ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

ROLLING KNOLLS LANDFILL
CHATHAM TOWNSHIP, MORRIS COUNTY, NEW JERSEY
EPA FACILITY ID: NJD980505192
JULY 5, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment 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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PUBLIC HEALTH ASSESSMENT

ROLLING KNOLLS LANDFILL
CHATHAM TOWNSHIP, MORRIS COUNTY, NEW JERSEY

EPA FACILITY ID: NJD980505192

Prepared by:

New Jersey Department of Health and Senior Services
Public Health Services Branch
Consumer and Environmental Health Services
Hazardous Site Health Evaluation Program

Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Summary

The Rolling Knolls Landfill site is located at 35 Britten Road in the Green Village section of Chatham Township, Morris County, New Jersey. The site covers approximately 200 acres and operated as an unlined municipal landfill from the early 1930s through December 1968. The site is bordered by the Great Swamp National Wildlife Refuge to the east, south, and southwest. Approximately 30 acres of the landfill property overlap the refuge. Loantaka Brook is located to the west of the site, and private properties, including residential housing, are located to the north and northwest. Wastes dumped at the landfill came from private companies and at least seven surrounding municipalities and included household refuse, residential septic wastes, pharmaceutical wastes, and construction and demolition debris. Pesticides were used on the landfill to control weeds, rodents, and mosquitoes, and oil was applied to landfill paths to control dust.

In 1985, the site was evaluated by the US Environmental Protection Agency (EPA) for possible addition to the National Priorities List. At that time, it was determined that results of surface water, soil, and sediment sampling did not warrant any further action or the addition of the site to the National Priorities List. Subsequently, a local environmental group voiced concern that inadequate data had been used to initially characterize the site and that the site posed a significant health threat to humans and wildlife. To address these concerns, the EPA performed additional environmental sampling in May 1999. Results indicated elevated levels of phthalates, metals, and polychlorinated biphenyls in site soils; mercury and polychlorinated biphenyls were also detected in surface water and sediment samples obtained from a portion of the site overlapping the refuge. Based on these results, the Rolling Knolls Landfill site was proposed to be added to the National Priorities List on April 30, 2003; the site was listed to the National Priorities List on September 29, 2003.

Based on the findings of this Public Health Assessment, the site was determined to pose ***No Apparent Public Health Hazard***. Completed human exposure pathways could not be identified for the site, and a review of available health outcome data is not warranted at this time. A potential exposure pathway exists relating to the incidental ingestion of contaminated soil by workers and trespassers visiting the site, but the potential for exposures is characterized to be minimal. Elevated lead concentrations detected in on-site surface soils may be attributable to on-site shooting range. It is important to note that environmental contamination has been identified at the Rolling Knolls Landfill site. This contamination may present a public health concern if conditions or land use at the site change, resulting in potential future exposures. To discourage trespassing, signs designating the Rolling Knolls Landfill site as a National Priorities List site should be posted, and fencing should be considered to discourage trespassing in contaminated areas. It is also recommended that additional environmental data be collected to better characterize the distribution and movement of contaminants. The NJDHSS and ATSDR will re-evaluate public health implications of the site when additional environmental data become available from the EPA.

Arsenic and trichloroethene were detected in off-site residential potable wells at levels above New Jersey drinking water maximum contaminant levels. Arsenic in groundwater may be naturally occurring and trichloroethene is unlikely to be site-related. Nonetheless, additional private well testing should be conducted and informational materials provided to area residents.

Statement of Issues

On April 30, 2003 the Environmental Protection Agency (EPA) proposed to add the Rolling Knolls Landfill site, Chatham Township, Morris County, New Jersey to the National Priorities List (NPL). The site was added to the NPL on September 29, 2003. Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) of 1986, the federal Agency for Toxic Substances and Disease Registry (ATSDR) is required to conduct public health assessments of sites listed or proposed to be added to the National Priorities List (NPL). The New Jersey Department of Health and Senior Services (NJDHSS), in cooperation with ATSDR, prepared the following public health assessment to review environmental data obtained from the site, define potential human exposure to contaminants, and determine whether the exposures are of public health concern.

Background

The Rolling Knolls Landfill site is located at 35 Britten Road in the Green Village section of Chatham Township, Morris County, New Jersey (see Figure 1). The site covers approximately 200 acres and was operated as a municipal landfill (unlined) from the early 1930s through 1968. Although the size of the landfill is currently estimated to be approximately 200 acres, it could actually be significantly larger (S. Vaughn, EPA Region 2, personal communication, 2006). The site is bordered by the Great Swamp National Wildlife Refuge to the east, south and west. Loantaka Brook is located to the west, and residences are located to the north and northwest of the site (see Figure 2). The Great Swamp National Wildlife Refuge provides critical habitat for state and federally designated or proposed endangered and threatened animal species (Weston 2003). The Refuge is also a designated National Natural Landmark. Approximately 30 acres of the site overlap the Great Swamp National Wildlife Refuge to the east and south (see Figure 2). According to the EPA, portions of the site are owned by multiple parties including a trust, the U.S. Department of the Interior, and private individuals.

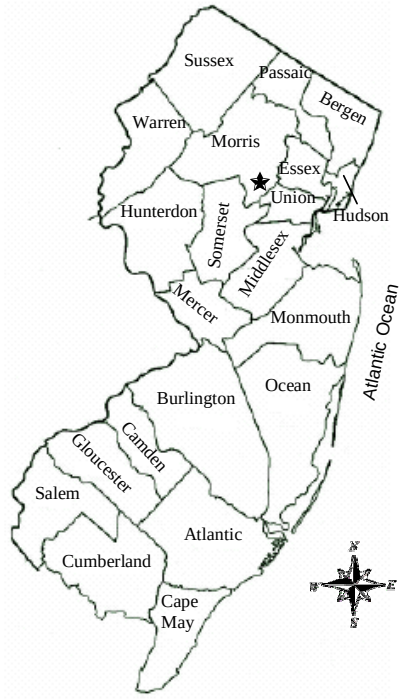

Figure 1: Location of Rolling Knolls Landfill Site

The area around the landfill is sparsely populated with large areas of open space. Based on year 2000 census data, the ATSDR estimated that approximately 1,700 individuals reside within a one-mile radius of the site (see Figure 3).

The landfill received wastes from private companies and at least seven surrounding municipalities including Summit, South Orange, Maplewood, Chatham, Madison, Harding, and Florham Park (EPA 2004). Wastes dumped at the landfill included household refuse, residential septic wastes, scrap metal, tires, tree stumps, and construction and demolition debris. Additionally, approximately 600 tons of pharmaceutical wastes generated by the Millmaster

Chemical Company, Berkeley Heights were deposited in the landfill from the 1930s to 1968. These wastes included alcohols, esters, ethers and other pharmaceutical waste products. Millmaster Chemical Company may have also disposed of 2,3,7,8-tetrachlorodibenzo-p-dioxin (a.k.a. dioxin) contaminated wastes at the site (NUS 1985). In order to comply with health code regulations adopted in 1959, operational procedures were implemented at the landfill and included the use of pesticides to control weeds, insects, and rodents. Oil was applied to unpaved paths to control dust, and semi-liquid swamp muck obtained from the edge of the landfill was used daily to cover wastes.

Subsequent to the landfill closing in 1968, a fire occurred on the site in 1974 (Weston 2003). Fire fighting equipment dispatched to the scene experienced trouble traversing the site due to the spongy nature of the refuse. As a result, the fire was not extinguished until five days after it started (Weston 2003). To address this problem, the landfill owner submitted an application to the New Jersey Department of Environmental Protection (NJDEP) to construct access fire roads on the landfill using construction and demolition debris (i.e., concrete, brick, stone, and wood) (EPA 2000). The NJDEP granted the property owner a variance to construct the fire roads, which were built between 1979 and 1982.

Previous Investigations

In 1985, the Rolling Knolls Landfill (a.k.a. Green Village Disposal Site, Miele's Dump) was investigated by the EPA. The purpose of the investigation was to determine landfill depth in selected areas, characterize the nature of soil contamination, and assess the possibility of dioxin contamination (Trube 1986). At that time, it was determined that results of surface water, soil, and sediment sampling did not warrant the addition of the site to the NPL (NUS 1985).

Subsequently, a local environmental group known as the Great Swamp Watershed Association voiced concern that inadequate data had been used to initially characterize the site and that the site posed a significant health threat to humans and wildlife. The Great Swamp Watershed Association was especially concerned about the critical habitat and endangered species present at the surrounding Great Swamp National Wildlife Refuge. To address this concern, the EPA, United States Geological Survey (USGS), and United States Fish and Wildlife Service (USFWS) conducted several site investigations between 1986 and 2000 that included soil, surface and groundwater, sediment, and biota sampling from both on- and off-site locations. Each sampling event confirmed the presence of contamination including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and metals.

Prior ATSDR Involvement

There has been no prior ATSDR or NJDHSS activity at this site.

Site Visit

On February 11, 2004, representatives of the NJDHSS, ATSDR and local health officials conducted a site visit of the Rolling Knolls Landfill site, which is situated southeast of Harding Township. NJDHSS representatives were Julie Petix, Christa Fontecchio, Steven Miller, and Tariq Ahmed; Arthur Block and Leah Escobar represented the ATSDR. Representatives of the Madison Health Department (which serves as the local health department for Chatham

Township) and Township of Harding Department of Health were also present. Weather conditions during the site visit were sunny and breezy with temperatures in the mid to upper 30s. The majority of the ground surface was covered with snow and ice (see Photograph 1).

The site is bordered by the Great Swamp National Wildlife Refuge to the east, south, and west. The area to the north of the site is residential. The only vehicular access to the landfill is from Britten Road (northern site border) (see Photograph 2). At this location, there are residences as well as a ball field (see Photographs 3 and 4). The site entry gate was open, and two "No Trespassing" signs were observed. The site is not fenced. A small seasonal tree farm, several ponds, a small one-story building, and a barbecue grill were noted on the site. During the site visit, staff spoke with one of the employees of Zander Landscaping. According to the employee, Zander Landscaping rents a large garage located on the site for the storage of equipment.

