SAT Initiative: East Elementary School (East Liverpool, OH)

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 East 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.
- This school was selected for monitoring due to its proximity to two S.H. Bell facilities (Stateline and Little England) that handle and store ferrous and non-ferrous materials and in consideration of previous and ongoing manganese monitoring conducted by the Ohio Environmental Protection Agency (OEPA), which has indicated elevated concentrations of manganese.
- The key pollutant monitored was manganese. Air monitoring for manganese and other metals in particulate matter less than 10 microns (PM_{10}) was performed from August 12, 2009 through October 4, 2009.
- Measured levels of manganese (PM_{10}) and associated longer-term concentration estimates at this school indicate a potential for health concerns from long-term continuous exposures, most particularly for locations closer to the sources than the location monitored in this project.
- The levels of manganese (PM_{10}) measured in the outdoor air at this school indicate influence of the identified sources. These levels are substantially elevated over typical air levels as had been suggested by the monitoring information available prior to this monitoring.
- Information on wind patterns on the sampling days indicates that locations closer to the two sources would have higher concentrations.
- Due to recent enforcement activities by OEPA, it is anticipated that there will be substantial reductions in particulate matter emissions, and subsequent reductions in manganese exposure, by November 19, 2010.
- EPA recommends additional monitoring for manganese (PM_{10} and $PM_{2.5}$) to better characterize the potential for exposures of concern in the community and to monitor any changes in airborne manganese concentrations that might be associated with source control activities.
- EPA will continue to support OEPA on actions to characterize manganese sources in this community. Both EPA and OEPA have taken enforcement actions to address particulate matter emissions from these sources, which will also reduce manganese emissions. It is anticipated that the recent actions taken by OEPA will substantially mitigate risks from

manganese in the area; however, OEPA is continuing to monitor the sources to verify that these emissions are decreasing.

- OEPA will continue to oversee industrial facilities in the area through air permits and other programs.

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 and 2 tribal areas (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 placed at each school for approximately 60 days, and take air samples on at least 10 different days during that time. The samples are 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.

[1] In analyzing air samples for these key pollutants, samples are also analyzed for some additional pollutants that are routinely included in the analytical methods for the key pollutants.

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

This school was selected for monitoring in consultation with the state air agency, Ohio Environmental Protection Agency (OEPA). Previous air monitoring data collected by OEPA (discussed in section V below) identified elevated levels of manganese in the ambient air in East Liverpool near two industrial facilities that handle and store bulk and packaged products, including metals, minerals, and various industrial products. The S.H. Bell Stateline facility is the larger of the two facilities, extending across the Ohio border into Pennsylvania, and the S.H. Bell Little England facility is located along the Ohio River to the southeast of East Elementary School monitoring location (Figure 1). Since March 2000, OEPA has conducted manganese monitoring at three locations in the East Liverpool community, located in close proximity to these two facilities. These sampling locations are the East Liverpool Water Plant, the Port Authority, and a monitor located at the East Elementary school at Maryland Avenue (Figure 1).

Monitoring for U.S. EPA's school air toxics initiative commenced at this school on August 12, 2009, and continued through October 4, 2009. During this period 10 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 pollutant (http://www.epa.gov/schoolair/techinfo.html).[5]

[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 airborne particles with a diameter of 10 microns or smaller, more of which would be considered to be in the respirable range on which the health-based comparison level for manganese is based.
[5] OEPA staff operated the monitors and sent the sample filters to the analytical laboratory under contract to EPA.

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 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

[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.

[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.

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 has 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 level(s). 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.[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 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 actions taken to address the type of ubiquitous emissions that come 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:

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[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.

[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).

- → 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 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

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 Figure 2) with regard to areas of interest identified below.

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

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 estimate indicate influence from nearby sources of manganese, and the manganese longer-term concentration estimate is somewhat above the long-term comparison level. These data, along with OEPA monitoring data for other locations indicate a potential for health concerns from continuous, long-term exposures, particularly in locations closer to the sources than those monitored in this project. This supports the finding of OEPA (see section V).

