

Letter Health Consultation

IMPERIAL LANDFILL SITE

IMPERIAL, ALLEGHENY COUNTY, PENNSYLVANIA

EPA FACILITY ID: PAD987285624

**Prepared by the
Agency for Toxic Substances and Disease Registry and the
Pennsylvania Department of Health**

MAY 17, 2010

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO

or

Visit our Home Page at: <http://www.atsdr.cdc.gov>

Re: Imperial Landfill Site
Imperial, Allegheny County, PA
Letter Health Consultation

Dear Petitioner,

In April 2009, ATSDR received your request to conduct public health assessment activities at the Wilson Elementary School located adjacent to the Imperial Landfill (Landfill) in Imperial, Allegheny County, Pennsylvania. As requested ATSDR obtained more information about the health risks associated with the chemicals released from the landfill. After internal review and initial data gathering, on May 15, 2009, ATSDR accepted your petition and provided you with a letter stating that ATSDR will work with the Pennsylvania Department of Health (PADOH) in evaluating the available data and summarizing our evaluation in a letter health consultation (LHC). This LHC will provide you with our evaluation of the available data, our conclusions based on this data, and our recommendations for future actions to protect the public's health, especially the students, faculty, and staff at the Wilson Elementary School (School).

PADOH and ATSDR concluded that the sampling conducted by the Allegheny County Health Department (ACHD) and Pennsylvania Department of Environmental Protection (PADEP) partially characterized two points of exposure for specific chemicals and exposure durations: the Wilson School parking lot and the indoor air at the Wilson Elementary School (School). However, additional sampling would be helpful in providing a more complete understanding of this ongoing exposure, especially inside the School where more extended exposures are likely to occur. ACHD has stated that it plans to conduct additional sampling to develop a more complete understanding of the air at the Wilson Elementary School. On March 4, 2010, ATSDR provided ACHD and PADEP with specific sampling recommendations and procedures for this additional sampling.

To date, ACHD and PADEP sampling included monitoring (hydrogen sulfide or H₂S, and methane), real-time sampling (with the PADEP mobile laboratory), grab sampling (with tedlar bags), and 24-hour sampling (with summa canisters and charcoal tubes). Although some real-time and grab sampling data are useful for evaluating acute chemical exposures to the public, these data are typically not well-suited for evaluating chronic exposures (i.e., detection limits may be too high to evaluate chemicals for chronic exposures to the public; sample collection periods may be too short). The extended sample collection period sampling events, such as those using summa canisters, charcoal tubes, and impinger samples provide the most appropriate data for evaluating intermediate (15 to 364 days) and chronic (365 or more days) exposures to chemicals in the air. Additionally, continuous monitoring provides the best data for evaluating exposures to certain chemicals (including hydrogen sulfide and methane) and for identifying the presence of landfill gases in the air outside and inside the School.

ATSDR and PADOH screened the available environmental sampling data for this site against appropriate ATSDR health and environmental guidelines (acute, intermediate or chronic exposure durations). These health-based screening values are called comparison values or CVs. ATSDR CVs are conservative estimates of contaminant levels below which no health

effects would be expected. Concentrations above a CV will not necessarily be harmful. CVs are considered screening values, and contaminants which exceed a CV require further evaluation to determine whether or not adverse health effects are likely. When an ATSDR CV is not available, screening values, when available, are acquired from other environmental and health agencies such as the U.S. Environmental Protection Agency or a state agency.

Most of the chemicals sampled and analyzed for at this site did not exceed their respective CVs. Acrolein in the indoor air at the School and benzene detected in the parking lot of the School and at the Santiago Distributors location exceeded their respective CVs. However, acrolein and benzene exposures at the levels detected are not expected to result in harmful health effects.

Methylamine, methyl mercaptan, and ethanol were detected in the School parking lot, outside of the School building. Although ATSDR does not have CVs for these chemicals, toxicological studies suggest adverse health effects can occur from acute and chronic exposures to high enough concentrations of these chemicals. ATSDR has identified a potential acute public health hazard from exposures to methylamine and methyl mercaptan in the parking lot of the School, but the data available cannot be used to make definitive public health conclusions. It is also important to note that these chemicals have not been monitored inside the School and further indoor air evaluation for these chemicals is recommended. Ethanol is not considered to be of public health concern at the levels detected in the air outside the school. Continuous methane monitoring levels inside the school are well below explosive levels or levels where displacement of oxygen can result in adverse health effects. Insufficient data are available to determine whether adverse health effects are possible from exposures to acetaldehyde or formaldehyde, although short-term sampling data from the School parking lot show detections over the chronic health-based comparison values, indicating that there may be a potential exposure concern. A detailed discussion of our screening process, the sampling results, and our public health conclusions and recommendations for all of the chemicals that exceed their CVs or for which we do not have CVs is provided after this letter.

People are capable of detecting a number of chemicals by smell at very low concentrations (although variability exists). A number of chemicals with offensive odors and low odor thresholds were detected in the parking lot at the School, including acetaldehyde, dimethyl sulfide, hydrogen sulfide, methyl mercaptan and methylamine. For some chemicals, odor thresholds can be orders of magnitude below the levels known to cause adverse human health effects. Hydrogen sulfide (maximum concentration of 14.5 ppb at the School), exceeded its odor threshold of 0.5 ppb, but was still below its health-based comparison value (20 ppb). Methylamine, detected in the School parking lot (maximum of 3,041 ppb), was considerably higher than its odor threshold of 19 ppb. It is most likely that the “rotten” and “fishy” smells and other foul odors being detected by people at the School are from hydrogen sulfide, dimethyl sulfide, aldehydes (including acetaldehyde and formaldehyde) and amines (including methylamine and triethylamine), although other chemicals are probably contributing to these odors. Though landfill odors may not be associated with a specific disease, these odors can cause symptoms such as headaches, nausea, watery eyes, irritated throat, coughing and congestion. The added disruption and stress caused by the annoyance with these odors during day-to-day activities, can greatly impact quality of life.

ACHD collected self-reported health information from School faculty and staff members in June 2009. It is not possible to use the results from a descriptive tool such as this survey to conclusively determine that odors are *causing* symptoms at the School. Using this survey, ACHD observed that a high percentage of the people surveyed reported noticing odors frequently, perceiving strong or very strong odors, and a high level of annoyance with these odors. Nearly all of the respondents to the survey (95.6%) were concerned about health risks that may be associated with working at the School, and no respondents reported not noticing odors or not being annoyed with the odors. ACHD determined there were significant correlations between how often people reported noticing odors and how often people also reported throat irritation and headache. ATSDR and PADOH conclude that the ACHD survey results support that symptoms consistent with exposures to odorous chemicals are occurring in School faculty and staff. ATSDR and PADOH concur with ACHD that this survey is helpful in emphasizing that odors are a serious issue for many employees and others at the School.

Through citizen reporting, regulatory inspections, and enhanced oversight by the ACHD, EPA, and PADEP, a number of violations and deficiencies have been identified at the Imperial Landfill. Because these regulatory enforcement agencies are working with the landfill owner, a number of corrective actions have already occurred and a number of additional activities are expected to take place, either through agreements or through enforcement actions. These steps are intended to eliminate releases of chemicals to offsite areas and to reduce the odors emanating from the landfill (i.e. upgrading gas collection system and onsite wells), and to provide an added level of protection within the School (e.g. activated carbon filtration on the ventilation system). Continued oversight and enforcement is essential in ensuring the safety and health of the community surrounding this landfill, especially at the Wilson Elementary School. ATSDR and PADOH support rigorous enforcement of the landfill permits and efforts to bring this landfill into permit compliance as soon as possible. ATSDR and PADOH will continue to work with ACHD and PADEP to address the nuisance odors and airborne chemicals identified at the Wilson Elementary School.

Additional information regarding the site, our evaluation of the sampling efforts and its relevance to human health, ongoing site activities, and recommendations, is attached. If you have any questions regarding this letter or its contents, please feel free to contact us. Our contact information is provided below.