According to the Township of Harding Department of Health representative, the closest potable wells to the site are located along Meyersville Road. Children play in the Loantaka Brook during the summer months (the brook runs under Meyersville Road and was frozen at the time of the site visit). Recreational activities (i.e., fishing, camping, hunting, swimming and boating) are not permitted in the Great Swamp National Wildlife Refuge (see Photograph 5).

Community Concerns

Between 1979 and 1982, local citizen groups expressed concern over the construction of the fire roads and alleged continued dumping at the landfill in violation of the NJDEP variance. The Chatham Township Environmental Commission also expressed concern regarding the potential impact from the fire roads on drainage and movement of landfill leachate.

In 1997, the Great Swamp Watershed Association demanded that the EPA reevaluate the landfill for inclusion on the NPL (Apgar 1997). They claimed that the landfill posed an environmental threat to the Great Swamp National Wildlife Refuge and nearby brooks polluted by landfill contaminants. The Great Swamp Watershed Association also indicated that the landfill posed a public health threat because water from the site flows into the Passaic River, a source of drinking water to central New Jersey residents.

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. 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 (COC), are selected for further evaluation. Contaminant levels above environmental guideline CVs do 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 the screening environmental contaminants to identify COCs. 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 also considered as comparison values. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (70 years). In the absence of an ATSDR CV, other comparison values may be used to evaluate contaminant levels in environmental media. These include New Jersey Maximum Contaminant Levels (NJMCLs) for drinking water, and EPA Region 3 Risk-Based Concentrations (RBCs). RBCs 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, whichever results in a lower contaminant concentration) in water, air, biota, and soil. For soils and sediments, other CVs include the New Jersey Residential and Non-Residential Direct Contact Soil Cleanup Criteria (RDSCC, NRDSCC). Based primarily on human health impacts, these criteria may also take into account natural background concentrations, analytical detection limits, and ecological effects.

Substances exceeding applicable environmental guideline CVs were identified as 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 was unavailable, the substance was retained for further evaluation. There are exceptions, however. For example, some naturally occurring substances such as sodium, calcium, potassium, and magnesium are typically not harmful under most environmental exposure scenarios and may not necessarily be retained for further analysis.

Site Conditions

The Rolling Knolls Landfill site and the adjacent Great Swamp National Wildlife Refuge are located within the Great Swamp Watershed (see Figure 2). The Great Swamp Watershed is a clay-lined basin, about seven miles long and three miles wide, the remains of glacial Lake Passaic (Hinkle 1992). Four brooks influence the Great Swamp Watershed hydrology: Black Brook, Loantaka Brook, Great Brook, and Primrose Brook (Primrose Brook is not shown in Figure 2). Drainage from the site flows into the Black Brook. The Great Brook receives site drainage via the Loantaka Brook. Except during severe drought conditions, the brooks flow throughout the year. They ultimately discharge into the Passaic River, which is used for drinking water and is fished for human consumption (EPA 2004).

The closest residential wells are located approximately one-half mile west of the site on Meyerville Road in Harding Township, side-gradient to groundwater flow. Groundwater is the sole source of potable water in Harding Township. Site-related contamination of these wells is

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

unlikely because the wells are screened in the deep bedrock aquifer and there appears to be a thick clay layer beneath the site (Foster Wheeler 2000).

Based on Great Swamp Watershed characteristics, shallow groundwater flow is divided (Foster Wheeler 2000). Groundwater beneath the eastern portion of the landfill may flow towards Black Brook (see Figure 2) whereas groundwater at the western portion of the landfill may be influenced by Loantaka Brook which flows in a southwesterly direction.

Both the Rolling Knolls Landfill site and the Great Swamp National Wildlife Refuge have a favorable hydrologic regime for the minimization of contaminant transport (USFWS 1991). That is, contaminant migration via surface water and the shallow aquifer is impeded by a relatively flat hydraulic gradient and low permeability. This results in low groundwater velocity and water ponding. In addition, due to the retention capacity of highly organic soils, significant surface or shallow subsurface mobilization of contaminants is unlikely. Contamination of the deep aquifer is unlikely due to the relatively impermeable silt and clay beds. The confined aquifer also exhibits artesian behavior leading to groundwater discharge into the swamp.

On-Site Contamination

In 1985, the EPA collected a limited number of environmental samples (four surface water, one surface soil, four sediment) from the site (see Figure 4); these samples were analyzed for priority pollutants (NUS 1985). Results indicated the presence of VOCs, SVOCs, and metals. Pesticides and PCBs were also detected, but results were invalidated due to quality assurance/quality control concerns.

In 1986, the EPA conducted surface and subsurface soil sampling to determine the depth of landfill wastes and to characterize the nature and extent of soil contaminants including dioxin (Trube 1986). Sample locations were selected based on accessibility and the presence of waste materials. In each borehole drilled, landfill wastes were encountered and varied in thickness ranging from four feet (borehole B-4) to 24 feet (borehole B-1) (see Figure 5). A peat/organic silt layer was present at the bottom of the waste materials, and a firm, gray clay layer (60 - 125 feet) was observed under the peat/organic silt layer. Organic vapors were frequently detected during drilling of the boreholes. Samples were collected from the soil surface (0 - 6 inches), the landfill waste materials (just below the water table), and the natural material at the bottom of each borehole. Twenty-three soil samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals, and 28 samples were analyzed for dioxin. VOCs were detected, although they were attributed to laboratory cleaning chemicals, and SVOC results were rejected due to quality assurance/quality control issues. Pesticides were detected mostly in surface samples, and PCBs were detected in subsurface samples. Metals detected were aluminum, barium, copper, lead, mercury, silver, and zinc. Dioxin was not detected in any of the 28 samples analyzed. Results are presented in Table 1. Due to data quality issues, the results were not included in the COC evaluation.

In 1999, the EPA conducted an expanded inspection of the Rolling Knolls landfill site which included the collection of surface and sub-surface soil, sediment and surface and ground water samples (see Figure 7) (Foster Wheeler 2000). Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals; the number of detections, minimum, maximum and mean concentrations are presented in Tables 2 - 6. VOCs were not detected in surface soils (see Table 2). Maximum concentration of aroclor 1248, cadmium, copper and lead exceeded their

corresponding environmental guideline CVs. The environmental guideline CVs of phenanthrene and benzo[g,h,i]perylene were unavailable (see Table 2). Phenanthrene and benzo[g,h,i]perylene belong to a class of chemicals known as polycyclic aromatic compounds (PAHs[2]). The maximum and mean concentrations of phenanthrene and benzo[g,h,i]perylene detected in surface soil are comparable to the maximum and mean concentrations of other PAH compounds such as fluoranthene or benzo[k]fluoranthene and orders of magnitude lower than the environmental guideline CVs. As such, phenanthrene and benzo[g,h,i]perylene were not considered as the COCs for the site. Maximum and mean concentrations of lead (2,940 milligrams per kilogram of soil or mg/kg and 627 mg/kg, respectively) detected in the surface soil were much higher than those detected in the sub-surface soil (9.3 mg/kg and 4.62 mg/kg, respectively) (see Tables 2 and 3). Lead contamination may be attributable to on-site shooting ranges (Rolling Knolls Rod and Gun Club). It should be noted that the concentrations of all contaminants detected in the sub-surface soil were below their corresponding environmental guideline CVs.

VOCs (acetone, trichloroethene) and PCBs (Aroclor 1254 and 1260) were detected at low levels in sediment samples (see Table 4). SVOCs consisting of polycyclic aromatic hydrocarbons (PAHs) and pesticides were detected at low concentrations in surface and sub-surface soils and sediment samples. Maximum concentration of cadmium, copper and lead exceeded their corresponding environmental guideline CVs. As discussed earlier, although the environmental guideline CVs for phenanthrene was unavailable, phenanthrene was not considered as the COC for the site. PCBs (Aroclor 1254 and 1260), PAHs, pesticides and metals were detected in the sediment samples. The maximum concentration of bis(2-Ethylhexyl)phthalate, aldrin, arsenic, barium, chromium, lead, mercury, thallium and vanadium detected in the on-site Brook sediments exceeded their corresponding environmental guideline CVs (see Table 5). Five on-site groundwater samples were collected; results show that the maximum concentration of alpha-BHC, gamma-BHC, heptachlor epoxide, dieldrin, 4,4'-DDE, 4,4'-DDE, 4,4'-DDE, alpha-Chlordane, aroclor 1248, aroclor 1260, cadmium and chromium exceeded their corresponding environmental guideline CVs (see Table 6).

In 2003, an additional site investigation and field screening of soil and sediments indicated that PCBs were present at concentrations greater than 1 mg/kg (Weston 2003).

Off-Site Contamination

In 1988, the USFWS collected sediment samples along the perimeter of the Great Swamp National Wildlife Refuge including areas bordering the Rolling Knolls landfill site; fish were also collected from the Great Swamp National Wildlife Refuge. All samples were analyzed for PAHs, pesticides, and inorganics. Results of sediment sampling indicated PAHs prevalent along the western perimeter of the refuge, whereas pesticides were more common along the eastern perimeter. Lead was detected at nearly all sampled locations. Elevated levels of cadmium, copper, lead, and zinc were detected in fish tissue. Levels of copper and zinc were not attributed to environmental contamination; elevated levels of cadmium and lead were attributed to road run-off. Although concentrations of synthetic organic insecticides were detected in fish tissue, they did not appear to be at levels of concern to aquatic biota (USFWS 1991).

[2]PAHs are a group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances.

In 1989, the USGS, in cooperation with the USFWS, conducted an investigation that focused on the landfill perimeter (see Figure 6) (USGS 1993). Surface water samples from the landfill periphery, surface water and sediment samples from the Loantaka Brook, and ground water samples from the east and south of the landfill were collected and analyzed semiquantitatively for VOCs, SVOCs, pesticides, and metals (see Figure 6). VOC analysis was performed by a New Jersey certified laboratory and the USGS National Water Quality Laboratory in Colorado. Although results reported by the two laboratories were inconsistent, no VOCs detected in the landfill periphery and Loantaka Brook surface water exceeded New Jersey drinking water Maximum Contaminant Levels (NJMCL). The USGS laboratory identified several tentatively identified compounds (TICs) obtained from ground and surface water as pharmaceuticals or compounds related to pharmaceuticals (e.g., meprobamate, phenobarbital) (see Table 7). No ATSDR or EPA toxicologic information was available for these compounds; limited animal toxicity data from other literature sources are presented in Table 7. Since the exposure dose of these compounds (assuming a drinking water ingestion rate of two liters per day and a body weight of 70 kilograms) were several orders of magnitude lower than observed effect levels, they are not considered COCs. For example, for carisprodol, the average daily surface water intake rate is 2.85×10^{-5} mg/kg [= (0.001 mg/L * 2 L/day) / 70 kg], which is about seven orders of magnitude lower than the NOAEL (i.e., 100 mg/kg). It is important to note that on-site samples were not analyzed for these compounds.

