

Health Consultation

Public Health Implications of Exposures to Chemicals
in Residential Indoor Air

(FORMER) LONG BRANCH MANUFACTURED GAS PLANT SITE
(a/k/a NEW JERSEY NATURAL GAS COMPANY/
LONG BRANCH GAS CONTAMINATION)

LONG BRANCH, MONMOUTH COUNTY, NEW JERSEY

EPA FACILITY ID: NJD980530471

APRIL 8, 2004

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR 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 which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

New Jersey Department of Health and Senior Services
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Summary

This Public Health Consultation evaluates indoor air contaminants measured in the Seaview Manor Property, which is adjacent to and partially built on the former Long Branch Manufactured Gas Plant site. It has been prepared in response to a petition that was submitted to the Agency for Toxic Substances and Disease Registry (ATSDR) by the Concerned Citizens Coalition of Long Branch, Monmouth County, requesting an evaluation of the health implications from living near the former manufactured gas plant.

Benzene, toluene, ethylbenzene and xylenes were identified in air in a crawl space on Seaview Manor property in 1994. Additional indoor air samples were taken in 2002 and 2003, when it was recognized that volatile organic chemicals present in soil or groundwater could enter structures built over the contaminated media. This is known as vapor intrusion.

Nineteen Seaview Manor apartments that were located on property formerly part of the manufactured gas plant were tested for benzene, toluene, ethylbenzene and xylenes on March 1, 2003. The New Jersey Department of Health and Senior Services (NJDHSS) evaluated the highest levels measured for potential health implications. Based on the sample results, the NJDHSS and ATSDR do not believe that adverse health effects are likely. However, because of weather conditions at the time of sampling (including a recent snow melt and heavy rains that caused flooding in some of the crawlspaces, resulting in more water than typical for winter months) the results may not represent a "worst case scenario" or maximum current exposures. Therefore, the NJDHSS and ATSDR classify indoor air exposures among residents of the Seaview Manor Property to represent an *Indeterminate Public Health Hazard*. Additional sampling of indoor air at Seaview Manor is recommended.

Indoor air at two nearby day care centers was also tested, based on their proximity to the former gas plant site. Indoor air was the only exposure pathway that was considered in this Public Health Consultation. Levels of benzene, ethylbenzene, toluene and xylenes were below health comparison values, and were also comparable to or below ambient air levels. Therefore, indoor air at the day care centers represents a *No Apparent Public Health Hazard*. Other potential exposure pathways will be evaluated as part of a Public Health Assessment of the (former) Long Branch Manufactured Gas Plant site.

The NJDHSS and ATSDR also considered other issues of concern to the community. Because a remedial plan for soil beneath the Seaview Manor Property has not yet been determined, and remedial actions will not occur if the buildings are occupied, the Long Branch Housing Authority has begun implementation of a relocation plan. All Seaview Manor residents have been or will be moved to other housing, beginning in April 2003. The relocation of residents during the remedial process, in addition to the knowledge that long-term exposure to the site has occurred, have raised concerns about stress among the residents. The NJDHSS and ATSDR recommend that licensed counselors with training in contaminated site issues be available to residents as needed.

None of the other diseases or health conditions of concern, such as bronchitis and lupus, are likely to be associated with the indoor air levels measured in Seaview Manor. However, asthma may be triggered by outdoor contaminants, including particulate matter. Dust suppression and odor control measures were in place during soil remediation, and will continue to be conducted

as future soil remedial actions occur. This is a standard requirement by the New Jersey Department of Environmental Protection during site remediation when soils are disturbed.

Purpose and Health Issues

This Public Health Consultation will evaluate potential indoor air exposures in the Seaview Manor property, based on sampling that was conducted through March 1, 2003, in residences adjacent to the former Long Branch Manufactured Gas Plant site in Long Branch, Monmouth County. This is in partial response to a petition from the Concerned Citizens Coalition of Long Branch to the Agency for Toxic Substances and Disease Registry (ATSDR), requesting an evaluation of public health issues related to the site (3). In addition, this Public Health Consultation evaluates results of air sampling taken inside two area day-care centers, as well as community concerns that were expressed relating to indoor air quality.

Background

The former Long Branch Manufactured Gas Plant (LBMGP) is a 12.33 acre site located at 100 Brook Street in the city of Long Branch (Monmouth County), New Jersey. It is bordered by Long Branch Avenue to the east, residential areas to the west, Seaview Avenue to the north, and the former Conrail property to the south (1). Troutman's Creek, a tidally influenced surface water feature, flows through the LBMGP site from the south to the north. The creek, prior to its diversion for remediation, ran through a culvert adjacent to the Seaview Manor property and beneath Seaview Avenue, resurfacing across the street from the complex. It drains into the Branchport Creek, a tributary of the Shrewsbury River. Groundwater generally follows the flow of Troutman's Creek (1).

The LBMGP manufactured coal gas from approximately 1870 through 1960 (2). The LBMGP site is presently owned by New Jersey Natural Gas.

A portion of the property between Seaview Avenue and the former Jerry Morgan Park was redeveloped in the early to mid-1950s by the Long Branch Housing Authority, and is known as the Seaview Manor Housing property. The Seaview Manor Housing property was built partially on the LBMGP site. The on-site portion of the Seaview Manor Housing property was not built on land that formerly contained any manufacturing structures or operations. The property was reported to have been filled with cinders prior to 1950.

Soil, groundwater, sediment and surface water samples were collected throughout the LBMGP site, beginning in 1983 (7, 20). Soil samples exhibited varying concentrations of priority pollutant volatile organic compounds, including benzene, toluene, ethylbenzene, xylenes, styrene, and n-propylbenzene, and non-priority pollutant volatiles; polyaromatic hydrocarbons (PAHs); and inorganic compounds, including lead, zinc, copper, arsenic, cyanides and phenols. Groundwater samples were found to contain PAHs, benzene, toluene, and ethylbenzene. The higher levels of contaminants are generally in the southern portion of the site (on the side opposite Seaview Manor); however, groundwater flows to the north in the direction of Troutman's Creek. Off-site testing of Troutman's Creek water and sediments across Seaview Avenue showed PAHs in both water and sediments.

The water table at the site is approximately two feet below surface (21). In November 1994 air sampling was conducted to address potential impact to Seaview Manor residences through vapor intrusion from groundwater. One Seaview Manor crawlspace and four outside (ambient) locations upwind of the site were selected, and sampled for benzene, toluene, ethylbenzene and xylenes (BTEX). Concentrations of contaminants in the crawlspace were comparable to those measured in ambient air, and were below the New Jersey Department of Environmental Protection (NJDEP) Reference Concentrations for Inhalation (January 1994) that were in effect at the time (22).

Further soil sampling on the Seaview Manor property in 1997 and 1998 found exceedences of NJDEP Residential Direct Contact Cleanup Criteria for volatile and semi-volatile organic compounds and metals (21). No exceedences of the NJDEP Class IIA Groundwater Standards were found in monitoring wells on the Seaview Manor property at that time (21); however, the NJDEP later determined that the sampling methodology employed was unacceptable for groundwater delineation, and required that additional monitoring wells be placed on the Seaview Manor property (7). Subsequently, elevated levels of several volatile and semi-volatile compounds were detected (21).

In August 2002, the Concerned Citizens Coalition of Long Branch petitioned the ATSDR to evaluate public health issues relating to the site, including the potential for adverse health effects in general and cancer specifically. The ATSDR and the NJDHSS began attending the regular meetings of the Concerned Citizens Coalition, and proposed responding to the petition through several Public Health Consultations, as well as a full Public Health Assessment. In addition to this Public Health Consultation evaluating indoor air, other Public Health Consultations will review cancer incidence in the area, and review the remedial plan for the site. The Public Health Assessment will consider all pathways of exposure to residents living near the former manufactured gas plant site. Community concerns were gathered through regular meetings of the Concerned Citizens Coalition, public meetings in Long Branch on the site, discussions with local officials, and Availability Sessions conducted in March 2003. Community concerns are discussed below.

Because of known site-related contamination on the Seaview Manor property, remediation of soil and groundwater is imminent. Remedial activities will, in effect, place the housing complex on a construction site. For the safety of the residents, the Long Branch Housing Authority has begun implementation of a relocation plan that will remove all residents from the Seaview Manor property. Relocation began in April 2003. It is currently unknown when all residents will be relocated from Seaview Manor, how long remediation will take, and when (or if) the residents will return.

Environmental Sampling for Indoor Air Exposures

Air sampling: November 1994

In November 1994, air samples were collected in and near the Seaview Manor Housing property, to determine if there were any impacts to the property as a result of volatilization from groundwater. One interior sample and four ambient samples were collected and tested for BTEX. The results of this sampling event did not exceed NJDEP reference concentrations for inhalation. Table 1 presents the results of the analysis of these samples (6, 8).

It was noted at the time of sampling that the average air temperature was approximately 69° F. Winds were from the northwest, placing the Seaview Manor property upwind of the former manufactured gas plant site (6). Sampling was conducted according to the USEPA Method TO-1. Samples were collected over a four hour period.

Air sampling: December 2002

On December 19, 2002, a total of eight crawl space air samples were collected from three buildings in the Seaview Manor Housing complex. These included seven distinct areas and one duplicate. Two additional samples were collected from areas outside the buildings: one upwind and one downwind. All samples were tested for BTEX. The results are found in Table 2. Benzene and ethylbenzene exceeded the NJDEP screening level at one location, resulting in additional sampling in January 2003 (17).

