Health Consultation

GRANT COURT PUBLIC HOUSING COMPLEX,

LONG BRANCH MANUFACTURED GAS PLANT

LONG BRANCH, MONMOUTH COUNTY, NEW JERSEY

EPA FACILITY ID: NJD980530471

Prepared by the
New Jersey Department of Health and Senior Services

NOVEMBER 16, 2011

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

Health Consultation: A Note of Explanation

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

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

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Summary

Introduction

In 1997, site-related contamination was detected during the repair of an underground water main located north of the former Long Branch Manufactured Gas Plant (LBMGP) site. In 2002, the Concerned Citizens Coalition of Long Branch petitioned the federal Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate health concerns (including cancer) and potential exposures during site remediation activities. The ATSDR and the New Jersey Department of Health and Senior Services (NJDHSS) accepted the petition and evaluated the cancer incidence and exposures associated with contaminants detected at on-site and adjacent areas in 2003 and 2008, respectively. However, the remedial investigation data for the Grant Court public housing complex were not available during the preparation of the Public Health Assessment for the Long Branch site. Results of remedial investigations made available since that time, indicated that the Grant Court public housing complex was contaminated with polycyclic aromatic hydrocarbons (PAHs) and metals.

The NJDHSS prepared this health consultation to review and evaluate exposure pathways associated with soil contamination at the Grant Court public housing complex. ATSDR and NJDHSS's top priority is to ensure that the community around the site has the best information possible to safeguard its health.

Conclusions

NJDHSS and ATSDR have reached the following two conclusions in this health consultation on the Grant Court public housing complex.

Conclusion 1

NJDHSS and ATSDR conclude that currently there are no site related exposures to soil contaminants at the Grant Court public housing complex that can harm people's health.

Basis for Conclusion

Contaminated surface soils of the Grant Court public housing complex have been excavated and transported off-site. The excavated areas were backfilled with clean fill. Thus, residents are not being exposed to any site-related contaminants.

Conclusion 2	*The NJDHSS and ATSDR conclude that past exposures to site-related soil contaminants at the Grant Court public housing complex may have harmed people's health.*
Basis for Conclusion	Based on the exposure point concentrations (EPC) of PAHs and arsenic detected in surface soil, the potential for non-cancer adverse health effects associated with past exposures are unlikely in children and adults. Cumulative lifetime excess cancer risks were calculated to be 4 in 10,000 to the exposed population. Exposures pose a low increase in lifetime cancer risk, compared to the background risk of cancer from all causes. If combined with on-site exposures (especially for children playing on the LBMGP site), there was a potential for adverse health effects. It should be noted that there is some uncertainty in this conclusion because the soil sampling data were from 0-2 feet below the ground, which may not represent actual surface soil conditions. This may under or overestimate the theoretical cancer risk.
Next Step	The NJDHSS and ATSDR recommend maintaining site access restriction to ensure integrity of the remedies for the Grant Court public housing complex.
For More Information	Questions about this health consultation should be directed to the NJDHSS Environmental and Occupational Health Surveillance Program (609) 826-4984.

Statement of Issues

In 1997, site-related contamination was detected during the repair of an underground water main located north of the former Long Branch Manufactured Gas Plant site. In 2002, the Concerned Citizens Coalition of Long Branch petitioned the federal Agency for Toxic Substances and Disease Registry (ATSDR) regarding health concerns (including cancer) and potential exposures during site remediation activities at the former Long Branch Manufactured Gas Plant site in Monmouth County. The petition was accepted by the ATSDR and the New Jersey Department of Health and Senior Services (NJDHSS). Through a cooperative agreement with the ATSDR, NJDHSS prepared a health consultation that evaluated cancer incidence in the community surrounding the site (ATSDR 2003). A second health consultation was also prepared which evaluated exposures to indoor air contamination detected at the Seaview Manor public housing complex (ATSDR 2004). In March 2008, a public health assessment was prepared addressing the public health implications of past, current, and future exposures associated with on-site contamination (ATSDR 2008). Further investigation and delineation of off-site contamination was not conducted at that time because the remedial investigation data were not available at the time.

Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the NJDHSS prepared this health consultation in order to determine the public health implications of exposures associated with off-site contamination detected at the Grant Court public housing complex.

Background

The Grant Court public housing complex is located in the City of Long Branch (New Jersey), approximately one-quarter mile west of the Atlantic Ocean (see Figure 1). It was constructed in 1943 and comprises 161,722 square feet. It is bounded by Central Avenue to the north, the former site and Jersey Central Power and Light (JCP&L) electrical substation to the east, the former site and C.P. Williams Place to the south, and a church and Liberty Street to the west (see Figure 2). The Long Branch Manufactured Gas Plant (LBMGP) site operated from the 1870s through the 1960s and used coal to produce manufactured gas for the surrounding community. The LBMGP site is located adjacent to the original and recently rebuilt Grant Court public housing complex. Wastes generated during the manufactured gas process were primarily coal tars containing a variety of hazardous substances including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals. These contaminants migrated from the LBMGP site to the Grant Court public housing complex (ASTDR 2008).

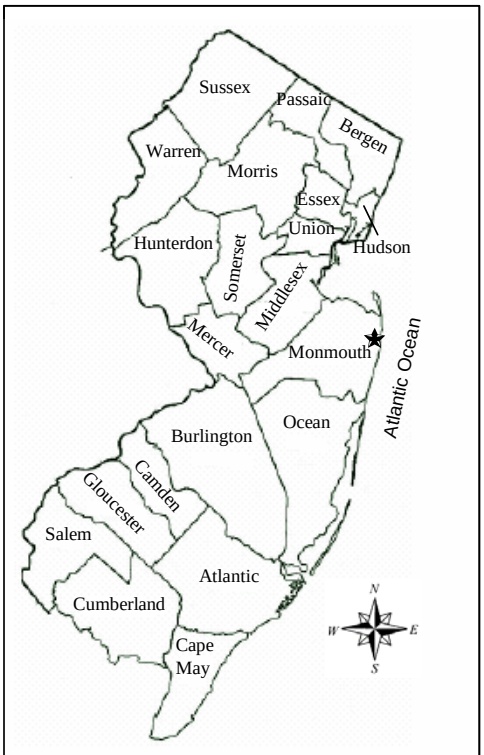

Figure 1: Location of Long Branch Manufactured Gas Plant Site

Following community concerns over site-related contamination present at the Grant Court public housing complex, the original housing complex was demolished in 2006 to allow investigations and necessary remedial actions to be conducted at the property. Once these actions were completed, the property was redeveloped as the new Grant Court public housing complex. Private streets run through the property and include a parking area with landscaped vegetation.