SVOCs detected in Loantaka Brook bottom sediment were PAHs, pesticides (chlordane, dichlorodiphenyldichloroethane or DDD, dichlorodiphenyldichloroethylene or DDE, and dieldrin), and PCBs (USGS 1993). Compared to upgradient sediment samples, concentrations of cadmium, copper, mercury, and lead were elevated in the Loantaka Brook sediment along the landfill periphery. An evaluation of core lithologies indicated that these sediment samples may not have been representative of the wetter landfill areas. As such, these results were not included in the COC evaluation.

As part of an expanded site inspection and sampling activity, EPA collected surface water and sediment from the Loantaka Brook and water samples from residential potable wells located on Meyersville Road (see Figure 7) (Foster Wheeler 2000). The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. The results are presented in Tables 8, 9, and 10. The concentrations of all contaminants detected in off-site sediment and surface water were below their corresponding environmental guideline CVs (see Table 8 and 9). As discussed earlier, although the environmental guideline CVs for phenanthrene and benzo[g,h,i]perylene detected in sediment were unavailable, these compounds were not considered as the COC for the site. The arsenic and TCE detected in the residential potable wells (see Table 10) may not be attributable to the landfill; TCE was not detected in the on-site groundwater (see Table 3) and arsenic occurs naturally in the groundwater in that area (NJGS 2005).

Contaminants of Concern: Summary

On-Site Contaminants

The maximum concentrations of contaminants detected in soil, sediment, surface and groundwater, along with appropriate environmental guideline CVs, are presented in Tables 2 - 6. The following contaminants exceeded their corresponding CV, and as such, are designated as COCs:

Media	VOC	SVOC/Pesticides/PCBs	Metals
On-site			
Soil[a]		Aroclor 1248	Cadmium, Copper, Lead
Sediment			Cadmium, Copper, Lead
Surface Water		Bis(2-Ethylhexyl)phthalate, Aldrin	Arsenic, Barium, Chromium, Lead, Mercury, Thallium, Vanadium
Groundwater		Alpha-BHC, gamma-BHC, Heptachlor Epoxide, Dieldrin, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-Chlordane, Aroclor 1248, Aroclor 1260	Cadmium, Chromium

[a]Concentrations of contaminants detected in the sub-surface soil were below their corresponding environmental guideline CVs.

There are no on-site potable wells, therefore, there are no current exposures from the groundwater ingestion pathway. In 2003, field screening results also indicated the presence of PCBs in excess of 1 mg/kg.

Toxicologic summaries for the COCs are provided in Appendix A.

Off-Site Contaminants

The maximum concentrations of contaminants detected in off-site sediment, surface water and residential potable wells, along with appropriate environmental guideline CVs, are presented in Tables 8 - 10. The following contaminants exceeded their corresponding CV, and as such, are designated as COCs:

Media	VOC	SVOC/Pesticides/PCBs	Metals
Off-site			
Sediment			
Surface Water			
Potable Wells	Trichloroethene		Arsenic

Toxicologic summaries for the COCs are provided in Appendix A.

Discussion

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 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.

Completed Pathways

Based on available information, the NJDHSS and the ATSDR were unable to identify completed human exposure pathways related to the Rolling Knolls Landfill site.

Potential Pathways

On-Site Contaminants. Two commercial businesses (landscaper, tree farm) are present on the site. The landscaper uses the site for equipment storage. Exposure to surface soil, sediment, and surface water is possible although limited for workers via incidental ingestion. As discussed previously, the presence of lead in the surface soil may not be attributable to landfill wastes.

There are no residents living within 200 feet of the site (Foster Wheeler 2000). Site access is restricted by a gated access road and "No Trespassing" signs are posted along the northern border of the site. The Great Swamp National Wildlife Refuge borders the site along the east, south, and west, also hindering access to the site. Recreational activities are prohibited at the Great Swamp National Wildlife Refuge. Although trespassing at the site may occur, the extent and frequency are unknown. Surface soils may be incidentally ingested through hand-to-mouth activity.

Off-Site Contaminants, Loantaka Brook. Exposure to contaminants in the Loantaka Brook sediment and surface water are possible particularly at the junction of Meyersville Road where residences are located. Children playing in the Loantaka Brook may incidentally ingest surface water and sediment. SVOC and metal concentrations detected in sediment both upstream and downstream are plotted in Figures 8 and 9, respectively. With the exception of bis(2-ethylhexyl)phthalate and benzo[b]fluoranthene which were determined not to be COCs, upstream (relative to the site) SVOC concentrations were higher than those detected downstream (see Figures 8). This indicates that the downstream concentrations of SVOCs may not be site related. The maximum downstream concentration of beryllium detected in the Loantaka Brook sediment (1.1 mg/kg) exceeded the respective environmental guideline CV of 1 mg/kg (see Table 8) and was higher than the upstream concentration (see Figure 9); however, the mean beryllium concentration detected in Loantaka Brook sediment (0.78 mg/kg) was below the environmental guideline CV. Maximum concentrations of all contaminants detected in surface water were below their respective environmental guideline CV (see Table 9). As such, residential exposures to Loantaka Brook sediment and surface water are unlikely to result in adverse health effects.

Contaminants in Residential Potable Wells. There is a potential exposure pathway to area residents using potable wells for household use. This may occur by ingestion and inhalation (for volatile contaminants only). Arsenic and TCE detected in residential wells located on Meyersville Road exceeded the NJMCL. However, this contamination may not be site-related since:

- arsenic and TCE were not detected in on-site groundwater (see Table 6);
- groundwater from the site flows south/southwest into the Great Swamp Wildlife Refuge; and,
- potable wells are screened in the bedrock aquifer and there is thick clay layer underneath the swamp bed.

On- and off-site potential exposure pathways are summarized in Table 11.

Public Health Implications

No completed human exposure pathways related to the Rolling Knolls Landfill site were identified. As such, no further evaluation of COCs was conducted.

Child Health Considerations

ATSDR's Child Health Initiative recognizes 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. Because they are smaller, children may experience greater doses of hazardous substances per unit of body weight than adults. Children's behaviors may cause them to breathe in or ingest more dust, soil, and heavy vapors. 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.

Children may be exposed to on-site contaminants in surface soil, sediment and surface water through trespassing on the site. Children may be exposed to off-site surface water and sediments at the Loantaka Brook, but contaminant concentrations in these media are below environmental guideline CVs and are unlikely to pose a health concern.

Although not site related, it is important to note that arsenic and TCE were detected in nearby potable wells at concentrations above their respective NJMCL (see Table 10). Birth defects have been observed in animals exposed to inorganic arsenic, although it is unknown whether exposure to arsenic will result in birth defects or other developmental effects in humans (ATSDR 2000). A study conducted in Woburn, Massachusetts concluded that the elevated incidence of childhood leukemia was associated with the mother's potential for exposure to drinking water contaminated with chlorinated organics including TCE, particularly during pregnancy (MDPH 1997). The study also suggested that exposures to these contaminants, whether individual or mixtures, might have had an effect on blood-forming organs during fetal development, but not during childhood. Similarly, a New Jersey study found a statistically

elevated rate of childhood leukemia in towns served by community water supplies contaminated with chlorinated organics including TCE (NJDHSS 2003a,b,c,d).

Health Outcome Data

Based on the exposure pathway analysis, a review of available health outcome data (e.g., childhood blood lead, adverse pregnancy outcomes, cancer incidence) is not warranted.

Public Comment

The public comment period for this public health assessment was from November 21 to January 6, 2006. No comments were received during this period.

Conclusions

Based on the findings of this Public Health Assessment, the NJDHSS and the ATSDR categorize the Rolling Knolls Landfill site as posing ***"No Apparent Public Health Hazard."*** Completed human exposure pathways could not be identified for the site, and a review of available health outcome data is not warranted at this time. A potential exposure pathway exists relating to the incidental ingestion of contaminated soil by workers and trespassers visiting the site, but the potential for exposures is characterized to be minimal. Elevated lead concentrations detected in on-site surface soils may be attributable to on-site shooting range.

Off-site surface and groundwater sample results indicated the presence of compounds related to pharmaceuticals; available toxicologic data indicate that the concentrations are unlikely to cause adverse health effects. This contamination may be site-related, as pharmaceutical wastes were reportedly dumped in the landfill. No on-site samples have been analyzed for pharmaceuticals. Children who trespass on the site may be exposed to on-site contaminants in surface soil, sediment and surface water. Exposures may also occur off-site at the Loantaka Brook, but contaminant concentrations in these media are unlikely to pose a concern to human health. Limited sampling of area residential potable wells indicated concentrations of arsenic and TCE which, although not site related, should be investigated.

It is important to note that environmental contamination has been identified at the Rolling Knolls Landfill site. This contamination may present a public health concern if conditions or land use at the site change, resulting in potential future exposures.

Recommendations

1. The EPA should continue sampling on- and off-site media (soil, sediment, surface and ground water) to better characterize the distribution and movement of contaminants.

2. Compounds related to pharmaceutical wastes were detected in off-site surface and ground water samples. Although limited toxicologic literature does not indicate observed effect levels at concentrations detected, sampling should continue.

3. Elevated concentrations of lead detected in surface soils may not be attributable to on-site landfill wastes. The EPA should inform the businesses and Rod and Gun Club members to avoid exposures to on-site soils.

4. Based on limited sampling data, arsenic and TCE were detected in area potable wells. NJDEP should offer assistance to the local health department(s) to conduct private potable well sampling and testing. The NJDEP should provide public educational materials on arsenic and TCE to residents with potable wells.