Air sampling: January 2003

On January 7, 2003, air from the crawlspace with the elevated benzene and ethylbenzene levels, as well as air from the apartment above that crawlspace and two outside air samples were tested for BTEX. Results are found in Table 3 (18). All results were below NJDEP reference concentrations.

Air sampling: March 2003

On March 1, 2003, New Jersey Natural Gas collected air samples from the living spaces of 19 apartments in the three buildings from which crawlspace samples were taken in December 2002. Results are found in Table 4 (19). Benzene exceeded the NJDEP reference concentration in four apartments (two each in two buildings) and one crawlspace in a third building.

Samples were collected via SUMMA canisters for approximately 8 hours. Ambient temperatures averaged approximately 36° F. SUMMA canisters were placed approximately four feet off the floor. It was also noted that water with an oil odor had been pumped out of the basement of Building B (units 27 through 32), although there is often water in this area during the winter months.

Weather conditions can impact air sample results, especially the volatilization of organic compounds. These factors are described in the Discussion section, under Vapor Intrusion Pathway.

Air Sampling: March 27-28, 2003 and April 9-10, 2003: Day Care Centers

Two day care centers are in the immediate vicinity of the LBMGP. These are the Check Mate Day Care Center on C. P. Williams Place, and the Second Baptist Church Day Care Center, at the intersection of Liberty Street and C. P. Williams Place. The day care centers are

approximately 50' and 250' from the site boundary, respectively. New Jersey Natural Gas collected indoor samples from both facilities for BTEX testing on March 27 through March 28, 2003.

Results for the Check Mate Day Care Center are presented in Table 5. Levels of benzene, toluene, ethylbenzene, and xylenes were similar to background concentrations, and below NJDEP reference concentrations. The samples collected at the Second Baptist Church Day Care Center at that same time were likely contaminated by a motor vehicle idling near the collection point (19); therefore, a second set of samples were taken April 9-10, 2003. These results are presented in Table 6. Concentrations of all compounds were below NJDEP reference concentrations.

Community concerns

Community members have voiced their concerns to the NJDHSS and the ATSDR through the Concerned Citizens Coalition, at public meetings, two Availability Sessions on March 26, 2003, and privately. Concerns have been grouped as follows:

- children's health issues – there have been questions regarding the possible relationship between site contaminants and asthma, autism, birth defects, specific cancers, and learning disorders in children. In addition, the Concerned Citizens Coalition asked the NJDEP how children's health would be protected during the ongoing remedial activities at the site (4).
- respiratory conditions in adults: specific concerns and conditions included asthma in adults and bronchitis.
- cancer: the community is concerned about the number of cancers in the vicinity of the site.
- other diseases and health issues: community members raised concerns about infections, rashes and lupus. Most Seaview Manor residents who attended the Availability Sessions on March 26, 2003 stated that they had frequent headaches while in their apartments. Many stated that they also had stomach aches, nausea and diarrhea. This was especially noted by those who lived elsewhere previously and did not have those symptoms until moving into Seaview Manor. Residents and the Concerned Citizens Coalition requested biomonitoring for site contaminants, specifically DNA testing for genetic damage and markers of exposure (4).
- stress: there have been concerns voiced about the likelihood of psychological stress among Seaview Manor residents. The length of relocation is uncertain, and it is unknown if the tenants will be able to return to their apartments upon completion of the Seaview Manor remediation. A spokesperson for residents also noted that residents expressed fears over the uncertainty about where they will be moved to and when (and if) they will be able to return, as well as the unknown health risks that they may face.
- chemical exposures and effects: residents asked about the health effects of the chemicals of concern. Questions were also posed regarding whether underlying health conditions could make individuals more susceptible to health effects from exposures.

Discussion

Summary of Data

The following table summarizes the March 1, 2003 data from the Seaview Manor living areas and compares each level to ATSDR Minimal Risk Levels and the NJDEP reference concentration for each of the contaminants of concern.

Contaminant	Range of levels detected	ATSDR Minimal Risk Level (MRL) ¹	NJDEP reference concentration ²
Benzene	0.83 – 4.5 $\mu\text{g}/\text{m}^3$	12.8 $\mu\text{g}/\text{m}^3$ (4 ppb) intermediate	1.59 $\mu\text{g}/\text{m}^3$
Ethylbenzene	Non-detect to 0.87 $\mu\text{g}/\text{m}^3$	4,333 $\mu\text{g}/\text{m}^3$ (1,000 ppb) intermediate	2.16 $\mu\text{g}/\text{m}^3$
Toluene	1.6 – 7.1 $\mu\text{g}/\text{m}^3$	300 $\mu\text{g}/\text{m}^3$ (80 ppb) chronic	420 $\mu\text{g}/\text{m}^3$
Xylenes	0.74 – 2.8 $\mu\text{g}/\text{m}^3$	433 $\mu\text{g}/\text{m}^3$ (100 ppb) chronic	7,300 $\mu\text{g}/\text{m}^3$

1. The ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste site. A MRL is an estimate of a level of daily human exposure to a contaminant below which non-cancer adverse health effects are unlikely. MRLs are developed for each route of exposure, e.g., ingestion and inhalation, and for the length of exposure, i.e., acute, less than 14 days; intermediate, 15–364 days; and chronic, 365 days or more. Because ATSDR has no methodology to determine amounts of chemicals absorbed through the skin, there are no MRLs for skin exposure. ATSDR presents information on MRLs in its series of Toxicological Profiles on hazardous substances. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status.
2. The NJDEP Reference Concentrations are guidance levels used in indoor air, based upon ambient air regulations.

Exposure Pathways and Contaminants of Concern

This Public Health Consultation was written to determine if there is (or was) a completed exposure pathway to site-related contaminants in indoor air in the Seaview Manor residences and the two area day care centers, and, if so, how these exposures may affect health.

Health Assessment Methodology

The ATSDR and NJDHSS evaluate the environmental and human components that lead to human exposure from releases of hazardous substances from a given site. A pathways analysis consists of five elements: (1) a source of contamination; (2) transport through an environmental medium; (3) a point of human exposure; (4) a route of human exposure; and, (5) a receptor population. ATSDR classifies exposure pathways into three groups: (1) "completed pathways", that is, those in which exposure is reasonably expected to have occurred, to occur, or to occur in

the future; (2) "potential pathways", that is, those in which exposure might have occurred, may be occurring, or may yet occur, and, (3) "eliminated pathways", that is, those that can be eliminated from further analysis because at least one of the five elements listed above is missing and will never be present, or in which no contamination of concern can be identified.

After the pathways are designated as "completed," "potential," or "eliminated," ATSDR follows a two-step methodology to comment on public health issues related to exposure pathways at hazardous waste sites. First, ATSDR obtains representative environmental monitoring data for the site of concern and compiles a list of site-related contaminants. ATSDR compares this list of contaminants to health-based values (health comparison values or HCVs) to identify those contaminants that do not have a realistic possibility of causing adverse health effects. Second, for the remaining contaminants, ATSDR evaluates site-specific conditions to determine what exposure scenario is realistic for a given exposure pathway. Given this exposure scenario, ATSDR determines a dose and compares this dose to scientific studies to determine whether the extent of exposure indicates a public health hazard.

The health-based comparison values used in this report are concentrations of contaminants that the current public health literature suggests are unlikely to result in adverse health effects. These comparison values are conservative because they include ample safety factors that account for the most sensitive populations. ATSDR typically uses HCVs as follows: if a contaminant is never found at levels greater than its comparison value, ATSDR concludes the levels of corresponding contamination are below levels of public health concern. If, however, a contaminant is found at greater than its HCV, ATSDR designates the pollutant as a contaminant of concern and examines it further in the assessment. Because HCVs are based on conservative assumptions, the presence of concentrations greater than an HCV does not necessarily suggest that adverse health effects will occur among the exposed population.

Contaminants of Concern

The NJDHSS and ATSDR find that, although contaminant levels are similar to background levels in urban environments, it is likely that a completed exposure pathway exists or has existed in the past to site related contaminants through inhalation of indoor air at Seaview Manor residences. The NJDEP and New Jersey Natural Gas have identified benzene, toluene, ethylbenzene and xylenes as contaminants associated with the Long Branch Manufactured Gas site which may be present in indoor air in the Seaview Manor Housing complex. These compounds can enter air in the living quarters in the residences by volatilization from groundwater into the soil in crawlspaces. The crawlspace floors are either bare soil or covered with a concrete slab. Some of the slabs reportedly have cracks, linking the soil below the slab to the air above. Contaminants can then enter the living quarters through air flow within the buildings. This pathway of exposure is referred to as the vapor intrusion pathway, and is discussed in the following section.

Benzene is the only contaminant of concern detected in Seaview Manor residential living spaces that is in excess of a health comparison value, and the only contaminant classified as a human carcinogen.

Indoor air at the two day care centers was tested in response to concerns about their proximity to the former manufactured gas plant, not because of known site-related contaminants. The day care centers had levels of benzene, toluene, ethylbenzene and xylenes below health comparison

values, and similar to those of outside air levels, and are not evaluated further in this Public Health Consultation.

