2009	8/23/2009	8/29/2009	9/1/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/1/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009
Acetaldehyde	µg/m^3	0.552	0.788	0.741	0.571	0.973	0.651	0.717	0.418	1.10	1.32	1.01	0.465	0.638	0.817	0.631	1.39
% Hours w/Wind Direction from Expected ZOI A[a]	%	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Wind Speed (avg. of hourly speeds)	mph	3.2	3.3	4.4	6.3	4.2	4.4	2.8	4.8	4.4	2.8	2.3	3.5	4.2	3.3	3.8	3.2
Wind Direction (avg. of unitized vector)[b]	deg.	75.2	237.4	266.7	31.7	47.4	44.0	83.2	39.5	250.0	55.4	36.0	255.0	8.9	73.3	275.7	43.9
% of Hours with Speed below 2 knots	%	12.5	29.2	0.0	0.0	20.8	20.8	37.5	0.0	25.0	45.8	58.3	33.3	4.2	25.0	20.8	25.0
Daily Average Temperature	° F	81.4	79.5	78.8	73.5	75.2	75.0	78.2	76.8	77.3	66.1	68.7	79.4	60.9	68.2	74.8	57.7
Daily Precipitation	inches	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.01	0.03	0.41	0.00	0.00	0.00
Jenkins Avenue FD: Acetaldehyde	µg/m^3	1.22	1.83	1.54	1.96	2.05	2.07	2.07	1.46	2.07	2.27	2.44	1.27	0.96	1.62	1.17	--

All precipitation and temperature data were from the Charleston Air Force Base/International Airport NWS Station.

Due to instrument error, wind data for some hours were not collected at the school. Thus, wind data from the Charleston Air Force Base/International Airport NWS Station were retrieved for these hours and used as a surrogate.

Data taken from the Jenkins Avenue Fire Department, which is approximately 2 miles north of the school. This station is operated by the South Carolina Department of Health and Environmental Control.

[a] Based on count of hours for which vector wind direction is from expected zone of influence (ZOI). For these pollutants, the ZOI is 0°-360°.

[b] Wind direction for each day is represented by values derived by scalar averaging of hourly estimates that were produced (by wind instrumentation's logger) as unitized vectors (specified as degrees from due north).

-- No sample was collected for this pollutant on this day or the sample was invalid.

Table 2c. Chicora Elementary School Key Pollutant Concentrations (Benzene and 1,3-Butadiene) and Meteorological Data. (Includes Jenkins Avenue Fire Department, Operated by SC DHEC)

Parameter	Units	10/10/2009	10/16/2009	10/28/2009	11/3/2009	11/18/2009	12/18/2009	2/22/2010	2/23/2010	3/1/2010	3/2/2010
Benzene	µg/m^3	1.04	0.467	1.05	2.17	0.540	0.751	2.13	1.15	0.969	0.726
Butadiene, 1,3-	µg/m^3	0.073	0.031	0.12	0.243	0.049	0.060	0.246	0.12	0.11	0.051
% Hours w/Wind Direction from Expected ZOI[a]	%	100	100	100	100	100	100	100	100	100	100
Wind Speed (avg. of hourly speeds)	mph	3.5	4.2	3.8	3.2	3.6	7.7	2.5	3.8	5.0	5.5
Wind Direction (avg. of unitized vector)[b]	deg.	255.0	8.9	275.7	51.7	62.2	35.7	217.0	225.8	93.8	2.9
% of Hours with Speed below 2 knots	%	33.3	4.2	20.8	37.5	4.2	4.2	62.5	8.3	0.0	0.0
Daily Average Temperature	° F	80.1	80.4	79.5	81.4	82.0	81.4	79.5	78.8	73.5	75.2
Daily Precipitation	inches	0.03	0.41	0.00	0.00	0.31	3.19	0.24	0.00	0.03	0.25
Jenkins Avenue FD: Benzene	µg/m^3	0.61	0.74	0.45	1.31	--	--	--	--	--	--
Jenkins Avenue FD: 1,3-Butadiene	µg/m^3	ND	ND	ND	ND	--	--	--	--	--	--

All precipitation and temperature data were from the Charleston Air Force Base/International Airport NWS Station.

Due to instrument error, wind data for some hours were not collected at the school. Thus, wind data from the Charleston Air Force Base/International Airport NWS Station were retrieved for these hours and used as a surrogate.

Data taken from the Jenkins Avenue Fire Department, which is approximately 2 miles north of the school. This station is operated by the South Carolina Department of Health and Environmental Control.

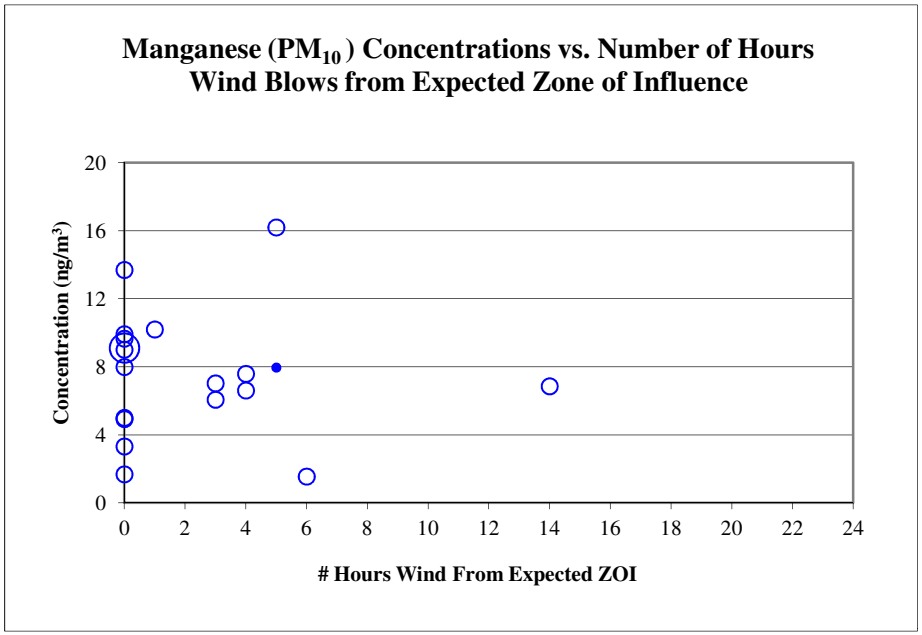
[a] Based on count of hours for which vector wind direction is from expected zone of influence (ZOI). For this pollutant, the ZOI is 0°-360°.

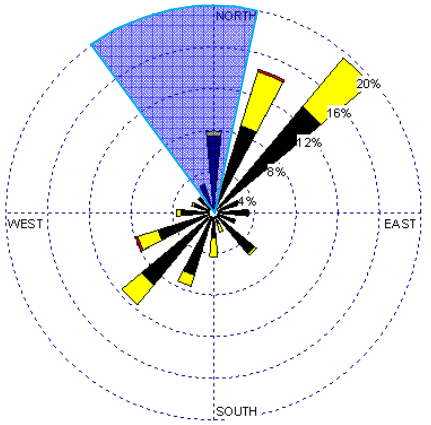
[b] Wind direction for each day is represented by values derived by scalar averaging of hourly estimates that were produced (by wind instrumentation's logger) as unitized vectors (specified as degrees from due north).

-- No sample was collected for this pollutant on this day or the sample was invalid.

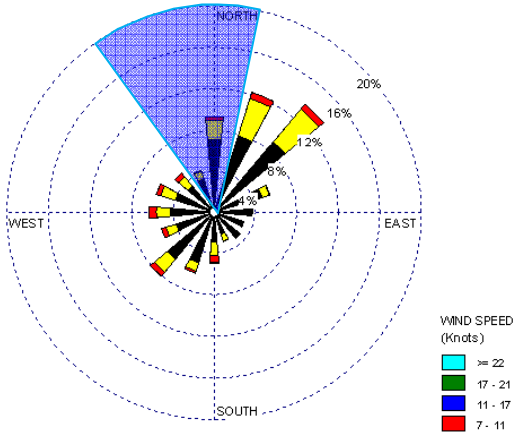
ND No detection of this chemical was registered by the laboratory analytical equipment.

Figure 3a. Chicora Elementary School (North Charleston, SC) Manganese (PM_{10}) Concentration and Wind Information.