5. To discourage trespassing, signs designating the Rolling Knolls Landfill site as a NPL Site should be posted. Fencing should be considered to discourage trespassing in contaminated areas.

Public Health Action Plan

The Public Health Action Plan (PHAP) for the Rolling Knolls Landfill site contains a description of the actions taken by the NJDHSS and/or ATSDR at or in the vicinity of the site subsequent to the completion of this Public Health Assessment. The purpose of the PHAP is to ensure that this health assessment not only identifies public health hazards, but 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 NJDHSS and ATSDR to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by NJDHSS and ATSDR are as follows:

Public Health Actions Taken

1. Available environmental data and other relevant information for the Rolling Knolls Landfill site have been reviewed and evaluated to determine human exposure pathways and public health issues.

Public Health Actions Planned

1. The NJDHSS will prepare a site-specific public health Citizen's Guide for the Rolling Knolls Landfill site which will be made available to the local health department and other interested parties.

2. The NJDHSS and ATSDR will re-evaluate public health implications of the site when additional environmental data become available from the EPA.

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CERTIFICATION

The public health assessment for the Rolling Knolls Landfill site, Chatham Township, Morris County, New Jersey was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and a procedure existing at the time the health assessment was initiated. Editorial review was a completed by the cooperative agreement partner.

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Agency for Toxic Substances and Disease Registry

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

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Agency for Toxic Substances and Disease Registry

Table 1: On-site Surface and Subsurface soil Sampling Results of Rolling Knolls Landfill site (Number of Samples = 23) (1985)

Contaminant[a]	Surface		Sub-surface		Environmental Guideline CV (mg/kg)
	Location[b]	Conc. (mg/kg)	Location	Conc. (mg/kg)	
Volatile Organic Compounds (VOCs)					
Toluene	B-1	0.018	-	-	10,000 (RMEG[c])
4-Methyl-2-pentanone	-	-	B-2	0.244	1,000 (NRDCSCC[d])
Semi Volatile Organic Compounds (SVOCs)					
Results were rejected due to delay in analyzing the extracted sample[e]					
Pesticide/Polychlorinated Biphenyls (PCBs)					
4,4'-DDE	B-5	0.102	-	-	1.9 (RBC[f])
Beta-BHC	-	-	B-2A	0.15	-
Chlordane	B-1	0.7	B-2	8.7[g]	30 (EMEG[h])
	B-2	0.16	-	-	
	B-2A	11	-	-	
Aroclor - 1254	B-3	1.8	B-6	0.44	1 (EMEG)
	-	-	B-3	1.9	
	-	-	B-1	1.7	
Metals					
Aluminum	-	-	B-5	21,200	100,000 (EMEG)
Barium	B-3	390	B-3	528	4,000 (RMEG)
Copper	B-3	333	B-1	674[g]	3,100 (RBC)
	-	-	B-2	164	
	-	-	B-3	238.5[i]	
Lead	-	-	B-1	3,790[g]	600 (NRDCSCC)
Mercury	-	-	B-1	3.3[g]	270 (NRDCSCC)
	-	-	B-3	1.35[g]	
Silver	-	-	B-1	40[g]	300 (RMEG)
	-	-	B-3	4	
Zinc	B-3	962	B-1	6,760[g]	20,000 (EMEG)
	-	-	B-3	1,030	

[a]phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[a]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene and benzo[g,h,i]perylene was detected in the surface and 2-methylphenol, 4-methylphenol, 2,4-dimethylphenol, naphthalene, fluoranthene, pyrene and bis(2-ethylhexyl) phthalate was detected in the subsurface soil; [b]See Figure 5 for sample location; [c]ATSDR Reference Media Evaluation Guide for chronic exposure for child; [d]NJDEP Non-Residential Direct Contact Soil Cleanup Criteria; [e]Results did not pass QA/QC requirements; [f]EPA Region 3 Risk-Based Concentration; [g]composite sample result; [h]ATSDR Environmental Media Evaluation Guide for chronic exposure for child; [i]mean of two subsurface samples

Table 2: On-site Surface Soil (0 – 2 ft) Sampling[a] Results of the Rolling Knolls Landfill site (Number of sample = 9) (1999)

Contaminants	No. of Detections	Concentration (mg/kg)			Environmental Guideline Comparison Value (mg/kg)	COC[b]
		Minimum	Maximum	Mean		
Semi Volatile Organic Compounds (SVOCs)						
Phenanthrene	3	0.12	0.22	0.16	NA[c]	No
Di-n-butylphthalate	1	0.15	0.15	0.15	10,000 (NRDCSCC[d])	No
Fluoranthene	4	0.11	0.35	0.21	2,000 (RMEG[e])	No
Pyrene	3	0.15	0.32	0.22	2,000 (RMEG)	No
Butylbenzylphthalate	3	0.06	0.5	0.227	10,000 (NRDCSCC)	No
Benzo[a]anthracene	3	0.058	0.17	0.107	0.87 (RBC[f])	No
Chrysene	4	0.066	0.14	0.107	40 (NRDCSCC)	No
bis(2-Ethylhexyl)phthalate	5	0.77	43	9.9	210 (NRDCSCC)	No
Di-n-octylphthalate	1	0.3	0.3	0.3	10,000 (NRDCSCC)	No
Benzo[b]fluoranthene	4	0.067	0.24	0.142	0.87 (RBC)	No
Benzo[k]fluoranthene	2	0.052	0.059	0.056	4 (NRDCSCC)	No
Benzo[a]pyrene	3	0.047	0.13	0.082	0.1 (CREG[g])	No
Indeno[1,2,3-cd]pyrene	2	0.061	0.11	0.086	4 (NRDCSCC)	No
Benzo[g,h,i]perylene	1	0.098	0.098	0.098	NA	No
Pesticides and PCBs						
beta-BHC[h]	1	0.026	0.026	0.026	2.2 (NRDCSCC)	No
Endosulfan I	1	0.0049	0.0049	0.0049	6,200 (NRDCSCC)	No
Dieldrin	4	0.0003	0.022	0.0111	3 (EMEG[i])	No
4-4'-DDE	5	0.0005	0.027	0.0169	9 (NRDCSCC)	No
4-4'-DDD	3	0.013	0.061	0.0313	12 (NRDCSCC)	No
Endosulfan sulfate[j]	1	0.011	0.011	0.011	6,200 (NRDCSCC)	No

Table 2: (Cont'd.)

Contaminants	No. of Detections	Concentration (mg/kg)			Environmental Guideline Comparison Value (mg/kg)	COC[b]
		Minimum	Maximum	Mean		
Pesticides and PCBs						
4-4'-DDT	4	0.0005	0.012	0.0034	30 (RMEG)	No
Endrin ketone[k]	1	0.0003	0.0003	0.0003	20 (EMEG)	No
alpha-Chlordane	4	0.0001	0.045	0.0165	30 (EMEG)	No
Aroclor-1248	2	2	3.6	2.8	1.4 (RBC)	**Yes**
Aroclor-1254	1	0.49	0.49	0.49	1 (EMEG)	No
Aroclor-1260	2	0.24	0.35	0.295	1.4 (RBC)	No
Metals						
Aluminum	9	6,250	10,600	8,540	100,000 (int. EMEG[m])	No
Antimony	3	2	8.2	5.53	20 (RMEG)	No
Arsenic	8	2.3	7.9	4.76	20 (EMEG)	No
Barium	9	19.8	340	114.56	4,000 (RMEG)	No
Beryllium	1	0.28	0.28	0.28	100 (EMEG)	No
Cadmium	2	20.2	37.1	28.65	10 (EMEG)	**Yes**
Chromium[n]	9	11.5	117	36.32	200 (RMEG)	No
Cobalt	9	3.4	14.7	7.96	500 (int. EMEG)	No
Copper	9	12.7	9,120	1,470	600 (NRDCSCC)	**Yes**
Iron	9	14,000	134,000	43,133	310,000 (RBC)	No
Lead	9	11.9	2,940	627	600 (NRDCSCC)	**Yes**
Manganese	9	59.4	1,960	688.6	3,000 (RMEG)	No
Mercury	3	3.2	8.8	6.5	270 (NRDCSCC)	No
Nickel	9	5.6	194	45.2	1,000 (RMEG)	No
Selenium	4	0.95	4.2	1.8	300 (RMEG)	No
Silver	3	3.7	6.9	5.57	300 (RMEG)	No

Table 2: (Cont'd.)

Contaminants	No. of Detections	Concentration (mg/kg)			Environmental Guideline Comparison Value (mg/kg)	COC[b]
		Minimum	Maximum	Mean		
Metals						
Thallium	1	1.8	1.8	1.8	72 (RBC)	No
Vanadium	9	16.8	34.9	26.34	1,000 (RBC)	No
Zinc	9	25.7	5,610	1,115	20,000 (EMEG)	No

[a]Location: W3, W1, W2, W4, W5, E1, SS1, SS2, SS3 (see Figure 7); [b]Contaminant of Concern; [c]Not available; [d]NJDEP Non-Residential Direct Contact Soil Cleanup Criteria; [e]ATSDR Reference Media Evaluation Guide for chronic exposure for child; [f]EPA Region 3 Risk-Based Concentration; [g]ATSDR Cancer Risk Evaluation Guide; [h]Based on gamma BHC; [i]ATSDR Environmental Media Evaluation Guide for chronic exposure for child; [j]Based on Endosulfan; [k]Based on Endrin; [m]ATSDR Environmental Media Evaluation Guide for intermediate exposure for child; [n]Based on Chromium (VI)

Table 3: On-site Sub-Surface Soil (>2 ft) Sampling[a] Results of the Rolling Knolls Landfill site (Number of sample = 5) (1999)