Vapor Intrusion Pathway – General Information

The United States Environmental Protection Agency (USEPA) developed guidance for the evaluation of indoor air contaminants resulting from groundwater or soil contamination that could affect indoor air quality (15). The Commonwealth of Massachusetts Department of Environmental Protection (MADEP) has also developed guidance for this pathway which provides a summary of factors that influence contaminant concentrations in indoor air (16). Many factors can influence the rate at which gaseous contaminants can enter a building, and these are described more fully in Appendix A. Factors that are relevant to the sampling that was conducted on March 1, 2003 at the Seaview Manor complex and community questions regarding the sampling are primarily meteorological factors, which affect the penetration and distribution of pollutants into a structure. These include:

- temperature. The temperature difference between the inside and outside of a structure influence the rate at which the contaminant enters the building, as well as its circulation throughout the building. In cold weather, as heated air rises through a building, the likelihood that soil gas will be taken in through lower levels (including a crawlspace or basement) is increased.
- wind. On windy days, pressure differences between the inside and outside of a building can cause air to be drawn into the building.
- moisture. Rainy, wet conditions can reduce permeability of structures (for example, leaky wooden window frames can swell with moisture). Rainy, wet conditions generally can trap soil gases in a building. Generally, soil around a building can become saturated, with soil beneath the building drier. Soil gas migrates to the drier soil, increasing the likelihood that it will enter indoor air. Under extremely wet conditions a groundwater lens may form over the contaminated soil, acting as a barrier and preventing the gas from diffusing into the building.
- other meteorological influences. In the winter, when the ground is frozen, soil gases that are trapped under snow and ice may migrate toward the warmer, thawed areas beneath the foundation of a building, increasing the likelihood that contaminants will enter the building. When the frozen layer thaws, trapped gas may also be released.

Temperatures on March 1, 2003 averaged 36° F. A representative of the Long Branch Housing Authority stated that the crawlspaces in one of the buildings typically contained water during the winter months (24). However, approximately two weeks prior to this sampling event, Long Branch received over 20 inches of snow (32). Standing water in at least one of the buildings was pumped out prior to sampling. Under these conditions, sampling may not demonstrate a “worst case scenario” to determine the public health significance of this exposure pathway.

Public Health Implications

This section focuses on the public health implications of indoor air levels of benzene, toluene, ethylbenzene and xylenes measured in living spaces of the Seaview Manor complex in January and March 2003. Each of the four compounds, as well as the mixture of all four, has been evaluated for its potential impact on human health.

In order to determine what the possible health effects might be, the NJDHSS and the ATSDR review the following:

- the amount of a chemical a person might take into their body, or the *dose*.
- how long a person might have been exposed to the chemical, or *duration* of exposure.
- how the chemical gets into the person's body, or *route of exposure*.
- what organs or body systems can be affected by the chemical (*target organs or systems*).
- are there individuals who might be at higher risk from exposures because of their age, underlying health issues, or other factor (*sensitive populations*)

The potential for health effects is related to all of the items on the list above. The ATSDR and NJDHSS generally consider a "worst case scenario" to evaluate potential health outcomes. To provide residents with information on the possible health effects from exposures to the chemicals measured in air in the Seaview Manor complex, several assumptions were made. These were:

- all of the residents were exposed to the highest concentrations of benzene, toluene, ethylbenzene and xylenes measured in air.
- exposures were long-term (chronic), with residents exposed 24 hours each day for more than one year.
- exposures occurred through breathing.

Benzene

Benzene is widely found in the environment, including indoor and ambient air. Studies indicate that both ambient air in urban areas and indoor residential air typically contain benzene levels of up to approximately $6 \mu\text{g}/\text{m}^3$ (10).

The highest concentration of benzene measured in indoor air on March 1, 2003 was $4.5 \mu\text{g}/\text{m}^3$, or 4.5 micrograms of benzene in one cubic meter of air. This was found in one Seaview Manor apartment living area on March 1, 2003, and is the level that will be used to evaluate public health implications of exposure. Since most studies that are discussed below provide benzene levels in parts per billion (ppb) or parts per million (ppm), the maximum level measured on March 1, 2003 has been converted to ppb for comparison purposes. Conversion equations are shown in Appendix B. The maximum level of benzene is 1.4 ppb.

Biologic fate of benzene: Benzene is rapidly absorbed by inhalation and ingestion (23). After exposure, benzene is found throughout the body, but then largely distributes into the bone marrow, organs or tissues that have a high fat content (such as the brain or fat cells), or tissues with a high blood or fluid flow (such as the kidney and liver). Once absorbed, benzene is initially metabolized in the liver, and later in the bone marrow. Bone marrow is the primary target organ for damage due to chronic benzene toxicity. Benzene, as well as the compounds that are produced during benzene metabolism, exit the body through exhalation and urine in several phases ranging from minutes to hours.

Effects of benzene: High levels of benzene can cause significant damage to blood and bone marrow, including a decrease in the number of red blood cells, white blood cells, and platelets. Aplastic anemia may result, in which the bone marrow ceases to produce blood cells. These

effects have been found to occur at levels more than 1,000 times greater than the levels measured in Seaview Manor.

At high levels of exposure, benzene is known to cause cancer in humans, specifically acute myelogenous leukemia (AML). Studies of workers have consistently linked benzene exposures with AML, the only form of cancer that is consistently associated with high occupational exposures to benzene. Studies have also shown that benzene causes cancer in animals (10).

Sensitive populations: Susceptible populations will show different or stronger reactions to benzene than will most people exposed to the same level of benzene. ATSDR examined studies that describe sensitive populations to benzene. The factors that increase an individual's sensitivity to benzene include:

- genetic susceptibility. Individuals whose genetic makeup causes an alteration of a particular liver enzyme (used to break down benzene) may be at higher risk to the toxic effects of benzene than the general population.
- thalassemia. Individuals with β thalassemia minor may be at increased risk from the effects of benzene.
- viral hepatitis. People with viral hepatitis may be at increased risk for aplastic anemia from benzene exposure.
- consumption of ethanol. Ethanol (alcohol) consumption can increase the severity of benzene-induced anemia and other blood cell conditions. Increased central nervous system disturbances may also occur following exposure to benzene and alcohol (10).

Non-cancer effects:

Acute and intermediate MRLs for benzene (inhalation) are 50 ppb and 4 ppb, respectively. No chronic MRL has been derived for benzene.

All benzene concentrations detected in the living spaces and crawl spaces in Seaview Manor are below ATSDR's intermediate MRL of 4 ppb. The intermediate MRL is derived from an animal study in which the Lowest Observed Adverse Effect Level (the effect was an increase in rapid response) occurred at 0.78 ppm, or 780 ppb (Li et al, 1992) (10). The ATSDR derives the MRL by adjusting for human and mouse ventilation rates and weight ratios. It also includes an uncertainty or margin-of-safety factor of 90. Therefore, at the maximum benzene level that was detected, acute or intermediate duration exposures are not likely to result in any serious adverse health effects. For chronic exposures, the effect of concern is cancer, which is discussed below.

Cancer effects:

The ATSDR utilizes Cancer Risk Evaluation Guidelines (CREG) for chemicals known or suspected to cause cancers. A CREG provides an estimated level of a contaminant that is associated with a 1 in a million excess risk for cancer. The CREG for benzene is $0.1 \mu\text{g}/\text{m}^3$, or 0.03 ppb.

The USEPA has estimated levels of exposure to benzene through inhalation that are associated with an increased risk for leukemia. They have estimated that, at a lifetime exposure (70 years) to 0.04 ppb benzene in air, there is a one in a million risk for leukemia. Based on the maximum level (1.4 ppb) found in Seaview Manor, risk for leukemia can be estimated at less than four in

100,000. The second highest level of benzene found in Seaview Manor living spaces was 2.7 $\mu\text{g}/\text{m}^3$, or 0.85 ppb. This is associated with a risk of approximately less than three in 100,000. The average level of benzene measured in living spaces was 1.4 $\mu\text{g}/\text{m}^3$, or 0.44 ppb, which relates to a risk of less than two per 100,000. Exposure to background levels of benzene for 70 years is associated with a risk of less than seven for 100,000. The ATSDR defined these levels of risk as a “low increased risk for cancer.”

Ethylbenzene, Toluene and Xylenes (Individually)

None of these contaminants was found at levels above health screening values, and are not evaluated further individually. However, because community members asked about the potential health effects of these chemicals, they are described further in Appendix C.

Chemical Mixtures - BTEX

Benzene, ethylbenzene, toluene and xylenes are among the most frequently found mixtures at contaminated sites. The ATSDR developed a draft Toxicological Profile to:

- evaluate data on the toxicology of mixtures of benzene, toluene, ethylbenzene, and xylenes (BTEX);
- evaluate data on the joint toxic actions (e.g., additive, less-than-additive, or greater-than-additive joint actions) of these chemicals in producing health hazards; and
- make recommendations for exposure-based assessments of the potential impact of joint toxic action of the mixture on public health (14).

Animal studies were conducted to learn if the presence of two or more of the compounds were broken down differently than each one alone. All four of the compounds are broken down in the liver. It was found that, at high levels of exposure, the compounds compete with each other for metabolism, resulting in higher levels of the chemicals in the blood than if exposure occurred to each chemical separately. However, this is only true at exposure levels greater than approximately 20,000 ppb for each compound. Therefore, at levels measured in Seaview Manor living spaces, it is unlikely that health effects from the mixtures would be different than health effects from each individual compound.

Odors

Former manufactured gas plants can be contaminated with odor-causing chemicals, including volatile and semi-volatile organic compounds, and coal tar residues. These are or were present at the Long Branch Manufactured Gas Plant site. In addition, there is a sewage treatment plant located approximately 1 block north of Seaview Manor. The NJDEP published guidance for odor control at municipal treatment facilities, and notes several odor-causing compounds, including hydrogen sulfide and methyl mercaptan (31).