Sincerely,

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LETTER HEALTH CONSULTATION

IMPERIAL LANDFILL SITE

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Prepared By:

Agency for Toxic Substances and Disease Registry
And the
Pennsylvania Department of Health
Division of Environmental Health Epidemiology
Under Cooperative Agreement with the
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Summary	
Introduction	<p>The Agency for Toxic Substances and Disease Registry (ATSDR) was petitioned by a community member to review air data at the Wilson Elementary School (School). Students and faculty have experienced smelling foul odors at the School and these odors have become more malodorous and more common since the winter of 2008/2009. The initial petition request stated that students and staff were experiencing headaches, nausea, sinus issues, throat problems and “a feeling of being drugged”. ATSDR and PADOH evaluated the chemical levels at the Wilson Elementary School and near the Imperial Landfill. More specifically, PADOH and ATSDR evaluated the potential and completed exposure pathways associated with the chemicals detected in the air on-site and off-site, especially at the School.</p>
Overview of Sampling Data and Limitations:	<p>The Allegheny County Health Department (ACHD) and Pennsylvania Department of Environmental Protection (PADEP) conducted sampling and monitoring both onsite (landfill) and offsite (including the Wilson Elementary School and the Santiago Distributors locations). All PADEP sampling conducted at the School was outside of the School buildings. ACHD conducted sampling both inside the School building and outside of the building. Offsite sampling techniques included real-time sampling (for permit compliance), grab (or tedlar bag) sampling, and longer duration (for public health evaluation purposes) sampling using charcoal tube and summa canisters.</p> <p>A wide range of sampling and analytical procedures were employed in the collection of the analytical data evaluated in this document. Some of the data evaluated in this document was not collected for public health evaluation, but instead to monitor for landfill permit compliance. These data have limited use for public health. Specifically:</p> <p>Sampling was conducted on the landfill property to determine instantaneous airborne gas concentrations, to identify the presence of chemicals or to fingerprint the chemical mixture for comparison. Some of the landfill monitoring locations are not human exposure points (i.e. monitoring well headspace), so a direct comparison to human health comparison values is not appropriate.</p> <p>Some sampling conducted offsite was performed for landfill permit compliance using a monitoring technology known as an open-phase Fourier transform infrared (OPFTIR) device. This</p>

	<p>device is used to identify the presence of chemicals from a known library, but the data have limitations: it provides an instantaneous average reading along the entire path of the infrared beam and due to environmental variables, it has a variable and often high lower detection limit. Since the results are obtained from instantaneous readings, they are only compared to acute exposure comparison values. The OPFTIR data has limited quality control and quality assurance, so these data are only used as screening level data for public health evaluation. For this reason, ATSDR and PADOH report the conclusions from our evaluation of OPFTIR data as of <i>potential</i> public health concern. ATSDR and PADOH recommend further confirmatory sampling of chemicals that are reported to be above acute comparison values by OPFTIR monitoring.</p> <p>Some of the sampling performed for public health evaluation at this site were limited by the analytes and compounds analyzed at the laboratory. Some common landfill chemicals, including aldehydes and amines, are not well sampled by traditional public health sampling protocols. These chemicals require specific sampling procedures.</p>
<p>Conclusions:</p> <p>General</p> <p>Inside School</p> <p>Outside School</p> <p>Conclusion 1</p> <p>Basis for conclusion</p>	<p>ATSDR and PADOH conclude:</p> <p>ACHD conducted monitoring of the indoor air for a subset of the chemicals of interest and found no chemicals at levels of public health concern. The indoor air system includes an activated charcoal filtration system which is designed to filter harmful organic chemicals before entering the indoor air.</p> <p>ACHD conducted monitoring of the air outside the School and did not find chemicals at levels of public health concern. PADEP conducted screening of chemicals related to the landfill for permit compliance purposes outside the School. Their screening events identified some chemicals which require further public health evaluation.</p> <p>Methyl Mercaptan and Methylamine Exposures: There is a potential for an acute public health hazard in the School parking lot.</p> <p>Although site-specific data are limited, the methylamine levels detected exceeded the Texas Commission on Environmental Quality (TCEQ) effect screening level (ESL) on six of eight occasions. For methylamine, transient irritation of the eye, nose and throat has resulted from brief exposures at high concentrations (20,000-100,000 ppb).</p>

	<p>The maximum instantaneous levels of methyl mercaptan detected in the School parking lot exceed the National Institute for Occupational Safety and Health (NIOSH) short-term recommended exposure limit (REL [15-minute]). The occupational limit is used since no other health screening level is available. For methyl mercaptan, acute inhalation exposure can irritate the mucous membranes of the respiratory tract, and restlessness, headache, staggering, and dizziness may develop.</p> <p>Children may be more vulnerable to gas exposure because of relatively higher minute ventilation per body weight and failure to evacuate an area promptly when exposed. Therefore, ATSDR and PADOH conclude that <i>potential adverse health effects may occur from exposure to either of these chemicals.</i></p>
<p>Conclusion 2 Basis for conclusion</p>	<p>Benzene Exposures: No harm is expected from short-term or long term exposures based on time spent at the School. The benzene levels at the School are not expected to result in acute health effects. Chronic health effects from benzene exposures are not expected at the School.</p>
<p>Conclusion 3 Basis for conclusion</p>	<p>Formaldehyde, Triethylamine Exposures: There is a lack of data or information for the levels of these chemicals. <i>The data on formaldehyde and triethylamine is too limited to determine whether levels at the School are of public health concern.</i></p>
<p>Conclusion 4 Basis for conclusion</p>	<p>Methane, Acetaldehyde, Acrolein, Ethanol, Hydrogen Sulfide, Dimethyl Sulfide Exposures: No harm is expected at these levels. The levels of methane are not at explosive concentrations and are not high enough to displace significant amounts of oxygen at the School. Based on the limited acetaldehyde data collected at the School, no adverse health effects from acute exposures are expected. There is no data to evaluate chronic exposures to acetaldehyde. No public health hazard has been identified for acute or chronic exposures to the acrolein levels at the School. The levels of ethanol detected at the School are not likely to cause adverse health effects. The hydrogen sulfide levels are below health screening levels.</p>
<p>Recommendations</p>	<p>ATSDR and PADOH recommend that the best way to prevent exposures to landfill chemicals is to control emissions from the landfill.</p> <p>ATSDR and PADOH recommend: 1) Continued monitoring for hydrogen sulfide and methane. Additional simultaneous monitoring of hydrogen sulfide inside and outside the School is recommended; 2) Continued efforts by regulatory agencies to enforce permit requirements which are meant to reduce the</p>

	<p>migration of chemicals offsite and to eliminate nuisance odor issues, especially at the Wilson Elementary School; 3) Acute and chronic exposure assessments of aldehydes and amines (including methylamine and acetaldehyde) and methyl mercaptan, which are not best evaluated via summa canister sampling, both inside and outside the School; 4) That the School limits the practice of idling buses and other vehicles in the school parking lot. This may help to reduce acute exposures to benzene at the School; 5) Further evaluation of formaldehyde inside and outside the School is recommended to determine chronic exposure conditions and to better evaluate short term exposures; 6) That the West Allegheny School District (especially Wilson Elementary School) consider looking into a program to evaluate indoor air sources of chemicals, if activities to evaluate and improve indoor air quality at the school have not already been initiated. One such program is the EPA 'Tools for Schools' program: http://www.epa.gov/iaq/schools/; 7) On particularly high odor days, school officials may want to consider reducing outdoor activities for students with underlying health conditions (such as asthma) and those who are especially sensitive to the noxious effects of the odors, as a precautionary measure; and 8) Children experiencing symptoms at school should be evaluated by the school nurse and their family health care provider. ATSDR and PADOH are available to discuss this public health evaluation and the available information for the school with parents and health care providers with questions or concerns about individual children.</p>
<p>PHAP: Completed and Ongoing or Planned Actions</p>	<p>Since April 2009, ATSDR and PADOH has held conference calls and meetings with the Allegheny County Health Department (ACHD) and the Pennsylvania Department of Environmental Protection (PADEP) to obtain environmental data for the Imperial Landfill and any additional relevant information about the landfill and its surroundings.</p> <p><u>Other Planned Actions</u> ATSDR and PADOH will: 1) Provide this <i>Imperial Health Consultation</i> to PADEP, ACHD, EPA, and the petitioner; 2) Recommend that PADEP or ACHD perform additional sampling, with reference to guidance provided by ATSDR. This would be helpful in providing a more complete understanding of this ongoing exposure concern. Additionally, continuous monitoring provides the best data for evaluating exposures to certain chemicals (including hydrogen sulfide and methane) and for identifying the presence of landfill gases in the air outside and inside the School; 3) Work through ACHD to distribute information to the Wilson Elementary School and the Parent Teacher Association (PTA); 4) Work through ACHD to distribute</p>

	information to the Community Board (initiated by the landfill); 5) Work through ACHD to distribute information to the residents and the community surrounding the landfill; and 6) Evaluate the future air results, if additional samples are collected for public health evaluation and if the evaluation is requested.
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I. Background

In April 2009, ATSDR received a request to conduct public health assessment activities at the Wilson Elementary School located adjacent to the Imperial Landfill (Landfill) in Imperial, Allegheny County, Pennsylvania. As requested, ATSDR obtained more information about the health risks associated with the chemicals released from the landfill. After internal review and initial data gathering, on May 15, 2009, ATSDR accepted the petition and provided a petition acceptance letter stating that ATSDR will work with the Pennsylvania Department of Health (PADOH) in evaluating the available data and summarizing our evaluation in a letter health consultation (LHC). This LHC will provide you with our evaluation of the available data, our conclusions based on this data, and our recommendations for future actions to protect the public's health, especially the students, faculty, and staff at the Wilson Elementary School (School).

The Imperial Landfill, located at 11 Boggs Road in Imperial, PA, is operated by Allied Waste/Browning-Ferris Industries (BFI). BFI has operated the Imperial Landfill since 1973. The landfill covers more than 400 acres of land; 140 acres are permitted for disposal. The facility is permitted to accept an average of 3,100 tons of waste per day and a maximum of 4,333 tons of waste per day. The site accepts municipal solid waste and nonhazardous industrial (residual) and special handling wastes (i.e. asbestos, sludges, etc.). The facility currently complies with EPA Subtitle D requirements (from <http://www.facilityreview.com/Site%20Profiles%20a-e/BFI%20Imperial.htm>).

The Wilson Elementary School is located at 100 Bruno Lane, a side street just east of the southern portion of the landfill along Boggs Road. The School property is located approximately a quarter mile (1,320 feet) to the east of the landfill. Figure 1 provides a layout of the site.