Summary of Previous Investigations/Remediation

During the fall of 1983, New Jersey Department of Environmental Protection (NJDEP) began evaluating the former site. PAHs, VOCs, metals, phenols, and cyanide were discovered in soils. Sediment and surface water samples taken off-site indicated the presence of PAHs and metals. Specific investigations relating to the Grant Court public housing complex did not begin until 2000.

A subsurface soil and groundwater investigation conducted in 2000-2001 identified VOC, semi-volatile organic compound (SVOC), and metal (arsenic and lead) contamination of soils at the complex. This contamination was attributed to activities at the adjacent former LBMPG site. In 2000, under a NJDEP approved Deed Notice, New Jersey Natural Gas (NJNG) was allowed restricted use of a portion of the Grant Court property. The Deed Notice required NJNG to install an impermeable asphalt cap and a two-foot soil cap with grass covering as engineering controls to prevent direct contact with contaminated soil of the Grant Court property (Figure 3 DRA-001 and DRA-002, respectively). Additionally, a pre-existing sediment retaining wall (DRA-003) served to restrict the spread of contaminated soils (Figure 3 DRA-003). These remediation areas are collectively defined as the "Deed Restricted Area."

In May 2005, NJDEP performed additional soil sampling in response to a Long Branch Environmental Justice Petition from the Long Branch Concerned Citizens Coalition (NJDEP 2006; NJDEP 2007). This petition letter raised concerns about the environmental integrity of the LBMPG site and the surrounding areas. The investigation revealed areas of PAHs, lead, and arsenic contamination at the Grant Court property. Four distinct areas in property boundaries were identified in this report as KCA-001, KCA-002, KCA-003, and DRA-004. The first three areas (KCA-001 thru KCA-003) were localized and identified as the "Known Contaminated Areas". The fourth area of contamination, DRA-004, is identified as a "Deed Restricted Area" (see Figure 3).

Hatch Mott MacDonald (HMM), an engineering firm, on behalf of Long Branch Housing Authority (LBHA) and Penrose Properties, issued a Remedial Investigation Report fully delineating the extent of soil contamination in the Known Contaminated Areas with further sampling (HHM 2006a). This report facilitated HMM's Remedial Action Workplan in October 2006 (HMM 2006c).

This NJDEP-approved Remedial Action Work plan proposed two phases of remediation work. The first phase of the remediation work, the excavation and backfill of the Known Contaminated Areas, including the removal of contaminated concrete and cinder block was completed in 2007 (HMM 2007). The second phase of the remedial work has been completed

and included the replacement/expansion of some of the engineering controls implemented in the Deed Notice (Robert Hayton, Site Project Manager, Personal Communication, NJDEP, 2011).

Site Visit

On August 26, 2010, the NJDHSS staff conducted a site visit of the former Grant Court site. The former building was a 50-year-old public housing complex that included eight to ten buildings with about ten apartments each. A newly constructed public housing complex is now located here(see Photograph 1) and a six-foot fence has been installed around the former LBMGP site perimeter to restrict unauthorized access (see Photograph 2). The former LBMGP site is no longer in use.

Community Health Concerns

The Concerned Citizens Coalition of Long Branch, a local group formed to oversee the remediation of the LBMGP site, meets on a monthly basis to discuss site updates. NJDHSS staff attended an August 26, 2010 meeting to update coalition members on NJDHSS activities. Committee members expressed concerns about the migration of contaminants from the LBMGP site to their residences and possible health effects from potential exposures. Several long-term residents still live near the original Grant Court public housing complex.

Follow-up conversations (via telephone) with several long-term residents confirmed past exposures occurred at the former Grant Court property. Some residents have lived at the Grant Court public housing complex all their lives. In response to NJDHSS inquiries, a number of residents stated that children and adults routinely accessed the LBMGP site. It was a location of various recreational activities. Children played on a daily basis on the LBMGP site for most of the year. Residents noted that in the past there were bad odors in the air and even in their clothing. Several residents stated that quite a few of their relatives and neighbors died of cancer, and presumed their illnesses were related to exposure to contamination from the LBMGP site.

Community members also voiced concern to the NJDHSS about a non-site related issue regarding the removal of asbestos before demolition of the (original) Grant Court public housing complex by contractors in 2006. The community was not informed about the presence of asbestos, but noted the posting of warning signs.

NJDHSS contacted the Asbestos Abatement Program and learned that there is no sampling data available for the asbestos abatement work that occurred at the Grant Court public housing complex. However, a contractor licensed through the New Jersey Department of Labor and Workforce Development did the asbestos abatement work.

Past ATSDR and NJDHSS Activities

In 2003, a health consultation was prepared to evaluate cancer incidence for the surrounding community (ATSDR 2003). The results of analysis provided little evidence that the cancer rate has been affected by the potential exposures to contamination related to the LBMGP site.

A second health consultation was prepared to address the indoor air exposures and health concerns of the Seaview Manor public housing complex residents and two off-site childcare centers (ATSDR 2004). Since conditions at the time of sampling were not representative of the "worst case scenario," indoor air exposures among residents were considered an indeterminate public health hazard. Concentrations of contaminants detected in the indoor air at the day care centers represented no apparent public health hazard.