Manganese, the key pollutant:

- Do the monitoring data indicate influence from a nearby source?
  - → The data collected include manganese (PM_{10}) concentrations higher than concentrations commonly observed in other locations nationally.[12] Additionally, as discussed in section IV.C below, on the day on which the highest concentration was measured, the wind information indicates portions of the average daily winds were from the direction of the two sources discussed in section III above.
- Do the monitoring data indicate elevated levels that pose long-term health concerns?
  - → The monitoring data for manganese, in addition to OEPA data for other locations, indicate a potential for health concerns from long-term, continuous exposures, particularly in locations closer to the sources.
    - 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 somewhat above 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]

[12] For example, more than half of the concentrations at this site (Table 2) were higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because the NATTS are generally sited so as not to be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark for indicating potential influence from a source nearby to this school.
[13] The upper end of the interval is nearly two times the mean of the monitoring data but only 10% of the noncancer-based long-term comparison level.
[14] 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). For example, continuous, long-term exposure levels approximately 1000 times higher than the comparison level are reported to cause neurological effects in workers exposed in industrial workplaces that process metallic materials.

  - As manganese has not been found to be carcinogenic, it has no cancer-based comparison level.[11, 15]
  - Given the distance between the monitoring location and the industrial facilities from which manganese is emitted (and consideration of other monitoring data discussed in section V below), and data collected by OEPA at this and other locations, airborne manganese concentrations are expected to be higher at locations closer to those facilities.

→ In summary, the estimate of longer-term concentration, while below longer-term exposure levels at which health effects have been documented, indicates a potential for health concerns from long-term, continuous exposure, most particularly in areas of the community closer to the sources than the location monitored in this project.

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

  → We identified one sample result which was higher than the individual sample screening level.[14] A sample result above the screening level does not mean that there is a risk to children at the school. The individual sample screening level was a signal to EPA to evaluate and track that and subsequent results. Based on all the results, we did not identify concerns regarding short-term exposure for this area.

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.

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)?

  → 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).[16]

[15] www.epa.gov/iris

[16] 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

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 sources in the air sample collected.

The meteorological station at East Elementary School collected wind speed and wind direction measurements beginning July 29, 2009, continuing through the sampling period (August 12, 2009-October 4, 2009), and ending November 20, 2009. As a result, on-site data for these meteorological parameters are available for all dates of sample collection, and also for a period before and after the sampling period, producing a continuous record of approximately nearly four months of on-site meteorological data. The meteorological data collected at the school on sample days are presented in Figure 3 and Table 2.

Several years of meteorological data have been collected by OEPA at their Water Plant monitoring location in the 2200 block of Michigan Avenue. Wind measurements taken at this station are presented in Appendix E. This wind data indicates a strong southwesterly wind influenced by the Ohio River.

The nearest NWS station is at Pittsburgh International Airport. This station is approximately 18 miles south-southeast of the school. Measurements taken at that station include wind, temperature, and precipitation. These are presented in Table 2 and Appendix E.

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

- Both the sampling results and the on-site wind data indicate that air samples were collected on days when the two key sources were contributing to conditions at the school location.
- The wind patterns at East Elementary School across sampling dates are generally similar to those observed across record of on-site meteorological data during the sampling period.
- Wind data collected by OEPA at their Water Plant monitoring location are not similar to the wind patterns observed at East Elementary. The possibility of a river influence on wind speed and direction is strongest at the Water Plant location because it is the monitoring location closest to the Ohio River.
- Our ability to provide a confident characterization of the wind flow patterns at the monitoring site over the long-term is somewhat limited as neither the data from the NWS station in Pittsburgh International Airport nor the data collected by OEPA from the Water Plant appear to represent the specific wind flow patterns at the school location during the monitoring period. Therefore, the 2-month sampling period may not be representative of year-round patterns.

- What is the direction of the key sources of manganese emissions in relation to the school location?
  - → There are two nearby industrial facilities owned by S.H. Bell that emit manganese compounds into the air (described in section III above). The larger facility, Stateline, lies less than two miles east-northeast of the school and the smaller facility, Little England, lies one-quarter mile southeast of the school.
  - → Using the property boundaries for both facilities (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 these facilities on air concentrations at the school.
  - → This general range of wind directions is referred to here as the expected zone of influence (ZOI). The zone of influence is approximately 55 to 135 degrees (see Figure 3).