In public meetings and the NJDHSS and ATSDR Availability Sessions, residents of Seaview Manor voiced their complaints about foul and strong odors. Some of the residents who described these odors stated that it didn't matter if the windows were open or closed, although several stated that odors were less of a problem when the windows were open. Several residents also

attributed heart palpitations or headaches with the odors. Description of odors included “mercaptan,” “lighter fluid,” and “sewage” (19). Most residents could not specifically describe the type of odor. The unit with mercaptan odors had been tested for natural gas leaks, but none were detected. In addition, water that was pumped from the crawlspace of Building B (units 27 through 32) prior to the March 1, 2003 sampling was noted to have smelled “like an oil odor,” according to a Long Branch Housing Authority representative (24). Charcoal briquettes were found in this crawlspace, but it could not be determined if they were the “matchlight” variety, which would contain volatile organic chemicals.

The relationship between odor and health is not fully understood because odors are complex, identifying and measuring odorous compounds is difficult, and human responses to odors are variable (25). Odor-causing chemicals can produce health symptoms by irritation, because of psychological or genetic factors, or because the odor is also associated with dusts or allergens.

The levels of benzene, ethylbenzene, toluene and xylenes measured in the residential units, as well as the crawlspaces, are not likely to produce the odors described by residents. Because there are at least two potential sources for strong odors, this issue should be examined further as part of a community-wide investigation of potential exposures.

Other Health Issues of Community Concern

Asthma

Asthma is a chronic inflammatory disorder of the airways. This inflammation causes periodic episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. Airflow to the lungs is usually blocked. Airflow often returns to normal on its own or with treatment. Inflammation also causes an increase in existing hyper-responsiveness to a variety of stimuli (9).

Many factors can cause or worsen asthma, including allergies, a family history of asthma, infectious diseases, occupational conditions, socioeconomic and psychosocial factors, environmental factors, weather changes, and exercise. Environmental agents associated with asthma include dust mites, cockroaches, pet dander, ragweed, and other pollens. Pollutants including ozone and sulfur dioxide can worsen asthma symptoms in a person who has asthma. Environmental tobacco smoke can both cause and worsen asthma. Smoke, dust, gas or diesel fumes, or chlorine, can trigger an asthma attack in people with increased airway hyper-responsiveness.

Environmental agents may affect asthma severity in the following ways:

- the pollutant may act as an inciter or trigger, leading to an asthma attack in an individual with hyper-responsive airways;
- the pollutant can worsen preexisting airway inflammation, leading to an increased airway hyper-responsiveness, which may persist after the exposure ends;
- the pollutant can change the immune responses to inhaled antigens or intensify the impact of other pollutants in the respiratory tract (9).

Particulate matter in air is a mixture of solid particles and liquid droplets. Larger particles (PM₁₀) include dust, vehicle exhaust, and particles released from crushing or grinding operations, and wood burning. These can increase the severity of health conditions such as asthma. Smaller particles (PM_{2.5}) penetrate deeper into the lungs and can cause more serious health effects. Sources of PM_{2.5} include vehicle exhaust, industrial and residential combustion, and reactions between gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds in the atmosphere.

Exposures due to releases from industrial facilities may affect asthma severity. Some hazardous air pollutants, including aldehydes, metals, and isocyanates are known to cause asthma in occupationally exposed adults. Noxious odors can increase the severity of symptoms in people with asthma.

There is no research to indicate that benzene, toluene, ethylbenzene and xylenes are associated with asthma, either individually or as a mixture (10, 11, 12, 13, 14).

Bronchitis

Bronchitis is an acute or chronic inflammation of the bronchial tubes, which are the tubes that conduct air to and from the windpipe (trachea) to the small sacs in the lungs (alveoli). Inflammation of the bronchial tubes causes swelling and an increased amount of mucous production, making it difficult to breathe. Bronchitis may result from an infection.

Chronic bronchitis may also result from exposure to environmental chemicals, including tobacco smoke, sulfur dioxide, and fine particulate matter (PM_{2.5}). Benzene, ethylbenzene, toluene and xylenes are not known to cause bronchitis, although very high levels (over 1,000,000 ppb) of ethylbenzene may cause respiratory depression in rats (10, 11, 12, 13).

Stress

Psychological stress can and does occur among individuals and within communities in which there is actual or perceived exposure to environmental contaminants. The ATSDR notes that, unlike catastrophic events in which there is a defined time frame (the event, the recovery phase, and eventually a return to a state of normalcy), living near a contaminated site “is a more nebulous and uncertain situation” (26). The slow onset and recovery from these situations may make adjustments difficult, cause concerns about exposures and potential health effects, and may cause social breakdowns, resulting in additional stress (27).

Chronic stress is related to physical health, and may be associated with long-term elevations in blood pressure, and heart rate, as well as evidence of changes in immune-system function and biochemical parameters. There may also be persisting symptoms of post-traumatic stress disorder (28).

Residents expressed stress-related concerns, including fears about their health and the health of their families (including children, parents and grandparents that were or are current residents of Seaview Manor). Residents expressed a distrust of the agencies involved in, as well as the

outcome of, the remediation. In addition, since the remediation of Seaview Manor will require relocation of all residents, there was much anxiety about where they would be moved to, the length of time the remediation will take, the protectiveness of the remedial plans for both Seaview Manor and the site itself, and whether they would be able to return to Seaview Manor after the remediation is complete. Residents range in age from infants to elderly, some of whom have been living at Seaview Manor for over thirty years. ATSDR has stated that relocations of this nature often lead to stress and a sense of loss and grieving, especially among long-term residents.

Lupus

Systemic lupus erythematosus, or lupus, is an autoimmune disease with a prevalence of approximately one in 2,000 for the general population, but one in 700 for women between the ages of 20 and 64 years, and one in 245 for black women of the same age group (29). Research indicates that there is a genetic component to the disease, although factors may influence the disease in susceptible individuals. These factors include sunlight, stress, certain drugs, and infectious agents such as viruses, as well as hormonal factors. (30). At the present time there is no indication that environmental contaminants are linked to lupus.

Cancer

Residents expressed concerns about the rate of cancer in the area. The New Jersey State Cancer Registry has collected data on most cancers since October 1978. The NJDHSS will review New Jersey State Cancer Registry data and evaluate the incidence of cancers in the area near the site. The results of that evaluation will be provided in a separate Public Health Consultation.

Child Health Considerations

ATSDR and NJDHSS recognize that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances emitted from a waste site. They are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. They are shorter than adults, which means they breathe dust, soil, and heavy vapors closer to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most important, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

The NJDHSS and the ATSDR evaluated the potential effects in children exposed to benzene, toluene, ethylbenzene and xylenes at the levels measured in Seaview Manor. At the levels detected in Seaview Manor it is unlikely that children would be affected differently than adults. Levels measured in the Check Mate Day Care Center and the Second Baptist Church Day Care Center are below those measured in Seaview Manor, and are also unlikely to result in adverse health effects.

Public Comment

A draft of this Public Health Consultation was released for public comment from October 9 through December 12, 2003. Comments are listed in Appendix D.

Conclusions

Public Health Hazard Category

Low levels of exposure have and are occurring to benzene, toluene, ethylbenzene and xylenes from indoor air in Seaview Manor residences. Sampling conducted on March 1, 2003 provides a “snapshot” of contaminants present under the conditions in which the samples were taken. Although the levels detected at that time are not likely to result in adverse health effects, the NJDHSS and the ATSDR classify indoor air exposures among residents of the Seaview Manor Property to represent an *Indeterminate Public Health Hazard*. This is because the sampling conducted on March 1, 2003 was performed after severe weather caused flooding in some of the crawlspaces, resulting in more water than typical for winter months. This may have had an effect on the vapor intrusion pathway. In addition, since seasonal variations can affect the volatility of the compounds measured, the sampling that occurred provides only a “snapshot” of exposures, and may not be indicative of year-round exposures.

The NJDHSS and the ATSDR classify indoor air exposures among children using the Check Mate Day Care Center or the Second Baptist Church Day Care Center, based solely on the sampling conducted on March 27-28 and April 9-10, 2003, as *No Apparent Public Health Hazard*.

The NJDHSS and the ATSDR further classify odors in the vicinity of the Seaview Manor Complex as an *Indeterminate Public Health Hazard* because of the following three factors: the long-term effects of repeated exposure are not well understood, odors are complex, and human response to odors is variable.

Recommendations

1. To better define potential seasonal variations in exposure, particularly because relocation is still ongoing, the NJDHSS and the ATSDR recommend additional indoor air sampling be conducted in residential living spaces at Seaview Manor. Sampling can occur at a time when conditions are more representative of normal weather conditions (if done in the winter), or other seasons (e.g., summer). The USEPA guidance for vapor intrusion notes that two or more sampling events at each location are desirable, and describes conditions under which sampling should occur (15). The Commonwealth of Massachusetts Department of Environmental Protection recommends seasonal sampling (16). In addition, measurements of other potential vapors that may be released (e.g., components of coal tar residues detected in soil) should also be considered in future sampling events.

2. The relocation of tenants can cause psychological stress, particularly as it is unknown if the relocation is temporary or permanent; and, if temporary, how long it will last. Concerns regarding health risk are also stressors. Professional counseling should be made available to tenants of Seaview Manor.
3. Residents should contact the NJDEP through its hotline (1-877-WARN DEP, or 1-877-927-6337) to report offensive odors.

