SAT Initiative: Ashland City Elementary School (Ashland City, Tennessee)

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 web site (www.epa.gov/schoolair).

I. Executive Summary

- Air monitoring has been conducted at Ashland Elementary School as part of the EPA initiative to monitor specific air toxics in the outdoor air around priority schools in 22 states.
- This school was selected for monitoring based on information indicating the potential for elevated ambient concentrations of manganese in air outside the school. That information included EPA's recently completed 2002 National Air Toxics Assessment. In addition, the school was ranked in the upper portion of the top 100 on a USA Today list due to 2005 Toxics Release Inventory estimates of manganese emissions for a nearby industrial facility.
- Air monitoring for manganese and other metals in PM_{10} was performed from April 13 through June 6, 2009.
- The levels of manganese measured in the outdoor air at this school indicate influence of a nearby source.
- Manganese levels measured and associated longer-term concentration estimates are below levels of concern for short- or long-term exposures. They are not as high as suggested by the information available prior to monitoring.
- Based on the analysis described here, EPA does not presently plan to continue air toxics monitoring at this school.
- The Tennessee Department of Conservation (TDEC) will continue to oversee industrial facilities in the area through air permits and other programs. The TDEC has continued to collect meteorological data at the school which will help improve our capabilities for assessing long-term concentrations in the future.

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 are monitoring specific (key) air toxics in the outdoor air around priority schools in 22 states (http://www.epa.gov/schoolair/schools.html).

- The schools selected for monitoring include 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 National-scale Air Toxics Assessment (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 are being placed at each school for approximately 60 days, and will take air samples on at least 10 different days during that time. The samples will be 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 will 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 web site.

[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.

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

This school was selected for monitoring in consultation with the State air agency, Tennessee Department of Environment and Conservation (TDEC). We were interested in evaluating the ambient concentrations of manganese in air outside the school because EPA's 2002 NATA analysis indicated the potential for levels of concern due to estimates of manganese emissions in the 2002 National Emissions Inventory for a nearby industry that is involved in the manufacture of water heaters. Additionally, this school was ranked at the top of the USA Today list due to estimates of manganese emissions in the 2005 Toxics Release Inventory for the same facility.

Monitoring commenced at this school on April 13, 2009 and continued through June 6. During this period 12 samples of airborne particles were collected using a PM_{10} sampler[4]. The samples were analyzed for manganese (the key pollutant at this school) and for a small standardized set of additional metals that are routinely included in the analytical methods for the key pollutants (http://www.epa.gov/ttn/amtic/files/ambient/airtox/2009sat/SATMonitoringPlan.pdf). [5]

IV. Monitoring Results and Analysis

A. Background for the 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 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 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.

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[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.
[4] In general, this sampler collects particles with an aerodynamic diameter of 10 microns or smaller
[5] TDEC staff operated the monitors and sent the sample filters 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.

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 for the estimate of the longer-term average concentration of each of these pollutants. This projected range (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 the air concentrations also includes a consideration of the potential for cumulative multiple pollutant impacts.[8] 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 noncancer-based comparison levels - we will consider 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 the type of ubiquitous emissions 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 data sets 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 program 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.

[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] 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).

→ Describes the meteorological data by considering conditions on sampling days as compared to those over all the days within the 2-3 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.

B. Chemical Concentrations

In addressing the primary objective identified above, to investigate through the monitoring data collected for key pollutants at the school whether levels measured and associated longer-term concentration estimates 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 (summarized in Appendix A below). 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.[9] 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 Figure 1) 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 2-month sampling period and the related longer-term concentration estimates, while indicating influence from a nearby source of manganese emissions, are below concentrations of significant concern for short- or long-term exposures.

[9] This is described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*

Manganese, the key pollutant:

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

  → Yes. The data collected include some Mn-PM_{10} concentrations that are appreciably higher than concentrations commonly observed in other locations nationally.[10] Additionally, as discussed in section IV.C below, on the days on which the higher concentrations were measured, the wind information indicates winds from the direction of a nearby source.

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

  → No. The monitoring data for manganese do not indicate levels of health concern for long-term exposures.

    - The estimate of longer-term manganese-PM_{10} concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below the noncancer long-term comparison level (Table 1).[11] This comparison level is a continuous exposure concentration (all 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.[12]
    - As manganese has not been found to be carcinogenic, it has no cancer-based comparison level.[13]

  → 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 up to at least a couple of weeks, and longer for some pollutants).[14]

  → In summary, none of the individual measurements 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.