- On days the air samples were collected, how often did wind come from the direction of one of the key sources?
  - → The highest manganese concentration (621 ng/m^3) was recorded on a day in which almost 30 percent of the hourly winds came from the ZOI. The second highest manganese concentration (116 ng/m^3) occurred on a day when 25 percent of the hourly winds came from the ZOI. There were an additional two days in which portions of the daily wind were coming from the ZOI (see 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 record of on-site meteorological data during the sampling period.
  → We note that wind patterns at the nearest NWS station (at Pittsburgh International Airport) during the sampling period are not similar to the on-site wind patterns; additionally, the on-site wind patterns at the school is not similar to those recorded at the NWS station over the long-term (2002-2007 period; Appendix E). There is some uncertainty as to whether the general wind patterns at the school location for longer periods would be similar to the general wind patterns at Pittsburgh International Airport (see below). Wind data collected by OEPA at the Water Plant location also differ from data collected at the school indicating winds predominantly from the southwest with a strong river influence.

- How do wind patterns at the school compare to those at the Pittsburgh 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 two months), prevalent winds at the school site are predominantly from the north and northwest, while those at the NWS station are more scattered around the compass from the north, east, and south. The windroses for the two sites during the sampling period (Figure 3 and Appendix E) show differences in wind flow patterns, most likely resulting from nearby terrain.

- 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, OEPA has been monitoring metals, including manganese, in total suspended particles (TSP) from the locations within 2 miles of this school. TSP samplers capture airborne particles of sizes ranging from about 0.1 up to about 25 to 50 microns, which 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.

The Agency for Toxic Substances and Disease Registry (ATSDR) has conducted an analysis of the OEPA data collected through December 2009.[17] These analyses indicate that, among the

[17] The analysis by ATSDR is available at: http://www.atsdr.cdc.gov/HAC/PHA/HCPHA.asp?State=OH

three OEPA sampling locations, the highest manganese concentrations were observed at the Water Plant site, where the long-term average concentrations were substantially higher than EPA and ATSDR health-based chronic comparison levels.[18] Concentrations at the other two monitoring locations, including the one near East Elementary, were somewhat above the comparison levels although much lower than those measured at the Water Plant location. Additionally, data for more samples collected in the most recent year indicate somewhat lower manganese concentrations than do earlier samples.[19]

VI. Key Source Information

- Were the sources operating as usual during the monitoring period?
  - Due to the downturn in the economy, the source was operating at about half capacity during the monitoring period.

- How have emissions from these sources been controlled?
  - To date, there have been no manganese emissions estimates for this source in the National Emissions Inventory.
  - Enforcement Actions by taken EPA and OEPA in 2008 required a number of changes to operations at S.H. Bell to control dust emissions including: construction of a truck load-out shed controlled with a baghouse on the Ohio side of the larger of the two facilities, and a road paving project for over 14,850 sq. feet of roadway. These actions also clarified that the facility no longer crushes or grinds nonmetallic minerals. The goal of the projects was to help minimize particulate matter emissions resulting from load-out and roadway use, which should result in reduced manganese emissions as well. These projects were completed by February 2009.
  - These sources of manganese (described in section III above) have submitted permit applications that are currently under review by OEPA.[20]
  - Recent enforcement activities by OEPA are anticipated to result in additional substantial reductions in particulate matter, including manganese, by November 19, 2010. The actions required by the state include installation of emission control devices such as baghouses, improved material handling requirements, and suppression of possible emissions from materials.

[18] The EPA comparison level considered by ATSDR is the same level used here, the EPA reference concentration or RfC (http://www.epa.gov/ncea/iris/subst/0373.htm). The ATSDR comparison level used was the ATSDR minimal risk level (MRL). Although ATSDR has published a draft revision to the MRL for comment, given its lack of final status, the comparison level used in ATSDR's analysis was the previously established level. The RfC and MRL are for inhalation exposure to manganese and consequently are based on manganese particles in the size range described as respirable, which is generally considered to be somewhat smaller than 10 microns in diameter. 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).

[19] Additionally, ATSDR's analysis, which included other metals measured in the OEPA samples, concluded that manganese is the only metal of health-related concern in the East Liverpool community for ambient air exposure.

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

VII. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What is the key HAP for this school?
   → Manganese is the key HAP for this school, identified based on its close proximity to two ferrous and non-ferrous handling and material storage facilities. The monitoring data collected confirm elevated airborne levels of manganese, which in conjunction with wind information indicates influences of these sources on airborne manganese concentrations at this school.