Figure 1. Site Map

During our initial discussions regarding the Wilson School, we learned that the students and faculty have experienced smelling very foul odors at the School and that these odors have become more malodorous and more common since the winter of 2008/2009. The initial petition request stated that students and staff were experiencing headaches, nausea, sinus issues, throat problems and “a feeling of being drugged”.

Since April 2009, ATSDR has held conference calls and meetings with the Allegheny County Health Department (ACHD) and the Pennsylvania Department of Environmental Protection (PADEP) in order to obtain environmental data for the Imperial Landfill and any additional relevant information about the landfill and its surroundings. Through these discussions and after reviewing relevant site documents provided by ACHD and PADEP, ATSDR and PADOH learned that the landfill had a number of problems controlling emissions and maintaining its site controls. The landfill was cited for violating its permit requirements on a number of occasions (3/3/09, 4/16/09, 4/23/09, 5/29/09, 10/1/09, and 10/3/09) and nearly 100 separate citizen complaints were submitted to the PADEP regarding landfill odors between March and October, 2009. The permit violations relate to landfill odors being detected off the landfill property. Citizen complaints were related to the offensive odors near the landfill, particularly in the morning and evening.

II. ATSDR Evaluation Process

Variable sampling techniques employed by ACHD and PADEP resulted in multiple data sets for evaluation by ATSDR and PADOH. ATSDR and PADOH conduct an evaluation of the analytical data to determine whether an exposure pathway exists. A completed exposure pathway exists when all of the five elements are present: (1) source of the contamination (landfill); (2) transport through an environmental medium (air); (3) a point of exposure (School); (4) a route of human exposure (inhalation); and (5) a receptor population (students, faculty, staff, visitors). ATSDR and PADOH categorize an exposure pathway as completed when all five elements exist and exposure to a contaminant has occurred in the past, is currently occurring, or will occur in the future.

The exposure pathway identified at the Wilson School is well documented; see the PADEP April 24, 2009 Press Release titled, *DEP Confirms Odors at the Wilson Elementary School Originating from Imperial Landfill*. After identifying the completed exposure pathway, an evaluation of the analytical data and sampling techniques was performed.

ATSDR has developed health-based comparison values (CVs) that are chemical-specific concentrations, which help to determine which environmental contaminants are of possible health concern and need further evaluation. If a chemical concentration is found in the environment at levels below the CV, it is not likely to cause adverse health effects, though chemicals that exceed CVs do not necessarily produce adverse health effects. If a contaminant exceeds its corresponding CV or does not have a CV, ATSDR and PADOH examine health-based, guideline levels and evaluates toxicological research and data for the contaminant. See <http://www.atsdr.cdc.gov/> for more information about the ATSDR health evaluation process.

During the evaluation process, ATSDR and PADOH will determine if the concentration detected exceeds its acute, intermediate or chronic CV. If a chemical in the exposure pathway exceeds its CV, it is identified as a contaminant of concern (COC) and further evaluation is performed (see Part IV). COCs are compared to toxicological studies which identify health effect levels for specific chemicals based on the exposure frequency and duration and specific exposure routes (such as inhalation). When a COC exceeds its health effect level, an exposure dose is calculated and a discussion of the potential adverse health effects is presented in the document. Some of the data provided for certain chemicals indicate elevated levels in the air, but cannot be compared to chronic CVs due to limited data. At the end of this document, ATSDR and PADOH will provide recommendations for filling data gaps where limited data does not allow for a comprehensive public health evaluation.

III. Data Limitations

A wide range of sampling and analytical procedures were employed in the collection of the analytical data evaluated in this document. Some of the data evaluated in this document was not collected for public health evaluation, but instead to monitor for landfill permit compliance. These data have limited use for public health and these limitations are discussed in the text and summarized here.

Sampling was conducted on the landfill property to determine instantaneous airborne gas concentrations, to identify the presence of chemicals or to fingerprint the chemical mixture for comparison. Some of the landfill monitoring locations are not human exposure points (i.e. monitoring well headspace), so a direct comparison to human health comparison values is not appropriate.

Some sampling conducted offsite was performed for landfill permit compliance using a monitoring technology known as an open-phase Fourier transform infrared (OPFTIR) device. This device is used to identify the presence of chemicals from a known library, but the data have limitations: it provides an instantaneous average reading along the entire path of the infrared beam and due to environmental variables, it has a variable and often high lower detection limit. Since the results are obtained from instantaneous readings, they are only compared to acute exposure comparison values. The OPFTIR data has limited quality control and quality assurance, so these data are only used as screening level data for public health evaluation. For this reason, ATSDR and PADOH report the conclusions from our evaluation of OPFTIR data as of potential public health concern. ATSDR and PADOH recommend further confirmatory sampling of chemicals that are reported to be above acute comparison values by OPFTIR monitoring.

Some of the sampling performed for public health evaluation at this site were limited by the analytes and compounds analyzed at the laboratory. Some common landfill chemicals, including aldehydes and amines, are not well sampled by traditional public health sampling protocols. These chemicals require specific sampling procedures.

IV. Analytical Data Summary and Evaluation

For this evaluation, ATSDR and PADOH evaluated many different data sets. The sampling procedures employed were performed for specific purposes, or data quality objectives. Because these objectives (such as identifying the presence of a chemical versus the concentration of a chemical) are not the same as the objectives of an ATSDR and PADOH public health evaluation, some data sets can only be evaluated for acute exposures while other data sets can only be evaluated for chronic exposures. Some data sets should only be used to identify the presence or absence of a chemical as an indicator for additional assessment needs.

In order to identify contaminants which require further evaluation for potential public health implications, airborne chemical concentrations are compared to health-based comparison values, or CVs. For this evaluation, ATSDR and PADOH compared chemicals concentrations first to ATSDR's CVs. If ATSDR has not identified a CV for comparison to a certain chemical, then a CV derived by EPA or another relevant agency was used. For this evaluation, EPA's regional risk-based concentrations (RBC), California Air Resource Board (CARB) acute reference exposure levels (CARB 2009), and Texas' Effects Screening Levels (ESL) were used for comparison (Texas 2009). RBCs are guidelines used to assess the potential for harm from chemicals found at a hazardous waste site. RBCs are developed by combining a substance's toxicologic properties with "standard" scenarios for encountering the substance. California has developed acute (one-hour) inhalation Reference Exposure Levels (RELs) for toxic air contaminants. The acute REL is an exposure that is not likely to cause adverse effects in a human population, including sensitive subgroups (such as infants and children), exposed to that concentration for one hour on an intermittent basis. ESLs are used to evaluate the potential for effects to occur as a result of exposure to concentrations of constituents in the air. Texas' ESLs are based on data concerning health effects, the potential for odors to be a nuisance, effects on vegetation, and corrosive effects. ESLs are not ambient air standards. If predicted airborne levels of a constituent do not exceed the ESL, adverse health or welfare effects are not expected. If predicted ambient levels of constituents in air exceed the ESL, it does not necessarily indicate a problem but rather triggers a review in more depth.

ACHD and PADEP conducted sampling and monitoring both onsite (landfill) and offsite (including the Wilson Elementary School and the Santiago Distributors locations). All PADEP sampling conducted at the School was outside of the School buildings. ACHD conducted sampling both inside the School building and outside of the building. Offsite sampling techniques included real-time sampling (for permit compliance), grab (or tedlar bag) sampling, and longer duration (for public health evaluation purposes) sampling using charcoal tube and summa canisters. Grab samples (tedlar bags) collected from the School parking lot on March 4, 9, 10, 16 to 20, 2009, provide limited data for public health evaluation due to the short sample collection duration. Real-time sampling data collected in 2009 and 2010 were limited for public health evaluation due to the variable and high detection limits, shorter duration sampling periods and limited list of analytes. Charcoal tube and summa canister sampling, which are collected over a more extended period of time (typically, 8 to 24 hours), provide the most appropriate sets of data for evaluating the public's chronic exposure to airborne chemicals, although the list of chemicals analyzed for this site

was limited. Charcoal tube samples, collected on March 19, 2009, had limited laboratory analyses, but did provide useful information related to public health exposures inside the School building. Summa canister samples were collected on 8 separate days from inside and outside the School between May 31, 2009 and July 12, 2009 (every 6 days). A total of 16 summa canister samples were collected and analyzed for VOCs.

Hydrogen sulfide monitoring outside the School provides relevant data on exposures to hydrogen sulfide in the School parking lot and is a good indicator of the presence of landfill gas on the School property. Methane monitors are designed to detect concentrations approaching explosive levels, so they have high detection limits. Methane monitors can provide evidence of landfill gas infiltration into the School, but do not provide relevant information for an environmental public health evaluation. Table 1 is a summary of the data obtained and evaluated by ATSDR and PADOH in this document. Table 1 includes the locations, sample dates and types, contaminants identified, comparison to health-based screening levels, which agency conducted the sampling, comments, and data use and limitations.

A. Landfill Sampling

This section summarizes the sampling conducted on the landfill. The data was used to identify chemicals being released from the landfill into the air. A comparison of chemical concentrations detected in the headspace of wells or on top of landfill waste to ATSDR's health-based comparison values was determined not appropriate because headspaces of wells and the top of landfills are not considered a human exposure point.