[10] For example, a few concentrations at this site (Table 2) were higher than 75 percent of samples collected at the National Air Toxics Trends Sites (NATTS) program from 2004-2007 (Appendix B).
[11] The upper end of the interval is nearly two times the mean of the monitoring data, but only 40% of the noncancer long-term comparison level.
[12] The comparison level for manganese is based on the RfC. Manganese concentrations at which health effects have been documented are higher than the RfC (http://www.atsdr.cdc.gov/tfacts151.html, http://www.epa.gov/ttn/atw/hlthef/manganes.html#conversion)
[13] www.epa.gov/iris
[14] 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*.

Other Air Toxics

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

  → No. 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 for that pollutant.[14]

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)?

  → No. The data collected for the key and other air toxics and the associated longer-term concentration estimates do not together pose significant concerns for cumulative health risk from these pollutants (Appendix C).[15]

C. Wind and Other Meteorological Data

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

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 the Ashland City school collected wind speed, wind direction, and temperature measurements during the sampling period, beginning on April 24 (subsequent to the first two sample collections on April 13 and 19) and continuing through the end of the sampling period. As a result, on-site data for these meteorological parameters are available for all but the first two dates of sample collection, and also for intervening days, producing an approximately 45-day record. Further, on-site wind and temperature data collection has continued beyond the

[15] 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

last sample collection, providing additional data for future consideration, but which is not summarized in this document.

The nearest NWS station is at Nashville International Airport. This station is approximately 23 miles east southeast of the school. Measurements taken at that station include wind, temperature and precipitation.

Wind speed and direction data collected at the school and at the Nashville Airport NWS station have been summarized in Figures 2 and 3, respectively. The data collected at the school are also presented in Table 2.

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 source was 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 full record of on-site meteorological data.
- Our ability to provide a confident characterization of the wind flow patterns at the monitoring site over the long-term is somewhat limited as the NWS site in Nashville does not appear to represent the specific wind flow patterns at the school location. Additional meteorological monitoring at the school site (or near to it) during additional seasonal periods would assist in characterizing true long-term patterns.
- Although we lack long-term wind data at the monitoring site, the wind pattern at the NWS site during the sampling period is generally similar to the historical long-term wind flow pattern at that location. This suggests that, on a regional scale, the 2-month sampling period is generally representative of year-round wind patterns.

- What is the direction of the key source of manganese emissions in relation to the school location?
  - → The nearby industrial facility emitting manganese into the air (described in section III above) lies generally to the west and south of the school.
  - → Using the property boundaries of the full facility (in lieu of information regarding the location of specific sources of manganese emissions at the facility), we have identified an approximate range of wind directions to use in considering the potential influence of this facility on air concentrations at the school.
  - → This general range of wind directions, from approximately 170 to 280 degrees, is referred to here as the expected zone of source influence (ZOI).

- On days the air samples were collected, how often did wind come from direction of the key source?

→ On four of the sampling days for which on-site wind data are available, the average wind direction for the day was from the expected ZOI (Figure 2, Table 2), and the Nashville station data indicates that it was also from the expected ZOI for the two days when on-site wind data were not available.

→ We additionally note that the concentrations on several sampling dates were higher than 75 percent of samples collected at 23 NATTS National Air Toxics Trends Sites from 2004-2007 (the most recently compiled period, Appendix B), also indicating that some samples were collected on days when there was a source contribution to air quality at the school site (Table 2).

- 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 to be generally similar to those observed over the full record of on-site meteorological data during the monitoring period, particularly with regard to the expected ZOI.
  → While wind data are not available at the school over the longer term, we note that wind patterns at the nearest NWS station (at Nashville) during the monitoring period are very similar to those recorded at the NWS station over the long-term (2002-2007 period; Figure 3), supporting the idea that regional meteorological patterns during the monitoring period were consistent with long-term patterns. However, there is some uncertainty as to whether this would also be the case at the school location as the general wind patterns at the Nashville station appear to differ from those at the school (see below).

- How do wind patterns at the school compare to those at the Nashville station, particularly with regard to prevalent wind directions and the direction of the key source?
  → During the period for which data are available both at the school site and at the reference NWS station (approximately 45 days), prevalent winds at the school site are predominantly from the east-southeast and south, while those at the NWS station are somewhat more from the south. The windroses for the two sites during the sampling period (Figures 2 and 3) show differences in wind flow patterns, most likely resulting from nearby terrain influences.
  → Wind speeds at the school monitoring site are somewhat lower than those measured at the Nashville station.

- Are there other meteorological patterns that may influence the measured concentrations at the school monitoring site?
  → There does not appear to be any correlation between the other meteorological measurement taken at the school (temperature) and the ambient levels of manganese during the sampling period.