2. Do the data collected at this school indicate a level of concern, as implied by information that led to identifying this school for monitoring?
   → The measured manganese (PM_{10}) levels and the estimated longer-term concentration estimate indicate a potential for health concerns from long-term continuous exposures, particularly for locations closer to and downwind of the key sources. The data collected here for manganese (PM_{10}) are consistent with previous monitoring for manganese-TSP performed by OEPA in the area. These data are also consistent with OEPA conclusions regarding influence of the two S.H. Bell facilities on airborne manganese levels at this location.

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 over 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 not be representative of long-term wind flow patterns at that site; however, the wind flow patterns at the NWS station during the sampling period are also not representative of the on-site wind flow patterns. Similarly, the long-term wind flow patterns at OEPA's Water Plant station do not appear to be representative of long-term wind flow patterns at the school. 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 limit somewhat our ability to confidently predict longer-term wind patterns at the school (which might provide further evidence relevant to concentrations during other times).

B. Next Steps for Key Pollutants

1. U.S. EPA recommends additional monitoring for manganese (PM_{10} and $PM_{2.5}$) to better characterize the potential for exposures of concern in the community and to monitor any changes in airborne manganese concentrations that might be associated with source control activities.
2. U.S. EPA will continue to support OEPA on actions to characterize manganese sources in this community. Both U.S. EPA and OEPA have taken enforcement actions to address particulate matter emissions from these sources, which will also reduce manganese emissions. It is anticipated that the recent actions taken by OEPA will substantially mitigate risks from manganese in the area; however, OEPA will continue to monitor to verify that these emissions are decreasing.
3. OEPA will continue to oversee industrial facilities in the area through air permits and other programs.

VIII. Figures and Tables

A. Tables

1. East Elementary School – Key Pollutant Analysis.
2. East Elementary School Key Pollutant Concentrations and Meteorological Data.

B. Figures

1. Locations of Key Sources and Monitor Locations.
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Figure 1. Locations of Key Sources and Monitor Locations.

Table 1. East 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	94.4 [d]	0 - 227	NA	50

ng/m^3 nanograms per cubic meter
NA Not applicable

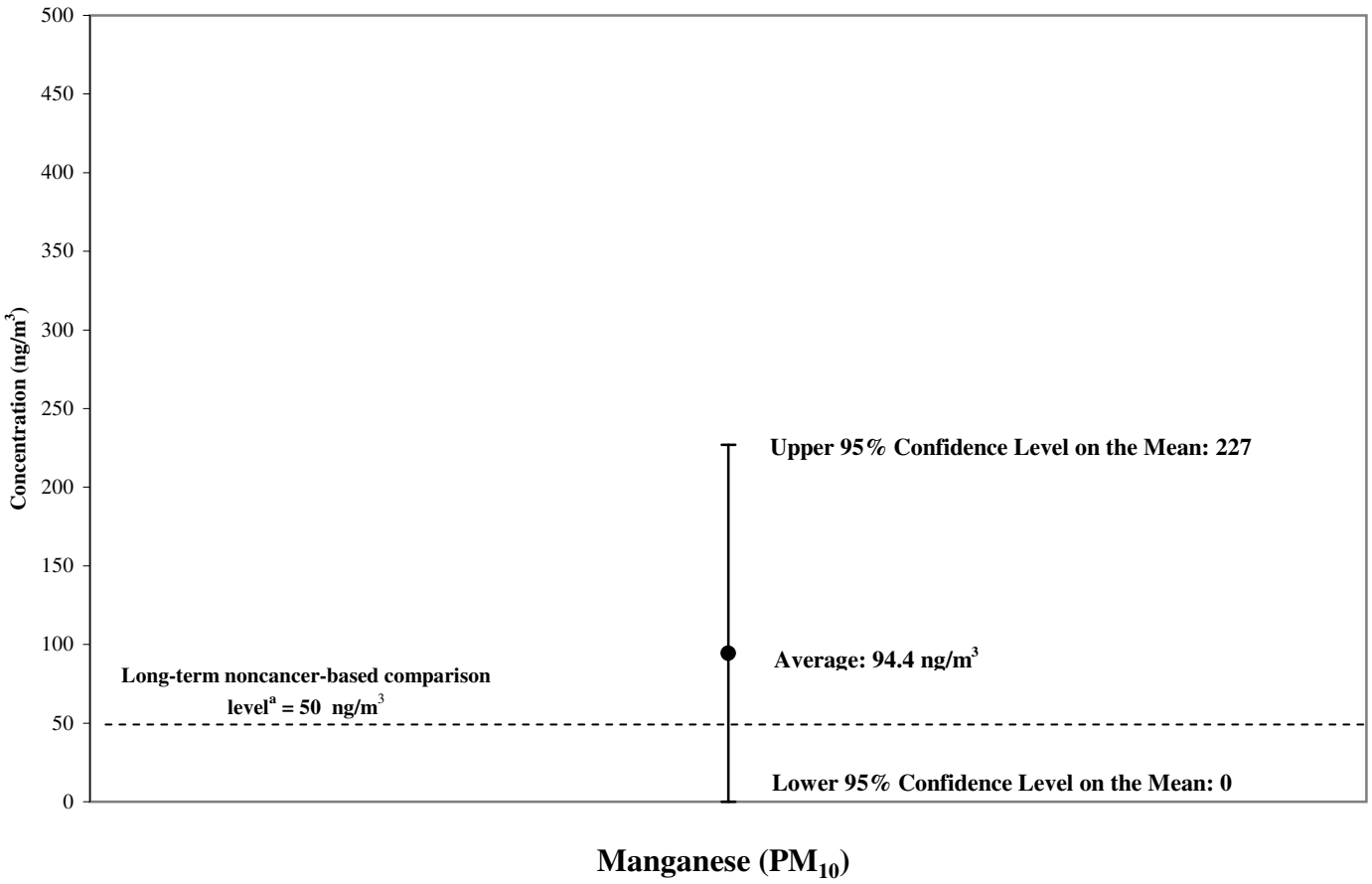
[a] Details regarding these values are in the technical report, Schools Air Toxics Monitoring Activity (2009) Uses of Health Effects Information.