Public Health Action Plan

Actions Taken

1. The NJDHSS and ATSDR have met regularly with residents and the Concerned Citizens Coalition to identify and address community concerns.
2. The NJDHSS and ATSDR held two Availability Sessions for residents of Seaview Manor on March 26, 2003 to identify community concerns, and to provide information to residents about exposure pathways and the contaminants of concern.
3. The Long Branch Housing Authority has begun implementation of a relocation plan during the remedial activities at Seaview Manor.
4. The NJDHSS and ATSDR have provided educational materials to residents that describe health aspects of the contaminants of concern.
5. The Monmouth County Division of Mental Health is working with the New Jersey Natural Gas Company and its relocation specialists to coordinate mental health counseling services for displaced residents, as needed.
6. As is NJDEP policy, the New Jersey Natural Gas Company has real-time monitoring in place to measure the efficiency of odor control and dust suppression methods during on-site soil remediation.

Actions Planned

1. The NJDHSS and ATSDR will develop a Public Health Assessment to evaluate all potential pathways of exposure associated with the Long Branch Former Manufactured Gas Plant site, and re-evaluate existing community concerns in light of additional exposure pathway information. It is anticipated that a Public Health Assessment will be released to the public by the Fall of 2004.
2. The NJDHSS and ATSDR will evaluate the protectiveness of the remedial plan by mid-2004.

3. Dust suppression and odor control measures were in place throughout the soil remedial action conducted. The NJDEP will continue to require such measures for all future soil remedial actions.
4. The NJDHSS will evaluate cancer incidence in the area surrounding the site. This report will be completed in 2004.
5. The NJDHSS and ATSDR will evaluate the results of future air sampling events in Seaview Manor, if additional sampling is performed.

Certification

This Health Consultation was prepared by the Division of Health Assessment and Consultation (DHAC), ATSDR, and the New Jersey Department of Health and Senior Services (NJDHSS) under a cooperative agreement with the ATSDR. It has been produced in accordance with approved methodology and procedures existing at the time the Health Consultation was begun.



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



for Roberta Erlwein

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References

1. Baseline Ecological Evaluation, Former Long Branch Manufactured Gas Plant, Long Branch, NJ. Arcadis G & M Inc.; March 2002
2. Human Health Risk Assessment, Former Long Branch Manufactured Gas Plant, Seaview Manor Housing Complex. Arcadis G & M Inc.; April 2002
3. Letter to Wyatt Kenoly (Concerned Citizens Coalition) from Robert Williams (ATSDR); Sept 20, 2002.
4. Issues and Concerns (Concerned Citizens Coalition); undated (issues discussed in CCC meeting December 2002).
5. Revised Pre-remediation Delineation Report. ARCADIS; April 2002.
6. Air Sampling at the Long Branch Housing Authority Performed 11/9/94. Geraghty & Miller; Feb 7, 1995
7. Revised Supplemental Focused Remedial Investigation Report; Long Branch Former Manufactured Gas Plant Site. Arcadis, Geraghty and Miller; September 1999.
8. Technical Manual 1003; Guidance on Preparing a Risk Assessment for Air Contaminant Emissions. New Jersey Department of Environmental Protection; Revised December 1994.
9. Case Studies in Environmental Medicine: Environmental Triggers of Asthma. Agency for Toxic Substances and Disease Registry; April 2002.
10. Toxicological Profile for Benzene. U.S. Department of Health and Human Services; Public Health Service; Agency for Toxic Substances and Disease Registry. September 1997.
11. Toxicological Profile for Toluene. U.S. Department of Health and Human Services; Public Health Service; Agency for Toxic Substances and Disease Registry. September 2000.
12. Toxicological Profile for Ethylbenzene. U.S. Department of Health and Human Services; Public Health Service; Agency for Toxic Substances and Disease Registry. July 1999.
13. Toxicological Profile for Xylene. U.S. Department of Health and Human Services; Public Health Service; Agency for Toxic Substances and Disease Registry. August 1995.
14. Draft Interaction Profile for: Benzene, Toluene, Ethylbenzene and Xylenes (BTEX). U.S. Department of Health and Human Services; Public Health Service; Agency for Toxic Substances and Disease Registry. Draft for Public Comment; comment period ends September 2002.
15. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils; U.S. Environmental Protection Agency.
16. Indoor Air Sampling and Evaluation Guide; WSC Policy #02-430; Commonwealth of Massachusetts Department of Environmental Protection; April 2002
17. VOC Report of Analysis 12/19/02; Accutest Labs; correspondence from NJDEP, January 6, 2003
18. VOC Report of Analysis 1/7/03; Accutest Labs; correspondence from NJDEP, February 10, 2003
19. Remedial Investigation Report – Indoor Air Quality Survey; Seaview Manor Housing Development (Units 27-32 and 34-46); Second Baptist Church Day Care Center; Check Mate Day Care Center; Long Branch, New Jersey. Arcadis; May 2003.
20. Final Draft Site Inspection Report, New Jersey Natural Gas Company, Long Branch, New Jersey, Field Investigation Team Activities at Uncontrolled Hazardous Substances Facilities; NUS Corporation Superfund Division; March 16, 1990
21. Final Remedial Action Workplan, Former MGP Site, Long Branch, New Jersey; Arcadis, Geraghty and Miller; September 1999

22. Air Sampling at Long Branch Housing Authority Performed 11/9/94; Geraghty and Miller, Inc; February 1995
23. Case Studies in Environmental Medicine: Benzene Toxicity. Agency for Toxic Substances and Disease Registry; Rev. April 2000.
24. New Jersey Department of Environmental Protection, Memorandum from Allan S. Motter to Paul Smith; RE: Long Branch Manufactured Gas Plant, Long Branch, Ocean County, NJ; Job # N250DW00, Activity Code V68B; Field Visit to Observe Crawl Space and First Floor Indoor Air Quality Sampling, March 1, 2003
25. Health Consultation, Exposure Investigation; Central Landfill, Johnston, Providence County, Rhode Island; ATSDR. November 20, 2002.
26. "Scientific Research Continues on the Psychological Responses to Toxic Contamination." P. Tucker, M.D.; Hazardous Substances and Public Health; ATSDR; Spring 2000.
27. Report of the Expert Panel Workshop on the Psychological Responses to Hazardous Substances. ATSDR
28. "ATSDR's Psychological Effects Program Addresses Stress-Related Health Concerns." P. Tucker, M.D.; Hazardous Substances and Public Health; ATSDR; Spring 2000
29. "Disorders of the immunologic system" from Environmental Medicine; Stuart Brooks et al; 1995.
30. "Handout on Health: Systemic Lupus Erythematosus." National Institute of Arthritis and Musculoskeletal and Skin Diseases. Rev. February 2000.
31. Guidance Document for Odor Control at Municipal Wastewater/Sludge Handling and Treatment Facilities. State of New Jersey Department of Environmental Protection, Air Quality Permitting. August 1997.
32. February 16-17, 2003 Snowfall Reports.
<http://climate.rutgers.edu/stateclim/02172003/02172003snowfall.html>

Table 1.

November 9, 1994 air samples collected in and near Seaview Manor
USEPA Method TO-1

Sample Location	Benzene $\mu\text{g}/\text{m}^3$	Toluene $\mu\text{g}/\text{m}^3$	Ethylbenzene $\mu\text{g}/\text{m}^3$	Xylenes $\mu\text{g}/\text{m}^3$
Play-ground	7.1	6.2	0.5	1.1
Fence line	5.7	3.3	1.0	2.2
Courtyard	0.8	0.9	0.1	0.1
Crawl space	11.1*	8.4*	0.6*	1.9*
East yard	13.6	11.7	0.4	1.1
NJDEP reference concentration**	19	68	1,000	165

$\mu\text{g}/\text{m}^3$: micrograms of contaminant per cubic meter of air
NJDEP: New Jersey Department of Environmental Protection
USEPA: United States Environmental Protection Agency

* Although this table list results as they were reported, these results should be qualified because one of the three surrogate compounds was detected below the laboratory's recovery limits.

** Reference Concentrations for Inhalation, NJDEP, as of January 1994. Note that later reference concentrations are different.

Table 2.

December 19, 2002 Seaview Manor Housing complex crawlspace testing.
USEPA Method TO-14/TO-15

Sample Location	Benzene $\mu\text{g}/\text{m}^3$	Toluene $\mu\text{g}/\text{m}^3$	Ethylbenzene $\mu\text{g}/\text{m}^3$	Xylenes $\mu\text{g}/\text{m}^3$
Crawlspace for Apt. 33	5.1	6.1	3.9	13
Crawlspace for Apt. 34/35	0.7	2.0	ND	1.6
Crawlspace for Apt. 36/37	1.2	4.5	0.65	2.9
Crawlspace for Apt. 38/39	0.89	3.8	0.82	3.7
Crawlspace for Apt. 40	0.64	2.2	ND	1.5
Crawlspace for Apt. 40 (dup)	0.45	1.4	ND	0.61
Crawlspace for Apt. 30	0.86	6.4	1.2	5.2
Crawlspace for Apt. 44	0.45	1.2	ND	0.65
Upwind, ambient	2.0	11	2.4	11
Downwind, ambient	1.7	7.5	1.2	5.6
NJDEP reference concentration	1.59	420	2.16	7300

Shaded boxes show levels above the NJDEP reference concentration.

$\mu\text{g}/\text{m}^3$: micrograms of contaminant per cubic meter of air
 ND: not detected
 NJDEP: New Jersey Department of Environmental Protection
 USEPA: United States Environmental Protection Agency

NJDEP reference concentrations for air based upon USEPA Region 3 Risk-Based Concentration for residential air (revised 4/99) for toluene and xylenes, and on the practical quantitation limit for benzene and ethylbenzene. The USEPA Risk-Based Concentrations for residential air for benzene and ethylbenzene are $0.22 \mu\text{g}/\text{m}^3$ and $1.60 \mu\text{g}/\text{m}^3$, respectively.