V. Key Source Information

- Was the source operating as usual during the monitoring period?
  - The nearby source of manganese (described in section III above) has an operating permit issued by TDEC that includes operating requirements.[16]
  - Information from the nearby source indicates that this facility was operating at approximately two thirds of its capacity during the monitoring period, which is generally similar to its usual conditions of 80% capacity.
  - The most recently available manganese emissions estimates for this source (2007 TRI) are appreciably lower than those relied upon in previous modeling analyses for this area (e.g., 2005 TRI and 2002 NATA).

VI. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What are the key HAPs for this school?
   → Manganese is the key HAP for this school, identified based on emissions information considered in identifying the school for monitoring. The ambient air concentrations on multiple days during the monitoring period indicate contributions from a source 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?
   → No; the levels measured and associated longer-term concentration estimates are not as high as that suggested by the information available prior to monitoring and are below levels of concern for long-term exposures.

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 we have 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, we have none that would indicate generally higher (or lower) concentrations during other times of year. The wind flow pattern at the nearest NWS station during the sampling period appears to be representative of long-term wind flow patterns at that site. The lack of long-term meteorological data at the school location and our finding that the wind patterns from the nearest NWS station differ from those at the school, however, limit somewhat our ability to confidently predict longer-

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

term wind patterns at the school (which might provide further evidence relevant to concentrations during other times).

B. Next Steps for Key Pollutants

1. Based on the analysis described here, EPA presently does not plan to continue air toxics monitoring at this school.
2. TDEC (as the agency with primary permitting authority) will continue their oversight of conditions imposed by operating permits for nearby facilities to ensure the conditions are being met.

C. Additional Activities for Maintaining and Improving Air Quality

1. Collection of on-site meteorological data has continued beyond the air sampling period. These data can further inform our understanding of long-term wind patterns and other air quality considerations at the school and surrounding community, thus improving our tools for assessment of long-term air concentrations in the future. For example, such data may provide additional wind data for future modeling analyses of the area (e.g., future NATA analyses). As resources allow, meteorological monitoring may continue for a limited time into the future

VII. Figures and Tables

A. Tables

1. Ashland City Elementary School – Key Pollutant Analysis.
2. Ashland City Elementary School - Key Pollutant Concentrations and Meteorological Data.

B. Figures

1. Ashland City Elementary School – Key Pollutant Analysis.
2. Ashland City Elementary School - Concentration and Wind Information.
3. Windrose for Nashville International Airport.

VIII. Appendices

A. Summary Description of Long-term Comparison Levels.

B. National Air Toxics Trends Stations Measurements (2004 through 2007).

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

D. Ashland City Elementary School - Pollutant Concentrations.

Table 1. Ashland City Elementary School - Key Pollutant Analysis.

School Name	Parameter	Units	Mean of Measurements	95% Confidence Interval on the Mean	Long-term Comparison Level[a]	
					Cancer-Based[b]	Noncancer-Based[c]
Ashland City Elementary School	Manganese PM_{10} (LC)	ng/m^3	10.24	1.14 - 19.33	NA	50

LC : The concentration is presented as "local" conditions, and not adjusted for temperature and pressure to "standard" conditions.

ng/m^3 : nanograms 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.

Table 2. Ashland City Elementary School Key Pollutant Concentrations and Meteorological Data.

School Name	Parameter	Units	4/13/2009	4/19/2009	4/25/2009	5/1/2009	5/7/2009	5/11/2009	5/13/2009	5/19/2009	5/25/2009	5/28/2009	5/31/2009	6/6/2009
Ashland City Elementary School (470215501)	Manganese PM_{10} (LC)	ng/m^3	7	2.22	6.61	5.88	16.8	3.51	4.06	8.27	0.99	56.4	7.96	3.14
	% Hours w/Wind Direction from Expected ZOI[a]	%	50.0	45.8	58.3	20.8	20.8	0.0	50.0	20.8	25.0	41.7	16.7	12.5
	Wind Speed (avg. of hourly speeds)	mph	10.23	9.30	4.65	3.08	3.00	3.05	5.50	2.43	2.73	5.13	3.49	2.14
	Wind Direction (avg. of unitized vector)[b]	deg.	188.6	177.0	180.0	161.5	190.7	158.6	166.4	128.4	158.9	239.7	225.0	123.8
	% of Hours with Speed below 2 knots	%	8.3	4.2	50.0	16.7	45.8	33.3	0.0	50.0	41.7	20.8	41.7	58.3
	Daily Average Temperature	°F	63.08	58.46	77.01	63.60	71.64	61.18	69.13	59.99	73.87	72.74	74.70	66.63
	Daily Precipitation	inches	0.35	1.07	0	2.99	0.02	0.10	0	0	0	0.09	0	0