A public health assessment was prepared in 2008 to evaluate LBMGP contamination (ATSDR 2008). Site related contaminants were detected in surface soil, sediment, shallow groundwater, and deeper parts of the underlying groundwater aquifer. Based on average contaminant concentrations, the theoretical cumulative lifetime excess cancer risk (LECR) may have been as high as seven in 10,000 to the exposed population. As such, based on LECR and childhood lead exposure in the past, the site posed a past public health hazard. Remedial actions were implemented with oversight from the NJDEP. Currently, there are no completed exposure pathways associated with contamination remaining on the LBMGP site. As such, the LBMGP site itself does not pose a current public health hazard.

Environmental Contamination

An evaluation of site-related environmental contamination consists of a two-tiered approach: 1) a screening analysis; and 2) a more in-depth analysis to determine public health implications of site-specific exposures (ATSDR 2005). First, maximum concentrations of detected substances are compared to media-specific environmental guideline comparison values (CVs). If concentrations exceed the environmental guideline CV, these substances, referred to as Contaminants of Concern (COCs), are selected for further evaluation. If contaminant levels are found above environmental guideline CVs, it does not mean that adverse health effects are likely, but that a health guideline comparison is necessary to evaluate site-specific exposures. Once exposure doses are estimated, they are compared with health guideline CVs to determine the likelihood of adverse health effects.

Environmental Guideline Comparison

There are a number of CVs available for screening environmental contaminants to identify COCs (ATSDR 2005). These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Media Evaluation Guides (RMEGs). EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation Guides (CREGs) were considered as CVs. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million persons exposed during their lifetimes (70 years).

In the absence of an ATSDR CV, comparison values from other sources may be used to evaluate contaminant levels in environmental media. These include New Jersey Maximum Contaminant Levels (NJMCLs) for drinking water, USEPA MCLs for drinking water and

USEPA Screening Levels (SLs). SLs are contaminant concentrations corresponding to a fixed level of risk (i.e., a Hazard Quotient[1] of 1, or lifetime excess cancer risk of one in one million, or 10^{-6}, whichever results in a lower contaminant concentration) in water, air, biota, and soil. For soils and sediments, CVs also include the NJDEP Residential Soil Remediation Standards (RDCSRS), Ingestion-Dermal Health Based Criterion (IDHBC) and Inhalation Health Based Criterion (IHBC). Based primarily on human health impacts, these criteria also take into account natural background concentrations, analytical detection limits, and ecological effects.

Substances exceeding applicable environmental guideline CVs were identified as contaminants of concern (COCs) and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed receptor populations. In instances where an environmental guideline CV or toxicologic information is unavailable, the substance may not be retained for further evaluation.

Soil – Grant Court Public Housing Complex

Several rounds of contaminant investigations have been performed by the NJNG along the eastern boundary (adjacent to the LBMGP site) of the Grant Court public housing complex (see Figure 3). Surface (0 to 2 feet depth)[2] and subsurface sampling was first reported in November 1984 and then again between May 2000 and February 2001 (ARCADIS 2001; HMM 2006a; NJDEP 2005). The results indicated concentrations of SVOCs and metals above NJDEP's soil remediation standard.

In May 2005, soil sampling was conducted by the NJDEP in the area to the west of previous sampling location (see Figure 3), to screen the area for PAH and metal contamination (HMM 2006a). Subsequent sampling by the NJNG in April and June of 2006 confirmed the results of NJDEP sampling (HMM 2006b). The sampling results indicated the presence of PAHs (acenaphthene, anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, and pyrene) and metals (arsenic, beryllium, lead, and thallium); the summary of surface soil historical analytical results (concentration ranges and maximums) at the Grant Court public housing property is provided in Table 1. Maximum concentrations of benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, and arsenic were present above their respective environmental guideline CVs. If the concentrations were elevated over the CV, the contaminant was designated as a contaminant of concern (COC) and was retained for further analysis as follows:

Exposure Point Concentration Calculation

Although the maximum concentration of contaminants is usually used to identify COCs, it would be inappropriate to calculate site health risks based on the single highest concentration.

[1]The ratio of estimated site-specific exposure to a single chemical from a site over a specified period to the estimated daily exposure level at which no adverse health effects are likely to occur.

[2] ATSDR considers a soil depth of 0-3 inches to be surface soil. The definition for this consultation has been expanded to include 0-24 inches, per NJDEP's Field Sampling Procedures Manual.

This is because a single measurement is unlikely to represent the contamination at the entire site. Alternatively, a 'conservative estimate' of the average chemical concentration, known as the exposure point concentration (EPC) can be used to effectively represent a concentration at a site. An exposure point is an area location within which an exposed population's contact with an environmental medium (e.g., air, soil) is assumed to be equally likely (USEPA 2009).

An EPC is an estimate of the true arithmetic mean concentration of a chemical in a medium at an exposure point. However, because the true arithmetic mean concentration cannot be calculated with certainty from a limited number of measurements, the USEPA recommends that the 95% upper confidence limit (UCL) of the arithmetic mean (referred to as UCL95 in this document) be used when calculating exposure and risk at that location. To this end, USEPA has recently developed software (ProUCL ®) that computes the UCL for a given data set by a variety of alternative statistical approaches and then recommends specific UCL values as being the most appropriate for that particular data set (USEPA 2007).

For this site, the ProUCL ® 4.1.00 software was used to estimate soil EPCs for those contaminants that were elevated above the CVs, (see Table 1). If the EPC was found to be elevated above the comparison values, it was considered to be a contaminant of concern (COC). Also, the maximum concentration was used as the EPC when the sample size was too small to calculate UCL95s or when a UCL95 exceeds the maximum detected value.

Summary of Contaminants of Concern

The following contaminants detected in the soil are designated as the COCs for the Grant Court public housing complex site:

PAHs	Metals
Benzo[a]anthracene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Chrysene, Dibenzo[a,h]anthracene, Indeno[1,2,3-cd]pyrene	Arsenic

Discussion

The method for assessing whether a health hazard exists to a community is to determine whether there is a completed or potentially completed exposure pathway from a contaminant source to a receptor population and whether exposures to contamination are high enough to be of health concern (ATSDR 2005). Site-specific exposure doses arecalculated and compared with health guideline CVs.