Chicora Elementary School Composite Hourly Windrose on Sample Days (Jul. 24, 2009-Nov. 3, 2009)



Chicora Elementary School Composite Hourly Windrose Across Sampling Period (Jul. 24, 2009-Mar. 2, 2010)

KEY

Pollutant: Manganese (PM_{10})
Timeframe: July 24, 2009 - November 3, 2009

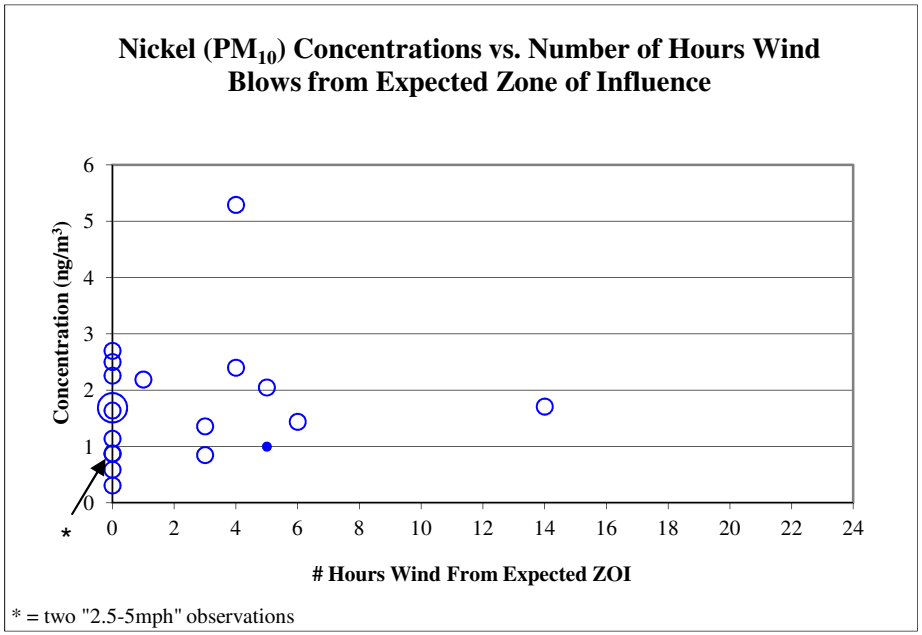
Note

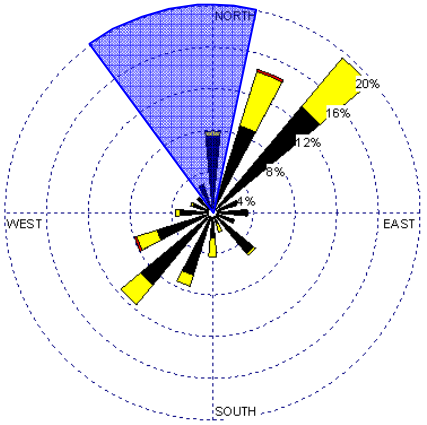
Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2a). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

- Wind Speed: 0.1-2.5 mph
- Wind Speed: 2.5-5.0 mph
- Wind Speed: > 5.0 mph

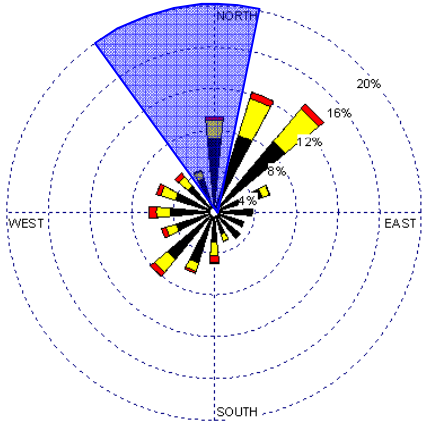
Expected Zone of Source Influence

Figure 3b. Chicora Elementary School (North Charleston, SC) Nickel (PM_{10}) Concentration and Wind Information.





Chicora Elementary School Composite Hourly Windrose on Sample Days (Jul. 24, 2009-Nov. 3, 2009)



Chicora Elementary School Composite Hourly Windrose Across Sampling Period (Jul. 24, 2009-Mar. 2, 2010)

KEY

Pollutant: Nickel (PM_{10})
Timeframe: July 24, 2009 - November 3, 2009

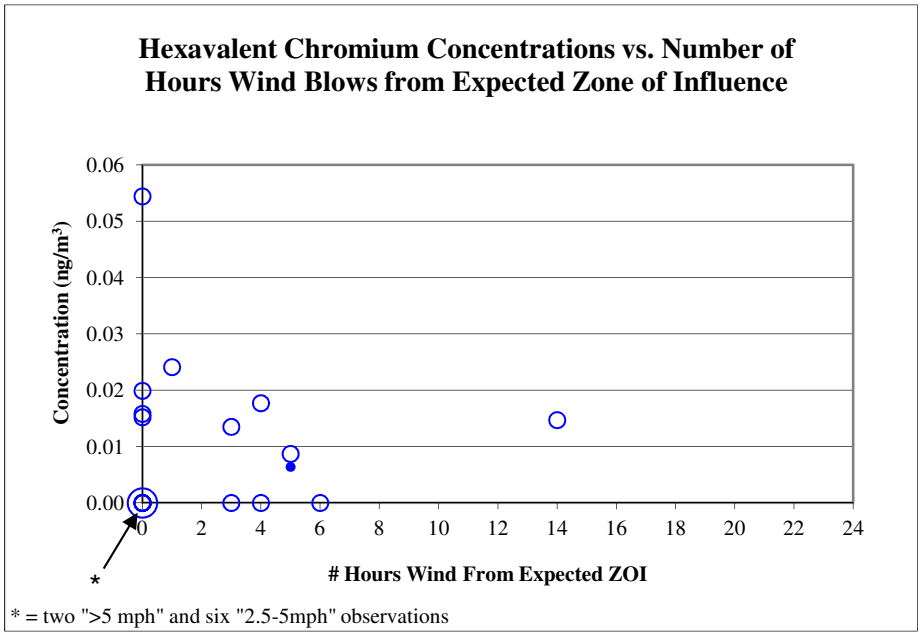
Note

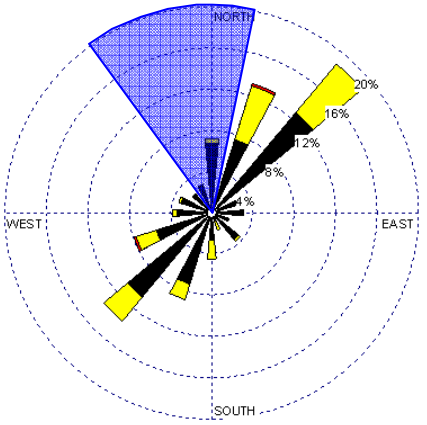
Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2a). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

- Wind Speed: 0.1-2.5 mph
- Wind Speed: 2.5-5.0 mph
- Wind Speed: > 5.0 mph

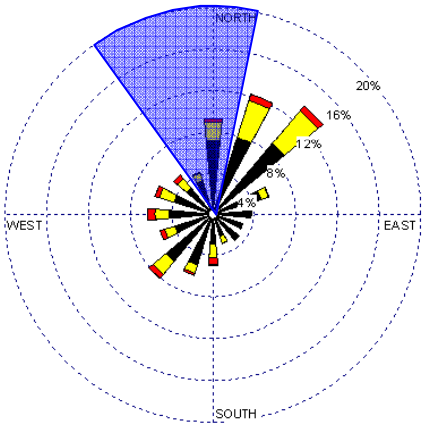
Expected Zone of Source Influence

Figure 3c. Chicora Elementary School (North Charleston, SC) Hexavalent Chromium Concentration and Wind Information.