[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 mean of measurements for manganese (PM_{10}) is the average of all sample results, which include ten detections that ranged from 4.44 to 621 ng/m^3.

Figure 2. East 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.

Table 2. East Elementary School Key Pollutant Concentrations and Meteorological Data.

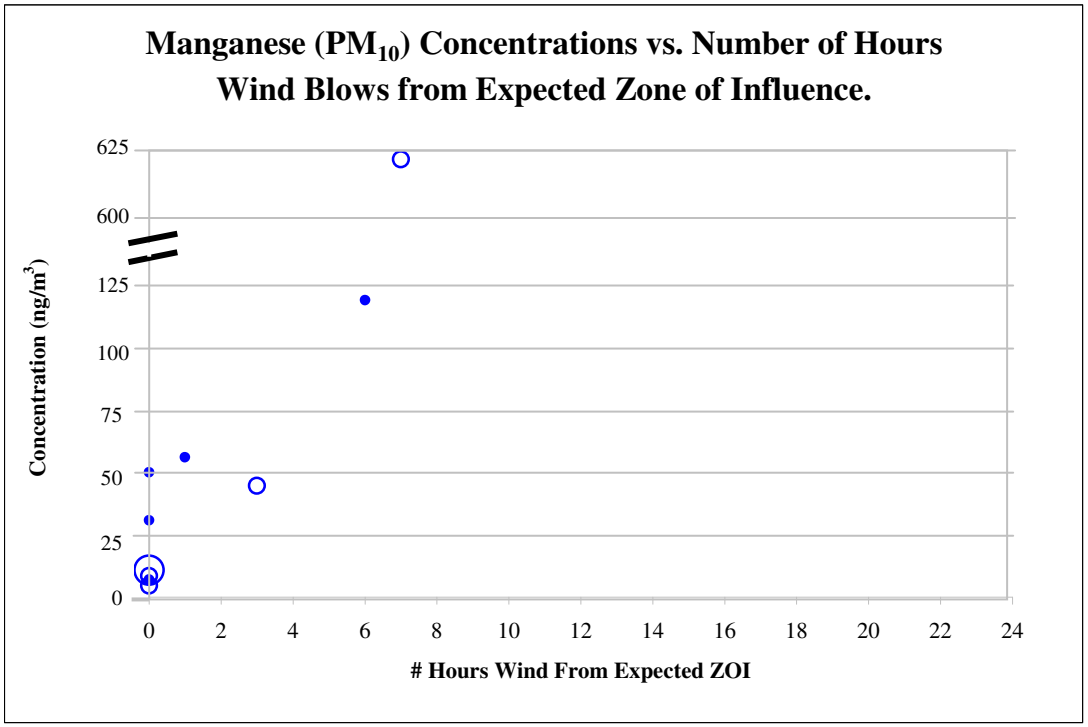
Parameter	Units	8/12/2009	8/17/2009	8/23/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009
Manganese (PM_{10})	ng/m^3	30.0	54.6	6.83	8.19	116	621	43.5	48.8	10.5	4.44
% Hours w/Wind Direction from Expected ZOI[a]	%	0.0	4.2	0.0	0.0	25.0	29.2	12.5	0.0	0.0	0.0
Wind Speed (avg. of hourly speeds)	mph	2.4	1.9	2.2	3.6	1.8	2.8	3.7	1.7	5.2	3.1
Wind Direction (avg. of unitized vector)[b]	deg.	342.4	316.8	309.2	283.5	10.6	28.6	34.5	319.7	254.7	276.2
% of Hours with Speed below 2 knots	%	45.8	70.8	75.0	45.8	79.2	50.0	29.2	87.5	12.5	33.3
Daily Average Temperature	° F	70.2	79.2	65.3	69.5	66.9	65.6	64.7	68.8	59.4	53.5
Daily Precipitation	inches	0.12	0.00	0.00	0.55	0.00	0.18	0.00	1.02	1.50	0.00