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;
4. route of exposure; and
5. receptor population.

Generally, the ATSDR considers three exposure pathway categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, one or more of the elements is absent. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

Based on sampling data, results and knowledge of accessibility to contaminated soil, exposure pathways for individuals who live (or lived) in the area of the Grant Court public housing complex site were identified as presented in Table 3.

Completed Pathways

Ingestion of contaminated soil (past). Surface soils of the Grant Court public housing complex were contaminated with PAHs and metals. Residents, including children, were exposed to contaminants while engaging in outdoor recreational activities. This scenario also includes site visitors and trespassers.

Potential Pathways

Inhalation of ambient air (past). Ambient air was an exposure pathway for the Grant Court public housing complex. Residents indicated that in the past there were bad odors in the air and even in their clothing. Residents, including children, were exposed to ambient air while engaging in outdoor activities. This scenario also includes site visitors and trespassers. However, since there are no emissions data available for the ambient air, public health implications associated with ambient air could not be evaluated.

Eliminated Pathways

Ingestion of contaminated soil (present, future). Contaminated surface soils of the Grant Court public housing complex were excavated and transported off-site in March 2007. The excavated areas were backfilled with clean fill. As such, there are no present or future exposures, as long as the properties and access restrictions are maintained, via this pathway.

Inhalation of ambient air (present, future). Manufacturing operations and emissions to ambient air at the LBMGP ceased in the 1960s, hence, present and future exposures were eliminated. Also, since there are no emissions data available for the ambient air, public health implications associated with ambient air could not be evaluated.

Public Health Implications

Once it has been determined that individuals have or are likely to come in contact with site-related contaminants (i.e., a completed exposure pathway), the next step in the public health assessment process is the calculation of site-specific exposure doses. This is called a health guideline comparison, which involves looking more closely at site-specific exposure conditions, the estimation of exposure doses, and the evaluation with health guideline comparison values (CVs). Health guideline CVs are based on data drawn from epidemiological/toxicological literature and often include uncertainty or safety factors to ensure that they are amply protective of human health. Completed human exposure pathways associated with the Grant Court public housing complex site include the past incidental ingestion of contaminated soil.

Non-Cancer Health Effects

To assess the possibility of non-cancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects. MRLs are developed for a route of exposure, i.e., ingestion or inhalation, over a specified time period, e.g., acute (less than 14 days); intermediate (15 - 364 days); and chronic (365 days or more). MRLs are based largely on toxicological studies in animals and on reports of human occupational (workplace) exposures. MRLs are usually extrapolated doses from observed effect levels in animal toxicological studies or occupational studies, and are adjusted by a series of uncertainty (or safety) factors or through the use of statistical models. In toxicological literature, observed effect levels include:

- no-observed-adverse-effect level (NOAEL); and
- lowest-observed-adverse-effect level (LOAEL).

NOAEL is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals. LOAEL is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals. In order to provide additional perspective on these health effects, the calculated exposure doses were then compared to observed effect levels (e.g., NOAEL, LOAEL). As the exposure dose increases beyond the MRL to the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases.

To ensure that MRLs are sufficiently protective, the extrapolated values can be several hundred times lower than the observed or no-observed adverse effect levels in experimental studies. When MRLs for specific contaminants are unavailable, other health based comparison values such as USEPA Reference Dose (RfD) may be used. The RfD is an estimate of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Ingestion of Contaminated Soil

Historically, portions of the Grant Court public housing complex site were used for residential purposes or redeveloped for recreational use. Additionally, residents report past routine use of the processing area for recreational purposes (i.e., picnicking, hiking). Exposures are based on ingestion of contaminated soil; non-cancer exposure doses were calculated using the following formula:

$$Exposure\ Dose\ (mg/kg/day) = \frac{C \times IR \times EF}{BW}$$

where, mg/kg/day = milligrams of contaminant per kilogram of body weight per day;
C = concentration of contaminant in soil (mg/kg);
IR = soil ingestion rate (kg/day);
EF = exposure factor representing the site-specific exposure scenario; and,
BW = body weight (kg)

The following site-specific exposure assumptions were used to calculate past contaminant doses based on the exposure related historic information provided by the community members, the EPA EF handbook, and the public health assessment for the Long Branch Manufactured Gas Plant Site (USEPA 1997; ATSDR, 2008).

Exposure Point	Number of Days Exposed Per Year
Grant Court public housing complex	108 days (3x per week for 9 months/year)

PAHs. PAHs are a class of over 100 different compounds that are found in and formed during incomplete combustion of coal, oil, wood, or other organic substances (ATSDR 1995). More commonly they are found in petroleum-based products such as coal tar, asphalt, creosote, and roofing tar. In the environment, PAHs are found as complex mixtures of compounds, and many have similar toxicological effects and environmental fate. Because combustion processes produce them, PAHs are widespread in the environment. PAHs have been found to exhibit antiandrogenic[3] properties in human cell cultures and are implicated in the loss of fertility in males (Kizu 2003). Non-cancer adverse health effects associated with PAH exposures have been observed in animals but generally not in humans (ATSDR 1995). Non-cancer effects are usually seen at much higher levels than found in the environment. The main potential concern for PAH exposures is for cancer effects.

The chronic past exposure doses for children and adults were calculated based on the EPC of PAHs detected in the surface soil (see Tables 4). No health guideline CVs are available for these PAHs; however, the NOAEL, RfD, and associated critical health effects for a number of PAHs are available and are shown below:

[3] Antiandrogenic substances block the action of androgens, the hormones responsible for male characteristics.