Chicora Elementary School Composite Hourly Windrose on Sample Days (Jul. 24, 2009-Nov. 3, 2009)



Chicora Elementary School Composite Hourly Windrose Across Sampling Period (Jul. 24, 2009-Mar. 2, 2010)

Expected Zone of Source Influence

KEY

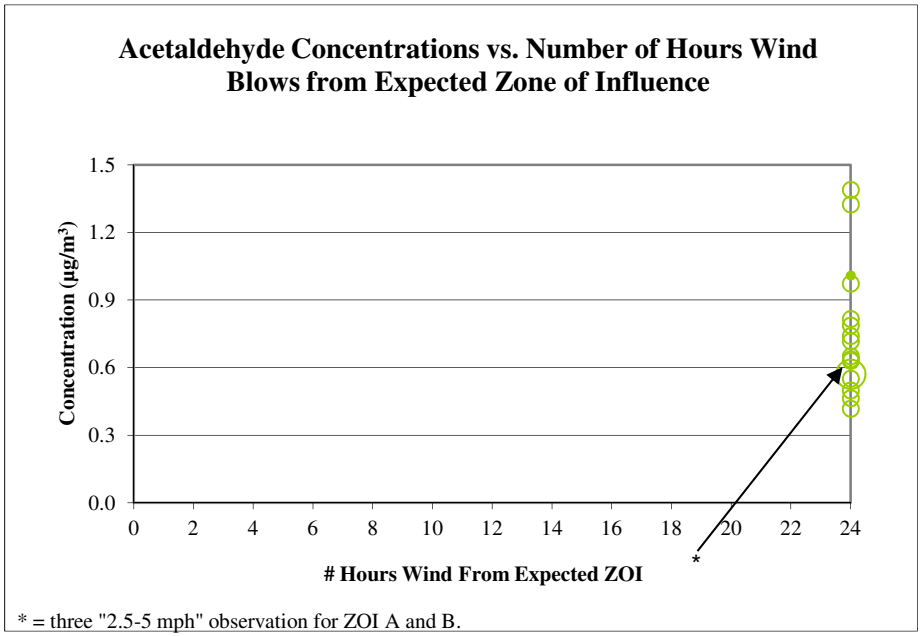
Pollutant: Hexavalent Chromium
Timeframe: July 18, 2009 - November 3, 2009

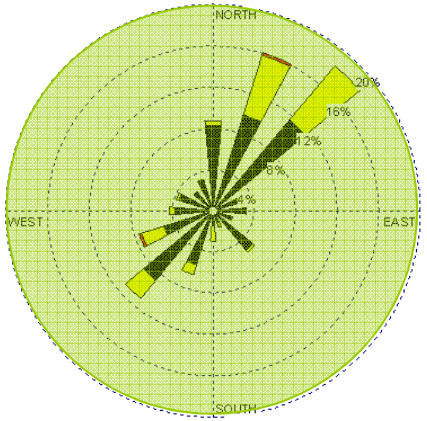
Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2a). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

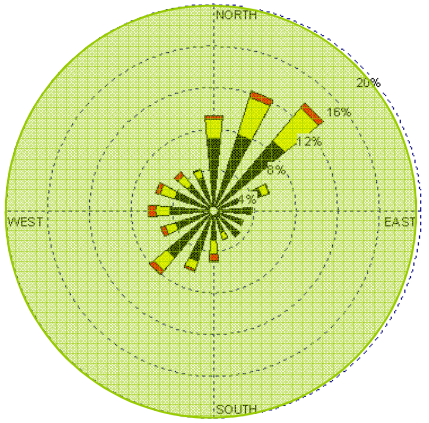
- Wind Speed: 0.1-2.5 mph
- Wind Speed: 2.5-5.0 mph
- Wind Speed: > 5.0 mph

Figure 3d. Chicora Elementary School (North Charleston, SC) Acetaldehyde Concentration and Wind Information.





Chicora Elementary School Composite Hourly Windrose on Sample Days (August 17, 2009-Nov. 3, 2009)



Chicora Elementary School Composite Hourly Windrose Across Sampling Period (Jul. 24, 2009-Mar. 2, 2010)

KEY

Pollutant: Acetaldehyde
Timeframe: August 17, 2009 - November 3, 2009

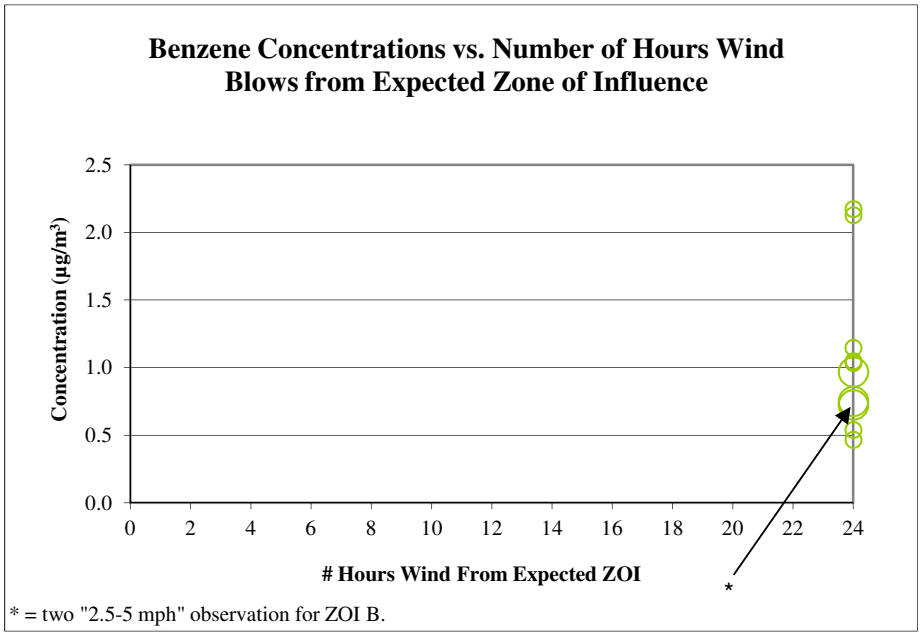
Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2b). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

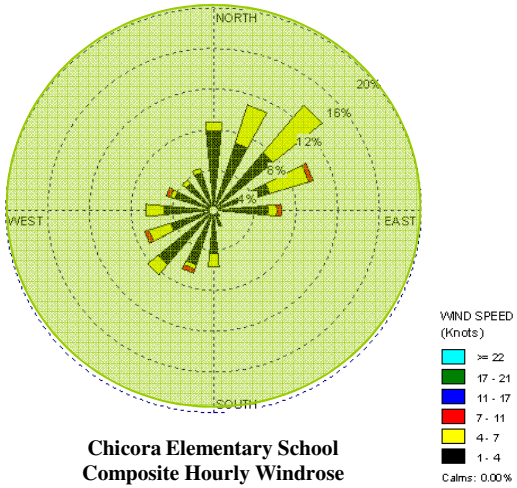
- Wind Speed: < 2.5 mph
- Wind Speed: 2.5-5.0 mph
- Wind Speed: > 5.0 mph

Expected Zone of Source Influence

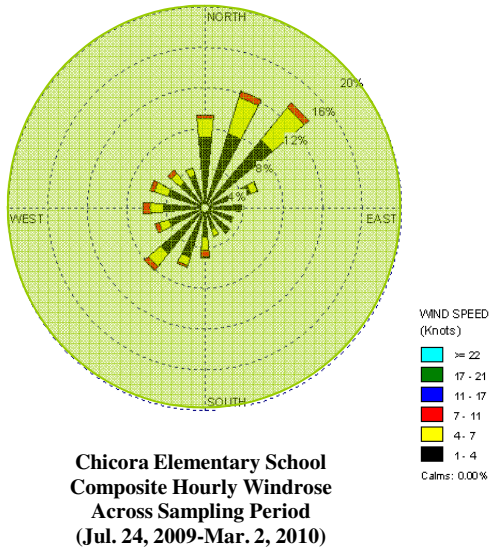
Figure 3e. Chicora Elementary School (North Charleston, SC) Benzene Concentration and Wind Information.



* = two "2.5-5 mph" observation for ZOI B.



Chicora Elementary School Composite Hourly Windrose on Sample Days (Oct. 10, 2009-Mar. 2, 2010)



Chicora Elementary School Composite Hourly Windrose Across Sampling Period (Jul. 24, 2009-Mar. 2, 2010)

