



Public Health Assessment for

**BARKHAMSTED-NEW HARTFORD LANDFILL
BARKHAMSTED, LITCHFIELD COUNTY, CONNECTICUT
EPA FACILITY ID: CTD980732333
MARCH 11, 1997**

**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

BARKHAMSTED-NEW HARTFORD LANDFILL

BARKHAMSTED, LITCHFIELD COUNTY, CONNECTICUT

CERCLIS NO. CTD980732333

Prepared by

Connecticut Department of Public Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry (ATSDR)

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E60), Atlanta, GA 30333.

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SUMMARY

The Barkhamsted-New Hartford Landfill (BLS) has been operating since 1974 as an unlined landfill. The 97.8 acre property contains a 10 acre municipal landfill which also functions as a recycling and reclamation center (1). From April of 1974 to August of 1988, BLS was used for solid waste disposal, and received municipal and industrial waste including but not limited to oily sludge, metal grindings, and degreasers (solvents) (2). This sludge contained cadmium, chromium, copper, lead, manganese, nickel, and zinc, as well as solvents. The Barkhamsted-New Hartford Landfill also conducted a barrel crushing operation from which reclaimed metals were obtained (3). Bulky waste continued to be accepted for disposal until October of 1993.

On October 4, 1989, the Barkhamsted-New Hartford Landfill was placed on the National Priorities List (NPL) by the United States Environmental Protection Agency (EPA). On December 16, 1991, the Agency for Toxic Substances and Disease Registry (ATSDR) completed an interim preliminary health assessment. The interim preliminary health assessment concluded that the Barkhamsted-New Hartford Landfill Site was an indeterminate public health hazard. At that time insufficient data were available to determine whether exposure to contaminated groundwater at levels of public health concern occurred. The interim preliminary health assessment recommended additional environmental sampling to further characterize the extent and magnitude of contamination.

A remedial investigation (RI) was conducted at the site between October of 1992 and October of 1993. The RI included sampling of residential drinking water wells, air, groundwater, surface soil, surface water, leachate seeps, and sediments.

A community group was formed in the 1980's: Barkhamsted Residents Acting to Conserve the Environment (BRACE). Community concerns in the past included: odor complaints, migrations of site-related contaminants, and the potential for private well contamination. The community group is now disbanded and citizens' concerns appear to be greatly reduced.

Employees who drank water from the Barkhamsted Landfill office well (up to four years) or from the Barkhamsted Town Garage, (up to four years) were exposed to volatile organic compounds (VOCs). All exposures to site-related contaminants in these wells represent no apparent public health hazard. The exposure period for the landfill office well was approximately 1980 - 1984 (well closing date). The exposure period for the Town Garage well was approximately 1986 - 1990, when an alternative water source was initiated.

Private well sampling was first conducted in 1988, and private well quarterly monitoring program is ongoing. No wells were identified with VOCs. Two wells contained arsenic, antimony, and selenium, however these levels represent no apparent public health hazard. The CT DPH will continue to review monitoring reports from the three private wells nearest the landfill that are included in the quarterly monitoring program.

Low levels of contaminants detected in the surface soil of the landfill have also been detected in surface soil of two adjacent properties. However, these low levels represent no apparent public health hazard to either young children, older children, or adults.

Lead was detected in water from five private homes. The source of lead is probably from plumbing fixtures in the individual homes not their well water. Therefore the potential exists for persons to be exposed to lead through ingestion.

Based on the above information, the Agency for Toxic Substances and Disease Registry and the Connecticut Department of Public Health have concluded that this site represent No Apparent Public Health Hazard. No follow-up health activities have been recommended for this site.

BACKGROUND

A. SITE DESCRIPTION AND HISTORY

The Barkhamsted-New Hartford Landfill Site (BLS) is a National Priorities List (NPL) Superfund hazardous waste site located in the towns of Barkhamsted and New Hartford, Litchfield County, Connecticut (1). This site currently operates under a Solid Waste Disposal Facility permit issued by the Connecticut Department of Environmental Protection (CT DEP). Regional Refuse Disposal District number one (RRDD #1) owns the property on which the landfill is located (1). RRDD #1 is a waste disposal district developed in September of 1970 for use by the following communities: Barkhamsted, Colebrook, New Hartford, and Winchester.