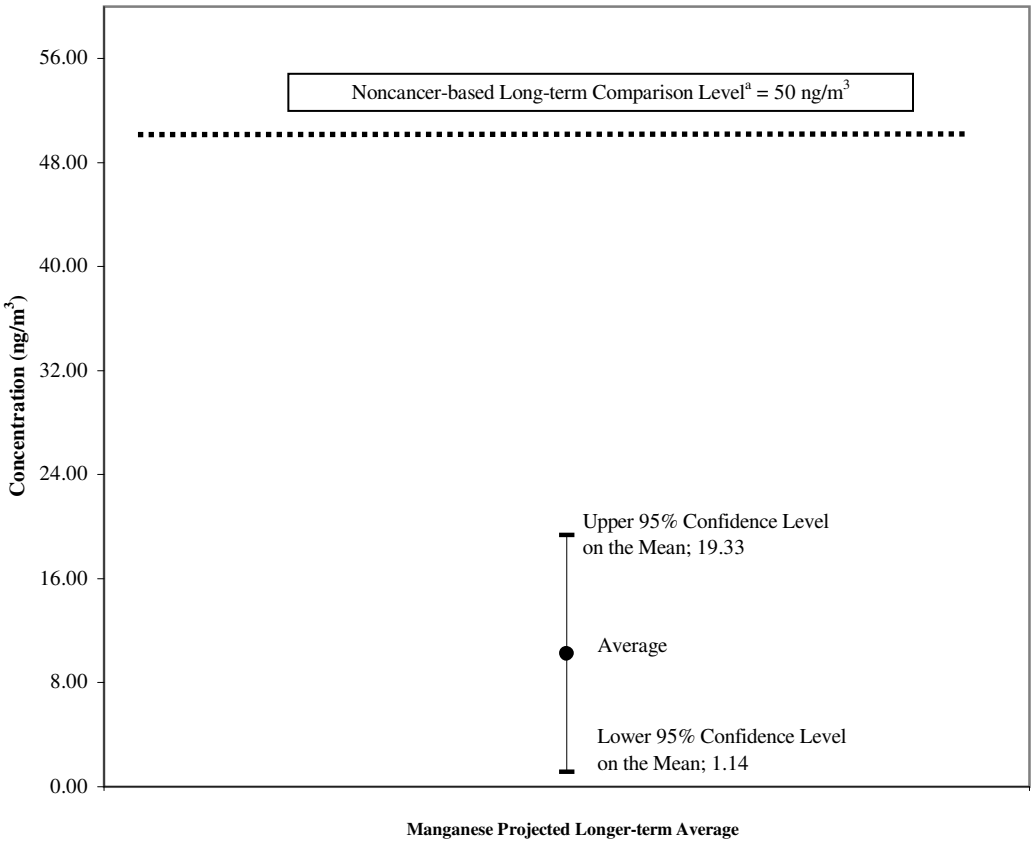
: Due to instrument error, meteorological measurements were not collected at Ashland City Elementary School on April 13 and 19. As such, hourly wind information was extracted from the Nashville International Airport (BNA) NWS Station for those days, and used as surrogates. Additionally, air temperature for May 13 were extracted from BNA due to questionably high readings(> 150 degrees) from that site.

: All precipitation data were from the BNA NWS Station.

[a] : Based on count of hours for which vector wind direction is from expected zone of influence.