Table 3.

January 7, 2003 Seaview Manor Housing complex sampling
USEPA Method TO-14/TO-15

Sample Location	Benzene $\mu\text{g}/\text{m}^3$	Toluene $\mu\text{g}/\text{m}^3$	Ethylbenzene $\mu\text{g}/\text{m}^3$	Xylenes $\mu\text{g}/\text{m}^3$
Crawl space	1.2	3.8	1.1	4.0
Apt. #33	0.89	2.3	0.43	1.8
Upwind, ambient	0.85	1.7	ND	1.2
Downwind, ambient	1.0	2.0	ND	1.8
NJDEP reference concentration	1.59	420	2.16	7300

$\mu\text{g}/\text{m}^3$: micrograms of contaminant per cubic meter of air

ND: not detected

NJDEP: New Jersey Department of Environmental Protection

USEPA: United States Environmental Protection Agency

NJDEP reference concentrations for air based upon USEPA Region 3 Risk-Based Concentration for residential air (revised 4/99) for toluene and xylenes, and on best available reporting limit for benzene and ethylbenzene. The USEPA Risk-Based Concentrations for residential air for benzene and ethylbenzene are $0.22 \mu\text{g}/\text{m}^3$ and $1.60 \mu\text{g}/\text{m}^3$, respectively.

Table 4.

March 1, 2003 living quarters and crawlspace air sampling, Seaview Manor Complex property.

Sample Location	Benzene $\mu\text{g}/\text{m}^3$	Toluene $\mu\text{g}/\text{m}^3$	Ethylbenzene $\mu\text{g}/\text{m}^3$	Xylenes $\mu\text{g}/\text{m}^3$
Upwind, ambient	0.93	2.3	ND	0.74
Downwind, ambient	0.77	1.7	ND	ND
Crawlspace for 27/28	0.57	1.1	ND	0.48
Apt. 27	1.1	3.5	0.43	1.9
Apt. 28	1.2	2.2	ND	1.1
Crawlspace for 29/30	1.6	2.7	1.7	2.3
Apt. 29	1.3	3.1	0.87	2.2
Apt. 30	1.5	2.9	1.0	1.6
Crawlspace for 31/32	0.70	1.1	ND	0.56
Apt. 31	0.99	2.5	ND	1.1
Apt. 32	0.89	3.4	ND	0.91
Crawlspace for 34/35	0.86	1.6	ND	ND
Apt. 34	1.2	7.1	0.61	2.8
Apt. 35	0.96	2.5	ND	0.78
Crawlspace for 36/37	1.2	2.9	ND	1.7
Apt. 36	0.99	2.6	ND	0.95
Apt. 37	1.9	22	0.56	2.5
Crawlspace for 38/39	0.86	2.1	ND	1.0
Apt. 38	2.7	3.1	ND	1.1
Apt. 39	0.89	2.1	ND	1.0
Crawlspace for 40	1.1	2.3	ND	0.74
Crawlspace 40 (dup)	0.83	1.6	ND	ND
Apt. 40	0.86	2.1	ND	0.74
Crawlspace for 41/42	0.57	1.0	ND	ND
Apt. 41	0.86	2.2	ND	0.82
Apt. 42	4.5	2.9	ND	0.65
Crawlspace for 43/44	0.86	1.8	ND	8.2
Apt. 43	1.7	5.4	ND	1.6
Apt. 44	0.89	3.2	ND	1.0
Crawlspace for 45/46	0.8	1.7	ND	0.69
Apt. 45	1.4	2.4	ND	1.1
Apt. 46	0.96	2.8	ND	1.0
NJDEP reference concentration	1.59	420	2.16	7300

Table 5.

Check Mate Day Care Center, March 27-28, 2003

Sample Location	Benzene $\mu\text{g}/\text{m}^3$	Toluene $\mu\text{g}/\text{m}^3$	Ethylbenzene $\mu\text{g}/\text{m}^3$	Xylenes $\mu\text{g}/\text{m}^3$
Upwind, ambient	0.83	2.0	ND	1.6
Downwind, ambient	0.99	2.5	0.48	1.7
Crawl space	0.54	1.2	ND	0.65
Main floor, center	0.93	2.3	0.43	1.2
Main floor, center	0.80	1.8	ND	1.0
NJDEP reference concentration	1.59	420	2.16	7300

Table 6

Second Baptist Day Care Center, April 9-10, 2003

Sample Location	Benzene $\mu\text{g}/\text{m}^3$	Toluene $\mu\text{g}/\text{m}^3$	Ethylbenzene $\mu\text{g}/\text{m}^3$	Xylenes $\mu\text{g}/\text{m}^3$
Upwind, ambient	ND	ND	ND	ND
Downwind, ambient	ND	ND	ND	ND
Basement, North	0.57	3.6	ND	1.0
Basement, South	0.57	2.2	ND	ND
Basement, South (duplicate)	0.61	2.1	ND	ND
NJDEP reference concentration	1.59	420	2.16	7300

Appendix A.

Vapor Intrusion Pathway

The Massachusetts Department of Environmental Protection describes the factors that may influence the vapor intrusion pathway. These can be found on their web site at <http://www.state.ma.us/dep/ors/files/indair.pdf>. In addition to the meteorological factors discussed in the Discussion section of this document, below is a summary of some of the other factors.

- Indoor air sources. Both the USEPA and the MADEP recommend that a determination of sources of volatile chemicals in the residence be conducted. VOCs are numerous in household products, and could affect results obtained. The March 1, 2003 sampling event included taking an inventory of household products that might contain the same chemicals that were being measured. Later, residents were also asked about personal activities (for example, smoking) that could affect results.
- Location and characteristics of groundwater and soil gas contamination. The concentration of contaminants of concern in groundwater, as well as the volatility of the contaminants, affects the concentration of contamination in indoor air. The depth of groundwater compared to the surface of the soil and the distance between the soil and the building also affect how quickly the contaminants of concern can enter the building.
- Air exchange rate. The rate at which indoor air is replaced by outdoor air (usually the number of complete or partial exchanges in an hour). This occurs through:
 - infiltration (air leaking in through cracks, joints, crawlspaces, and non-airtight gaps in windows, doors, etc.);
 - natural ventilation (through open doors and windows); and
 - mechanical ventilation (any system that mechanically moves air through a building, such as fans or vents).
- Pollution depletion mechanisms. Volatile chemicals in a building may be removed from air by chemical breakdown, or by adsorbing onto surfaces.
- Building and grounds features. These are unique to each building, and include the size of the building; the depth of foundation walls; the presence of a slab, crawlspace or basement, or the presence of cracks in walls or floors that have direct contact with soil. Chimneys and flues can draw air in at lower levels and exhaust them out at higher levels. Buildings with exhaust fans and vents, and/or gas or oil furnaces may preferentially draw soil gases into the indoor air. Ground cover can also influence the concentrations of volatile chemicals in indoor air. Impermeable ground covers such as pavements or sidewalks can cause vapors to collect in those areas.

The USEPA guidance (15) also provides more detail on sampling procedures. The guidance document can be found on their website at <http://www.epa.gov/correctiveaction/eis/vapor/complete.pdf>. The USEPA reviews the impact of background contaminant levels on sampling. Background can include contaminants introduced

into the indoor environment by consumer products or human activities. The USEPA recommends that an inventory of household products and a survey of personal activities be conducted prior to sampling. It also recommends that these background sources either be removed prior to sampling, or carefully considered when evaluating what contaminants are entering a building through the vapor intrusion pathway, and what may be introduced through other means.

The USEPA notes that concentrations of compounds found in indoor air are often subject to temporal and spatial variations, which may complicate estimates of exposure. They recommend the collection of at least one 24-hour sample, and state that two or more sampling events at each location are desirable. They also recommend that the house be closed 12 to 24 hours before measurements begin, and that the use of appliances that cause large pressure differences such as exhaust fans, clothes dryers and furnaces be avoided during this time. They also recommend not sampling near windows and air supplies.

Appendix B.

Conversion Factors

Conversions of concentrations of contaminants measured to comparison concentrations.

General information for benzene, toluene, ethylbenzene and xylenes:

1.0 milligram = 1,000 micrograms (1.0 mg = 1,000 µg)

1.0 µg = 0.001 mg

1,000 parts per billion (ppb) = 1.0 part per million (ppm)

1.0 ppb = 0.001 ppm

Conversions from µg/m³ to ppb:

$$\text{ppb} = \frac{\text{concentration of chemical in } \mu\text{g/m}^3 \times 24.45}{\text{molecular weight of chemical}}$$

(24.45 is a constant, and is the volume in liters of one mole of gas.)

Part 2. Specific conversions.

Benzene:

Maximum concentration is 4.5 µg/m³

Molecular weight of benzene is 78.11

$$\text{ppb} = \frac{4.5 \mu\text{g/m}^3 \times 24.5}{78.11}$$

= 1.4 ppb benzene in air

Toluene:

Maximum concentration is 7.1 µg/m³

Molecular weight = 92.14

$$\text{ppb} = \frac{7.1 \mu\text{g/m}^3 \times 24.5}{92.14}$$

= 1.9 ppb toluene in air

Ethylbenzene:

Maximum concentration is 1.0 µg/m³

Molecular weight is 106.17

$$\text{ppb} = \frac{1.0 \mu\text{g}/\text{m}^3 \times 24.5}{106.17}$$

= 0.23 ppb ethylbenzene in air

Xylenes:

Maximum concentration is 2.8

Molecular weight is 106.16

$$\text{ppb} = \frac{2.8 \mu\text{g}/\text{m}^3 \times 24.5}{106.16}$$

= 0.65 ppb total xylenes in air

Appendix C.