From April of 1974 to August of 1988, BLS was used for solid waste disposal and received municipal and industrial waste including but not limited to oily sludge, metal grindings, and degreasers (solvents) (2). This sludge contained cadmium, chromium, copper, lead, manganese, nickel, and zinc, as well as solvents. The Barkhamsted Landfill had a barrel crushing operation from 1982 through 1984 (1) from which reclaimed metals were obtained. In addition, the BLS has been an active metal and paper recycling center since 1974. The landfill ceased accepting waste in October of 1993. Presently, the BLS functions only as a transfer station and recycling center. The items included for recycling include: antifreeze, automotive batteries, box-board, cardboard, drycell batteries, food containers, grass clippings, junk mail, leaves, magazines, newspaper, office paper, old clothes, telephone books, tire tubes, tires, and waste oil (4).

The BLS consists of 97.8 acres, (10 acres of which is the landfill itself), and is located on a northward and eastward sloping hill, with the highest elevation above mean sea level located on the south-west portion. Several springs are reported to be buried under the landfill (2). An unnamed Brook is located along the west and northern periphery of the site. Active seeps and leachate from the landfill have been identified along the southwestern border near the unnamed Brook. This brook flows through a wetland area and into the Farmington River. The area where the landfill is located is heavily wooded. A state road is located several hundred yards south of the landfill. (See Appendix A for the site location map).

Access to the BLS site is partially restricted to vehicular traffic, but not to pedestrians (4). A paved access road serves as the limited entrance point for the landfill. A portion of the site is fenced. Access to the remainder of the site is difficult due to the heavily wooded terrain surrounding the landfill. The site operates as an active public recycling center and is open to the public only during special times. Within the landfill, the public is restricted to specific areas which exclude areas known to be contaminated (5).

Two drinking water wells have been contaminated with site-related contaminants. The first detection of well water contamination was in September of 1982. One of the wells, the landfill office well (located on-site), was subsequently closed in 1984 by the Farmington Valley Health District. The closure consisted solely of electrically disconnecting the power from the well pump (6). The other contaminated well, located at the Barkhamsted Town Garage (located off-site), is not being used for drinking, and bottled water is currently used as the potable water supply. Although this well is not closed, a posted sign advises against drinking water from that well. Well water reportedly is used for industrial purposes only.

The EPA has developed a list of hazardous waste sites throughout the country that meet eligibility requirements to obtain federal funding to assist investigation and cleanup under the Superfund program. This list is known as the National Priorities List (NPL). The Barkhamsted Landfill Site was proposed for inclusions on the NPL on June 21, 1988, and on October 4, 1989, was listed as an NPL site (1). Figure 1. highlights the chronology of activities conducted at the Barkhamsted Landfill Site.

Figure 1.
Chronology of Activities at Barkhamsted Landfill Site (1970 - Present) (1)

Date	Activity
September 1970	Refuse Disposal District number one formed
September 1972	CT DEP solid waste permit issued
September 1972	RRDD #1 bought the landfill property from Town of Barkhamsted
May 1974	Landfill became fully operational
1974 - 1979	Problems recorded concerning lack of daily cover for the landfill
1970s	Chemical pit operational, received oily sludge, metal grindings, and degreasers
April 1974 - August 1988	Solid waste disposal period
1980	CT DEP site inspection
1981	EPA conducts preliminary assessment of the site
March 1981	CT DEP requests RRDD #1 eliminate hazardous waste from site
July 1981	CT DEP approved metal grindings waste disposal at RRDD #1
1982	Farmington Valley Health Department conducted on-site drinking water well testing.
1983	Two complaints noted regarding the large number of drums at landfill (by CT DEP)
April 1983	CT DEP requests 25 drums removed to paved area on-site
November 1983	Discovery of 30 drums near scrap metal area
1984	Farmington Valley Health Department ordered the on-site well serving landfill office shut down due to contamination.
1987	EPA conducts site inspection
November - December 1988	Solid waste disposal at RRDD #1, as Mid-CT Waste to Energy Plant was unable to process waste during this period
August 1988 - October 1993	Allowed disposal items: bulky and non-processible waste only
1988	CT DEP determines that 50 percent of drums received at the site contained unknown quantities of chlorinated hydrocarbons or methyl ethyl ketone.
February 1990	RRDD#1 allowed to accept dewatered sludge from Winsted Publicly Owned Treatment Works
October 1993	BLS ceased accepting waste
January 1995	CT DEP approved the landfill closure.