Reference Dose for Chronic Oral Exposure			
PAH	**NOAEL (mg/kg/day)**	**RfD (mg/kg/day)**	**Health Effect**
Acenaphthene	175	0.06	Hepatotoxicity
Anthracene	1,000	0.3	No observed effect
Fluoranthene	125	0.04	Nephropathy, increased liver weights, hematological alterations, and clinical effects
Fluorene	125	0.04	Decreased red blood count, packed cell volume and hemoglobin
Naphthalene	71	0.02	Decreased mean terminal body weight in males
Pyrene	75	0.03	Kidney effects (renal tubular pathology, decreased kidney weights)

The RfDs of these PAHs are based on the NOAEL and are much higher than the exposure doses calculated for the PAHs detected on-site. Based on the maximum concentration of chrysene (the PAH with the highest mean concentration) detected in surface soil of Grant Court public housing complex, the calculated chronic child exposure dose (0.001 mg/kg/day) was about twenty times lower than the lowest reported RfD for a related PAH (i.e., 0.02 mg/kg/day for naphthalene) (Table 4).

As such, non-cancer adverse health effects associated with past exposures from the ingestion of PAH contaminated soil at the Grant Court public housing complex are unlikely in children and adults.

Arsenic. Arsenic is a naturally occurring element widely distributed in the earth's crust. Chronic exposure to low levels of inorganic arsenic can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso (less serious effect). Skin contact with inorganic arsenic may cause redness and swelling. Organic arsenic compounds are less toxic than inorganic arsenic compounds (ATSDR 2000).

Based on the EPC of arsenic detected at the Grant Court public housing complex, the chronic exposure doses calculated for children (0.000098 mg/kg/day) and adults (0.000015 mg/kg/day), respectively did not exceed the ATSDR MRL of 0.0003 mg/kg/day (see Table 4). The MRL for arsenic is set at a level meant to protect against non-cancer health effects, specifically dermal lesions. As such, non-cancer adverse health effects associated with past exposures from the ingestion of arsenic contaminated soil at the Grant Court public housing complex are unlikely in children and adults.

Cancer Health Effects

Site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants and is usually expressed in terms of excess cancer cases in an exposed population. The LECR indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of

cancer. For perspective, the lifetime risk of being diagnosed with cancer in the United States is 46 per 100 individuals for males, and 38 per 100 for females; the lifetime risk of being diagnosed with any of several common types of cancer ranges between 1 in 10 (10^{-1}) and 1 in 100 (10^{-2}) (SEER 2005). Typically, health guideline CVs developed for carcinogens are based on one excess cancer case per 1,000,000 (10-6) individuals. The NJDHSS uses the following cancer risk descriptions for health assessments:

Risk Description for Public Health Assessment/Health Consultation in New Jersey

LECR	Risk Description
$<10^{-3}$	Increase
10^{-4} to $<10^{-3}$	Low increase
10^{-6} to $<10^{-4}$	No apparent increase
$< 10^{-6}$	No expected increase

The United States Department of Health and Human Services (USDHHS) cancer classes for the Grant Court public housing complex contaminants are presented in Table 5. The cancer classes are defined as follows:

1 = Known human carcinogen
2 = Reasonably anticipated to be a carcinogen
3 = Not classified

Ingestion of contaminated Soil

The cancer classes of the COCs detected in the surface soil of various areas are given in Table 5. The carcinogens found in these environmental media were PAHs and arsenic in surface soil. Exposure doses were calculated using the following formula:

$$\textit{Cancer Exposure Dose (mg/kg/day)} = \frac{C \times IR \times EF}{BW} * \frac{ED}{AT}$$

where, C = concentration of contaminant in soil (mg/kg);
IR = soil ingestion rate (kg/day);
EF = exposure factor representing the site-specific exposure scenario;
ED = exposure duration[4] (year);
BW = body weight (kg); and,
AT = averaging time (year).

The USEPA has developed a relative potency estimate approach for PAHs (USEPA 1993). Using this approach, the cancer potency of carcinogenic PAHs can be estimated based on

[4]A lifetime exposure time of 63 years was used based on exposure related historic information provided by the community members.

their relative potency with reference to benzo[a]pyrene. For each of the carcinogenic PAHs, the benzo[a]pyrene equivalence was calculated by multiplying the mean concentration detected with the cancer potency factor. The total benzo[a]pyrene equivalence was then obtained by summing each of the individual benzo[a]pyrene equivalences (see Table 5).

Based on previously described exposure assumptions, LECRs were calculated by multiplying the exposure dose by the cancer slope factor. The cancer slope factor is defined as the slope of the dose-response curve obtained from animal and/or human cancer studies and is expressed as the inverse of the daily exposure dose, i.e., $(mg/kg/day)^{-1}$. LECRs based on mean contaminant concentrations detected are presented in Table 5.

LECRs associated with ingestion of contaminated soil during recreational activities at Grant Court public housing complex were evaluated (see Table 5). Based on the EPCs of PAHs and arsenic concentrations detected in soil, the calculated LECRs showed a low increase in the theoretical cancer risk of 4 in 10,000 individuals exposed for adults (including children) who may contact contaminated soil in this area.

Past individual exposures to site-related contaminants may be higher than those presented in this Health Consultation. That is, individuals may have accessed or frequented more than one area of concern (AOC) on a regular basis. Combining on-site and off-site exposures (based on the findings of the PHA in 2008) may increase the possibility of adverse health effects. However, it is important to note that the dose estimates were based on surface soil sampling of 0-2 feet depth, which is not representative of surface soil that people are most likely to be exposed. This may under or overestimate the theoretical cancer risk.

Child Health Considerations

The NJDHSS and ATSDR 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 types of exposures to hazardous substances. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of 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 ASTDR evaluated the potential risk for children residing in the area who may have been exposed to site contaminants. The potential exposure to contaminants in the soil of residences did not exceed the health-based CVs; no non-cancer adverse health effects in children are expected. However, based on the EPC concentrations of PAHs and metals detected, a 4 in 10,000 cumulative LECR was determined for residents (including children) due to past exposures. Even though, this exposure poses a low increase in lifetime cancer risk (compared to the background risk of cancer from all causes), if combined with on-site exposures there is a potential for adverse health effects. This is particularly true for children, residing in both areas (on and off-site).