Contaminants	No. of Detections	Concentration (mg/kg)			Environmental Guideline Comparison Value (mg/kg)	COC[b]
		Minimum	Maximum	Mean		
Semi Volatile Organic Compounds (SVOCs)						
bis(2-Ethylhexyl)phthalate	2	1.2	2	1.6	210 (NRDCSCC[c])	No
Pesticides and PCBs						
4-4'-DDT	1	0.00028	0.00028	0.00028	30 (RMEG[d])	No
Methoxychlor	1	0.00026	0.00026	0.00026	300 (RMEG)	No
Metals						
Aluminum	5	6,160	7,570	7,058	100,000 (int. EMEG[e])	No
Arsenic	4	2.3	4.9	3.2	20 (EMEG[f])	No
Barium	5	18.3	46.6	31.18	4,000 (RMEG)	No
Chromium[g]	5	11	18	14.64	200 (RMEG)	No
Cobalt	5	3.2	15.4	7.84	500 (int. EMEG)	No
Copper	5	8	18.9	15.32	600 (NRDCSCC)	No
Iron	5	7,020	27,000	17,024	310,000 (RBC[h])	No
Lead	5	2.3	9.3	4.62	600 (NRDCSCC)	No
Manganese	5	43.4	550	227.28	3,000 (RMEG)	No
Nickel	5	7.2	11.8	9.44	1,000 (RMEG)	No
Selenium	2	0.88	0.94	0.91	300 (RMEG)	No
Thallium	2	1.6	1.7	1.65	72 (RBC)	No
Vanadium	5	14	33	26.08	1,000 (RBC)	No
Zinc	5	21.3	36.3	28.56	20,000 (EMEG)	No

[a]Location: W1, W2, W3, W4 and E1 (see Figure 7); [b]Contaminant of Concern; [c]NJDEP Non-Residential Direct Contact Soil Cleanup Criteria; [d]ATSDR Reference Media Evaluation Guide for chronic exposure for child; [e]ATSDR Environmental Media Evaluation Guide for intermediate exposure for child; [f]ATSDR Environmental Media Evaluation Guide for chronic exposure for child; [g]Based on Chromium (VI); [h]EPA Region 3 Risk-Based Concentration

Table 4: On-site Sediment Sampling[a] Results of the Rolling Knolls Landfill site (Number of sample = 12) (1999)

Contaminants	No. of Detections	Concentration (mg/kg)			Environmental Guideline Comparison Value (mg/kg)	COC[b]
		Minimum	Maximum	Mean		
Volatile Organic Compounds (VOCs)						
Acetone	1	0.25	0.25	0.25	50,000 (RMEG[c])	No
Trichloroethene	1	0.007	0.007	0.007	54 (NRDCSCC[d])	No
Semi Volatile Organic Compounds (SVOCs)						
4-Methylphenol	1	1.1	1.1	1.1	10,000 (NRDCSCC)	No
Dimethylphthalate	1	0.13	0.13	0.13	10,000 (NRDCSCC)	No
Diethylphthalate	1	0.085	0.085	0.085	40,000 (RMEG)	No
Phenanthrene	1	0.074	0.074	0.074	NA[e]	**Yes**
Di-n-butylphthalate	2	0.17	0.82	0.495	10,000 (NRDCSCC)	No
Fluoranthene	3	0.089	0.36	0.193	2,000 (RMEG)	No
Pyrene	3	0.11	0.33	0.186	2,000 (RMEG)	No
Butylbenzylphthalate	1	0.13	0.13	0.13	10,000 (RMEG)	No
Chrysene	1	0.061	0.061	0.061	40 (NRDCSCC)	No
bis(2-Ethylhexyl)phthalate	5	0.12	7.4	2.072	210 (RBC[f])	No
Di-n-octylphthalate	2	0.14	0.21	0.175	10,000 (NRDCSCC)	No
Benzo[b]fluoranthene	2	0.087	0.26	0.173	0.87 (RBC)	No
Benzo[k]fluoranthene	1	0.031	0.031	0.031	4 (NRDCSCC)	No
Pesticides and PCBs						
alpha-BHC[g]	2	0.00037	0.0037	0.002	2.2 (NRDCSCC)	No
gamma-BHC (Lindane)	2	0.00038	0.00039	0.00038	2.2 (NRDCSCC)	No
Heptachlor	1	0.0015	0.0015	0.0015	30 (RMEG)	No
Heptachlor Epoxide	1	0.0036	0.0036	0.0036	0.7 (RMEG)	No
Dieldrin	1	0.011	0.011	0.01	3 (EMEG[h])	No
4-4'-DDE	4	0.0027	0.019	0.0081	1.9 (RBC)	No

Table 4: (Cont'd.)

Contaminants	No. of Detections	Concentration (mg/kg)			Environmental Guideline Comparison Value (mg/kg)	COC[b]
		Minimum	Maximum	Mean		
Pesticides and PCBs						
4-4'-DDD	4	0.00084	0.018	0.0085	12 (RBC)	No
Endosulfan sulfate[i]	2	0.00088	0.0012	0.001	6,200 (NRDCSCC)	No
4-4'-DDT	1	0.003	0.003	0.003	30 (RMEG)	No
Methoxychlor	1	0.0056	0.0056	0.0056	300 (RMEG)	No
alpha-Chlordane[j]	5	0.0046	0.0097	0.0065	30 (EMEG)	No
gamma-Chlordane[k]	1	0.00094	0.00094	0.00094	30 (EMEG)	No
Aroclor-1254	2	0.21	0.4	0.305	1 (EMEG)	No
Aroclor-1260[l]	2	0.093	0.13	0.11	1 (EMEG)	No
Metals						
Aluminum	12	3,880	10,300	5,994	100,000 (int. EMEG[m])	No
Antimony	1	4.5	4.5	4.5	20 (RMEG)	No
Arsenic	4	3.9	12.2	6.35	20 (EMEG)	No
Barium	12	28.1	713	129.2	4,000 (RMEG)	No
Beryllium	7	0.51	2.9	1.15	100 (EMEG)	No
Cadmium	2	0.5	43	21.75	10 (EMEG)	**Yes**
Chromium[n]	12	8.1	88.7	19.75	200 (RMEG)	No
Cobalt	12	1.4	13.1	4.4	500 (int. EMEG)	No
Copper	12	9.2	1,560	170	600 (NRDCSCC)	**Yes**
Iron	12	4,030	132,000	21,442	310,000 (RBC)	No
Lead	12	12.1	1,430	228.5	600 (NRDCSCC)	**Yes**
Mercury	3	0.33	6	2.91	270 (NRDCSCC)	No
Nickel	12	4.4	79.5	16.26	1,000 (RMEG)	No
Selenium	2	1.3	4.8	3.05	300 (RMEG)	No
Silver	2	1.9	10.1	6	300 (RMEG)	No

Table 4: (Cont'd.)

Contaminants	No. of Detections	Concentration (mg/kg)			Environmental Guideline Comparison Value (mg/kg)	COC[b]
		Minimum	Maximum	Mean		
Metals						
Vanadium	12	10.7	46.5	21.3	1,000 (RBC)	No
Zinc	6	30.8	1,640	451.5	20,000 (ENEG)	No

[a]Location: S10, S11, S12, S13, S14, S15, S16, S18, S19, S20, S22 and S23 (see Figure 7); [b]Contaminant of Concern; [c]ATSDR Reference Media Evaluation Guide for chronic exposures for child; [d]NJDEP Non-Residential Direct Contact Soil Cleanup Criteria; [e]Not available; [f]EPA Region 3 Risk-Based Concentration; [g]Based on Lindane; [h]ATSDR Environmental Media Evaluation Guide for chronic exposures for child; [i]Based on Endosulfan; [j,k]Based on Chlordane; [l]Based on Aroclor 1254; [m]ATSDR Environmental Media Evaluation Guide for chronic exposures for child; [n]Based on Chromium (VI)

Table 5: On-site Surface Water Sampling[a] Results of the Rolling Knolls Landfill site (Number of sample = 11) (1999)

Contaminant	Concentration (μg/L)				Environmental Guideline Comparison Value (μg/L)	COC[b]
	No. of Detection	Minimum	Maximum	Mean		
Volatile Organic Compounds (VOCs)						
Chloromethane	1	1	1	1	190 (RBC[c])	No
Methylene Chloride	1	2	2	2	600 (EMEG[d])	No
Carbon disulfide	6	1	5	287.33	1,000 (RMEG[e])	No
Toluene	1	1	1	1	2,000 (RMEG)	No
Semi Volatile Organic Compounds (SVOCs)						
bis(2-Ethylhexyl)phthalate	2	1	5	3	4.8 (RBC[f])	**Yes**
Pesticides and PCBs						
gamma-BHC (Lindane)	1	0.0057	0.0057	0.0057	0.2 (NJMCL)	No
Heptachlor	1	0.015	0.015	0.015	5 (RMEG)	No
Aldrin	2	0.006	0.0074	0.0067	0.0039 (RBC)	**Yes**
Dieldrin	1	0.011	0.011	0.011	0.5 (EMEG)	No
Endosulfan II	1	0.0023	0.0023	0.0023	20 (EMEG)	No
4-4'-DDD	2	0.0033	0.0066	0.0049	0.1 (CREG[g])	No
alpha-Chlordane	1	0.97	0.97	0.97	6 (EMEG)	No
Metals						
Aluminum	11	37	7,630	980	20,000 (int. EMEG[h])	No
Arsenic	3	10	40	22	3 (EMEG)	**Yes**
Barium	11	26.4	2,600	352	700 (RMEG)	**Yes**
Chromium	3	1.5	45	17	30 (RMEG)	**Yes**
Cobalt	5	1.7	35	9.4	400 (int. EMEG)	No

Table 5: (Cont'd.)