B. SITE VISITS

Three site visits were conducted at the Barkhamsted Landfill Site (April 6, 1992, October 17, 1994, and April 23, 1996).

Site visit 1:

This site visit was conducted by Jennifer Kertanis of the Connecticut Department of Public Health's Division of Environmental Epidemiology and Occupational Health (CT DPH), and by one

representative of the CT DEP. The Landfill manager lead the site visit. The site visit occurred on Monday, April 6, 1992.

The following observations were made:

The landfill manager expressed concern about an area to the south of the landfill office where leachate seeps down the landfill bank were evident. A berm was present that was designed to trap leachate. This trap had evidence of discolored leachate and stained soil. The trap flows east along the bank into a storm drain. The storm drain pipe travels north below the working surface and drains down an embankment into the unnamed brook. Workers were replacing a part of the broken pipe and may have come in contact with contaminated soil and leachate.

Leachate seeps were evident on the northeast toe of the landfill. Areas of stained soil and grass were observed.

Monitoring well 110 was viewed at the northwest toe.

In the area where sedimentation basin 2 is located, there was a large empty abandoned tank. This tank was used previously for water storage and fire fighting purposes. This area also contained a wood pile, a small pile of metals, and other materials.

Metal grindings were observed on the road surface along the southern portion of the landfill.

The site visit proceeded along the unnamed brook. Monitoring well 107 was viewed and leachate seep was noted south of the well. There were heavy leachate seeps observed near monitoring well 106.

The drum crushing area behind the landfill office was in the process of being cleaned up.

The site visit proceeded to a railroad bridge. There were heavy leachate seeps in this area. The unnamed brook travels under this bridge. A fence was observed in this area, just north of the bridge.

Odors were noticed near the fence. The odors were possibly from VOCs.

The site visit proceeded to the sand and gravel pit. Two active seeps were observed in the gravel pit, as well as areas of stained soil and sand.

Landfill access seems limited by terrain.

General public does not have access to the area behind the landfill office.

A full time worker has been assigned to monitor dumping activities.

Site visit 2:

This site visit was conducted by Gary Perlman and Kenneth Foscue of the Connecticut Department of Public Health's Division of Environmental Epidemiology and Occupational Health (CT DPH): The CT DPH personnel were accompanied by one representative of the CT DEP. Two additional people were present during the site visit: the Landfill manager, and a representative of the Farmington Valley Health District. The site visit occurred on Monday, October 17, 1994, from 11:00 am to 12:45 pm. The following facilities were visited: Barkhamsted-New Hartford Landfill Site and an adjacent sand-gravel pit.

The following observations were made:

Access to the BLS site is restricted. The entrance to the landfill is limited to a paved access road. Town residents must stop at a guard house before proceeding into the landfill. A guard house representative directs the residents to the correct disposal locations for each class of household waste. Additionally, a transfer station house attendant informs the public about which bin recyclable waste should be deposited.

The former drum crushing zone was examined. This area now houses the phone book recycling storage unit. The ground contained an abundance of crushed glass. The landfill office is located east of the drum crushing area. A leachate collection ditch is located southwest of the landfill office by approximately 100 feet.

Seepage was observed in several locations during the site visit. The color of the seepage was reddish brown. One seepage area was noted adjacent to the landfill office. The seepage from this area flowed into a collection basin. The site visit proceeded up the landfill dirt road where various areas of wet soil were noted with brown discoloration and intermittent sheens. Rain water, seepage, or both filled many deep tire tracks.

The unnamed brook is located along the eastern portion of the landfill. Sediment located within the Brook was reddish brown in color, and sections on the surface of the brook contained a sheen.

A drainage discharge outflow pipe was actively discharging liquid into the unnamed brook. The discharge contained an opaque sheen. An unlocked, open chain linked fence was located in this area. Adjacent to this area were active sources of seepage. The color of this discharge was brown and the flow was directly out of the hillside into the unnamed brook.

The site visit proceeded up the main access road towards the highest point on the landfill. An area of dried brownish discoloration appeared along one portion of this paved road. This discoloration was identified as seepage by the CT DEP representative.

The unused well which formerly served the office was observed in an uncapped condition.