Conclusion

Almost 100 years of operation at the former LBMGP site resulted in the generation of hazardous wastes and environmental contamination of off-site areas, including the Grant Court public housing complex. There was a completed exposure pathway via the incidental ingestion of contaminated surface soil in the past. The exposed population included residents at the Grant Court public housing complex. Contaminants of concerns are PAHs and arsenic in the surface soil. The ATSDR and NJDHSS have reached the following two conclusions in this report.

NJDHSS and ATSDR conclude that currently there are no site related exposures to soil contaminants at the Grant Court public housing complex that can harm people's health. Contaminated surface soils of the Grant Court public housing complex have been excavated and transported off-site. The excavated areas were backfilled with clean fill. Thus, residents are not being exposed to any site-related contaminants.

The NJDHSS and ATSDR conclude that past exposures to site-related soil contaminants at the Grant Court public housing complex may have harmed people's health. Based on the EPC of PAHs and arsenic detected in surface soil, the potential for non-cancer adverse health effects associated with past exposures are unlikely in children and adults. Cumulative lifetime excess cancer risks were calculated to be 4 in 10,000 to the exposed population. Exposures pose a low increase in lifetime cancer risk, compared to the background risk of cancer from all causes. If combined with on-site exposures (especially for children playing on the LBMGP site), there was a potential for adverse health effects. It should be noted that there is some uncertainty in this conclusion because the soil sampling data were from 0-2 foot, which may not represent actual surface soil conditions. This may under or overestimate the theoretical cancer risk.

Recommendations

The NJDHSS and ATSDR recommend maintaining site access restriction to ensure integrity of the remedies for the Grant Court public housing complex.

Public Health Action Plan (PHAP)

The purpose of a PHAP is to ensure that this Health Consultation not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the ATSDR and the NJDHSS to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by the ATSDR and NJDHSS are as follows:

Public Health Actions Taken Undertaken by NJDHSS and ATSDR

1. Contamination data collected from the Grant Court public housing complex were evaluated by the NJDHSS and ATSDR.

2. Representatives of the NJDHSS conducted a site visit of the Grant Court public housing complex on August 26, 2010.

3. A public health assessment was prepared in 2008 to characterize and delineate LBMGP contamination (ATSDR 2008).

Public Health Actions Planned by NJDHSS and ATSDR

1. A copy of this Health Consultation will be sent to the petitioner (Concerned Citizens Coalition of Long Branch).

2. Copies of this Health Consultation will be provided to concerned residents via the township library and the Internet.

3. If requested, in cooperation with the NJDEP, a meeting could be scheduled with the Concerned Citizens Coalition of Long Branch to discuss the findings of this report and to determine and address any additional community concerns.

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REPORT PREPARATION

This Health Consultation for the Long Branch Manufactured Gas Plant Site, Grant Court Public Housing Complex, was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented. ATSDR's approval of this document has been captured in an electronic database, and the approving agency reviewers are listed below.

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Table 1. Surface Soil (0 to 2 ft depth) Sampling Results: November 1984 through June 2006 Grant Court Public Housing Complex

Contaminant	Concentration (mg/kg[a])	No. of Samples	Environmental Guideline CV[b] (mg/kg)	COPC[c]
	Range			
Acenaphthene	110	1	3400 (RSL[d])	No
Anthracene	310	1	17,000 (RSL)	No
Benzo[a]anthracene	0.11 - 390	11	0.15 (RSL)	**Yes**
Benzo[b]fluoranthene	0.12 - 90	11	0.15 (RSL)	**Yes**
Benzo[k]fluoranthene	0.13 – 8.44	6	1.5 (RSL)	**Yes**
Benzo[a]pyrene	0.14 - 140	12	0.1 (CREG[e])	**Yes**
Chrysene	14.1 - 410	3	15 (RSL)	**Yes**
Dibenzo[a,h]anthracene	0.5 – 3.38	3	0.015 (RSL)	**Yes**
Fluoranthene	460	1	2,000 (RMEG[f])	No
Fluorene	360	1	2,000 (RMEG)	No
Indeno[1,2,3-cd]pyrene	0.1 – 7.65	4	0.15 (RSL)	**Yes**
Naphthalene	960	1	1,000 (RMEG)	No
Pyrene	640	1	2,000 (RMEG)	No
Arsenic	ND[g] – 68.2	18	0.5 (CREG)	**Yes**
Beryllium	1.3	1	100 (RMEG)	No
Lead	ND - 24.2	2	400 (RSL)	No
Thallium	1.8 – 3.2	2	2 (RDCSCC[h])	No

[a]milligrams of contaminant per kilogram of soil; [b]Comparison Value; [c]Contaminant of Potential Concern; [d]EPA Regional Screening Level; [e]ATSDR Cancer Risk Evaluation Guide for chronic exposure; [f]ATSDR Reference Media Evaluation Guide for chronic exposure for child; [g]Not Detected; [h]NJDEP Residential Direct Contact Soil Cleanup Criteria.

Table 2. Exposure Point Calculation (using USEPA ProUCL®)

Contaminant	Exposure Point Calculation (mg/kg[a])		Environmental Guideline CV[b] (mg/kg)	COC[c]
	UCL95	Max		
Benzo[a]anthracene	389	---	0.15 (RSL[d])	**Yes**
Benzo[b]fluoranthene	48.1	---	0.15 (RSL)	**Yes**
Benzo[k]fluoranthene	---	8.4	1.5 (RSL)	**Yes**
Benzo[a]pyrene	59.3	---	0.1 (CREG[e])	**Yes**
Chrysene	---	410	15 (RSL)	**Yes**
Dibenzo[a,h]anthracene	---	3.4	0.015 (RSL)	**Yes**
Indeno[1,2,3-cd]pyrene	---	7.6	0.15 (RSL)	**Yes**
Arsenic	34.9	---	0.5 (CREG)	**Yes**

[a]milligrams of contaminant per kilogram of soil; [b]Comparison Value; [c]Contaminant of Concern; [d] EPA Regional Screening Level; [e] ATSDR Cancer Risk Evaluation Guide for chronic exposure.