Contaminant	Concentration (μg/L)				Environmental Guideline Comparison Value (μg/L)	COC[b]
	No. of Detection	Minimum	Maximum	Mean		
Metals						
Copper	11	14	410	61	1,500 (RBC)	No
Lead	10	2.4	416	54.5	15 (AL[i])	**Yes**
Mercury	1	2.5	2.5	2.5	2 (NJMCL)	**Yes**
Nickel	9	1.5	66.3	15	200 (RMEG)	No
Selenium	1	29	29	29	50 (EMEG)	No
Silver	5	1.1	3	1.6	50 (RMEG)	No
Thallium	2	9.2	12	15	2 (NJMCL)	**Yes**
Vanadium	10	1	67	12.5	37 (RBC)	**Yes**
Zinc	5	55	1,990	625	3,000 (EMEG)	No

[a]Location: S10, S11, S12, S13, S14, S15, S16, S18, S19, S20, S22 and S23 (see Figure 7); [b]Contaminant of Concern; [c]EPA Region 3 Risk-Based Concentration; [d]ATSDR Environmental Media Evaluation Guide for chronic exposure for child; [e]ATSDR Reference Media Evaluation Guide for chronic exposure for child; [f]New Jersey Maximum Contaminant Level; [g]ATSDR Cancer Risk Evaluation Guide; [h]ATSDR Environmental Media Evaluation Guide for intermediate Exposures; [i]Action Level

Table 6: On-site Groundwater Sampling[a] Results of the Rolling Knolls Landfill site (Number of sample = 5) (1999)

Contaminants	No. of Detections	Concentration (µg/L)			Environmental Guideline Comparison Value (µg/L)	COC[b]
		Minimum	Maximum	Mean		
Volatile Organic Compounds (VOCs)						
bis(2-Ethylhexyl)phthalate	1	1	1	1	4.8 (RBC[c])	No
Semi Volatile Organic Compounds (SVOCs)						
alpha-BHC[d]	2	0.37	3.7	2.035	0.2 (NJMCL[e])	**Yes**
gamma-BHC (Lindane)	2	0.38	0.39	0.385	0.2 (NJMCL)	**Yes**
Heptachlor	1	1.5	1.5	1.5	5 (RMEG[f])	No
Heptachlor Epoxide[g]	1	3.6	3.6	3.6	0.1 (RMEG)	**Yes**
Dieldrin	1	11	11	11	0.5 (EMEG[h])	**Yes**
4-4'-DDE	4	2.7	19	8.17	0.1 (CREG)	**Yes**
4-4'-DDD	4	0.84	18	8.51	0.1 (CREG[i])	**Yes**
Endosulfan sulfate	2	0.88	1.2	1.04	20 (EMEG)	No
4-4'-DDT	1	3	3	3	0.1 (CREG)	**Yes**
Methoxychlor	1	5.6	5.6	5.6	50 (RMEG)	No
alpha-Chlordane[j]	5	4.6	9.7	6.5	6 (EMEG)	**Yes**
gamma-Chlordane[k]	1	0.94	0.94	0.94	6 (EMEG)	No
Aroclor-1254	2	210	400	305	0.2 (EMEG)	**Yes**
Aroclor-1260[m]	2	93	130	111.5	0.2 (EMEG)	**Yes**
Metals						
Aluminum	5	8.4	507	152.96	20,000 (int. EMEG[n])	No
Barium	5	5.9	24.8	12.62	700 (RMEG)	No
Cadmium	1	3.8	3.8	3.8	2 (EMEG)	**Yes**
Chromium[p]	2	13.2	57.2	35.2	30 (RMEG)	**Yes**
Cobalt	2	1.4	1.6	1.5	400 (int. EMEG)	No

Table 6: (Cont'd.)

Contaminants	No. of Detections	Concentration (µg/L)				COC[b]
		Minimum	Maximum	Mean		
Metals						
Copper	5	10.8	17.4	14.28	1,500 (RBC)	No
Nickel	4	1.1	51.6	18.62	200 (EMEG)	No
Silver	1	1.6	1.6	1.6	50 (RMEG)	No
Vanadium	5	1.4	5.4	3.44	37 (RBC)	No

[a]Location: X1, X2, X3, X4, AND X5 (see Figure 7); [b]Contaminant of Concern; [c]EPA Region 3 Risk-Based Concentration; [d]Based on Lindane; [e]New Jersey Maximum Contaminant Level; [f]ATSDR Reference Media Evaluation Guide for chronic exposure for child; [g]Based on Heptachlor; [h]ATSDR Environmental Media Evaluation Guide for chronic exposure for child; [i]ATSDR Cancer Risk Evaluation Guide; [j,k]Based on Chlordane; [m]Based on Aroclor 1254; [n]ATSDR Environmental Media Evaluation Guide for intermediate exposure for child

Table 7: Estimated Concentration[a] of Organic Compounds Tentatively Identified in Surface and Groundwater (Concentrations are in µg/L) (1986)

Contaminant	Sample Location[b]							Comments	Reference
	A	B-C	B	C	H	I	L		
	Groundwater		Surface Water						
Nonanal	ND[c]	ND	0.6	0.2	ND	ND	5	Oral-Rat LD_{50}[d]>5000 mg/kg Skin-Rabbit LD_{LO}[e] 5000 mg/kg	University of Oxford (2005a)
Carisoprodol	3	2	1	ND	ND	ND	ND	Carisoprodol, a skeletal muscle relaxant, is metabolized to meprobamate. NOAEL[f] = 100 mg/kg	National Library of Medicine (2005)
Mebutamate	ND	2	ND	ND	ND	ND	ND	Maximum Recommended Therapeutic Dose = 20 mg/kg/day	U.S. Food and Drug Administration (2005a)
6e-diol, 2-methyl-2-propyl, dicarbamate (meprobamate)	0.9	2	0.7	ND	20	4	ND	Maximum Recommended Therapeutic Dose = 40 mg/kg/day	U.S. Food and Drug Administration (2005b)
2,6-Piperidinedione, 3-ethyl-3-phenyl	10	30	ND	2	20	1	ND	In adults, the usual lethal dose is 10 to 20 g	International Programme on Chemical Safety (2005)
Phenobarbital	ND	0.3	ND	ND	0.5	ND	ND	In general, an oral dose of 1 g can result in poisoning in an adult. As little as 6 g can be fatal.	San Diego Reference Laboratory (2005)
Phenobarbital Metabolites	ND	ND	ND	ND	0.4	ND	ND	Not Available	-
5-Allyl-5(1-methylbutyl)barbituric acid	ND	ND	ND	ND	0.4	ND	ND	Not Available	-
Benzothiazole	0.3	0.3	0.3	ND	ND	ND	ND	IVN-MUS[g] LD_{50} 95 mg/kg ORL-Rat LD_{50} 466 mg/kg	University of Oxford (2005b)
Benzenesulfonamide, n-ethyl-4-methyl	0.4	0.5	0.5	ND	ND	ND	ND	Not Available	-

Table 7: (Cont'd.)

Contaminant	Sample Location[b]							Comments	Reference
	A	B-C	B	C	H	I	L		
	Groundwater		Surface Water						
Benzamide, 2,6-dichloro	1	ND	2	0.3	ND	ND	ND	Microbial degradation product of dichlobenil, NOAEL = 180 ppm	Huntingdon Research Centre (2005)
1,2-Benzenedicarboxylic acid, dipropyl ester	ND	6	ND	ND	ND	ND	ND	Reproductive toxicity in mice. Sterility at 8,630 mg/kg/day	National Toxicology Program (2005)
2(3H)-Benzothiazolone	ND	0.9	ND	ND	ND	ND	ND	Not Available	-
Benzene, ethoxymethyl	ND	ND	ND	ND	0.6	ND	ND	Not Available	-
1H-benzimidazole, 5-chloro-2-methyl	ND	ND	ND	ND	0.4	ND	ND	Not Available	-
1,3-isobenzofurandione	ND	ND	ND	ND	ND	ND	0.4	Inhalation LC_{50} Rat : >210 mg/m³/1H Oral LD_{50} Rat : 1,530 mg/kg Oral LD_{50} Mouse : 1,500 mg/kg Dermal LD_{50} Rabbit : >10 gm/kg	MP Fine Chemicals and Solvents, Inc. (2005)
Naphthalene, 2-ethyl	ND	ND	ND	ND	ND	0.1	ND	Not Available	
Phenol, 2,4-dimethyl	ND	ND	ND	ND	0.3	ND	ND	Oral LD_{50} (Rat): 809 to 3,200 mg/kg	BG Chemie (2005)
Phenol, 3-(1,1-dimethyl)	ND	0.2	ND	ND	ND	ND	ND	Not Available	-
Tetradecanoic acid	ND	ND	ND	2	ND	ND	ND	Oral LD_{50} (Rat): > 3,200 mg/kg	University of Oxford (2005c)
1-Hexanol, 2-ethyl	ND	ND	ND	ND	ND	ND	0.8	Oral rat LD_{50}: 3,730 mg/kg; Skin rabbit LD_{50}: 1,970 mg/kg	J.T. Baker (2005)
Sulfur (S8)	ND	ND	2	ND	ND	ND	ND	Virtually non-toxic (ingestion route)	The Pestell Group (2005)
Hexamedioic acid, dioctyl ester	ND	ND	ND	0.8	ND	ND	ND	Oral LD_{50} (Rat): 15,800 mg/kg	Solutia Inc. (2002)
Phosphoric acid, triethyl ester	ND	0.2	ND	ND	ND	ND	ND	Oral LD_{LO} (Rat): 1,600 mg/kg	University of Oxford (2005d)

[a]Concentrations are accurate to one order of magnitude; [b]see Figure 6 for sample location; [c]Not Detected; [d]amount of a solid or liquid material that kill 50% of test animals; [e]lowest amount of a solid or liquid material reported to have caused the death of animals or humans; [f]No Observed Adverse Effect Level; [g]Intravenous Muscular

Table 8: Off-site Sediment Sampling Results of the Rolling Knolls Landfill site (Number of downstream sample = 3) (1999)

Contaminants	Concentration (mg/kg)					Environmental Guideline Comparison Value (mg/kg)	COC[c]
	Downstream[a]				Upstream[b]		
	No. of Detections	Minimum	Maximum	Mean			
Semi Volatile Organic Compounds (SVOC)							
Phenanthrene	2	0.13	0.27	0.2	0.35	NA[d]	No
Fluoranthene	3	0.1	0.6	0.316	0.64	2,000 (RMEG[e])	No
Pyrene	3	0.077	0.6	0.302	0.48	2,000 (RMEG)	No
Benzo[a]anthracene	2	0.1	0.25	0.175	0.22	3.9 (RBC[f])	No
Chrysene	2	0.16	0.4	0.28	0.29	40 (NRDCSCC[g])	No
bis(2-Ethylhexyl)phthalate	2	0.083	0.1	0.09	NA	210 (RBC)	No
Benzo[b]fluoranthene	2	0.2	0.6	0.4	0.26	0.87 (RBC)	No
Benzo[k]fluoranthene	2	0.13	0.2	0.16	0.18	4 (NRDCSCC)	No
Benzo[a]pyrene	2	0.11	0.26	0.18	0.22	0.39 (RBC)	No
Indeno[1,2,3-cd]pyrene	2	0.11	0.26	0.18	0.22	3.9 (RBC)	No
Benzo[g,h,i]perylene	2	0.1	0.18	0.14	0.2	NA	No
Pesticies and PCBs							
4-4'-DDE	2	0.0034	0.0054	0.0044	0.003	1.9 (RBC)	No
Endrin	1	0.0012	0.0012	0.0012	NA	20 (EMEG)	No
4-4'-DDD	2	0.0019	0.0032	0.0025	0.0018	12 (NRDCSCC)	No
4-4'-DDT	2	0.002	0.0051	0.0035	NA	30 (EMEG)	No
alpha-Chlordane	2	0.0011	0.0047	0.0029	0.0025	30 (EMEG)	No
gamma-Chlordane	1	0.00058	0.00058	0.00058	NA	30 (EMEG)	No
Metals							
Aluminum	3	3,730	11,500	6,840	5,460	100,000 (int. EMEG[h])	No
Arsenic	1	1.5	1.5	1.5	2.8	20 (EMEG)	No
Barium	3	36.1	95.6	59.83	60.9	4,000 (RMEG)	No

Table 8: (Cont'd.)