Expected Zone of Source Influence

KEY

Pollutant: Benzene
Timeframe: October 10, 2009 - March 2, 2010

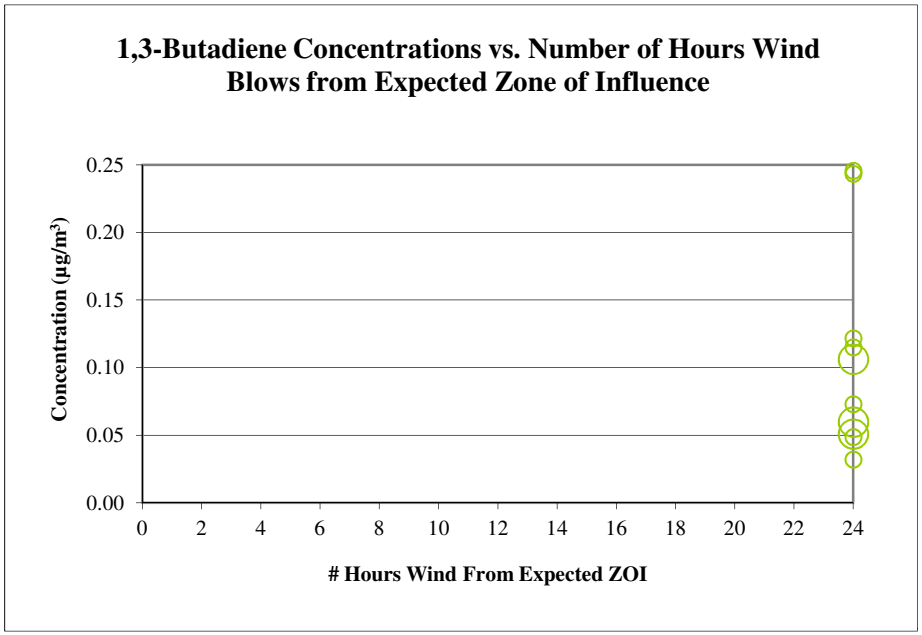
Note

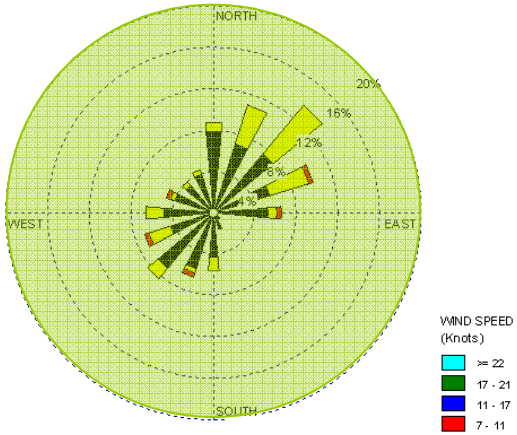
Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2c). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

Wind Speed: 2.5-5.0 mph

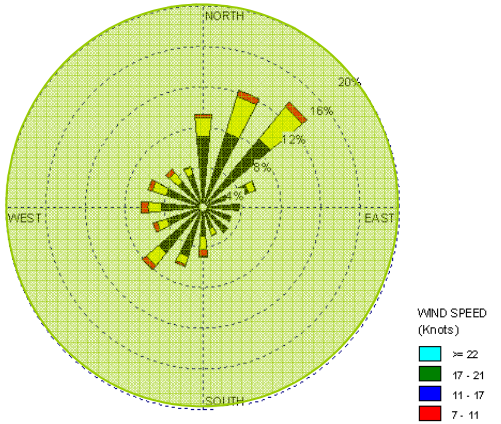
Wind Speed: > 5.0 mph

Figure 3f. Chicora Elementary School (North Charleston, SC) 1,3-Butadiene Concentration and Wind Information.





Chicora Elementary School Composite Hourly Windrose on Sample Days (Oct. 10, 2009-Mar. 2, 2010)



Chicora Elementary School Composite Hourly Windrose Across Sampling Period (Jul. 24, 2009-Mar. 2, 2010)

Expected Zone of Source Influence

KEY

Pollutant: 1,3-Butadiene
Timeframe: October 10, 2009 - March 2, 2010

Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2c). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

Wind Speed: 2.5-5.0 mph

Wind Speed: > 5.0 mph

Appendix A. Summary Description of Long-term Comparison Levels

In addressing the primary objective identified above, to investigate through the monitoring data collected for key pollutants at the school whether levels are of a magnitude, in light of health risk-based criteria, to indicate that follow-up activities be considered, we developed two types of long-term health risk-related comparison levels. These two types of levels are summarized below.[26]

Cancer-based Comparison Levels

- For air toxics where applicable, we developed cancer risk-based comparison levels to help us consider whether the monitoring data collected at the school indicate the potential for concentrations to pose incremental cancer risk above the range that EPA generally considers acceptable in regulatory decision-making to someone exposed to those concentrations continuously (24 hours a day, 7 days a week) over an entire lifetime.[27] This general range is from 1 to 100 in a million.
- Air toxics with long-term mean concentrations below one one-hundredth of this comparison level would be below a comparably developed level for 1-in-a-million risk (which is the lower bound of EPA's traditional acceptable risk range). Such pollutants, with long-term mean concentrations below the Agency's traditional acceptable risk range, are generally considered to pose negligible risk.
- Air toxics with long-term mean concentrations above the acceptable risk range would generally be a priority for follow-up activities. In this evaluation, we compare the upper 95% confidence limit on the mean concentration to the comparison level. Pollutants for which this upper limit falls above the comparison level are fully discussed in the school monitoring report and may be considered a priority for potential follow-up activities in light of the full set of information available for that site.
- Situations where the summary statistics for a pollutant are below the cancer-based comparison level but above 1% of that level are fully discussed in Appendix C.

[26] The comparison levels are described in more detail *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*.

[27] While no one would be exposed at a school for 24 hours a day, every day for an entire lifetime, we chose this worst-case exposure period as a simplification for the basis of the comparison level in recognition of other uncertainties in the analysis. Use of continuous lifetime exposure yields a lower, more conservative, comparison level than would use of a characterization more specific to the school population (e.g., 5 days a week, 8-10 hours a day for a limited number of years).

Noncancer-based Comparison Levels

- To consider concentrations of air toxics other than lead (for which we have a national ambient air quality standard) with regard to potential for health effects other than cancer, we derived noncancer-based comparison levels using EPA chronic reference concentrations (or similar values). A chronic reference concentration (RfC) is an estimate of a long-term continuous exposure concentration (24 hours a day, every day) without appreciable risk of adverse effects over a lifetime.[28] This differs from the cancer risk-based comparison level in that it represents a concentration without appreciable risk *vs* a risk-based concentration.
- In using this comparison level in this initiative, the upper end of the 95% confidence limit on the mean is compared to the comparison level. Air toxics for which this upper confidence limit is near or below the noncancer-based comparison level (i.e., those for which longer-term average concentration estimates are below a long-term health-related reference concentration) are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed below and may be considered a priority for follow-up activity if indicated in light of the full set of information available for the pollutant and the site.
- For lead, we set the noncancer-based comparison level equal to the level of the recently revised national ambient air quality standard (NAAQS). It is important to note that the NAAQS for lead is a 3-month rolling average of lead in total suspended particles. Mean levels for the monitoring data collected in this initiative that indicate the potential for a 3-month average above the level of the standard will be considered a priority for consideration of follow-up actions such as siting of a NAAQS monitor in the area.

In developing or identifying these comparison levels, we have given priority to use of relevant and appropriate air standards and EPA risk assessment guidance and precedents. These levels are based upon health effects information, exposure concentrations and risk estimates developed and assessed by EPA, the U.S. Agency for Toxic Substances and Disease Registry, and the California EPA. These agencies recognize the need to account for potential differences in sensitivity or susceptibility of different groups (e.g., asthmatics) or lifestages/ages (e.g., young children or the elderly) to a particular pollutant's effects so that the resulting comparison levels are relevant for these potentially sensitive groups as well as the broader population.

[28] EPA defines the RfC as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's noncancer health assessments." http://www.epa.gov/ncea/iris/help_gloss.htm#r

Appendix B. National Air Toxics Trends Stations Measurements (2004-2008).[a]