All precipitation and temperature data were from the PITTSBURGH INTERNATIONAL AIRPORT 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 3. East Elementary School (East Liverpool, OH) Manganese (PM_{10}) Concentration and Wind Information.



KEY

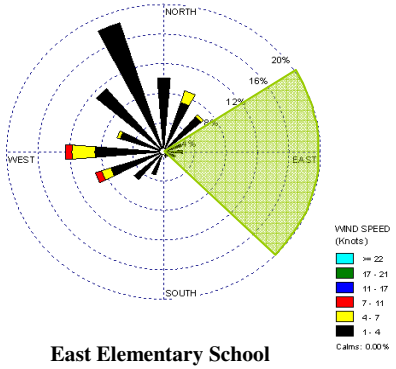
Pollutant: Manganese (PM_{10})

Timeframe: August 12 - October 4, 2009

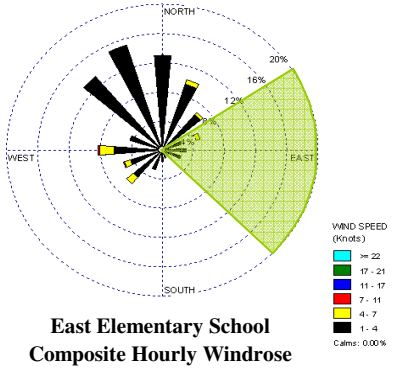
Note

Each symbol denotes a 24-hour collection of air for chemical analysis. The size of the symbol indicates the magnitude of the wind speed for that day (wind data shown in Table 2). The expected zone of source influence (ZOI) 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



East Elementary School Composite Hourly Windrose on Sample Days (Aug. 12, 2009-Oct. 4, 2009)



East Elementary School Composite Hourly Windrose Across Sampling Period (Aug. 12, 2009-Oct. 4, 2009)

Expected Zone of Source Influence

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.[21]

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.[22] 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.

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

[22] 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.[23] 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.

[23] 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
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

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).[24] 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?

  → 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 (chromium and arsenic) are more than tenfold lower and all but three (chromium, arsenic, and cadmium) are more than 100-fold lower.[25]

  → 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.[26]

Additional Information on Three HAPs:

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

[24] 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.

[25] 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.

[26] 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 mean for chromium (PM_{10}) are approximately 50-60% of the cancer-based comparison level. Further, as Cr^{+6} is commonly only a small fraction of the total,[27] the levels of Cr^{+6} in these samples would be expected to be appreciably lower than this. A review of information available at other sites nationally shows that the mean concentration of chromium (PM_{10}) at this site is lower than the 95th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS (Appendix B). Additionally, as part of the analysis by ATSDR described in section V above, additional chemical analysis was performed on Ohio EPA samples collected in East Liverpool to investigate the potential for chromium to be present in the hexavalent form. The analysis found no hexavalent chromium in the samples.[28]

- The second of the three HAPs mentioned above is arsenic. The mean and 95 percent upper bound on the mean for arsenic (PM_{10}) at the site are approximately 10-17% of the cancer-based comparison level. Additionally, a review of information available at other sites nationally shows that the mean concentration of arsenic (PM_{10}) at this site falls below 95th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS (Appendix B).