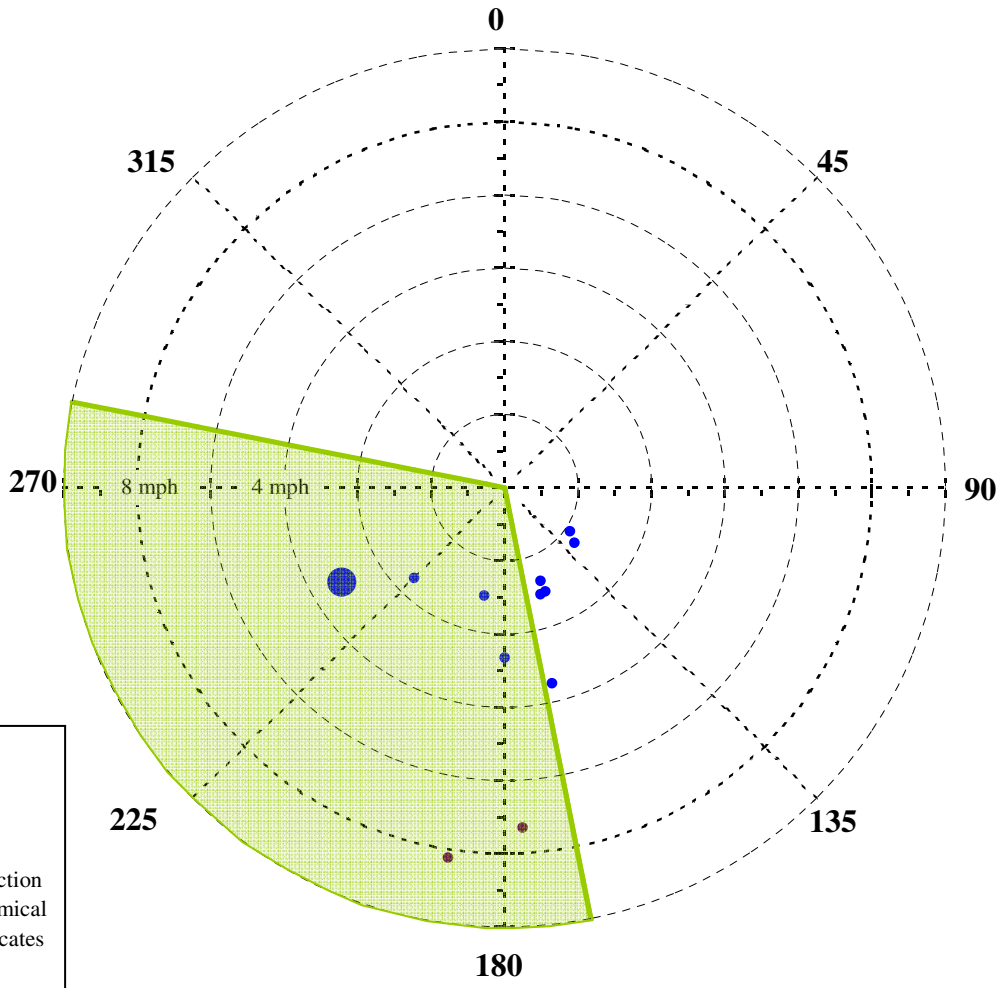
[b] : Wind direction for each day is represented by values derived by scalar averaging of hourly estimates that were produced (by wind instrumentation's logger) as unitized vectors (specified as degrees from due north).

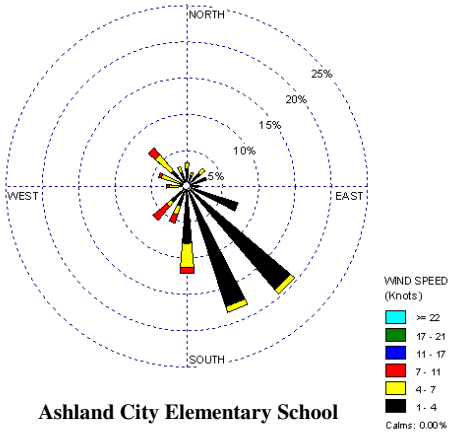
Figure 1. Ashland City Elementary School - Key Pollutant Analysis.



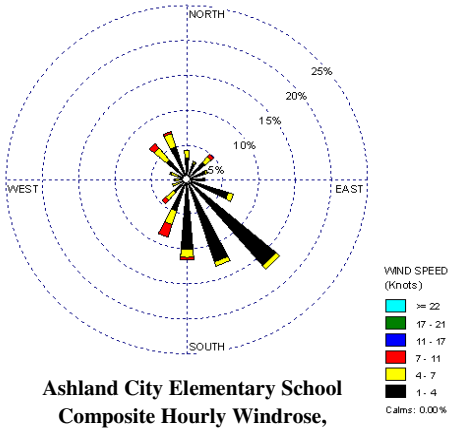
[a]: Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably 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 2. Ashland Elementary School (Ashland City, TN) Concentration and Wind Information.





Ashland City Elementary School Composite Hourly Windrose On Sample Days (beginning with 4/25/09)



Ashland City Elementary School Composite Hourly Windrose, For Full Period From April 24 - June 6, 2009

KEY

Pollutant: Manganese PM_{10} (LC)