On November 11, 2008, a tedlar bag sample was collected at the landfill and analyzed for volatile organic compounds (VOC) and hydrogen sulfide (H₂S) and reduced sulfur compounds. A number of VOCs were detected in this tedlar bag sample, including vinyl chloride (197 ppb) and benzene (16.3 ppb). Hydrogen sulfide and reduced sulfur compound analysis of the tedlar bag sample identified a hydrogen sulfide concentration of 1,320 ppb, and a total reduced sulfur concentration of 1,320 ppb.

In February 2009, ACHD inspectors identified strong landfill gas odors in wells onsite. The well sample results were recorded and catalogued for later "fingerprinting," or comparison, to offsite air sampling results.

In October 2009, landfill compliance sampling was conducted by the EPA. The compliance sampling event identified a number of areas on the landfill where methane levels exceeded their regulatory standard. Although these onsite levels of methane in the air indicate uncontrolled release of vapors from the landfill waste, it cannot be used to evaluate offsite exposures.

B. Offsite Sampling

This section summarizes the sampling conducted at areas surrounding the landfill, including the Wilson Elementary School, both indoors and outside, and the Santiago Distributors location on Old Steubenville Pike. The varied sampling activities are discussed below.

1. April 28 to May 1, 2008 (Outdoor air samples) - PADEP deployed a mobile laboratory to Imperial, PA and collected real-time air and tedlar bag samples near the landfill. During this event, sampling was performed at the Findlay Township Walking Trail (background location) and Santiago Distributors on Old Steubenville Pike. This assessment was conducted to obtain qualitative data to compare onsite and offsite odors, although concentrations of some chemicals were provided. For a number of chemicals, the detection limits were well above health-based comparison values (the mobile laboratory was mobilized by PADEP to collect screening samples of airborne landfill chemicals, and not for comparison to health-based comparison values). Samples were collected on three consecutive days (April 29 and 30 and May 1, 2009) for discreet sampling time periods. A number of chemical compounds were reported with their maximum concentration, including ethanol (113 ppb), benzene (242 ppb), methylamine (259 ppb), methane (5,525 ppb), ammonia (15 ppb), and methyl mercaptan (1,204 ppb).

Benzene concentrations on two occasions exceeded the acute exposure CV of 9 ppb. Benzene was detected on 2 of the 3 sampling days. Due to the very high detection limit for benzene (over 175 ppb on all 3 days), the average benzene concentration for this sampling event cannot be determined.

Table 1
Analytical and Monitoring Data Summary
Imperial Landfill and Wilson Elementary School

Location	Sample Date	Sample type	Contaminant Identified at Maximum Concentration (CV Exceeded?)	CV source (Value)	Sampling Conducted by/for	Comments/ Data Limitations
Landfill	November 11, 2008	Tedlar/grab	Vinyl chloride at 197 ppb (NA) and benzene at 16.3 ppb (NA)	Not a human exposure point; applicable	PADEP	Sampling location was onsite well; Short duration and higher detection limits
Landfill	February 26, 2009	Electronic nose plus various monitoring techniques	Methane at over 30,000,000 ppb (NA); Hydrogen Sulfide at 7,000 ppb (NA); VOC at 4,500 ppb (NA); benzene at 13,970 ppb (NA); toluene at 241,700 ppb (NA); total xylenes at 66,950 ppb (NA)	Not a human exposure point; not applicable	ACHD	Samples collected from well headspace; Short duration and higher detection limits
Landfill	September 2009	Monitoring	Methane up to 4,000,000 ppb (NA)	Not a human exposure point; not applicable	EPA	Multiple landfill locations were out of compliance; Only methane monitored by FID
Findlay Township Walking Trail	April 28, 2009	Real-time (tedlar bag)	BTEX, aldehydes, hydrocarbons (only tentatively identified compounds provided)	No concentrations provided; not applicable	PADEP	No concentrations provided
Santiago Distributors	April 29, 2009 to May 1, 2009	Real-time (OPFTIR)	Methane (NA*), ethanol (NA)	Not available	PADEP	Short duration and high detection limits
			Ammonia at 15 ppb (No)	Acute EMEG (2,000 ppb)		
			Benzene at 242 ppb (Yes)	Acute EMEG (9 ppb)		
			Methylamine at 144 ppb (Yes)	TCEQ ESL (50 ppb)		
			Methyl mercaptan at 1,204 ppb (Yes)	NIOSH REL 15-min (500 ppb)		
School	March 3, 9, and 10, 2009	Tedlar/grab	None above detection limits	Data not provided; not applicable	ACHD	DLs not known, data not provided, short sampling duration

Table 1 (Continued)
Analytical and Monitoring Data Summary
 Imperial Landfill and Wilson Elementary School

Location	Sample Date	Sample type	Contaminant Identified at Maximum Concentration (CV Exceeded?)	CV source (Value)	Sampling Conducted by/for	Comments/ Data Limitations
School	March 16, 2009 to March 18, 2009	Real-time (OPFTIR)	Acetaldehyde at 2,755 ppb (Yes)	CARB Acute (256 ppb)	PADEP	Short duration and high detection limits
			Ammonia at 67 ppb (No)	Acute EMEG (2,000 ppb)		
			Benzene at 1,310 ppb (Yes)	Acute EMEG (9 ppb)		
			Chloroform at 28 ppb (No)	Acute EMEG (100 ppb)		
			Formaldehyde at 24 ppb (No)	Acute EMEG (40 ppb)		
			Methylamine at 3,041 ppb (Yes)	TCEQ ESL (50 ppb)		
			Methyl mercaptan at 481 ppb (No)	NIOSH REL 15-min (500 ppb)		
			Methane at 41,768 ppb and ethanol at 1,913 ppb (NA*)	Not available		
School	March 19, 2009	Charcoal tube (24-hr)	BTEX (at or below DL)	ATSDR EMEGs	ACHD	Analysis limited to BTEX
School	May 31, 2009 to July 12, 2009 Total of 8 sampling days)	Summa canister (24-hr)	Acrolein at 0.54 ppb average indoor and 0.20 ppb outdoor (Yes)	Intermediate EMEG (0.03 ppb)	ACHD	Indoor and outdoor sampled; Summa canisters not best method for evaluating some landfill gases
			VOCs at various concentrations (No)	ATSDR EMEGs		
School	May 8, 2009 to October 9, 2009	Real-time monitoring	Methane (<1,000,000 ppb)*	Not available	ACHD	Monitoring is ongoing
			H ₂ S at 14.5 ppb (No)	Acute EMEG (70 ppb); Intermediate EMEG (20 ppb)		

Table 1 (Continued)
Analytical and Monitoring Data Summary
 Imperial Landfill and Wilson Elementary School

Location	Sample Date	Sample type	Contaminant Identified at Maximum Concentration (CV Exceeded?)	CV source (Value)	Sampling Conducted by/for	Comments/ Data Limitations
School	March 16, 2010 to March 18, 2010	Real-time (OPFTIR)	Ethanol at 231 ppb (NA)	Not available	PADEP	DLs above CVs; Short duration and high detection limits
			Triethylamine at 86 ppb (NA)	EPA RfC (1.6 ppb)		
			Dimethyl sulfide at 177 ppb (NA)	Not available		
			Formaldehyde at 15 ppb (No)	Acute EMEG (40 ppb)		
			Acetaldehyde at 128 ppb (No)	CARB Acute (256 ppb)		
			Methyl mercaptan at 1,338 ppb (Yes)	NIOSH REL 15-min (500 ppb)		
			n-octane at 47 ppb (NA)	Not available		
			Chloroform at 14 ppb (No)	Acute EMEG (100 ppb)		
			Ammonia at 8 ppb (No)	Acute EMEG (2,000 ppb)		
			Methylamine at 169 ppb (Yes)	TCEQ ESL (50 ppb)		
			Methanol	Not available		

Notes: * = Lower explosive limit is 50,000,000 ppb; ACHD = Allegheny County Health Department; BTEX = Benzene, toluene, ethyl-benzene, and xylenes; CARB = California Air Resources Board; CV = Comparison Value; DL = Detection limit; ELCR = Excess lifetime cancer risk; EMEG = ATSDR Environmental Media Evaluation Guide; EPA = Environmental Protection Agency; ESL = Effect Screening Level; FID = flame ionization detector; H2S = Hydrogen sulfide; NA = Not applicable or available, NIOSH = National Institute for Occupational Safety and Health; OPFTIR = Open-Path Fourier Transform Infrared Spectrometer; PADEP = Pennsylvania Department of Environmental Protection; RfC = Reference Concentration for chronic exposures; REL = Recommended Exposure Level; TCEQ = Texas Commission on Environmental Quality; VOCs = Volatile organic compounds

2. March 4, 9, and 10, 2009 (Outside the School) - ACHD conducted a screening assessment of ambient air outside the School using tedlar bags and hand-held monitoring equipment. This screening level data did not identify compounds for comparison to the fingerprint samples collected from the landfill. During this event, the inspector observed slight to moderate odors while collecting the samples.