Review of Ethylbenzene, Toluene and Xylenes

Ethylbenzene

None of the ethylbenzene levels measured in Seaview Manor living spaces were above the screening value for further evaluation ($2.16 \mu\text{g}/\text{m}^3$). Low levels were detected in 5 apartments, ranging from, 0.43 to $1.0 \mu\text{g}/\text{m}^3$, and in 1 crawlspace at $1.7 \mu\text{g}/\text{m}^3$. The remaining units had non-detectable levels of ethylbenzene. The ATSDR has established an intermediate MRL for inhalation exposure to ethylbenzene at 1,000 ppb ($4,333 \mu\text{g}/\text{m}^3$). There is no acute or chronic MRL.

Ethylbenzene is a volatile organic compound with a gasoline-like odor at levels approximately 1,000 times higher than the highest level measured in Seaview Manor ($1.0 \mu\text{g}/\text{m}^3$, or 0.23 ppb) (12). Studies on human exposure to ethylbenzene show that inhaled ethylbenzene primarily affects the pulmonary system, and there can be eye irritation. There may also be some short-term effects on the blood system.

Ethylbenzene has been classified as a possible human carcinogen, although there is limited human evidence and insufficient animal evidence.

Toluene

The highest level of toluene detected in any of the living quarters was $5.4 \mu\text{g}/\text{m}^3$, or 1.44 ppb. This is more than 75 times less than the reference concentration of $420 \mu\text{g}/\text{m}^3$. The ATSDR has established acute and chronic Minimal Risk Levels for toluene exposure through inhalation at 1,000 ppb and 80 ppb, respectively (11). Therefore, the levels found in the living quarters at Seaview Manor are unlikely to result in adverse health effects.

Toluene is a common outdoor air contaminant because gasoline contains 5 to 7% toluene. The ATSDR estimates that levels between 1.3 and 6.6 ppb are typical in suburban and urban areas. Toluene is also a common indoor air contaminant because it is found in many household products, including paints, paint thinners, adhesives, and nail polish, as well as in cigarette smoke (11). In fact, indoor air levels are generally higher than outdoor levels.

At levels significantly higher than those found in Seaview Manor, toluene can effect the nervous system. Workers exposed to an average of 32,000 ppb for an average of 16 years showed an alteration in the ability to differentiate colors. This is the basis to establish a Lowest Observed Adverse Effect Level, or LOAEL. Higher levels showed more serious neurological effects. Toluene may also be toxic to a developing fetus, according to studies of mothers who abused toluene while pregnant. Cancer does not appear to be a concern for persons who may experience low exposures to toluene by living or working near hazardous waste sites containing toluene (11).

Xylenes

There are three forms of xylene, which were measured as a group (total xylenes, referred to as “xylene” for the remainder of this section).

The highest level of xylene detected in any of the living quarters of Seaview Manor was 2.8 $\mu\text{g}/\text{m}^3$, or 0.65 ppb. This may be compared to the ATSDR MRLs of 1,000 ppb, 700 ppb, and 100 ppb for acute, intermediate and chronic exposures, respectively. Therefore, at the levels measured, xylene is not expected to result in any adverse health effects. Xylene has not been classified for its ability to cause cancer (13).

Xylenes are widely found in the environment. The individual forms or the mixture of xylenes are used as solvents, cleaning agents, in paint thinners, and in varnishes. Small amounts are found in gasoline. It is also a component of cigarette smoke.

A study of workers exposed to xylenes at significantly higher levels than those found in Seaview Manor living spaces (approximately 7,000 times higher than the highest level measured) found an increased prevalence of anxiety, forgetfulness, inability to concentrate, and dizziness (13).

Appendix D

Response to Public Comments

Commenter A

1. There is no confirmed impact from the site on the concentrations of chemicals measured.

Response: There is neither a confirmed impact nor a clear indication that the site does not impact indoor air at Seaview Manor. For this reason, the site is considered to pose an Indeterminate Public Health Hazard for the vapor intrusion pathway that was evaluated in this Public Health Consultation.

2. For benzene, the concentrations measured were typical of indoor air concentrations, the concentration patterns do not point to the crawl spaces as a source, and there are typically multiple sources of benzene in residences. In the four units at Seaview Manor in which benzene slightly exceed the NJDEP Reference Concentration, the indoor benzene concentrations are higher than their respective crawl space concentrations, suggesting a source other than soil gases. Measured indoor benzene concentrations in living spaces at Seaview Manor are comparable to concentrations that people experience from benzene exposure during common daily activities, and are in the range of normal indoor air concentrations published by NJDHSS, ATSDR, EPA, and others. When the indoor air concentrations of benzene are compared to background concentrations, all concentrations measured indoors are less than the benzene background concentration of up to $6 \mu\text{m}^3$ established by the NJDHSS and ATSDR in the assessment.

Response: The NJDHSS and ATSDR agree and have stated that the benzene levels measured in indoor air are within the typical background range found in urban environments. Furthermore, NJDHSS and ATSDR do not identify potential sources of the chemicals measured, but evaluate the impact those chemicals may have on health at the levels measured.

3. There is no clear basis for NJDHSS's and ATSDR's assumption that the sampling conditions in March 2003 did not represent a "worst case scenario." Although standing water, if present, could have hindered the diffusion of chemicals from soil into crawl space air, NJDHSS/ATSDR note three factors that would have favored transfer of contaminants from a lower space, such as a crawl space, up through a building in winter: (1) heated air rising through the building; (2) migration of frozen soil gases toward warmer, thawed areas of the building foundation and into the building; and (3) the removal of standing water in at least one building crawl space prior to sampling. In addition, NJDHSS and ATSDR assume that the concentrations in the units would be higher in summer. However, because windows would be open in the summer (the buildings are not air-conditioned), lower indoor air concentrations could occur in summer.

Response: The NJDHSS and ATSDR do not assume that concentrations would be higher in the summer than winter. We are uncertain if the conditions at the time of monitoring represent the "worst case scenario," and have stated in the document that "...the results **may not** represent a

‘worst case scenario.’ ” The USEPA, in its vapor intrusion guidelines, recommend that at least two rounds of sampling be conducted to verify results over time. Additionally, the NJDEP recommends two rounds of indoor air sampling, with seasonal monitoring for indoor air preferred.

4. Benzene concentrations in the crawl space air are in the range of normal outdoor air concentrations measured in other parts of the state.

Response: While this is true, the NJDHSS and ATSDR only evaluated air concentrations in living areas.

5. NJDHSS and ATSDR should emphasize the health protective nature of the NJDEP Reference Concentrations for indoor air. In the case of benzene, no adverse health effects were observed in workers exposed for years to benzene concentrations more than 1,000 times greater than the NJDEP Reference Concentration.

Response: The NJDEP Reference Concentration is based upon sampling technology, and is not a health-based standard. The Reference Concentration, as well as the ATSDR Intermediate MRL for non-cancer outcomes, do consider populations other than workers, and use margins of safety in developing these values. However, this is noted and added to the section Benzene, Effects of benzene.

6. NJDHSS and ATSDR should emphasize that the risk assessment (health consultation) showed low risk.

Response: This was previously noted in the Summary (“Based on the sample results, the NJDHSS and ATSDR do not believe that adverse health effects are likely.”), as well as the Conclusion, Public Health Hazard Category (“...the levels detected at that time are not likely to result in adverse health effects...”).

7. Both the (Citizen’s Guide) and the report should be revised to indicate that there is no confirmed impact from the site on the concentrations of chemicals measured indoors in Seaview Manor. There is no evidence that contaminants found at Seaview Manor originated from the Long Branch Manufactured Gas Plant site, as opposed to other sources.

Response: The NJDHSS and ATSDR do not positively identify a source of contamination, as that is a function of state and federal environmental agencies. However, since the contaminants of concern (BTEX) were identified and analyzed in and near Seaview Manor as early as 1994 (Table 1), and based on the past practices at the site and the presence of contamination in on-site soil and groundwater, it is realistic to assume that the site may be at least partially contributing to the indoor air levels found. Additional testing of air in Seaview Manor, particularly since there are no longer residents living in the buildings, may provide more definitive information on the source of benzene.

8. The fact that background risk exceeds 10^{-6} should be discussed and explained. It should be emphasized that the low increased risk for cancer associated with the benzene concentrations

in four of the units would be the same as (and perhaps less than) that for background exposure.

Response: In the Cancer Effects discussion under Benzene, the risk is stated to be a “low increased risk for cancer.” However, a statement regarding the cancer risk from exposure to background levels of benzene is added to the section Benzene, Cancer effects.

9. NJDHSS and ATSDR should discuss how odor is not necessarily indicative of adverse health effects (e.g. xylene), and that nausea, which sometimes occurs due to strong odors, is a short term effect that subsides once exposure ceases.

Response: For the purpose of this Public Health Consultation, odors are addressed primarily as they may relate to BTEX compounds. The consultation states that odors are not likely to occur at the levels of BTEX measured. Other sources will be discussed further in the full Public Health Assessment.

10. NJDHSS and ATSDR note that while particulates can trigger asthma attacks in individuals with hyperresponsive airways or preexisting airway inflammation, dusts have been controlled to a level of $0.071 \text{ mg/m}^3 \text{ PM}_{10}$ during remediation under a rigorous protocol approved by the NJDEP. The site-wide average concentration during remediation from December 2000 to August 2003 (based on samples collected every five minutes) is 0.0085 mg/m^3 ($8.5 \mu\text{m}^3$), which is well below EPA’s National Ambient Air Quality Standard (NAAQS) for PM_{10} of 50 ug/m^3 as an annual average.