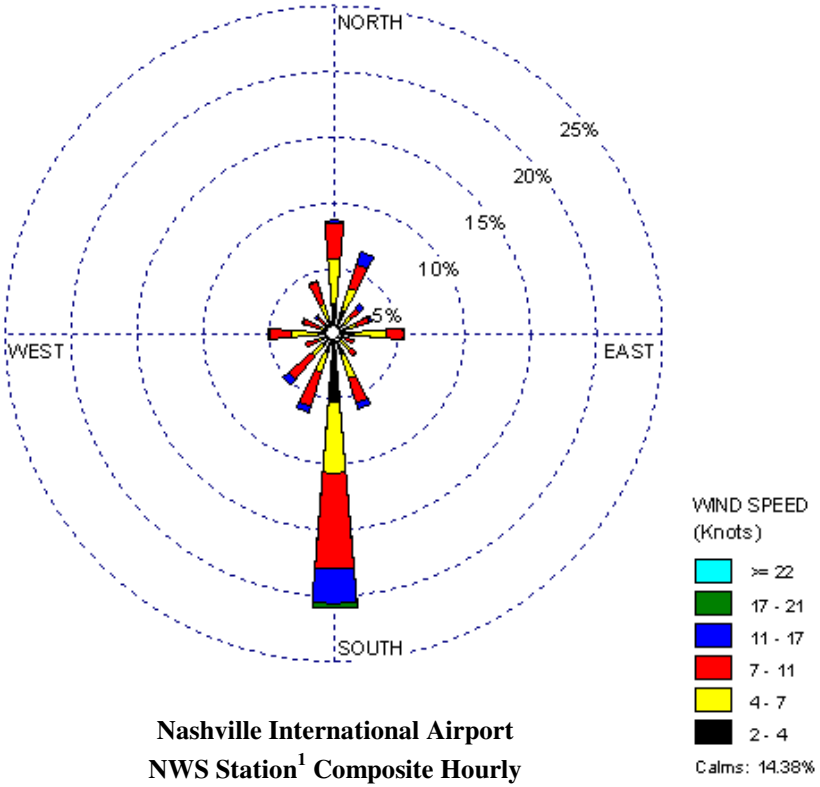
Timeframe: April 13 - June 6, 2009

Note

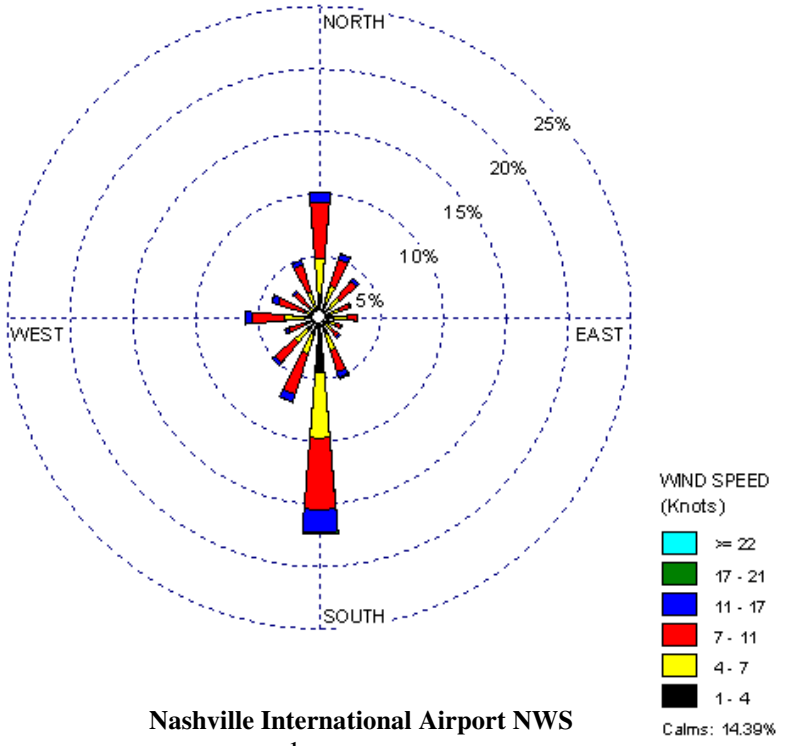
Each circle denotes a 24-hour collection of wind information and air for chemical analysis. The size of the circle indicates the magnitude of the chemical concentration and the location of the circle on the figure indicates the daily average wind speed and direction (as shown in Table 2). The expected 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.

- Concentration: 0-25 ng/m^3
- Concentration: 25-50 ng/m^3
- Concentration: 50-75 ng/m^3
- Expected Zone of Source Influence
- Purple circles denote wind information from the closest NWS station for days when on-site data were not available (see section III.B of report regarding potential limitations associated with this NWS Station as surrogate for on-site information).

Figure 3. Windrose for Nashville International Airport.



Nashville International Airport NWS Station[1] Composite Hourly Windrose, 2002-2007



Nashville International Airport NWS Station[1] Composite Hourly Windrose, April 24 - June 6, 2009

[1]: Nashville International Airport NWS Station (WBAN 13897) is ~23 miles ESE of Ashland City Elementary School

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.[17]

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.[18] 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.

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

[18] 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 effect over a lifetime.[19] 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.