3. March 16 to 18, 2009 (Outside the School) - PADEP conducted four real-time air sampling events at the School over these 3 days. Detection limits during these sampling events were variable, but often were well above health-based CVs. The sampling procedures and equipment utilized during this sampling event provide instantaneous peak concentrations and are for evaluating short-term airborne chemical concentrations. ATSDR and PADOH did not compare these results to chronic exposure guidelines. [**Note - the data were collected for a different use and, therefore, were viewed as screening data only for health-based comparison purposes**]. A number of compounds were detected during these sampling events. The results reported below are the maximum concentrations reported during the sample run:

- Acetaldehyde was detected once at 2,755 ppb and below varying detection limits on three occasions. Acetaldehyde exceeded the CARB acute reference exposure level of 256 ppb.
- Ammonia was detected at 67 ppb, 60 ppb, and twice below the detection limit of 5 ppb. Ammonia did not exceed its CVs.
- Benzene was detected at 1,310 ppb, 250 ppb, 179 ppb, and once below the detection limit of 1,581 ppb. Benzene concentrations exceeded the acute (9 ppb) exposure CV. Based on the time of day for the higher benzene values, buses and cars may be contributing to the benzene levels detected in the parking lot at the school. But, it remains unclear what the source of the benzene vapors is.
- Chloroform was detected at 28 ppb, 18 ppb, 6 ppb, and below the detection limit of 4 ppb. Results showed that chloroform levels remained below the acute CV of 100 ppb.
- Formaldehyde was detected at 24 ppb and three times below detection limits of 18 ppb, 35 ppb, and 202 ppb. Formaldehyde concentrations are below the acute CV of 40 ppb. Three of the four results were below the acute CV and the concentration of one sample cannot be determined for comparison due to its high detection limit of 202 ppb.
- Ethanol (1,913 ppb) and methane (41,800 ppb) do not have ATSDR CVs for comparison. Further discussion of these chemicals is provided in the next section.
- Methylamine was detected at 3,041 ppb, which exceeds the TCEQ ESL of 50 ppb.
- Methyl mercaptan was detected 4814 ppb, which does not exceed the NIOSH 15-minute REL of 500 ppb.

These chemicals and their potential impacts on public health are discussed in the next section.

4. March 19 and 20, 2009 (Inside the School) - ACHD conducted charcoal tube sampling for volatile organic compounds (VOC) and had these samples analyzed by the county medical examiner's laboratory. The results for benzene, ethyl benzene, toluene,

xylene (collectively known as BTEX) and total petroleum hydrocarbons were below their respective detection limits (all were below 0.45 part per billion). ACHD noted that the maximum possible concentrations reported from this event (i.e. the detection limits) were in the range of background air concentrations at Allegheny County's remote South Fayette air monitoring site, where industrial impacts are believed to be negligible.

5. May 31 to July 7, 2009 (Inside the School) - ACHD conducted sampling with summa canisters simultaneously inside the School and outside the School building, for a total of four (4) 24-hour sampling days (6 samples total). Acrolein results (average of 0.54 ppb indoor and 0.20 ppb outdoor) were above the health-based comparison (CV) of 0.03 ppb (intermediate environmental media evaluation guide or EMEG) for all days of sampling both indoor and outdoor at the School. Average benzene concentrations only slightly exceeded the cancer risk evaluation guideline (CREG) of 0.04 ppb. All other results were below their respective CV.

6. May 8 to October 9, 2009 (Outside and inside the School) - ACHD conducted real-time hydrogen sulfide (H₂S) monitoring outside the School and methane monitoring inside the School. The highest 24-hour average H₂S (3.1 ppb) and the highest overall H₂S results (14.5 ppb) were below CVs.

7. March 16 to March 18, 2010 (Outside the School) - PADEP conducted four real-time air sampling events at the School over these 3 days (2 monitoring events during the morning and 2 monitoring events during the evening). Detection limits during these sampling events were variable, but often were well above health-based CVs. The sampling procedures and equipment utilized during this sampling event provide instantaneous peak concentrations and are for evaluating short-term airborne chemical concentrations. ATSDR and PADOH did not compare these results to chronic exposure guidelines. **[Note - the data were collected for a different use and, therefore, were viewed as screening data only for health-based comparison purposes]**. A number of compounds were detected during these sampling events:

- Acetaldehyde was detected at 128 ppb. Acetaldehyde did not exceed the CARB reference exposure level of 256 ppb during this sampling event.
- Ammonia was detected at 8 ppb. Ammonia did not exceed its CV.
- Chloroform was detected at 8 and 14 ppb. Chloroform did not exceed its acute CV of 100 ppb.
- Dimethyl sulfide was detected at 177 ppb. The potential impact on public health of this chemical is discussed in the next section.
- Ethanol was detected at 53 ppb, 110 ppb, 40 ppb, and 231 ppb. Ethanol does not have a CV. Further discussion of this chemical is provided in the next section.
- Formaldehyde was detected at 15 ppb on one occasion. Formaldehyde concentrations were below the acute CV of 40 ppb.
- Methane was detected at 3553 ppb, 14712 ppb, 5274 ppb, and 25400 ppb. Methane does not have a CV. The potential impact on public health is discussed in the next section.
- Methylamine was detected at 134 ppb, 169 ppb, and 110 ppb, which exceeds the TCEQ ESL of 50 ppb.

- Methyl mercaptan was detected at 697 ppb, 1310 ppb, and 1338 ppb, which exceeds the NIOSH 15-minute REL of 500 ppb.
- Methanol was detected at 11 ppb, 12 ppb, and 31 ppb. Methanol did not exceed its comparison value (California Air Resources Board reference exposure level of 20,974 ppb; ATSDR has not identified a CV; CARB 2009).
- Triethylamine was detected at 36 ppb, 86 ppb, and 35 ppb. ATSDR does not have a CV for this chemical, but a comparison of this chemical to a number of other comparison values is provided in the next section of this document.

V. Public Health Implications

ATSDR evaluates both non-cancer and cancer health effects. In order to evaluate the potential for non-cancer adverse health effects from exposure to contaminated media (i.e., soil, water, and air), a dose is estimated for each contaminant of concern. Doses are calculated for situations in which people might come into contact with the contaminated media. The estimated dose for each contaminant of concern under each situation is then compared to ATSDR's minimal risk level (MRL) or EPA's inhalation reference concentration (RfC) to determine if there is a potential for non-cancer adverse health effects. MRLs and RfCs are derived from toxic effects levels obtained from human and animal laboratory studies. The toxic effects levels are expressed as either the lowest adverse effect level (LOAEL) or the no-observed adverse effect level (NOAEL). In human or animal studies, the LOAEL is the lowest dose at which an adverse effect is seen; the NOAEL is the highest dose that did not result in any adverse human health effect. To account for uncertainty, the toxic effect levels are divided by safety factors (10, 100, or 1,000) to provide the more protective MRL or RfC. If a dose exceeds the MRL or RfC, the *potential* exists for adverse health effects. In general, the higher the estimated dose is above the MRL or RfC, the closer it will be to a toxic effect level.

By calculating a dose similar to that described above and multiplying the dose by the EPA cancer slope factor, the hypothetical increased excess lifetime cancer risk can be estimated. An exposure to a contaminant that results in an estimated increased cancer risk of one additional cancer in a population of one million people exposed, averaged over a 70 year lifetime, is considered an acceptable risk, and is used as the screening value. In a population of one million men in the U.S., 440,500 (44.05 percent or about one in two) are expected to develop cancer from all causes in the lifetime. For U.S. women, the figure is 376,300 (37.63 percent or about one in three). The additional estimated cancer risk means that if those one million men are exposed for 70 years to this level of chemical, 440,501 would be expected to develop cancer. For the one million women exposed, 376,301 would be expected to develop cancer.

Methylamine: There is a potential for an acute public health hazard in the School parking lot. (There is acute exposure data only.)

Methylamine was detected by OPFTIR spectrometry outside in the parking lot at the Wilson Elementary School on six of eight occasions at 3,041 ppb, 2,878 ppb, and 140 ppb, 134 ppb, 169 ppb, and 110 ppb. The data were collected for a different use and, therefore, were viewed as screening data only for health-based comparison purposes. Although ATSDR does not

have a comparison value for methylamine, the Texas Commission on Environmental Quality (TCEQ) has provided an effect screening level (ESL) of 50 ppb for short term exposures to methylamine (TCEQ 2009). TCEQ developed their methylamine ESL by adding a safety factor to the American Conference of Government Industrial Hygienists (ACGIH) threshold limit value of 5,000 ppb for an 8 hour work day (email communication from TCEQ Manny Reyna to Robert Helverson on January 12, 2010). This short-term exposure ESL is for comparison to approximate 1-hour exposure data, such as that acquired by OPFTIR spectrometer. Although site-specific data is limited, the concentrations at the site exceed TCEQ ESLs on six of eight occasions. *Without additional assessment information, including longer duration sampling events to determine average air concentrations, ATSDR and PADOH conclude that acute exposures have the potential to result in adverse health effects.*

It has been reported that transient irritation of the eyes, nose, and throat has resulted from brief exposures to methylamine concentrations of 20,000 to 100,000 ppb; the odor was intolerable at 100 to 500,000 ppb (Clayton and Clayton 1981). Inhalation of methylamine vapors (at concentrations greater than 100,000 ppb) has caused irritation of the nose and throat, followed by violent sneezing, burning sensation of the throat, coughing, constriction of the larynx and difficulty in breathing, pulmonary congestion, and edema of the lungs (Deichmann and Gerarde 1969).