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean[b]	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Acetaldehyde	µg/m^3	6,401	100%	92.78	1.87	1.40	0.41	0.86	1.42	2.34	4.48
Formaldehyde	µg/m^3	6,403	100%	91.50	3.09	2.22	0.51	1.35	2.32	3.92	7.65
Propionaldehyde	µg/m^3	4,330	93%	5.53	0.28	0.22	ND	0.13	0.21	0.35	0.77
Antimony (PM_{10})	ng/m^3	2,372	94%	43.30	1.71	1.21	ND	0.60	1.13	2.17	4.33
Arsenic (PM_{10})	ng/m^3	5,076	86%	47.70	0.93	0.70	ND	0.29	0.56	1.02	2.89
Beryllium (PM_{10})	ng/m^3	4,771	64%	1.97	0.05	0.02	ND	ND	<0.01	0.02	0.50
Cadmium (PM_{10})	ng/m^3	4,793	85%	15.30	0.27	0.17	ND	0.05	0.13	0.29	0.94
Chromium (PM_{10})	ng/m^3	5,094	92%	172.06	2.71	1.66	ND	0.93	1.98	2.85	7.10
Cobalt (PM_{10})	ng/m^3	2,614	91%	20.30	0.28	0.18	ND	0.08	0.15	0.27	1.00
Manganese (PM_{10})	ng/m^3	4,793	99%	734.00	10.39	5.20	<0.01	2.41	4.49	9.96	33.78
Mercury (PM_{10})	ng/m^3	1,167	81%	2.07	0.07	0.04	ND	0.01	0.02	0.06	0.32
Nickel (PM_{10})	ng/m^3	4,815	90%	110.10	2.05	1.49	ND	0.74	1.44	2.50	5.74
Selenium (PM_{10})	ng/m^3	2,382	96%	13.00	1.10	0.53	<0.01	0.24	0.53	1.07	5.50
Acetonitrile	µg/m^3	1,804	69%	542.30	3.55	0.72	ND	ND	0.27	0.76	8.60
Acrylonitrile	µg/m^3	3,673	31%	5.51	0.06	0.10	ND	ND	ND	0.03	0.33
Benzene	µg/m^3	6,313	94%	10.19	1.03	0.84	ND	0.48	0.80	1.31	2.81
Benzyl chloride	µg/m^3	3,046	9%	2.49	0.01	0.05	ND	ND	ND	ND	0.05
Bromoform	µg/m^3	2,946	4%	1.18	0.01	0.16	ND	ND	ND	ND	ND
Bromomethane	µg/m^3	5,376	61%	120.76	0.11	0.05	ND	ND	0.03	0.05	0.12
Butadiene, 1,3-	µg/m^3	6,427	67%	15.55	0.10	0.09	ND	ND	0.05	0.13	0.38
Carbon disulfide	µg/m^3	1,925	91%	46.71	2.32	0.25	ND	0.03	0.09	0.96	12.65
Carbon tetrachloride	µg/m^3	6,218	86%	1.76	0.52	0.58	ND	0.47	0.57	0.65	0.87
Chlorobenzene	µg/m^3	5,763	30%	1.10	0.02	0.04	ND	ND	ND	0.01	0.11
Chloroethane	µg/m^3	4,625	37%	0.58	0.02	0.04	ND	ND	ND	0.03	0.08
Chloroform	µg/m^3	6,432	73%	48.05	0.17	0.14	ND	ND	0.10	0.17	0.61
Chloromethane	µg/m^3	5,573	95%	19.70	1.17	1.20	ND	1.03	1.18	1.36	1.68
Chloroprene	µg/m^3	2,341	11%	0.17	<0.01	0.03	ND	ND	ND	ND	0.02
Dichlorobenzene, *p*-	µg/m^3	5,409	60%	13.65	0.19	0.16	ND	ND	ND	0.18	0.90
Dichloroethane, 1,1-	µg/m^3	5,670	16%	0.36	0.01	0.02	ND	ND	ND	ND	0.02
Dichloroethylene, 1,1-	µg/m^3	5,480	19%	0.44	0.01	0.02	ND	ND	ND	ND	0.04
Dichloromethane	µg/m^3	6,206	82%	214.67	0.59	0.34	ND	0.14	0.28	0.49	1.35
Dichloropropane,1,2-	µg/m^3	6,225	17%	1.80	0.01	0.03	ND	ND	ND	ND	0.04

Appendix B. National Air Toxics Trends Stations Measurements (2004-2008).[a]

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean[b]	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Dichloropropylene, c*is*-1,3-	µg/m^3	4,705	18%	0.80	0.01	0.05	ND	ND	ND	ND	0.11
Dichloropropylene, *trans*-1,3-	µg/m^3	4,678	18%	1.13	0.02	0.05	ND	ND	ND	ND	0.11
Ethyl acrylate	µg/m^3	1,917	1%	0.08	<0.01	0.04	ND	ND	ND	ND	ND
Ethylbenzene	µg/m^3	6,120	84%	8.84	0.42	0.32	ND	0.10	0.29	0.53	1.33
Ethylene dibromide	µg/m^3	5,646	19%	4.15	0.01	0.05	ND	ND	ND	ND	0.05
Ethylene dichloride	µg/m^3	6,143	38%	4.49	0.03	0.05	ND	ND	ND	0.04	0.09
Hexachlorobutadiene	µg/m^3	3,727	20%	0.97	0.03	0.10	ND	ND	ND	ND	0.18
Methyl chloroform	µg/m^3	5,944	73%	3.17	0.09	0.10	ND	ND	0.08	0.11	0.20
Methyl isobutyl ketone	µg/m^3	2,936	60%	2.95	0.11	0.09	ND	ND	0.02	0.12	0.49
Methyl methacrylate	µg/m^3	1,917	9%	14.05	0.13	0.49	ND	ND	ND	ND	0.53
Methyl *tert*-butyl ether	µg/m^3	4,370	41%	20.50	0.28	0.12	ND	ND	ND	0.04	1.53
Styrene	µg/m^3	6,080	70%	27.22	0.16	0.11	ND	ND	0.05	0.16	0.60
Tetrachloroethane, 1,1,2,2-	µg/m^3	5,952	20%	2.47	0.02	0.04	ND	ND	ND	ND	0.07
Tetrachloroethylene	µg/m^3	6,423	71%	42.12	0.28	0.20	ND	ND	0.13	0.27	0.88
Toluene	µg/m^3	5,947	95%	482.53	2.46	1.54	0.01	0.70	1.51	3.05	7.42
Trichlorobenzene, 1,2,4-	µg/m^3	4,301	21%	45.27	0.07	0.10	ND	ND	ND	ND	0.16
Trichloroethane,1,1,2-	µg/m^3	5,210	19%	5.89	0.01	0.04	ND	ND	ND	ND	0.05
Trichloroethylene	µg/m^3	6,410	46%	6.50	0.05	0.07	ND	ND	ND	0.05	0.22
Vinyl chloride	µg/m^3	6,284	18%	1.61	0.01	0.02	ND	ND	ND	ND	0.03
Xylene, *m/p*-	µg/m^3	4,260	90%	21.41	1.12	0.71	ND	0.26	0.69	1.43	3.65
Xylene, *o*-	µg/m^3	6,108	83%	9.21	0.41	0.30	ND	0.09	0.24	0.52	1.39
Hexavalent Chromium	ng/m^3	4,233	66%	2.97	0.03	0.03	ND	ND	0.01	0.04	0.13

Key Pollutant

ND No results of this chemical were registered by the laboratory analytical equipment.

[a] The summary statistics in this table represent the range of actual daily HAP measurement values taken at NATTS sites from 2004 through 2008. These data were extracted from AQS in summer 2008 and 2009. During the time period of interest, there were 28 sites measuring VOCs, carbonyls, metals, and hexavalent chromium. We note that some sites did not sample for particular pollutant types during the initial year of the NATTS Program, which was 2004. Most of the monitoring stations in the NATTS network are located such that they are not expected to be impacted by single industrial sources. The concentrations typically measured at NATTS sites can thus provide a comparison point useful to considering whether concentrations measured at a school are likely to have been influenced by a significant nearby industrial source, or are more likely to be attributable to emissions from many small sources or to transported pollution from another area. For example, concentrations at a school above the 75th percentile may suggest that a nearby industrial source is affecting air quality at the school.

[b] In calculations involving non-detects (ND), a value of zero is used.

Appendix C. Analysis of Other (non-key) Air Toxics Monitored at the School and Multiple-pollutant Considerations.

At each school, monitoring has been targeted to get information on a limited set of key hazardous air pollutants (HAPs).[29] These pollutants are the primary focus of the monitoring activities at a school and a priority for us based on our emissions, modeling and other information. In analyzing air samples for these key pollutants, we have also obtained results for some other pollutants that are routinely included with the same test method. Our consideration of the data collected for these additional HAPs is described in the first section below. In addition to evaluating monitoring results for individual pollutants, we also considered the potential for cumulative impacts from multiple pollutants as described in the second section below (see Table C-1).

Other Air Toxics (HAPs)

- Do the monitoring data indicate elevated levels of any other air toxics or hazardous air pollutant (HAPs) that pose significant long-term health concerns?

  → The longer-term concentration estimates for the other HAPs monitored are below their long-term comparison levels.

    - For pollutants with cancer-based comparison levels, longer-term concentration estimates for all but one (formaldehyde) is more than 10-fold lower and all but six (also arsenic, carbon tetrachloride, *p*-dichlorobenzene, tetrachloroethylene, and ethylbenzene) are more than 100-fold lower.[30]

  → Additionally, each individual measurement for these pollutants is below the individual sample (short-term) screening level developed for considering potential short-term exposures for that pollutant.[31]

Additional Information on Six Other HAPs:

- The first HAP mentioned above is formaldehyde. The mean and 95 percent upper bound on the mean for formaldehyde are approximately 20-23% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of formaldehyde at this site is between the 25th and 50th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B). This pollutant may occur in the air at this school as a result of several different sources, as well as cars and trucks and the exhaust of other gasoline-powered engines.