Response: A discussion on asthma is included in this Public Health Consultation because it is an issue of concern to community members. Part of the scope of this consultation was to discuss concerns as they relate to chemicals that may be present through the vapor intrusion pathway. The discussion on asthma does review other triggers of asthma, including particulates. The data provided will be evaluated as part of the full Public Health Assessment for the site.

11. The report should be reorganized so that the toxicity information is presented in the same place for all compounds (i.e., BTEX is all together instead of benzene in the body of the report and toluene, ethylbenzene and xylenes in an appendix.

Response: Generally, only contaminants measured at levels above comparison values are evaluated in a Public Health Consultation. Toluene, ethylbenzene, and xylenes are at levels below comparison values, but are included as an education component as requested by community members. They are listed in an appendix instead of the body because of their importance relative to benzene.

12. The authors should specifically point out that the health effects associated with high concentrations of benzene are not relevant to any exposures at Seaview Manor where high concentrations of benzene in air were not measured.

Response: The section Effects of Benzene is amended to include information on one of the “high levels of exposure” and disease outcome as a comparison.

13. The use of multiple comparison values for benzene is confusing. All of the numbers should be discussed and presented in one place, where discrepancies should be discussed and clarified.

Response: The ATSDR MRLs and the NJDEP Reference Concentrations are presented in tabular form, under "Discussion." Although MRLs were defined, the NJDEP Reference Concentration was not. The table has been amended to incorporate the derivation of the NJDEP RC. Since only benzene has a Cancer Risk Evaluation Guideline (CREG) discussion of this comparison value is only incorporated into the text reviewing cancer the effects of benzene.

Commenter B

1. The report is written so that our community can read and understand its essence. The glossary and other explanatory comments were very helpful.
2. The report addresses issues of our community concerns, (including) respiratory, cancer, (and) stress, but we are not aware of other possible health impacts such as brain, skin or eye diseases.

Response: The NJDHSS and ATSDR thank you for your comments.

3. The report should state in bold faced letters in the Summary and various tables and where appropriate, that "This report is an analysis of data collected and provided by NJNG consultants, only."

Response: The source of data sets are included in the text.

4. The classification "Indeterminate Public Health Hazard" in the Summary should be followed by the recommendation for further testing under the various conditions that the residents experienced.

Response: The summary is amended to include recommendations.

5. The classification "No Apparent Public Health Hazard" for the two day care centers should be reconsidered with future testing, since the day care centers relocated the children on at least two occasions during remediation, and nearby borings indicate the presence of contaminants in the surrounding soil, to place community readers at ease with the report.

Response: The "No Apparent Public Health Hazard" category for the day care centers is based solely on the sampling conducted on March 27-28 and April 9-10, 2003. All pathways of exposure relating to the day care centers will be incorporated into the full Public Health Assessment.

6. The "Actions Planned" seem to be all-inclusive, and when completed would provide our community with some confidence in the impact of the situations/exposures, whether hazardous or not.

Response: The NJDHSS and ATSDR thank you for your comments.

7. The future testing should be mandatory, and it would be helpful if NJDHSS and ATSDR did some limited testing for verification/certification.

Response: The NJDHSS and the ATSDR do not have the regulatory authority to make additional testing mandatory.

Commenter C

1. Dust suppression, odor control and air monitoring: The last paragraph of the Summary Section (pages 4 and 5) and Recommendation 3 (page 18) may be misinterpreted as written. The report could be interpreted to suggest that the NJDHSS is recommending that measures be taken to prevent exposures to dusts and odors during soil remediation because such measures have not been taken in the past, even though such measures are a standard NJDEP requirement during soil remedial actions. The commenter recommends that the Summary section and Recommendation 3 be revised to clearly relay that dust suppression and odor control measures were in place throughout the soil remedial action conducted and that the NJDEP will continue to require such measures for all future soil remedial actions. These portions of the report should further clarify that real-time air monitoring has been, and will continue to be conducted as required by the NJDEP as a method for documenting the effectiveness of these measures in reducing/preventing exposure to dusts and odors potentially associated with soil remediation.

Response: The Summary and Recommendations are amended to reflect this comment.

2. Public Health Implications: Benzene – Cancer Effects: This section of the report (page 13) explains how the NJDHSS calculates risk based on the highest benzene levels detected. The commenter recognizes that this is standard practice, but recommends that the NJDHSS revise the report to indicate that the highest benzene levels detected in this study are below typical ambient levels recorded for urban areas. Such a revision would provide an added perspective to the benzene levels detected.

Response: The first three sentences of the Benzene section list ambient, or background, levels of benzene, and the levels found at Seaview Manor. However, in response to Commenter A , comment number 8, the cancer risk related to background levels of benzene has been incorporated in to the document.

3. Conclusions: Public Health Hazard Category: The Report (page 18) concludes that the indoor air exposures among residents of the Seaview Manor Property represent an “Indeterminate Public Health Hazard.” This conclusion is largely because it does not consider the flooding conditions that existed when the March 1, 2003 sampling was conducted as typical for the area. The commenter recommends that the NJDHSS contact the Long Branch Housing Authority (LBHA) to verify the accuracy of utilizing this information as the basis for this determination prior to finalizing the Report. According to statements made by a LBHA representative to an NJDEP representative during the March 1, 2003 sampling event, flooding in Building B is a typical condition for that time of year. If the NJDHSS confirms that the flooding conditions are in fact typical for the area during that time of year, then the NJDHSS may wish to re-evaluate its determination.

Response: Please see response to the following comment.

4. Recommendations – Recommendation 1 (page 18) states that the NJDHSS and the ATSDR recommend that additional indoor air sampling be conducted in residential living spaces at Seaview Manor. The NJDHSS is advised that the NJDEP currently recommends a minimum of two rounds of indoor air sampling, with seasonal monitoring for indoor air preferred. The Department also recommends that future use of Seaview Manor be considered with respect to implementing this recommendation.

Response: Although the future use of Seaview Manor as it presently exists may not occur, the NJDHSS and ATSDR consider past exposures in identifying health risks. Therefore, additional sampling to reflect a broader range of exposures would provide a better basis for a hazard category conclusion.

5. Please refer to comment 1 above, with regard to Recommendation 3.

Response: Recommendation 3 is amended.

6. Actions taken: With regard to number 6 (page 19), the Report states that “as is NJDEP policy, the New Jersey Natural Gas Company has real-time monitoring in place to reduce odors and dust emissions during site remediation.” As a point of clarification, real-time air monitoring is conducted to verify the efficiency of the dust suppression and odor control methods. However, the monitoring itself does not reduce odors or dust emissions.

Response: Actions Taken: #6 is amended.

Appendix E

ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

General Terms

Absorption

The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute

Occurring over a short time [compare with chronic].

Acute exposure

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect

A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect

A change in body function or cell structure that might lead to disease or health problems

Aerobic

Requiring oxygen [compare with anaerobic].

Ambient

Surrounding (for example, ambient air).

Anaerobic

Requiring the absence of oxygen [compare with aerobic].

Analyte

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect

A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation

Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study

A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring

Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake

The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing

Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden

The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see Community Assistance Panel.]

Cancer

Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk

A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen

A substance that causes cancer.

Case study

A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study

A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number

A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system

The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic

Occurring over a long time [compare with acute].

Chronic exposure

Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation

A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)

A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide

information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect

A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal

Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact

Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology

The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention

Measures used to prevent a disease or reduce its severity.

Disease registry

A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD

United States Department of Defense.

DOE

United States Department of Energy.

Dose (for chemicals that are not radioactive)

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship

The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media

Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism

Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA

United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction

A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation

The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry

A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)

A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds

Training sessions for physicians and other health care providers about health topics.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life ($t_{1/2}$)

The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number

of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard

A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste

Potentially harmful substances that have been released or discarded into the environment.

Health consultation

A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education

Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion

The process of enabling people to increase control over, and to improve, their health.

Health statistics review

The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence

The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation

The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure

Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro

In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo

Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL)

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring

A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism

The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite

Any product of metabolism.

mg/kg

Milligram per kilogram.

mg/cm²

Milligram per square centimeter (of a surface).

mg/m³

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration

Moving from one location to another.

Minimal risk level (MRL)

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity

State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality

Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen

A substance that causes mutations (genetic damage).

Mutation

A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)

Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)

A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica

A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume

A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure

The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)

A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb

Parts per billion.

ppm

Parts per million.

Prevalence

The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevalence survey

The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention

Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period

An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action

A list of steps to protect public health.

Public health advisory

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)

An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement

The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance

The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting

A public forum with community members for communication about a site.

Radioisotope

An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide

Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population

People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry

A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA

RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

Risk

The probability that something will cause injury or harm.

Risk reduction

Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication

The exchange of information to increase understanding of health risks.

Route of exposure

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

Sample

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size

The number of units chosen from a population or an environment.

Solvent

A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations

People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder

A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics

A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance

A chemical.

Substance-specific applied research

A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

Superfund Amendments and Reauthorization Act (SARA)

In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water

Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen

A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent

Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology

The study of the harmful effects of substances on humans or animals.

Tumor

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:

Environmental Protection Agency (<http://www.epa.gov/OCEPAterms/>)

National Center for Environmental Health (CDC)
(<http://www.cdc.gov/nceh/dls/report/glossary.htm>)

National Library of Medicine (NIH)
(<http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>)

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