Methylamine is not analyzed by the standard chronic air sampling summa canister sampling procedures. Therefore, no chronic exposure data are currently available for evaluation. ATSDR and PADOH recommend further evaluation of methylamine, along with other amines that are commonly found in landfill gases to determine whether chronic exposures are of public health concern. This additional assessment activity should be conducted inside and outside of the Wilson Elementary School building.

Methyl Mercaptan: There is a potential for an acute public health hazard in the School parking lot. (There is acute exposure data only.)

Methyl Mercaptan is identified as a nuisance odor with a very low odor detection level of about 1.6 ppb for most individuals. Methyl mercaptan was detected by OPFTIR spectrometry outside in the parking lot at the Wilson Elementary School during four of eight monitoring events (481 ppb, 697 ppb, 1310 ppb, and 1338 ppb). The data were collected for a different use and, therefore, were viewed as screening data only for health-based comparison purposes. Very little information is available related to chronic exposures to low levels of this chemical. The National Institute of Occupational Safety and Health (NIOSH) has set a short-term recommended exposure limit (REL [15-minute]) of 500 ppb for 15 minutes of exposure for workers. The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10,000 ppb as the ceiling exposure concentration for workers. NIOSH and OSHA determine their permissible and recommended exposure limits for healthy, working age individuals. These occupational exposure values are not protective of children, immuno-compromised individuals or the elderly. Therefore, without additional toxicological information, ATSDR and PADOH conclude that methyl mercaptan concentrations, which exceed the NIOSH REL: 500 ppb [15-minute] have the *potential to adversely affect the health of individuals* at the Wilson Elementary School.

Three of the four concentrations detected in the School parking lot exceeded the NIOSH short-term REL [15-min]. *Based on these four instantaneous OPFTIR readings, ATSDR and PADOH conclude that students, faculty and staff exposures to methyl mercaptan in the parking lot at the Wilson Elementary School has the potential to result in adverse health effects.* Steps to reduce methyl mercaptan exposures, especially to children at the school, should be taken. Not enough data are available to evaluate intermediate or chronic exposures to methyl mercaptan, and no data are available to evaluate methyl mercaptan in the School's indoor air. Therefore, further assessment of acute and chronic exposure concentrations inside and outside of the School is recommended.

The maximum concentration detected at the Santiago Distributors site (1,204 ppb) exceeded the NIOSH REL [15-minute] of 500 ppb but not the OSHA PEL of 10,000 ppb. *Adverse health effects may occur from short term exposures to methyl mercaptan at the levels identified at the Santiago Distributors site.*

Acute inhalation exposure can irritate the mucous membranes of the respiratory tract. This may cause cough, dyspnea, and a sensation of tightness of the chest. Children may be more vulnerable to gas exposure because of relatively higher minute ventilation per body weight and failure to evacuate an area promptly when exposed. Restlessness, headache, staggering, and dizziness may develop. Respiratory depression, apnea, and pulmonary edema were observed in animals. Exposure to high concentrations of methyl mercaptan can cause eye irritation. Nausea and vomiting may occur even with inhalation exposure to the gas. Methyl mercaptan exposure may result in altered blood synthesis.

Benzene: No harm is expected from short-term or long term exposures based on time spent at the School (There is acute and chronic exposure data.)

Everyone is exposed to a small amount of benzene every day. You are exposed to benzene in the outdoor environment, in the workplace, and in the home. Exposure of the general population to benzene mainly occurs through breathing air that contains benzene. The major sources of benzene exposure are tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions (ATSDR 2007). Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure. Automobile exhaust and industrial emissions account for about 20% of the total national exposure to benzene. About half of the exposure to benzene in the United States results from smoking tobacco or from exposure to tobacco smoke. The average smoker (32 cigarettes per day) takes in about 1.8 milligrams (mg) of benzene per day. This amount is about 10 times the average daily intake of benzene by nonsmokers (ATSDR 2007).

Typically measured levels of benzene in outdoor air have ranged from 0.02 to 34 parts of benzene per billion parts of air (ppb). People living in cities or industrial areas are generally exposed to higher levels of benzene in air than those living in rural areas. Benzene levels in the home are usually higher than outdoor levels. People may be exposed to higher levels of benzene in air by living near hazardous waste sites, petroleum refining operations, petrochemical manufacturing sites, or gas stations (ATSDR 2007).

Benzene concentrations were monitored at the Wilson Elementary School using three different techniques: (1) real-time open path fourier transform infrared spectrometry (OPFTIR) in the parking lot, which provides data most appropriate in determining short-term air concentrations for acute exposure evaluation, (2) charcoal tube sampling inside and outside of the School, which provides valuable data for assessing acute or chronic exposures, and (3) summa canister sampling inside and outside of the School building which provides the best data for evaluating chronic exposures to benzene. An evaluation of the acute exposure data from the OPFTIR followed by an evaluation of chronic exposure data from the charcoal tube and summa canister sampling is provided in the following subsections.

ATSDR's current chronic EMEG/MRL for benzene is 3 ppb; this concentration of benzene in air is unlikely to be associated with any appreciable risk of adverse, non-cancer effects for more than one year of continuous exposure. For cancer effects, ATSDR has derived benzene CREG of 0.04 ppb based primarily on studies of U.S. workers exposed to high levels of benzene (up to hundreds of thousands of ppb) during rubber manufacturing. It is based on an EPA-estimated cancer slope factor which is in turn based on the assumption of a linear dose-response relationship; that is, the proportion of effects seen at high doses range will be the same at the low-dose range where the effects are not measurable. ATSDR and PADOH evaluate both cancer and non-cancer health effects for benzene. Benzene is a known human carcinogen and is leukemogenic. Occupational-level benzene exposures have been specifically linked to acute myelocytic leukemia (AML). The lowest human effect levels reported in ATSDR's Toxicological Profile for Benzene (ATSDR 2007) are 300 ppb for leukemia (Ott et al. 1978) and 570 ppb for reduced white blood cell and platelet counts (Lan et al. 2004). These values (570 ppb and 300 ppb) represent the lowest measured concentrations in a range of workplace measurements from the two studies (300–35,000 ppb and 570–28,000 ppb, respectively). Use of the lowest measured concentration as an indicator of exposure in the facilities is conservative and underestimates actual exposures.

In some epidemiological and toxicological studies, estimates of benzene exposure were converted to 1000 ppb-years, i.e., average benzene levels in thousands of parts per billion (ppbs), multiplied by exposure duration in years, to compare with reported occupational health effects on an equivalent basis. For example, a worker exposed to 2,000 ppb for 20 years and another one exposed to 20,000 ppb for 2 years both received the same cumulative exposure (i.e., 40,000 ppb-years). Epidemiologic data have suggested that there are thresholds for leukemia. Available studies indicate no detectable excess of leukemia below cumulative exposures of 40,000 ppb-years (Rinsky et al 1987). This would be numerically, if not biologically, equivalent to about 190 ppb, 24 hours a day, over a 70-year lifetime. However, this apparent threshold is most likely an underestimate because it is based on underestimated exposures and the inclusion of all leukemia, not just AML. When only AML is considered, the estimated threshold was found to be at least 200,000 ppb-years (numerically equivalent to 950 ppb, 24 hours a day, over a 70-year lifetime); note, however, that this is based on re-analysis by industry consultants of the original set of exposure estimates (Paustenbach et al 1992; Wong 1995).

Evaluation of Acute Exposures to Benzene

Maximum benzene concentrations detected during the PADEP's March 16 through 18, 2009, sampling event in the parking lot of the Wilson Elementary School exceeded the non-cancer acute comparison value of 9 ppb. Benzene concentrations detected in the School parking lot by OPFTIR spectrometry were 1,310 ppb, 250 ppb, and 179 ppb. Benzene concentrations reported from OPFTIR sampling by PADEP at Santiago Distributors (242 ppb and 229 ppb) were also above the acute CV of 9 ppb. It is unclear whether these elevated benzene results were due to nearby automobile exhaust or are more indicative of ambient air levels in this area.

Breathing benzene at 60,000 ppb has been shown to cause dizziness, nausea, headache, peculiar or strong odor, chemical taste and fatigue (ATSDR 2007). The benzene concentrations identified at the School (maximum of 1,300 ppb outside the School) and at the Santiago Distributors (242 ppb) are much lower and are not expected to result in these acute health effects.

Evaluation of Chronic Exposures to Benzene (Non-Cancer and Cancer Risk)

Charcoal tube sampling showed benzene levels inside the School were not detected above the detection limit of 0.191 ppb. Summa canister sampling conducted at the School from May through July 2009 identified average 24-hour benzene concentrations of 0.19 ppb in the School and 0.17 ppb outside the School. Both concentrations are below the chronic CV, but slightly over the CREG of 0.04 ppb. Based on available data, chronic non-cancer health effects from exposure to benzene are not expected at the School.