[19] 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 (2004-2007)[a]

Pollutant	# Detections	Units	Maximum	Arithmetic Mean	Geometric Mean	Median	25th Percentile	75th Percentile
Antimony (PM_{10})	2,328	ng/m^3	43.30	1.86	1.23	1.24	0.72	2.17
Arsenic (PM_{10})	3,365	ng/m^3	47.70	1.14	0.74	0.69	0.48	1.13
Beryllium (PM_{10})	2,312	ng/m^3	1.97	0.09	0.02	0.02	0.01	0.05
Cadmium (PM_{10})	3,125	ng/m^3	15.30	0.32	0.18	0.17	0.09	0.40
Chromium (PM_{10})	3,493	ng/m^3	172.06	3.22	1.82	2.05	1.37	3.15
Cobalt (PM_{10})	2,478	ng/m^3	20.30	0.32	0.18	0.17	0.09	0.31
Manganese (PM_{10})	3,684	ng/m^3	412.00	10.92	5.41	4.79	2.54	10.37
Mercury (PM_{10})	647	ng/m^3	2.07	0.07	0.03	0.02	0.01	0.06
Nickel (PM_{10})	3,397	ng/m^3	110.10	2.61	1.63	1.83	0.97	3.02
Selenium (PM_{10})	2,381	ng/m^3	13.00	1.14	0.53	0.53	0.27	1.12

: Key Pollutant

[a]: The summary statistics in this table represent the HAP measurements taken at NATTS sites from 2004 through 2007. These data were extracted from AQS in summer 2008. During the time period of interest, there were 23 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 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.

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)[20]. 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 secton below.

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?

  → No. Longer-term concentration estimates for the other HAPs monitored are below their long-term comparison levels.

  → Further, for pollutants with cancer-based comparison levels, longer-term concentration estimates for all but two of these (discussed below) are more than tenfold lower and the rest are more than 100-fold lower.[21]

  → Additionally each individual measurement for these pollutants is below the individual sample screening level developed for considering potential short-term exposures for that pollutant.[22]

Additional Information on two HAPs:

- The first of the two HAPs mentioned above is chromium-PM_{10} (Cr-PM_{10}). The comparison values for Cr-PM_{10} are conservatively based on the most toxic form of chromium (hexavalent chromium, Cr^{+6}) which is only a fraction of the Cr-PM_{10} in the ambient air. Nonetheless, the longer-term concentration estimate for Cr-PM_{10} is well below even these very restrictive comparison values. The mean and 95 percent upper bound on the mean for Cr-PM_{10} are approximately 15-25% of the lowest comparison

[20] 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.

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

[22] 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*.

level. Further, as Cr^{+6} is commonly only a small fraction of the total,[23] the levels of Cr^{+6} in these samples would be expected to be appreciably lower than this. Additionally, a review of information available at other sites nationally shows that the mean concentration of Cr-PM_{10} at this site is lower than the mean and median of samples collected from 2004 to 2007 (the most recently compiled period) at the NATTS (Appendix B).

- The second of the two HAPs mentioned above is arsenic-PM_{10} (As-PM_{10}). The mean and 95 percent upper bound on the mean As-PM_{10} at the site are approximately 5-10% of the cancer-based comparison level. The upper bound is more than two times the mean due to a single measurement being much different from the others (although still well below the individual sample screening level). Additionally, a review of information available at other sites nationally shows that the mean concentration of As-PM_{10} at this site falls between the mean and median of samples collected from 2004 to 2007 (the most recently compiled period) at the NATTS (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.[24]

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)?

  → The data collected for the key and other air toxics and the associated longer-term concentration estimates do not together pose significant concerns for cumulative health risk from these pollutants

  - Aside from the key pollutant, manganese-PM_{10}, the only other HAPs monitored whose longer-term concentration estimates are more than ten percent of their lowest comparison level are chromium-PM_{10} and arsenic-PM_{10}. As a conservative screening consideration it can be seen that when aggregated as a group, the upper

[23] Data in EPA's Air Quality System for locations that are not near a facility emitting hexavalent chromium indicate hexavelent chromium concentrations to comprise less than approximately 10% of total chromium concentrations.
[24] General information on additional air pollutants is available at http://www.epa.gov/air/airpollutants.html.

bounds of their longer-term concentration estimates comprise somewhat less than 100 percent of their lowest comparison levels.[25] Further, the lowest comparison levels for these three pollutants differ with regard to the types of risks and targets in the body, reducing the potential for cumulative impact. For example, the comparison level for manganese is based on noncarcinogenic effects on the nervous system, while the lowest comparison level for Cr-PM_{10} is based on carcinogenic risk to the respiratory system posed by hexavalent chromium.[26] The cancer-based comparison level for arsenic is based on risks to the respiratory system, while the noncancer-based comparison level is based on noncancer effects considering several endpoints including development. Additionally, as noted above, hexavalent chromium is commonly only a small fraction of the total Cr-PM_{10} reported. Taken together these considerations reduce any concerns for cumulative health risk from these pollutants.