Contaminants	Concentration (mg/kg)					Environmental Guideline Comparison Value (mg/kg)	COC[c]
	Downstream[a]				Upstream[b]		
	No. of Detections	Minimum	Maximum	Mean			
Metals							
Beryllium	3	0.47	1.1	0.78	0.59	100 (EMEG)	No
Chromium[k]	3	10.6	24.7	15.83	13.6	200 (RMEG)	No
Cobalt	3	6.1	11.1	8.06	7.2	500 (int. EMEG)	No
Copper	3	19.4	48.8	29.96	26.9	600 (NRDCSCC)	No
Iron	3	9,870	23,000	14,890	14,500	310,000 (RBC)	No
Lead	3	8.9	52.3	26.6	23.6	600 (NRDCSCC)	No
Manganese	3	145	717	432	463	3,000 (RMEG)	No
Nickel	3	7.8	15.3	10.86	8.4	1,000 (RMEG)	No
Silver	1	0.6	0.6	0.6	0	300 (RMEG)	No
Vanadium	3	20	39.3	26.7	28.6	1,000 (RBC)	No
Zinc	2	38.5	68.3	53.4	80.5	20,000 (EMEG)	No

[a]Downstream Location: S8, S9 and S17 (see Figure 7); [b]Upstream Location: S6 (see Figure 7); [c]Contaminant of Concern; [d]Not available; [e]ATSDR Reference Media Evaluation Guide for chronic exposure for child; [f]NJDEP Non Residential Direct Contact Soil Cleanup Criteria; [g]EPA Region 3 Risk-Based Concentration; [h]ATSDR Environmental Media Evaluation Guide for chronic exposure for child; [k]Based on Chromium (VI)

Table 9: Off-site Surface Water Sampling[a] Results of the Rolling Knolls Landfill site (Number of samples = 4) (1999)

Contaminant	Concentration (μg/L)				Environmental Guideline Comparison Value (μg/L)	COC[b]
	No. of Detection	Minimum	Maximum	Mean		
VOC						
Carbon disulfide	3	1	79	51.66	1,000 (RMEG[c])	No
Metals						
Aluminum	4	175	503	340	20,000 (int. EMEG[d])	No
Barium	4	18.8	25	21.7	700 (RMEG)	No
Beryllium	1	2	2	2	4 (NJMCL[e])	No
Copper	4	14.2	34	20.5	1,500 (RBC[f])	No
Iron	4	364	1,060	678	11,000 (RBC)	No
Lead	2	2.5	4.8	3.6	15 (AL[g])	No
Manganese	4	77.6	126	107	730 (RBC)	No
Nickel	1	1.4	1.4	1.4	200 (RMEG)	No
Vanadium	3	1.9	3	2.4	37 (RBC)	No
Zinc	3	25	37	30.5	3,000 (EMEG[h])	No

[a]Location: S6, S8, S9 and S17 (see Figure 7); [b]Contaminant of Concern; [c]ATSDR Reference Media Evaluatoin Guide for chronic exposure for child; [d]ATSDR Environmental Media Evaluatoin Guide for intermediate exposure for child; [e]New Jersey Maximum Contaminant Level; [f]EPA Region 3 Risk-Based Concentration; [g]Action Level; [h]ATSDR Environmental Media Evaluation Guide for chronic exposure for child

Table 10: Off-site Residential Potable Well Sampling[a] Results of the Rolling Knolls Landfill site (Number of well sampled = 3) (1999)

Contaminant	Concentration (μg/L)				Environmental Guideline Comparison Value (μg/L)	COC[b]
	No. of Detection	Minimum	Maximum	Mean		
VOC						
Carbon disulfide	2	1	2	1.5	1,000 (RMEG[c])	No
1,1,1-Trichloroethane	1	1	1	1	30 (NJMCL[d])	No
Trichloroethene	2	2	7	4.5	1 (NJMCL)	**Yes**
Pesticides and PCBs						
beta-BHC[e]	1	0.019	0.019	0.019	0.2 (NJMCL)	No
4-4'-DDT	1	0.0022	0.0022	0.0022	0.1 (CREG[f])	No
Metals						
Aluminum	1	8.2	8	8	200 ($NJMCL_s$[g])	No
Arsenic	3	9.5	12.6	10.86	5 (NJMCL)	**Yes**
Barium	3	69	105	81.2	2,000 (NJMCL)	No
Copper	3	13.7	18	15.36	1,300 (AL[h])	No
Vanadium	3	1.4	8.9	6.3	37 (RBC)	No
Zinc	1	54.6	54.6	54.6	5,000 ($NJMCL_s$)	No

[a]Location: X6, X7 and X8 (see Figure 7); [b]Contaminant of Concern; [c]ATSDR Reference Media Evaluatoin Guide for chronic exposure for child; [d]New Jersey Maximum Contaminant Level; [e]Based on Lindane; [f]ATSDR Cancer Risk Evaluation Guide; [g]New Jersey Secondary Standards; [h]Action Level

Table 11: Contaminant Exposure Pathways for Rolling Knolls Landfill Site

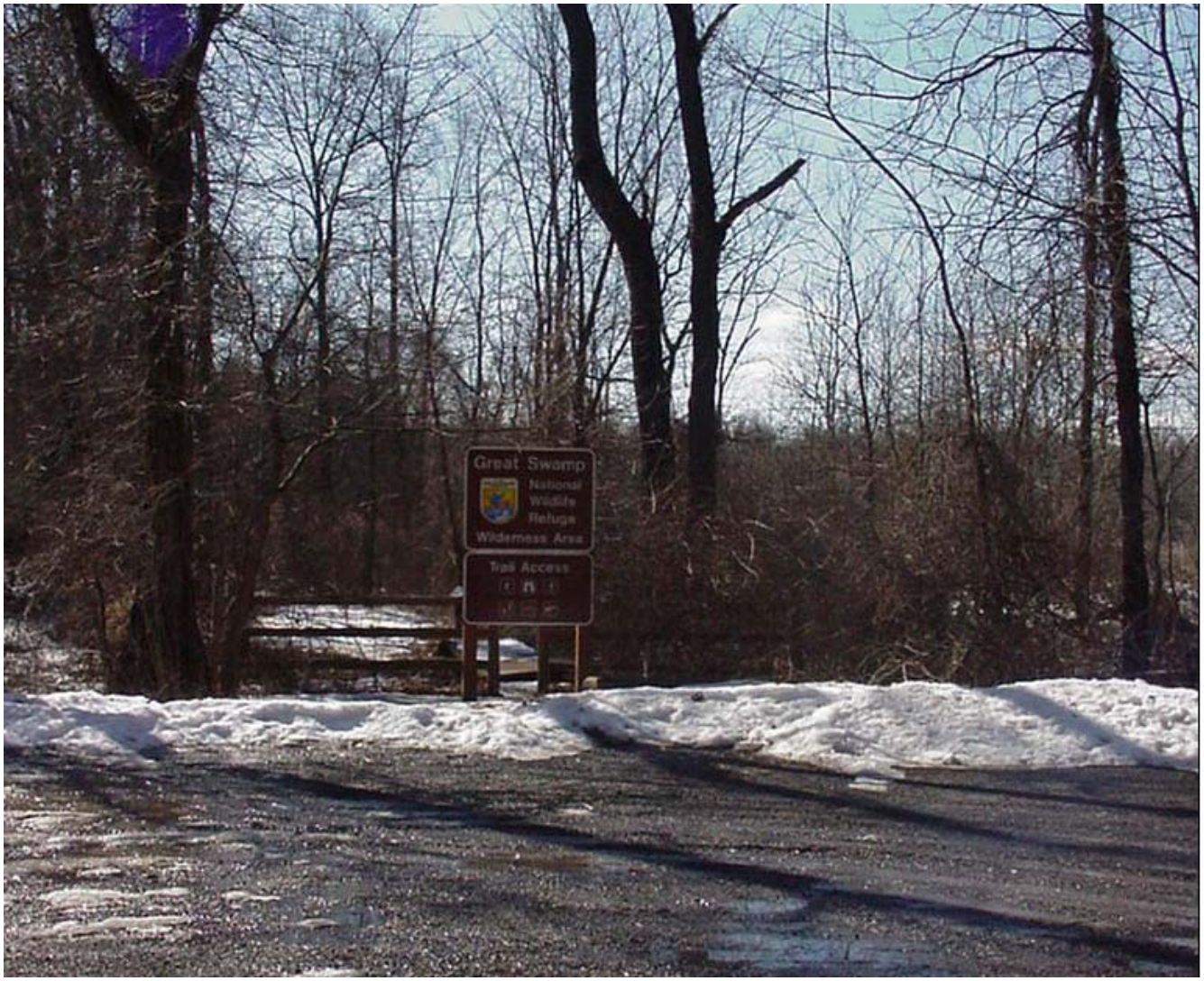
Pathway	Exposure Point	Exposure Route	Receptor Population	Pathway Classification		
				Past	Present	Future
On-site						
Surface Soil	On-site	Incidental Ingestion, Dermal	On-site workers, trespassers	Potential	Potential	Potential
Surface Water and Sediment	On-site	Incidental Ingestion, Dermal	On-site workers, trespassers	Potential	Potential	Potential
Off-site						
Surface Water and Sediment	Loantaka Brook	Incidental Ingestion, Dermal	Nearby residents (including children)	Potential	Potential	Potential
Groundwater	Tapwater (private wells)	Ingestion, Inhalation, Dermal	Nearby residents (including children) with potable wells	Potential	Potential	Potential

Photograph 1: Loantaka Brook crossing under Meyersville Road

Photograph 2: End of Britten Road leading to Landfill

Photograph 3: Ball Field on Britten Road adjacent to landfill property

Photograph 4: Homes at the end of Britten Road



Photograph 5: Great Swamp property at the end of Meyersville Road

Appendix A

Toxicologic Summaries

The toxicological summaries provided in this appendix are based on ATSDR's ToxFAQs (http://www.atsdr.cdc.gov/toxfaq.html). Health effects are summarized in this section for the chemicals of concern found off-site in area private wells. The health effects described in the section are typically known to occur at levels of exposure much higher than those that occur from environmental contamination. The chance that a health effect will occur is dependent on the amount, frequency and duration of exposure, and the individual susceptibility of exposed persons.