- The third HAP mentioned above is cadmium. The mean and 95 percent upper bound on the mean for cadmium (PM_{10}) at the site 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 cadmium (PM_{10}) at this site is lower than the 95th percentile of samples collected from 2004 to 2008 (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.[29]

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

[27] 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.
[28] The analysis by ATSDR is available at: http://www.atsdr.cdc.gov/HAC/PHA/HCPHA.asp?State=OH
[29] General information on additional air pollutants is available at http://www.epa.gov/air/airpollutants.html.

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 does 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 average concentration are more than ten percent of their lowest comparison level are chromium (PM_{10}) and arsenic (PM_{10}). Hexavalent chromium and arsenic pose different types of risks and act on different targets in the body than does manganese, reducing the potential for a cumulative impact. The comparison level for manganese is based on noncarcinogenic effects on the nervous system, whereas the lowest comparison level for hexavalent chromium is based on carcinogenic risk to the respiratory system.[30] Further, as noted above, hexavalent chromium is commonly only a small fraction of the total chromium (PM_{10}) reported and has not been detected in any samples collected in this area by Ohio EPA. Additionally, 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. The longer-term estimate for arsenic (PM_{10}) is only about 10-27% of the arsenic comparison levels. Taken together these considerations reduce any concerns for cumulative health risk from these pollutants.

[30] 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. East 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					
Chromium (PM_{10})	ng/m^3	3.93	2.85 - 5.01	8.3 [e]	100 [e]
Arsenic (PM_{10})	ng/m^3	2.33	0.70 - 3.97	23	15
Non-Key HAPs with mean lower than 10% of the lowest comparison level					
Cadmium (PM_{10})	ng/m^3	0.52	0.16 - 0.87	56	10
Nickel (PM_{10})	ng/m^3	0.60	0.30 - 0.90	420	90
Antimony (PM_{10})	ng/m^3	1.13	0.73 - 1.52	NA	200
Cobalt (PM_{10})	ng/m^3	0.11	0.05 - 0.17	NA	100
Selenium (PM_{10})	ng/m^3	1.51	0.80 - 2.22	NA	20,000
Mercury (PM_{10})	ng/m^3	0.01	0.002 - 0.02	NA	300 [f]
Non-Key HAPs with more than 50% ND results.					
Beryllium (PM_{10})	ng/m^3	60% of results were ND[g]		42	20

ng/m^3 micrograms per cubic meter

NA Not applicable

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

[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] The comparison levels are specific to hexavalent chromium (recognized as the most toxic form) which is a fraction of the total chromium reported.

[f] 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).

[g] Beryllium (PM_{10}) was detected in only 4 of 10 samples, ranging from 0.007 to 0.02 ng/m^3. The MDL is 0.03 ng/m^3.

Appendix D. East Elementary School Pollutant Concentrations.

Parameter	Units	8/12/2009	8/17/2009	8/23/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009	Sample Screening Level[a]
Manganese (PM_{10})	ng/m^3	30.0	54.6	6.83	8.19	116	621	43.5	48.8	10.5	4.44	500
Chromium (PM_{10})	ng/m^3	4.51	5.45	2.15	2.71	4.88	5.58	3.51	6.02	2.15	2.32	580[b]
Arsenic (PM_{10})	ng/m^3	1.12	1.53	2.23	8.27	2.70	2.13	0.99	0.80	0.04	3.51	150
Cadmium (PM_{10})	ng/m^3	0.35	1.14	0.13	0.44	0.50	1.68	0.16	0.35	0.06	0.36	30
Nickel (PM_{10})	ng/m^3	0.41	0.83	ND	0.43	0.89	1.46	0.81	0.69	0.34	0.15	200
Antimony (PM_{10})	ng/m^3	1.27	2.00	0.78	0.72	2.01	1.39	0.73	0.97	0.30	1.09	2,000
Cobalt (PM_{10})	ng/m^3	0.04	0.18	ND	0.06	0.24	0.25	0.16	0.08	0.07	0.02	100
Selenium (PM_{10})	ng/m^3	0.83	3.01	0.46	1.33	1.76	2.16	0.47	3.09	1.56	0.41	20,000
Mercury (PM_{10})	ng/m^3	0.01	0.01	0.001	0.004	0.03	0.02	ND	0.02	ND	ND	3,000[c]
Beryllium (PM_{10})	ng/m^3	ND	0.01	ND	0.007	0.02	0.01	ND	ND	ND	ND	20