An estimated increased excess lifetime cancer risk (ELCR) is not a specific estimate of expected cancers. Rather, it is a plausible upper bound estimate of the probability that a person may develop cancer sometime in his or her lifetime following exposure to that contaminant. There is general consensus among the scientific and regulatory communities on what level of estimated excess cancer risk is acceptable. An excess lifetime cancer risk (ECLR) of one in one million or less is generally considered an insignificant increase in cancer risk. The ECLR associated with exposures to the average benzene concentration (0.19 ppb or 0.6 ug/m³ [micrograms per cubic meter]) detected at the School is less than one excess cancer in a million. This is considered no increase in excess cancer risk. In order to estimate benzene exposure at the school, the longest exposure duration (30 years for a teacher) was multiplied by the number of hours per day spent at the school (12 hour) multiplied by the number of days per year (200 days). The following formula was used to calculate the ECLR for this site:

ECLR = Exposure Dose	x Unit Risk Factor	x (Exposure Sum*/70 years)
= 0.6 ug/m ³	x 7.8E-06 (ug/m ³) ⁻¹	x (8.3/70)
= 0.6 ug/m ³	x 7.8E-06 (ug/m ³) ⁻¹	x 0.12
= 5.6E-7		
* Exposure sum is based on 12 hours of exposure per day for 200 days per year for 30 years.		

Acetaldehyde: No harm is expected at these levels. (There is acute exposure data only.)

Acetaldehyde levels were monitored by OPFTIR spectrometry in March 2009 and March 2010, which provides instantaneous screening level data. Although insufficient data are available to determine the average concentration in the parking lot at the School, two results

(2,755 ppb in March 2009 and 128 ppb in March 2010) were above their sampling detection limit. The March 2009 result is well above the acute CV identified by the California Air Resources Board of 256 ppb (ATSDR has not identified an acute CV) (CARB 2009). Six additional sampling results (all below the CARB acute reference value of 256 ppb) were below their sampling detection limits of 106 ppb, 229 ppb, 112 ppb, 174 ppb, 124 ppb and 134 ppb. Although the March 2009 result suggests that airborne acetaldehyde levels exceeded the ATSDR CV of 5 ppb, further assessment of chronic exposures is necessary to determine average concentrations inside the School and outside in the parking lot. This additional assessment is recommended by ATSDR and PADOH.

Although results from acute exposure sampling exceeded the chronic exposure CV, they are well below the health effect levels (NOAEL and LOAEL) identified in animal studies. *Based on the limited data from the School, ATSDR and PADOH conclude that no adverse health effects from acute exposures to acetaldehyde are expected.*

At levels between 50,000 to 200,000 ppb exposure, eye irritation and upper respiratory discomfort was observed in humans (Sullivan et al, 2001). Humans exposed acutely to moderate concentrations of acetaldehyde experience irritation of the eyes and respiratory tract and altered respiratory function (EPA 1994). Based on the one result of 2,755 ppb at the School, adverse health effects from acute exposures are not expected.

The acetaldehyde chronic CV (5 ppb), derived from the EPA reference concentration (RfC), is based on animal studies where health effect levels were reported, including the no observed adverse effect level (NOAEL) of 150,000 ppb and the lowest observed adverse effect level (LOAEL) of 400,000 ppb (EPA, 1994). The LOAEL and NOAEL identified from animal studies were much higher than the one positive result of 2,755 ppb observed at the School. The acetaldehyde data collected from the School can only be evaluated for acute exposures. ATSDR and PADOH recommend a chronic exposure assessment of acetaldehyde and other common landfill chemicals (i.e. aldehydes and amines) that are not evaluated via summa canister sampling.

Additional Acetaldehyde Information

The odor threshold of acetaldehyde is 50 ppb (EPA, 1987; Amoore et al, 1983). Acetaldehyde is degraded in the atmosphere with a half-life in air estimated to be 24 hours (HSDS, 2002). Acetaldehyde has a pungent suffocating odor, but at dilute concentrations it has a fruity and pleasant odor. Acetaldehyde is used to manufacture acetic acid, synthetic flavors (orange, apple or butter flavors), plastics, drugs, dyes, and disinfectants. It can also be found in perfumes, antioxidants, varnishes, vinegar, and yeast (Sullivan et al, 2001). It is naturally present in plant juices, essential oils, roasted coffee, and tobacco smoke (Sullivan et al, 2001). It is present in all ripe fruits that have tart tastes before ripening (HSDS, 2002).

Acrolein: No harm is expected at these levels. (There is acute and chronic exposure data.)

Acrolein concentrations (average of 0.54 ppb indoor and 0.20 ppb outdoor) were above the health-based CV of 0.03 ppb (intermediate EMEG) for all days of sampling. Although acrolein levels were above the screening level (CV), it remained below levels where health

effects in humans have been identified. Health effects, including decreased respiratory rate, and nose and throat irritation were identified in a study where humans were exposed to acrolein at 300 ppb for one day for one hour (ATSDR 2007a). A NOAEL of 60 ppb was identified in an animal study where rats were exposed for 61 days for 24 hours a day with no observed adverse health effects (ATSDR 2007A). This same study identified a LOAEL for decreased body weights in the rats exposed to acrolein at 320 ppb (ATSDR 2007A).

Based on the data available and a review of the toxicological literature, ATSDR and PADOH do not expect exposures to acrolein at levels identified inside and outside the School to result in adverse health effects. *No public health hazard has been identified for acute or chronic exposures to acrolein.*

Methane: No harm is expected at these levels. (There is acute and chronic exposure data.)

The primary public health concern for methane is flammability and the potential for explosive atmospheres. When an ignition source is introduced, an explosion will occur if the air is composed of more than 5% methane or less than 15% methane. Methane at 5% is equal to 50,000,000 ppb. The maximum levels detected at the Wilson Elementary School, at 41,030 ppb, are not high enough to be an explosion concern. Methane is not toxic, but it will displace oxygen and can result in asphyxiation. The levels detected (maximum of 41,030 ppb) at the School property are not high enough to displace enough oxygen to be of public health concern. The ongoing monitoring at the school is designed to detect methane levels that are less than the explosive limit. *Based on the continuous monitoring in the School, adverse public health effects from methane are not expected and the ongoing monitoring is considered protective.* ATSDR and PADOH support continued real-time methane monitoring at the School as a proxy for other landfill gas intrusion into the building and to detect increasing methane levels before explosive atmospheric methane levels develop.

Ethanol: No harm is expected at these levels. (There is acute exposure data only.)

Ethanol levels were monitored by OPFTIR spectrometry in March 2009 and March 2010, which provides instantaneous screening level data. Ethanol is an alcohol compound that was detected in the air at the School parking lot by OPFTIR sampling. In general, ethanol is a slight irritant at high concentrations, but less irritating than aldehydes or ketones (Williams 1985). Ethanol has a mild rather pleasant odor, like wine or whiskey (HSDS 2002). Ethanol is present in solvents, medicines, consumer products, and alcoholic beverages (HSDS 2002). It naturally occurs as a plant volatile.

ATSDR has not identified a CV for ethanol in the air. The NIOSH has identified a 10-hour REL of 1,000,000 ppb for workers who are exposed to ethanol. The NIOSH REL is more than 500 times higher than the maximum level (1,913 ppb) of ethanol detected in the School parking lot. *Ethanol levels are not present at levels that are considered likely to cause adverse health effects.*

Dimethyl sulfide: No harm is expected at these levels. (There is acute exposure data only.)

Dimethyl sulfide levels were monitored by OPFTIR spectrometry in March 2009 and March 2010, which provides instantaneous screening level data suitable for evaluating acute exposures but not chronic exposures. The data were collected for a different use and, therefore, were viewed as screening data only for health-based comparison purposes. The maximum instantaneous concentration of dimethyl sulfide detected outside in the Wilson Elementary School parking lot was 177 ppb. Dimethyl sulfide was detected once in eight monitoring events. No acute exposure screening values were identified for comparison to dimethyl sulfide. The lowest exposure comparison value identified was the occupational exposure time weighted average (TWA) of 10,000 ppb, as determined by ACGIH (ACGIH 2007). Detection limits during the monitoring events of 2009 and 2010 were variable, but remained more than 10 times lower than the ACGIH TWA. Based on this limited data, ATSDR and PADOH *do not expect adverse health effects to occur from short term exposures* to these levels of dimethyl sulfide.

Formaldehyde: There is a lack of data or information for the levels of these chemicals.
(There is acute exposure data only.)

Formaldehyde levels were monitored by OPFTIR spectrometry in March 2009 and March 2010, which provides instantaneous screening level data suitable for evaluating acute exposures but not chronic exposures. The data were collected for a different use and, therefore, were viewed as screening data only for health-based comparison purposes. During the March 16-18, 2009, OPFTIR sampling event, formaldehyde detection limits (18 ppb, 35 ppb, and 202 ppb) were above the chronic CV of 8 ppb. One detection of formaldehyde reported at 24 ppb was below the acute CV of 40 ppb, but the detection limit for another sample was too high to determine whether the result was above or below the acute CV. In March 2010, detection limits remained above the acute CV, and one result of 15 ppb was reported above its detection limit. The three additional samples from the School parking lot were below their detection limits of 45, 21, and 120 ppb.

The data is too limited to determine whether formaldehyde levels at the Wilson Elementary School are of public health concern or not. As stated previously, OPFTIR spectrometry data is not suited for an evaluation of chronic exposures because of the short sampling period, but very limited data is available for formaldehyde at this site to assess the public's exposures, and further evaluation of formaldehyde inside and outside of the School is recommended to determine chronic exposure conditions and to better evaluate short term exposures.

Triethylamine: There is a lack of data or information for the levels of these chemicals.
(There is acute exposure data only.)