Lead Lead is a naturally occurring metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing. Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from gasoline, paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. People may be exposed to lead by eating food or drinking water that contains lead, spending time in areas where lead-based paints have been used and are deteriorating, and by working in a job or engaging in a hobby where lead is used. Small children are more likely to be exposed to lead by swallowing house dust or soil that contains lead, eating lead-based paint chips or chewing on objects painted with lead-based paint.

Lead can affect many organs and systems in the body. The most sensitive is the central nervous system, particularly in children. Lead also damages kidneys and the reproductive system. The effects are the same whether it is breathed or swallowed. At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may cause anemia, a disorder of the blood. It can also damage the male reproductive system. The connection between these effects and exposure to low levels of lead is uncertain.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead, for example by eating old paint chips, may develop blood anemia, severe stomachache, muscle weakness, and brain damage. A large amount of lead might get into a child's body if the child ate small pieces of old paint that contained large amounts of lead. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, however, lead can affect a child's mental and physical growth. Exposure to lead is more dangerous for young children and fetuses. Fetuses can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead.

The United States Department of Health and Human Services (USDHHS) has determined that two compounds of lead (lead acetate and lead phosphate) may reasonably be anticipated to be carcinogens based on studies in animals. There is inadequate evidence to clearly determine whether lead can cause cancer in people.

Thallium Thallium is a bluish-white metal that is found in trace amounts in the earth's crust. It is used mostly in manufacturing electronic devices, switches, and closures, primarily for the semiconductor industry. It also has limited use in the manufacture of special glass and for certain medical procedures. Thallium enters the environment primarily from coal-burning and smelting, in which it is a trace contaminant of the raw materials. Exposure to thallium may occur through eating food contaminated with thallium, breathing workplace air in industries that use thallium, smoking cigarettes, or contact with contaminated soils, water or air.

Exposure to high levels of thallium can result in harmful health effects. A study on workers exposed on the job over several years reported nervous system effects, such as numbness of fingers and toes, from breathing thallium. Studies in people who ingested large amounts of thallium over a short time have reported vomiting, diarrhea, temporary hair loss, and effects on the nervous system, lungs, heart, liver, and kidneys. High exposures can cause death. It is not known what the reproductive effects are from breathing or ingesting low levels of thallium over a long time. Studies in rats exposed to high levels of thallium showed adverse reproductive effects, but such effects have not been seen in people. Animal data suggest that the male reproductive system may be susceptible to damage by low levels of thallium.

The USDHSS, the International Agency for Reaserch on Cancer (IARC), and the EPA have not classified thallium as to its human carcinogenicity. No studies are available in people or animals on the carcinogenic effects of breathing, ingesting, or touching thallium.

Beryllium Beryllium is a hard, grayish metal naturally found in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and the beryllium is purified for use in nuclear weapons and reactors, aircraft and space vehicle structures, instruments, x-ray machines, and mirrors. Beryllium ores are used to make speciality ceramics for electrical and high-technology applications. Beryllium alloys are used in automobiles, computers, sports equipment (golf clubs and bicycle frames), and dental bridges.

Ingesting beryllium has not been reported to cause effects in humans because very little beryllium is absorbed from the stomach and intestines. Ulcers have been seen in dogs ingesting beryllium in the diet. Beryllium contact with skin that has been scraped or cut may cause rashes or ulcers. Chronic exposures increase the risk of developing lung cancer in people. The USDHHS and IARC have determined that beryllium is a human carcinogen. The EPA has determined that beryllium is a probable human carcinogen.

Zinc Zinc is one of the most common elements in the earth's crust. It is found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal. Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments. The source of most zinc contamination is from human activities like mining, steel production, coal burning, and burning of waste.

Zinc is an essential element in our diet. Too little zinc can cause health problems, but too much zinc is also harmful. Adverse health effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth even for a short time can cause stomach cramps, nausea, and vomiting. Chronic exposures can cause anemia and decrease the levels of good cholesterol. There are no known mutagenic effects of zinc on human. Rats that were fed large amounts of zinc became infertile.

The USDHHS and IARC have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity.

Bis(2-Ethylhexyl)phthalate Bis(2-ethylhexyl) phthlate (DEHP)is a manufactured chemical that is commonly added to plastics to make them flexible. It is a colorless liquid with almost no odor. DEHP is present in plastic products such as wall coverings, tablecloths, floor tiles, furniture upholstery, shower curtains, garden hoses, swimming pool liners, rainwear, baby pants, dolls, some toys, shoes, automobile upholstery and tops, packaging film and sheets, sheathing for wire and cable, medical tubing, and blood storage bags.

At the levels found in the environment, DEHP is not expected to cause harmful health effects in humans. Most of the toxicological information is obtained from animal studies. Harmful effects in animals generally occurred only with high amounts of DEHP or with prolonged exposures. Moreover, metabolic pathway of DEHP in humans is different than in rats or mice, so the effects observed in rats and mice may not occur in humans. Acute exposures to DEHP damaged sperm in mice. Although the effect reversed when exposure ceased, sexual maturity was delayed in the animals. High doses of DEHP damaged the liver of rats and mice, however, similar effects on human are unclear. Skin contact with products containing DEHP will probably cause no harmful effects because it cannot be taken up easily through the skin.

The USDHHS has determined that DEHP may reasonably be anticipated to be a human carcinogen. The EPA has determined that DEHP is a probable human carcinogen. These determinations were based entirely on liver cancer in rats and mice. The IARC has stated that DEHP cannot be classified as to its carcinogenicity to humans.

Aldrin Aldrin is an insecticide that quickly breaks down to dieldrin in the body and in the environment. Pure aldrin is white powders with a mild chemical odor. It does not occur naturally in the environment. From the 1950s until 1970, aldrin was widely used pesticides for crops like corn and cotton. Because of concerns about damage to the environment and potentially to human health, EPA banned all uses of aldrin in 1974, except to control termites. In 1987, EPA banned all uses.

Ingesting large amounts of aldrin causes convulsions and some lethality. Chronic health effects may also occur because it bioaccumulates in the body. Workers exposed to prolonged, moderate levels developed symptoms including headaches, dizziness, irritability, vomiting, and uncontrolled muscle movements. Workers removed from the source of exposure recovered rapidly from most of these effects. Animals exposed to high levels of aldrin also developed

nervous system effects. In animals, oral exposure to lower levels for a long period also affected the liver and decreased their ability to resist infections. There is no known effect on the human immune system. Reproductive studies in animals yield conflicting results.

There is no conclusive evidence that aldrin cause cancer in humans. Aldrin was shown to cause liver cancer in mice. The IARC has determined that aldrin is not classifiable as to human carcinogenicity. The EPA has determined that aldrin is a probable human carcinogens.

Chromium Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms: chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds. The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

Chromium enters the air, water, and soil mostly in the chromium(III) and chromium(VI) forms. In air, chromium compounds are present mostly as fine dust particles which eventually settle over land and water. Chromium can strongly attach to soil and only a small amount can dissolve in water and move deeper in the soil to underground water. Fish do not accumulate much chromium from water.

Breathing high levels of chromium(VI) can cause nasal irritation, such as runny nose, nosebleeds, and ulcers and holes in the nasal septum. Ingesting large amounts of chromium(VI) can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and even death. Skin contact with certain chromium(VI) compounds can cause skin ulcers. Allergic reactions consisting of severe redness and swelling of the skin have been noted.

Several studies have shown that chromium(VI) compounds can increase the risk of lung cancer. Animal studies have also shown an increased risk of cancer. The World Health Organization (WHO) has determined that chromium(VI) is a human carcinogen. The USDHHS has determined that certain chromium(VI) compounds are known to cause cancer in humans. The EPA has determined that chromium(VI) in air is a human carcinogen.

It is unknown whether exposure to chromium will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to chromium(VI). It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

Arsenic Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased

production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are used as pesticides, primarily on cotton plants. Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as those caused by inorganic arsenic.

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the USDHHS, and the EPA have determined that inorganic arsenic is a human carcinogen.

Trichloroethene (TCE) TCE is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers. TCE dissolves sparingly in water, and can remain in groundwater for a long time. It quickly evaporates from water, so it is commonly found as a vapor in the air. People can be exposed to TCE by breathing air in and around the home if it has been contaminated with TCE vapors from shower water or household products, or by drinking, swimming, or showering in water that has been contaminated with TCE.

Breathing small amounts of TCE may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Breathing large amounts of TCE may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Ingesting large amounts of TCE may cause nausea, liver damage, unconsciousness, impaired heart function, or death. Ingesting small amounts of TCE for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear. Skin contact with TCE for short periods may cause skin rashes.

Some studies with mice and rats have suggested that high levels of TCE may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of TCE in drinking water or in workplace air have found evidence of increased cancer. The National Toxicology Program has determined that TCE is “reasonably anticipated to be a human carcinogen,” and the IARC has determined that trichloroethylene is “probably carcinogenic to humans.”

Appendix B

Glossary

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 (t½)
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/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
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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