[29] Section 112(b) of the Clean Air Act identifies 189 hazardous air pollutants, three of which have subsequently been removed from this list. These pollutants are the focus of regulatory actions involving stationary sources described by CAA section 112 and are distinguished from the six pollutants for which criteria and national ambient air quality standards (NAAQS) are developed as described in section 108. One of the criteria pollutants, lead, is also represented, as lead compounds, on the HAP list.

[30] For pollutants with cancer-based comparison levels, this would indicate longer-term estimates below continuous (24 hours a day, 7 days a week) lifetime exposure concentrations associated with 10^{-5} and 10^{-6} excess cancer risk, respectively.

[31] The individual sample screening levels and their use is summarized on the website and described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results.*

- The second HAP mentioned above is arsenic. The mean and 95 percent upper bound on the mean for arsenic (PM_{10}) are approximately 5-7% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of arsenic (PM_{10}) at this site is between the 75th and 95th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B).

- The third HAP mentioned above is carbon tetrachloride. The mean and 95 percent upper bound on the mean for carbon tetrachloride are approximately 4-5% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of carbon tetrachloride at this site is between the 75th and 95th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B). Carbon tetrachloride is found globally as a result of its significant past uses in refrigerants and propellants for aerosol cans and its chemical persistence. Virtually all uses have been discontinued. However, it is still measured throughout the world as a result of its slow rate of degradation in the environment and global distribution in the atmosphere.

- The fourth HAP mentioned above is *p*-dichlorobenzene. The mean and 95 percent upper bound on the mean for *p*-dichlorobenzene are approximately 2% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of *p*-dichlorobenzene at this site is less than the 75th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B).

- The fifth HAP mentioned above is tetrachloroethylene. The mean and 95 percent upper bound on the mean for tetrachloroethylene are approximately 1-2% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of tetrachloroethylene at this site is between the 50th and 75th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B).

- The sixth HAP mentioned above is ethylbenzene. The mean and 95 percent upper bound on the mean for ethylbenzene are approximately 1-2% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of ethylbenzene at this site is between the 50th and 75th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B).

Multiple Pollutants

As described in the main body of the report and background materials, this initiative and the associated analyses are focused on investigation of key pollutants for each school that were identified by previous analyses. This focused design does not provide for the consideration of

combined impacts of pollutants or stressors other than those monitored in this project. Broader analyses and those involving other pollutants may be the focus of other EPA activities.[32]

In our consideration of the potential for impacts from key pollutants at the monitored schools, we have also considered the potential for other monitored pollutants to be present at levels that in combination with the key pollutant levels contribute to an increased potential for cumulative impacts. This was done in cases where estimates of longer-term concentrations for any non-key HAPs are within an order of magnitude of their comparison levels even if these pollutant levels fall below the comparison levels. This analysis is summarized below.

- Do the data collected for the air toxics monitored indicate the potential for other monitored pollutants to be present at levels that in combination with the key pollutant levels indicate an increased potential for cumulative impacts of significant concern (e.g., that might warrant further investigation)?

  → Although the multiple air toxics monitored at this site were below the levels of significant concern for multi-pollutant cumulative risk than had been suggested by the modeling information available prior to monitoring, these results indicate the presence of multiple mobile source pollutants of concern that are the focus of EPA actions nationwide.

  - HAPs whose estimated long term levels were within an order of magnitude below their comparison levels included manganese (PM_{10}), acetaldehyde, benzene, formaldehyde, and arsenic (PM_{10}). As a conservative screening consideration, it can be seen that when aggregated as a group, the upper bounds of their longer-term concentration estimate comprise somewhat less than 100 percent of their lowest comparison levels. Further, the lowest comparison levels for these pollutants differ with regard to the types of risks and targets in the body, reducing the potential for cumulative impact. For example, the lowest comparison levels for benzene and formaldehyde are based on carcinogenic risk to the hematopoietic and respiratory systems, respectively. The lowest comparison levels for the other three pollutants are based on non-carcinogenic effects to different organs or systems. Specifically, the lowest comparison level for acetaldehyde and manganese are based on non-carcinogenic effects to the respiratory and central nervous systems, respectively, while the noncancer-based comparison level for arsenic is based on noncancer effects considering several endpoints including development.

[32] General information on additional air pollutants is available at http://www.epa.gov/air/airpollutants.html.

Table C-1. Chicora Elementary School - Other Monitored Pollutant Analysis.

Parameter	Units	Mean of Measurements[a]	95% Confidence Interval on the Mean	Long-term Comparison Level[b]	
				Cancer-Based[c]	Noncancer-Based[d]
Non-Key HAPs with mean greater than 10% of the lowest comparison level					
Formaldehyde	µg/m^3	1.56	1.27 - 1.86	8	9.8
Non-Key HAPs with mean lower than 10% of the lowest comparison level					
Arsenic (PM_{10})	ng/m^3	1.23	0.91 - 1.55	23	15
Carbon tetrachloride	µg/m^3	0.70	0.63 - 0.77	17	100
Cadmium (PM_{10})	ng/m^3	0.18	0.11 - 0.25	56	10
Propionaldehyde	µg/m^3	0.13	0.11 - 0.15	NA	8
Dichlorobenzene, *p*-	µg/m^3	0.14	0.06 - 0.22	9.1	800
Bromomethane	µg/m^3	0.08	0.04 - 0.11	NA	5
Chloromethane	µg/m^3	1.36	1.13 - 1.59	NA	90
Tetrachloroethylene	µg/m^3	0.20	0.12 - 0.27	17	270
Ethylbenzene	µg/m^3	0.45	0.25 - 0.66	40	1000
Xylene, *m/p*-	µg/m^3	1.12	0.56 - 1.67	NA	100
Antimony (PM_{10})	ng/m^3	1.18	0.72 - 1.65	NA	200
Acetonitrile	µg/m^3	0.29	0.23 - 0.35	NA	60
Xylene, *o*-	µg/m^3	0.44	0.21 - 0.66	NA	100
Dichloromethane	µg/m^3	0.43	0.31 - 0.54	210	1000
Cobalt (PM_{10})	ng/m^3	0.10	0.07 - 0.12	NA	100
Chloroform	µg/m^3	0.10	0.05 - 0.16	NA	98
Toluene	µg/m^3	2.58	0.92 - 4.24	NA	5000
Carbon disulfide	µg/m^3	0.16	0.07 - 0.25	NA	700
Styrene	µg/m^3	0.12	0.06 - 0.18	NA	1000
Methyl isobutyl ketone	µg/m^3	0.29	0.18 - 0.40	NA	3000
Chloroethane	µg/m^3	0.38	0.21 - 0.55	NA	10000
Selenium (PM_{10})	ng/m^3	0.74	0.58 - 0.91	NA	20000
Methyl chloroform	µg/m^3	0.063	0.057 - 0.07	NA	5000
Vinyl chloride	µg/m^3	0.018 [e]	0.001 - 0.03 [e]	11	100
Chlorobenzene	µg/m^3	0.40 [f]	0.14 - 0.65 [f]	NA	1000
Beryllium (PM_{10})	ng/m^3	0.006 [g]	0.002 - 0.01 [g]	42	20
Mercury (PM_{10})	ng/m^3	0.011 [h]	0.003 - 0.02 [h]	NA	300 [i]
Non-Key HAPs with more than 50% ND Results					
Ethylene dichloride	µg/m^3	60% of results were ND[j]		3.8	2400
Chloroprene	µg/m^3	90% of results were ND[k]		NA	20
Benzyl chloride	µg/m^3	90% of results were ND[l]		2	NA
Hexachloro-1,3-butadiene	µg/m^3	90% of results were ND[m]		4.5	90
No other HAPs were detected in any other samples					

ng/m^3 nanograms per cubic meter

µg/m^3 micrograms per cubic meter

NA Not available

ND No detection of this chemical was registered by the laboratory analytical equipment.

Table C-1. Chicora Elementary School - Other Monitored Pollutant Analysis.

[a] Mean of measurements is the average of all sample results which include actual measured values. If no chemical was registered, then a value of zero is used when calculating the mean

[b] Details regarding these values are in the technical report, Schools Air Toxics Monitoring Activity (2009) Uses of Health Effects Information in Evaluating Sample Results.