Key Pollutant

ng/m^3 nanograms per cubic meter

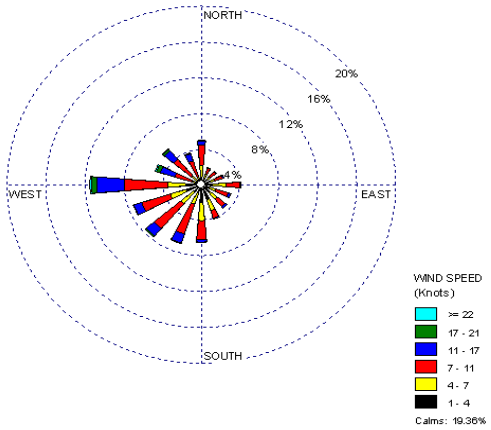
ND No detection of this chemical was registered by the laboratory analytical equipment.

[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 http://www.epa.gov/schoolair/pdfs/UsesOfHealthEffectsInfoinEvalSampleResults.pdf. These 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.

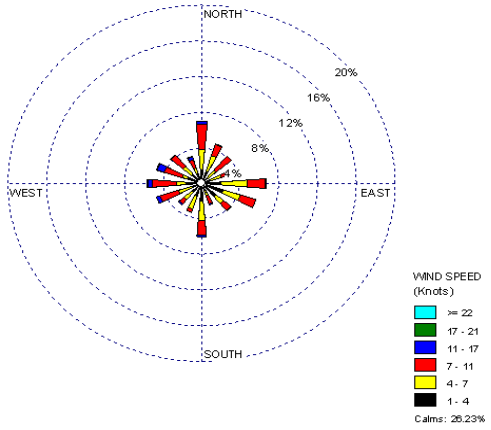
[b] The sample screening levels are specific to hexavalent chromium (recognized as the most toxic form) which is a fraction of the total chromium reported.

[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).

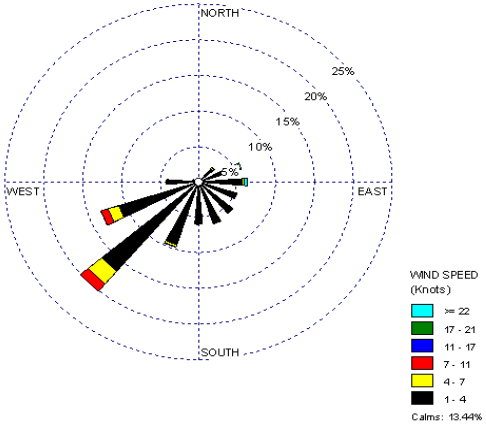
Appendix E. Windroses for Pittsburgh International Airport NWS Station and the Ohio EPA Meteorological Station at the Water Plant.



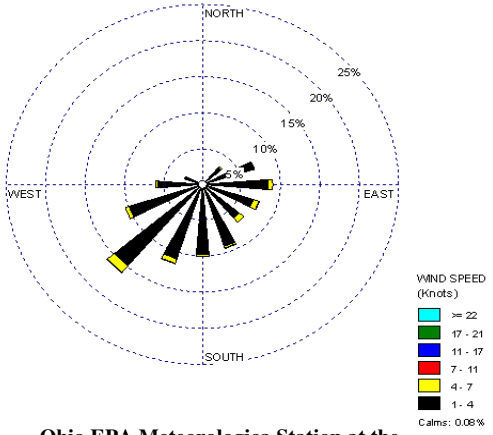
Pittsburgh International Airport NWS Station Composite Hourly Windrose, 2002-2007[1]



Pittsburgh International Airport NWS Station Composite Hourly Windrose Across Sampling Period (Aug 12, 2009-Oct 4, 2009)[1]



Ohio EPA Metorological Station at the Water Plant (Michigan Ave.) Composite Hourly Windrose, 2008[2]



Ohio EPA Meteorologica Station at the Water Plant (Michigan Ave.) Across Sampling Period (Aug 12, 2009-Oct 4, 2009)[2]

[1] **Pittsburgh International Airport (WBAN 94823) is 18.07 miles from East Elementary School.**

[2] **The Ohio EPA Meteorological Station at the Water Plant is 1.25 miles from East Elementary School.**