Table 3: Major Exposure Pathways for the Grand Court Public Housing Complex

Environ Pathway	Exposure Point	Exposure Scenario	Route of Exposure	Receptor	Location	Pathway Status		
						Past	Present	Future
Soil	Soil	Direct Contact	Ingestion	Resident	Grant Court Public Housing Complex	Completed	Eliminated	Eliminated
Ambient Air	Air		Inhalation			Potential		

Table 4. Comparison of Surface Soil Exposure Dose with the Health Guideline CVs
Grant Court Public Housing Complex (past exposure)

Contaminants of Concern	EPC (mg/kg[a])	Exposure Dose (mg/kg/day [h])		Health Guideline CV[d] (mg/kg/day)	Potential for Non-Cancer Health Effects
		Child[b]	Adult[c]		
Polycylic Aromatic Hydrocarbons (PAHs)					
Benzo[a] anthracene	389	1×10^{-3}	2×10^{-4}	NA[e]	No[f]
Benzo[b] fluoranthene	48.1	1×10^{-4}	2×10^{-5}	NA	No
Benzo[k] fluoranthene	8.4	2×10^{-5}	4×10^{-6}	NA	No
Benzo[a]pyrene	59.3	2×10^{-4}	3×10^{-5}	NA	No
Chrysene	410	1×10^{-3}	2×10^{-4}	NA	No
Dibenzo[a,h] anthracene	3.4	1×10^{-5}	1×10^{-6}	NA	No
Indeno[1,2,3-cd] pyrene	7.6	2×10^{-6}	3×10^{-6}	NA	No
Metals					
Arsenic	34.9	1×10^{-4}	2×10^{-5}	3.5×10^{-4} (MRL[g])	No

[a]milligrams of contaminant per kilogram of soil; [b]Child exposure scenario: 3 days/week, 9 month/year, 200 mg/day ingestion rate and 21 kg body weight; [c]Adult exposure scenario: 3days/week, 9 month/year, 100 mg/day ingestion rate and 70 kg body weight,; [d]Comparison Value; [e]Not Available; [f]Basis presented in the document on page 11; [g]ATSDR Minimal Risk Level; [h]Sample Calculation (for Benzo[a] anthracene): Exposure Dose (mg/kg/day) = C x IR x EF/BW = 389mg/kg x 100mg/day x (108days/365days) x (1/70kg) x (1/1000000mg) = 0.0001643mg/kg/day.

Table 5: Calculated LECR associated with past exposure to Contaminants detected in Surface Soil Grant Court Public Housing Complex

Contaminants of Concern	EPC (mg/kg[a])	DHHS[b] Cancer Class	Potency Factor[c]	BaP Equiv. (mg/kg)	Total BaP Equiv. (mg/kg)	Cancer Exposure Dose[d] (mg/kg/d)	CSF[e] (mg/kg/d)	LECR[f]
Polycyclic Aromatic Compounds (PAHs)								
Benzo[a]anthracene	388.8	2	0.1	38.88	125.59	4.77×10^{-5}	7.3	3.5×10^{-4}
Benzo[b]fluoranthene	48.09	2	0.1	4.809				
Benzo[k]fluoranthene	8.44	2	0.1	0.844				
Benzo[a]pyrene	59.29	2	1	59.29				
Chrysene	410	3	0.01	4.10				
Dibenzo[a,h]anthracene	3.38	2	5	16.9				
Indeno[1,2,3-cd]	7.65	2	0.1	0.765				
Metals								
Arsenic	34.93	1	NA[g]	NA	NA	5.36×10^{-6}	1.5	8.0×10^{-6}
							Sum =	**3.6×10^{-4}**

[a]milligrams of contaminant per kilogram of soil; [b]Department of Health and Human Services Cancer Class: 1 = known human carcinogen; 2 = reasonably anticipated to be a carcinogen; 3 = not classified; [c]Cancer potency factor relative to benzo[a]pyrene (BaP); [d]Adult exposure scenario: 3 days/week, 9 month/year, 100 mg/day ingestion rate, 70 kg body weight and 63 year exposure duration; [e]Cancer Slope Factor; [f]Lifetime Excess Cancer Risk, Sample [g]Not Applicable; [h]Cancer Risk = Cancer Exposure Dose (mg/kg/day) x Cancer Slope Factor = C x IR x EF/BW x ED/AT = 125.6mg/kg x 100mg/day x (108days/365days) x (1/70kg) x (1/1000000mg) x (63years/70years) = 3.5×10^{-4} mg/kg/day.

Photograph 1: Grant Court public housing complex (2010) on original Grant Court site