[c] Air toxics for which the upper 95% confidence limit on the mean concentration is above this level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[d] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

[e] Vinyl Chloride was detected in 4 of 10 samples, ranging from 0.031 to 0.049 $\mu g/m^{3.}$ The MDL range is 0.005 to 0.033 $\mu g/m^3$.

[f] Chlorobenzene was detected in 6 of 10 samples ranging from 0.437 to 0.852 $\mu g/m^3$. The MDL range is 0.009 to 0.065 $\mu g/m^3$.

[g] Beryllium (PM_{10}) was detected in 10 of 19 samples, ranging from 0.0008 to 0.02 ng/m^3. The MDL range is 0.03 to 0.04 ng/m^3.

[h] Mercury (PM_{10}) was detected in 11 of 19 samples, ranging from 0.001 to 0.06 ng/m^3. The MDL range is 1.12 to 1.63 ng/m^3.

[i] The comparison level is specific to elemental mercury, which is more readily and completely absorbed into the body than mercury conveyed on particles (e.g., divalent species).

[j] Ethylene dichloride was detected in only 4 of 10 samples, ranging from 0.073 to 0.22 $\mu g/m^3$. The MDL range is 0.008 to 0.061 $\mu g/m^3$.

[k] Chloroprene was detected in only 1 of 10 samples, with a value equal to equal to 0.12 $\mu g/m^3$. The MDL range is 0.011 to 0.051 $\mu g/m^3$.

[l] Benzyl chloride was detected in only 1 of 10 samples, with a value equal to 0.02 $\mu g/m^3$. The MDL range is 0.010 to 0.088 $\mu g/m^3$.

[m] Hexachloro-1,3-butadiene was detected in only 1 of 10 samples, with a value equal to 0.04 $\mu g/m^3$. The MDL is 0.128 $\mu g/m^3$.

Appendix D. Chicora Elementary School Pollutant Concentrations.

Parameter	Units	7/18/2009	7/24/2009	7/30/2009	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/29/2009	9/1/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/1/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009	11/18/2009	12/18/2009	2/22/2010	2/23/2010	3/1/2010	3/2/2010	Sample Screening Level[a]
Manganese (PM_{10})	ng/m^3	--	9.66	9.01	6.07	4.93	7.03	--	5	9.11	7.99	10.2	7.59	13.7	3.32	16.2	7.96	1.68	6.86	9.92	1.55	6.61	--	--	--	--	--	--	500
Nickel (PM_{10})	ng/m^3	--	2.26	0.88	0.85	0.87	1.36	--	0.59	1.69	1.64	2.19	2.4	2.5	0.31	2.05	1.00	1.14	1.71	2.7	1.44	5.29	--	--	--	--	--	--	200
Hexavalent Chromium	ng/m^3	ND	0.0199	0.0158	0.0135	ND	--	ND	ND	ND	ND	0.0241	ND	0.0544	ND	0.0087	0.0064	0.0152	0.0147	ND	ND	0.0177	--	--	--	--	--	--	580
Acetaldehyde	µg/m^3	--	--	--	--	--	0.552	0.788	0.741	0.571	0.973	0.651	0.717	0.418	1.1	1.32	1.01	0.465	0.638	0.817	0.631	1.39	--	--	--	--	--	--	90
Benzene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.04	0.467	--	1.05	2.17	0.54	0.751	2.13	1.15	0.969	0.726	30
Butadiene, 1,3-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.073	0.031	--	0.12	0.243	0.049	0.060	0.246	0.12	0.11	0.051	20
Formaldehyde	µg/m^3	--	--	--	--	--	1.61	1.87	1.89	1.38	2.27	1.4	1.35	1.28	3.07	1.89	1.44	0.941	0.81	1.19	1.13	1.51	--	--	--	--	--	--	50
Arsenic (PM_{10})	ng/m^3	--	1.02	0.89	1.33	0.17	1.47	--	1.17	0.52	1.21	1.23	1.54	0.51	0.81	1.88	1.06	2.33	1.24	1.1	0.77	3.14	--	--	--	--	--	--	150
Carbon tetrachloride	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.642	0.629	--	0.919	0.6	0.58	0.736	0.718	0.743	0.686	0.768	200
Cadmium (PM_{10})	ng/m^3	--	0.11	0.19	0.13	0.18	0.29	--	0.05	0.1	0.08	0.15	0.36	0.11	0.06	0.61	0.16	0.03	0.1	0.44	0.06	0.18	--	--	--	--	--	--	30
Propionaldehyde	µg/m^3	--	--	--	--	--	0.14	0.095	0.17	0.12	0.17	0.11	0.12	0.088	0.19	0.19	0.16	0.100	0.10	0.12	0.088	0.17	--	--	--	--	--	--	80
Dichlorobenzene, *p* -	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.084	0.078	--	0.14	0.32	0.04	0.04	0.36	0.21	0.09	0.05	10,000
Bromomethane	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.074	0.051	--	0.054	0.043	0.039	0.066	0.14	0.2	0.047	0.051	200
Chloromethane	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.73	0.781	--	1.93	1.22	1.12	1.51	1.43	1.39	1.25	1.24	1,000
Tetrachloroethylene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.088	0.16	--	0.26	0.32	0.19	0.088	0.42	0.16	0.20	0.088	1,400
Ethylbenzene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.656	0.4	--	0.27	0.821	0.16	0.26	1.04	0.38	0.3	0.22	40,000
Xylene, *m/p*-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.72	0.95	--	0.73	2.22	0.33	0.55	2.63	0.80	0.78	0.45	9,000
Antimony (PM_{10})	ng/m^3	--	1.36	0.4	0.53	0.68	0.77	--	0.51	0.49	0.79	1.05	1.72	0.42	0.83	4.6	1.43	2.19	0.83	1.41	0.72	1.75	--	--	--	--	--	--	2,000
Acetonitrile	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.297	0.14	--	0.402	0.336	0.183	0.282	0.383	0.349	0.282	0.227	600
Xylene, *o*-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.63	0.33	--	0.3	0.765	0.12	0.21	1.16	0.37	0.3	0.18	9,000
Dichloromethane	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.23	0.455	--	0.355	0.719	0.29	0.518	0.646	0.403	0.31	0.34	2,000
Cobalt (PM_{10})	ng/m^3	--	0.23	0.18	0.14	0.11	0.05	--	0.1	0.05	0.07	0.1	0.09	0.07	0.07	0.15	0.09	0.03	0.04	0.08	0.05	0.11	--	--	--	--	--	--	100
Chloroform	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.12	0.22	--	0.17	0.18	0.088	0.12	ND	0.12	ND	ND	500
Toluene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.37	1.02	--	1.84	6.49	0.773	0.46	6.52	2.15	1.54	0.626	4,000
Carbon disulfide	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.312	0.053	--	0.23	0.17	0.12	0.436	0.1	0.081	0.065	0.034	7,000
Styrene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.15	0.047	--	0.094	0.17	ND	0.047	0.29	0.17	0.13	0.081	9,000
Methyl isobutyl ketone	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.32	0.23	--	0.57	0.36	0.15	0.16	0.36	0.484	0.14	0.13	30,000
Chloroethane	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.084	ND	--	0.702	0.483	0.23	0.18	0.481	0.594	0.623	0.407	40,000
Selenium (PM_{10})	ng/m^3	--	1.04	0.53	0.79	0.98	0.45	--	0.53	0.86	0.74	0.63	1.10	0.39	1.13	0.77	0.22	0.45	0.70	0.53	0.57	1.72	--	--	--	--	--	--	20,000
Methyl chloroform	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.055	0.066	--	0.082	0.06	0.055	0.06	0.066	0.071	0.055	0.06	10,000
Vinyl chloride	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	ND	ND	ND	ND	0.049	0.049	0.036	0.031	1,000
Chlorobenzene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	0.852	ND	0.44	0.521	0.815	0.7	0.654	ND	10,000
Beryllium (PM_{10})	ng/m^3	--	ND	ND	ND	0.02	ND	--	0.01	0.0008	0.002	ND	0.009	ND	ND	0.02	0.01	ND	ND	0.01	0.02	0.005	--	--	--	--	--	--	20
Mercury (PM_{10})	ng/m^3	--	0.003	0.06	0.009	0.03	0.002	--	0.009	ND	ND	ND	0.01	ND	ND	0.02	0.001	ND	ND	0.02	0.04	ND	--	--	--	--	--	--	3,000 [b]
Ethylene dichloride	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	0.073	ND	ND	ND	0.22	ND	0.16	0.089	270
Chloroprene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	0.12	ND	ND	200
Benzyl chloride	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	0.02	ND	ND	ND	ND	140
Hexachloro-1,3-butadiene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	0.04	ND	ND	ND	ND	ND	ND	ND	320
Trichloroethylene	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	10,000
Acrylonitrile	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	200
Bromoform	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	6,400
Dichloroethane, 1,1-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	4,400
Dichloroethylene, 1,1-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	80
Dichloropropane, 1,2-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	200

Appendix D. Chicora Elementary School Pollutant Concentrations.