Triethylamine levels were monitored by OPFTIR spectrometry in March 2009 and March 2010, which provides instantaneous screening level data. Triethylamine was detected on three of four monitoring events in March 2010 (36 ppb, 86 ppb, and 35 ppb) and was not detected during the four events in March 2009. The data were collected for a different use and, therefore, were viewed as screening data only for health-based comparison purposes. ATSDR does not have a CV for triethylamine. The concentrations detected are below the acute reference exposure level of 664 ppb, developed by the California Air Resources Board and Office of Environmental Health Hazard Assessment (CARB 2009), but above the EPA's

risk-based screening level of 1.7 ppb (EPA 2009). The EPA risk-based screening level is not specifically developed for comparison to acute exposures. The American Conference of Governmental Industrial Hygienists (ACGIH) identified a short term exposure limit of 3,000 ppb (ACGIH 2007). Based on the available data set, ATSDR and PADOH conclude that the data is too limited to determine whether adverse health effects might occur, although the concentrations detected are below the acute screening levels identified above. *ATSDR and PADOH recommend additional sampling of amines, including triethylamine to evaluate the public's acute and chronic exposures to this class of airborne chemicals. Indoor and outdoor sampling is recommended for amines at the Wilson Elementary School.*

Triethylamine has a strong fishy ammonia-like odor, with an odor threshold of 0.48 parts per million (ppm). Acute (short-term) exposure of humans to triethylamine vapor causes eye irritation, corneal swelling, and halo vision. People have complained of seeing "blue haze" or having "smoky vision." These effects have been reversible upon cessation of exposure. Acute exposure can irritate the skin and mucous membranes in humans. Chronic (long-term) exposure of workers to triethylamine vapor has been observed to cause reversible corneal edema. Chronic inhalation exposure has resulted in respiratory and hematological effects and eye lesions in rats and rabbits. No information is available on the reproductive, developmental, or carcinogenic effects of triethylamine in humans. EPA has not classified triethylamine with respect to potential carcinogenicity.

VI. Conclusions

ACHD conducted monitoring of the indoor air for a subset of the chemicals of interest and found no chemicals at levels of public health concern. The indoor air system includes an activated charcoal filtration system which is designed to filter harmful organic chemicals before entering the indoor air.

ACHD conducted monitoring of the air outside the School and did not find chemicals at levels of public health concern. PADEP conducted screening of chemicals related to the landfill for permit compliance purposes outside the School. Their screening events identified some chemicals which require further public health evaluation.

Methylamine: There is a potential for an acute public health hazard in school parking lot. (There is acute exposure data only.)

The maximum levels detected in the School parking lot exceed the TCEQ ESL. ATSDR and PADOH conclude that adverse health effects may occur.

Methyl Mercaptan: There is a potential for an acute public health hazard in school parking lot. (There is acute exposure data only.)

The maximum levels detected in the School parking lot exceed the short-term recommended exposure limit or NIOSH REL [15-minute]. ATSDR and PADOH conclude that adverse health effects may occur.

Benzene: No harm is expected from short-term or long term exposures based on time spent at the School.

The concentrations identified outside the School and at the Santiago Distributors are not expected to result in acute health effects. Chronic health effects are not expected at the School.

Methane: No harm is expected at these levels.

The levels are not at explosive concentrations and not high enough to displace oxygen at levels of public health concern at the School.

Acetaldehyde: No harm is expected at these levels. (There is acute exposure data only.)
Based on the limited data from the School, ATSDR and PADOH conclude that no adverse health effects from acute exposures are expected.

Acrolein: No harm is expected at these levels.

The concentrations identified at the School are not expected to result in adverse health effects. No public health hazard has been identified for acute or chronic exposures to acrolein at the School.

Ethanol: No harm is expected at these levels.(There is acute exposure data only.)
Concentrations detected at the School are not expected to result in adverse health effects.

Hydrogen Sulfide: No harm is expected at these levels.

Concentrations detected at the School are not expected to result in adverse health effects, but continuous monitoring at the School shows that exposures are occurring.

Dimethyl Sulfide: No harm is expected at these levels. (There is acute exposure data only.)
Concentrations detected at the School are not expected to result in adverse health effects.

Formaldehyde: There is a lack of data or information for the levels of these chemicals.

(There is acute exposure data only.)

The data are too limited to determine whether levels at the School are of public health concern.

Triethylamine: There is a lack of data or information for the levels of these chemicals.

(There is acute exposure data only.)

The data are too limited to determine whether levels at the School are of public health concern.

All other chemicals evaluated were below health-based comparison values (CVs) and are not expected to result in adverse health effects.

VII. Recommendations

ATSDR and PADOH recommend that the best way to prevent exposures to landfill chemicals is to control emissions from the landfill.

ATSDR and PADOH recommend continued monitoring for hydrogen sulfide and methane. Additional simultaneous monitoring of hydrogen sulfide inside and outside the School is recommended.

ATSDR and PADOH recommend continued efforts by regulatory agencies to enforce permit requirements which are meant to reduce the migration of chemicals offsite and to eliminate nuisance odor issues, especially at the Wilson Elementary School.

ATSDR and PADOH recommend additional acute and chronic exposure assessments both inside and outside the School of aldehydes and amines (including methylamine, triethylamine, formaldehyde and acetaldehyde) and methyl mercaptan, which are not best evaluated via summa canister sampling.

ATSDR and PADOH recommend that the School limit the practice of idling buses and other vehicles in the school parking lot. This may help to reduce acute exposures to benzene at the School.

ATSDR and PADOH recommend that the West Allegheny School District (especially Wilson Elementary School) consider looking into a program to evaluate indoor air sources of chemicals, if activities to evaluate and improve indoor air quality at the school have not already been initiated. One such program is the EPA 'Tools for Schools' program: <http://www.epa.gov/iaq/schools/>.

On particularly high odor days, school officials may want to consider reducing outdoor activities for students with underlying health conditions (such as asthma) and those who are especially sensitive to the noxious effects of the odors, as a precautionary measure.

Children experiencing symptoms at school should be evaluated by the school nurse and their family health care provider. ATSDR and PADOH are available to discuss this public health evaluation and the available information for the school with parents and health care providers with questions or concerns about individual children.

VIII. Public Health Action Plan

Completed Actions

Since April 2009, ATSDR and PADOH has held conference calls and meetings with the Allegheny County Health Department (ACHD) and the Pennsylvania Department of Environmental Protection (PADEP) in order to obtain environmental data for the Imperial Landfill and any additional relevant information about the landfill and its surroundings.

Ongoing or Planned Actions

1. ATSDR and PADOH will provide this *Imperial Health Consultation* to PADEP, ACHD, EPA, and the petitioner.

2. ATSDR and PADOH concluded that the sampling conducted by ACHD and PADEP was sufficient to characterize the point of exposure (Wilson Elementary School) for some specific chemicals and exposure durations. ATSDR recommends that PADEP or ACHD perform additional sampling. Sampling recommendations were provided to ACHD and PADEP in an email from ATSDR on March 4, 2010. Additional assessment data would be helpful in developing a more complete understanding of this ongoing exposure concern. ACHD and PADEP sampling included: monitoring (H₂S and methane), real-time sampling (with the PADEP mobile laboratory), grab sampling (with tedlar bags), and 24-hour sampling (with summa canisters and charcoal tubes). Although the real-time and grab sampling data are useful for evaluating acute chemical exposures to the public, these data are typically not well-suited for evaluating chronic exposures (i.e., detection limits may be too high to evaluate chemicals for chronic exposures to the public; sample collection periods may be too short). The 24-hour sampling events using summa canisters and charcoal tubes provides the most appropriate data for evaluating intermediate (15 to 364 days) and chronic (365 or more days) exposures to chemicals in the air, although the list of chemicals analyzed does not include some of the common landfill chemicals (e.g. aldehydes and amines). Additionally, the continuous monitoring provides the best data for evaluating exposures to certain chemicals (including hydrogen sulfide and methane) and for identifying the presence of landfill gases in the air outside and inside the School.
3. ATSDR and PADOH will work through ACHD to distribute information to the Wilson Elementary School and the Parent Teacher Association (PTA).
4. ATSDR and PADOH will work through ACHD to distribute information to the Community Board (initiated by the landfill).
5. ATSDR and PADOH will work through ACHD to distribute information to the residents and the community surrounding the landfill.
6. Evaluate the future air results, if additional samples are collected for public health evaluation and if the evaluation is requested.

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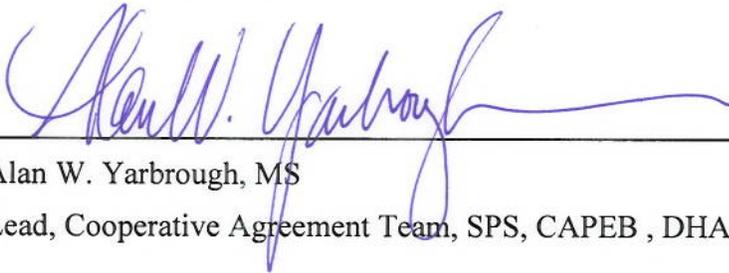
This Letter Health Consultation for the Imperial Landfill site was prepared by ATSDR and PADOH under a cooperative agreement with ATSDR. It is in accordance with approved methodology and procedures existing at the time the Health Consultation was initiated. Editorial review was completed by the cooperative agreement partner.



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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this Health Consultation and concurs with its findings.



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