Photograph 2: LBMGP site surrounded by 6' fence

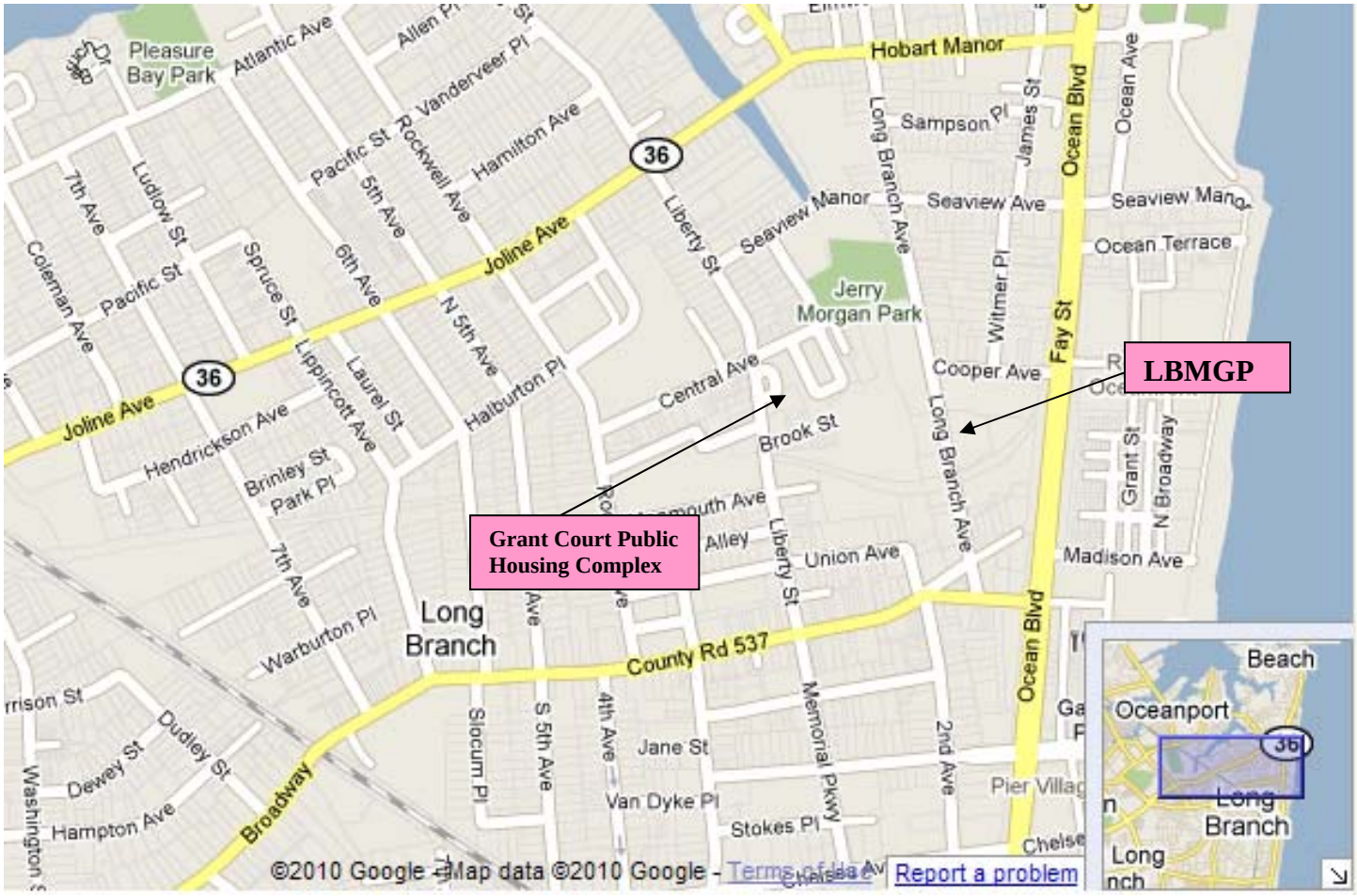

Figure 2: Street map showing the location of Grant Court public housing

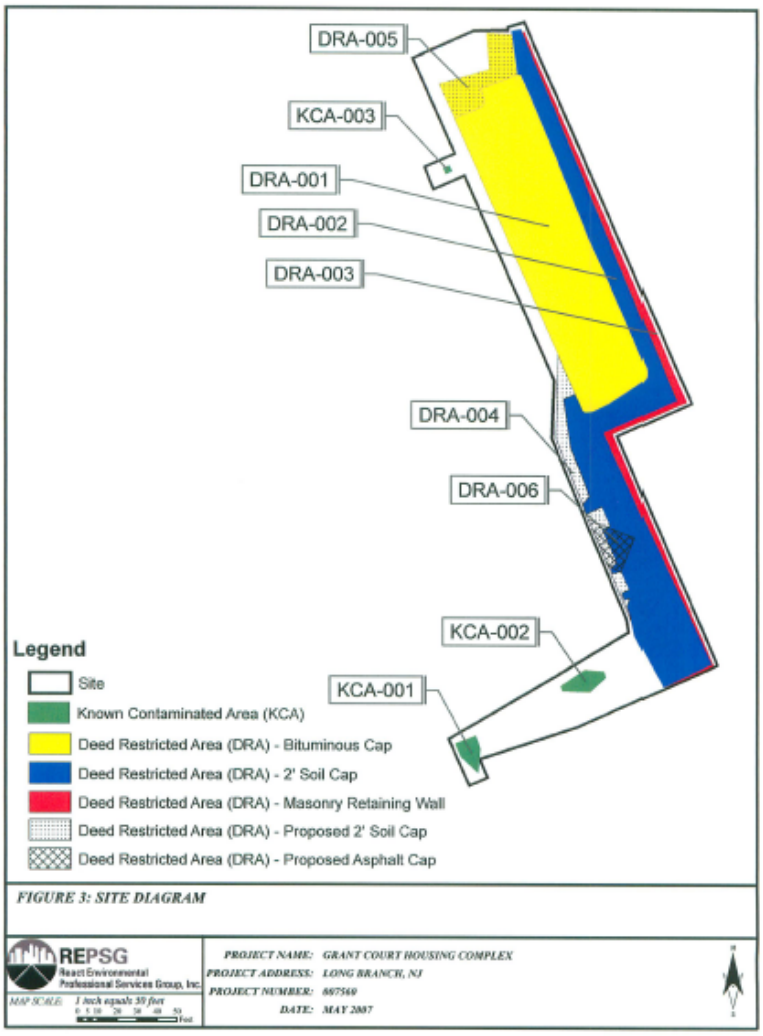

Figure 3: Location Deed Restricted Area in the Grant Court Public Housing

ATSDR Glossary of Terms

Acute
Occurring over a short time [compare with chronic].

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

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.

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]

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].

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.

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

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.

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.

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-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 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.

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

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

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.

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].

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.

mg/kg
Milligram per kilogram.

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].

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-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.

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

ppm
Parts per million.

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].

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.

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

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

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]

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.

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.

Substance
A chemical.

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

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.

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