Parameter	Units	7/18/2009	7/24/2009	7/30/2009	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/29/2009	9/1/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/1/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009	11/18/2009	12/18/2009	2/22/2010	2/23/2010	3/1/2010	3/2/2010	Sample Screening Level[a]
Dichloropropylene, *cis* -1,3-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	40
Dichloropropylene, *trans* -1,3-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	40
Ethyl acrylate	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	7,000
Ethylene dibromide	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	12
Methyl methacrylate	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	7,000
Methyl *tert* -butyl ether	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	7,000
Tetrachloroethane, 1,1,2,2-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	120
Trichlorobenzene, 1,2,4-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	2,000
Trichloroethane, 1,1,2-	µg/m^3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	440

Key Pollutant

ng/m^3 nanograms per cubic meter

µg/m^3 micrograms per cubic meter

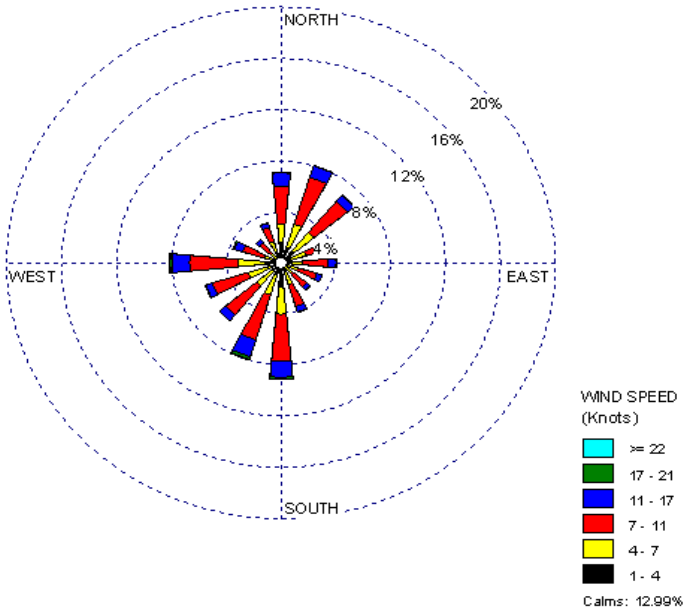
-- No sample was collected for this pollutant on this day or the sample was invalid.

ND No detection of this chemical was registered by the laboratory analytical equipment.

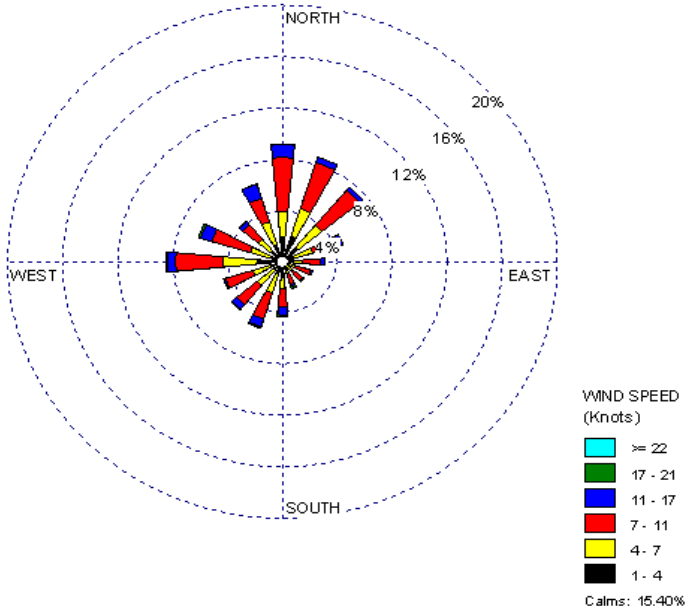
[a] The individual sample screening levels and their use is summarized on the web site and described in detail in Schools Air Toxics Monitoring Activity (2009), "Uses of Health Effects Information in Evaluating Sample Results" see see http://www.epa.gov/schoolair/pdfs/UsesOfHealthEffectsInfoinEvalSampleResults.pdf. These screening levels are based on condieration of exposure all day, every day over a period ranging up to at least a couple of weeks, and longer for some pollutants.

[b] The sample screening level is specific to elemental mercury, which is more readily and completely absorbed into the body than mercury conveyed on particles (e.g., divalent species).

Appendix E. Windroses for Charleston Air Force Base/International Airport NWS Station.



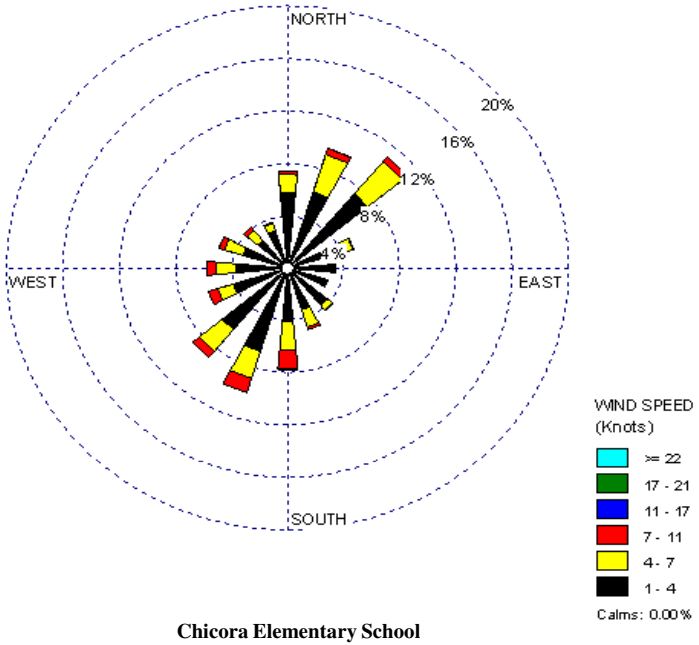
Charleston Air Force Base/ International Airport NWS Station 2002-2007[1]



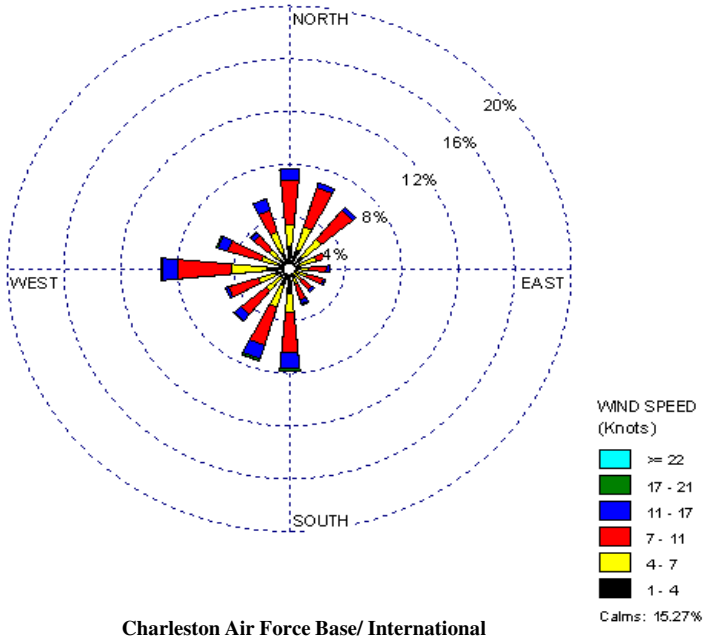
Charleston Air Force Base/ International Airport NWS Station Across Sampling Period (Jul. 18, 2009-Mar. 2, 2010)[1]

[1] Charleston Air Force Base/International Airport NWS Station (WBAN 13880) is 4.97 miles from Chicora Elementary School.

Appendix F. Windroses Comparison, Entire Meteorological Period.



Chicora Elementary School
For Entire Meteorological Period
(Jul. 20, 2009-Aug. 2, 2010)[1]



Charleston Air Force Base/ International Airport NWS Station
For Entire Meteorological Period
(Jul. 20, 2009-Aug. 2, 2010)[1]

[1] Charleston Air Force Base/International Airport NWS Station (WBAN 13880) is 4.97 miles from Chicora Elementary School.