[25] When aggregated as a group in this conservative screening approach the means of these pollutants comprise less than 50 percent of their corresponding lowest comparison levels.

[26] The noncancer-based comparison level for chromium is much higher than the cancer-based level and is based on risk of other effects posed to the respiratory system by hexavalent chromium in particulate form.

Table C-1. Ashland City Elementary School - Other Monitored Pollutants Analysis.

School Name	Parameter	Units	Mean of Measurements	95% Confidence Interval on the Mean	Long-term Comparison Level[a]	
					Cancer-Based[b]	Noncancer-Based[c]
Ashland City Elementary School	***Non-Key HAPs with mean between 10% and 50% of the lowest comparison level***					
	Chromium PM_{10} (LC)	ng/m^3	1.42	0.88 - 1.96	8.3[d]	100[d]
	Non-Key HAPs with mean lower than 10% of the lowest comparison level					
	Arsenic PM_{10} (LC)	ng/m^3	1.28	0 - 2.85	23	15
	Cadmium PM_{10} (LC)	ng/m^3	0.15	0.03 - 0.26	56	10
	Nickel PM_{10} (LC)	ng/m^3	0.74	0.29 - 1.20	420	90
	Antimony PM_{10} (LC)	ng/m^3	0.61	0.39 - 0.83	NA	200
	Cobalt PM_{10} (LC)	ng/m^3	0.16	0 - 0.33	NA	100
	Mercury PM_{10} (LC)	ng/m^3	0.35	0.15 - 0.54	NA	300[e]
	Beryllium PM_{10} (LC)	ng/m^3	0.01	0 - 0.02	42	20
	Selenium PM_{10} (LC)	ng/m^3	0.85	0.3 - 1.41	NA	20,000

LC : The concentration is presented as "local conditions", and not adjusted for temperature and pressure to "standard conditions".

ng/m^3 : nanograms 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 comparison levels are specific to hexavalent chromium (recognized as the most toxic form) which is a fraction of the total chromium reported.

[e]: 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).

Appendix D. Ashland City Elementary School Pollutant Concentrations.

School Name	Parameter	Units	4/13/2009	4/19/2009	4/25/2009	5/1/2009	5/7/2009	5/11/2009	5/13/2009	5/19/2009	5/25/2009	5/28/2009	5/31/2009	6/6/2009	Sample Screening Level[a]
Ashland City School (470215501)	Manganese PM_{10} (LC)	ng/m^3	7	2.22	6.61	5.88	16.8	3.51	4.06	8.27	0.99	56.4	7.96	3.14	500
	Chromium PM_{10} (LC)	ng/m^3	1.55	0.43	1.04	1.43	1.86	1.34	1.13	0.71	0.67	3.87	1.88	1.13	580[b]
	Arsenic PM_{10} (LC)	ng/m^3	0.35	0.6	0.41	0.17	0.51	0.61	0.47	0.65	0.84	0.4	0.76	9.56	150
	Cadmium PM_{10} (LC)	ng/m^3	0.07	0.07	0.1	0.02	0.04	0.12	0.75	0.13	0.09	0.08	0.13	0.15	30
	Nickel PM_{10} (LC)	ng/m^3	0.41	0.15	1.01	0.23	0.57	0.68	0.46	2.29	0.49	2.26	0.25	0.13	200
	Antimony PM_{10} (LC)	ng/m^3	0.33	0.51	0.74	0.41	0.31	0.47	0.44	0.69	0.55	0.49	0.7	1.7	2,000
	Cobalt PM_{10} (LC)	ng/m^3	0.17	0.03	0.08	0.04	0.18	0.06	0.05	0.1	0.02	1.05	0.07	0.04	100
	Mercury PM_{10} (LC)	ng/m^3	0.44	0.61	0.41	1.25	0.25	0.29	0.19	0.18	0.09	0.25	0.07	0.14	3000[c]
	Beryllium PM_{10} (LC)	ng/m^3	0.002	ND	2E-04	ND	0.03	0.03	0.008	0.006	0.002	0.008	0.01	0.005	20
	Selenium PM_{10} (LC)	ng/m^3	0.67	0.64	0.5	0.13	0.27	0.9	0.69	0.37	3.67	0.5	1.04	0.85	20,000

: Key Pollutant

ng/m^3 : nanograms per cubic meter

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

[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 Informatic in Evaluating Sample Results." These short-term screening levels are based on consideration 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 levels are specific to hexavalent chromium (recognized as the most toxic form) which is a fraction of the total chromium reported.

[c] : 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).