Adjacent to the landfill is an active sand and gravel pit. There were two seepage areas observed within this pit. On the two seepage areas the gravel is reddish brown in color; a possible indication of contamination. This area is accessible to all workers at the gravel pit. One construction vehicle was parked at the edge of this seepage area, and the rear left tire contained reddish brown discoloration similar to the seepage.

Site visit 3:

The second site visit was conducted by one representative of the CT DPH, Gary Perlman. The site visit occurred on Tuesday, April 23, 1996, from 10:30 am to 11:00 am. The unnamed brook was the focus of this visit.

The unnamed brook exits the landfill area and runs under Route 44. The Brook then runs parallel to Route 44. Access to the unnamed brook after going under Route 44 is difficult. There is a steep gradient leading from the highway down approximately 30 feet to the heavily wooded area where the unnamed brook runs. The heavily wooded area contained about five soda and beer cans.

C. COMMUNITY HEALTH CONCERNS

A community group was formed in the 1980's: Barkhamsted Residents Acting to Conserve the Environment (BRACE). This community group has been disbanded, and the past leader of BRACE currently feels that there are no public health concerns associated with the site (7). Past concerns include the following:

- Reports of odor complaints by area residents from time to time.
- Concern was raised about runoff coming through a resident's property and the possible association with a cancer diagnosis.
- A resident reported dizziness and loss of balance in the resident's spouse and occasional severe diarrhea in the resident's spouse, in the resident's in-law and in the resident.
- A resident expressed concern regarding migration of contaminants off the site that were allegedly responsible for damaging fruit trees.
- One citizen expressed concern that the contaminated plume may reach a school.

An incident occurred in late spring of 1983, in which a contractor complained of nausea, headaches, and dizziness while collecting leachate and surface water samples from the unnamed brook bordering the site. This was corroborated by Farmington Valley Health Department officials through a telephone conversation. An investigation was subsequently performed by the local health department who failed to uncover any further information about this incident. In another incident (spring/summer 1983) three beavers were found dead off the site. It was suggested that runoff from the landfill may have been responsible. No further information was reported. Since that time, there have been no further incidents reported to officials.

D. HEALTH OUTCOME DATA

In a Preliminary Public Health Assessment conducted in 1991 (2), no follow-up health actions were proposed by the ATSDR Health Activities Recommendation Panel (HARP). This determination was based on the following conclusions made at that time: (a) no current exposures were occurring to site contaminants at a level of public health concern; and (b) no recent community health concerns had been expressed. An evaluation of available health outcome data is not indicated at this time, because the conclusions listed in the Preliminary Public Health Assessment remain accurate.

E. DEMOGRAPHICS, LAND USE, AND NATURAL RESOURCE USE

The site is located in northwestern Connecticut in the towns of Barkhamsted and New Hartford. This area is sparsely populated and somewhat rural. The approximate size of the population within a 3-mile radius of the site is 4,100 (8). The nearest residence is approximately 700 feet from the site. A significant amount of this area is used for recreational purposes (e.g., fishing, boating, hiking, and swimming). The town of Barkhamsted, CT has a population of approximately 3,300 people based on the 1990 Census (8). Nine percent of the population is under the age of six. Eighteen percent of the population is between the ages of six and nineteen. Sixty percent of the population is between the ages of twenty and fifty-nine. Thirteen percent of the population is over the age of fifty-nine. The town of New Hartford, CT has a population of approximately 4,400 people based on the 1990 Census (8). Eleven percent of the population is under the age of six. Sixteen percent of the population is between the ages of six and nineteen. Sixty-one percent of the population is between the ages of twenty and fifty-nine. Twelve percent of the population is over the age of fifty-nine.

The area around BLS is heavily wooded. An unnamed brook runs along the landfill and originates south of the landfill. The unnamed brook flows in a northerly direction along the west side of the landfill. The unnamed brook then flows northeast on-site, then under Route 44. The unnamed brook flows into the Farmington River after flowing under Route 44. Landfill discharges enter the unnamed brook at three locations. The first discharge location is a 42-inch diameter pipe which empties runoff from the upper access road on the landfill. The next discharge area is from a culvert located west of the recycling area. This discharge area includes runoff from the areas near the recycling section and the landfill office. The third discharge point is a 24-inch pipe 170 feet north west of the Barkhamsted Town Garage. The discharge from this area includes runoff from the lower access road and the Barkhamsted Town Garage.

Approximately 2 miles southeast of the site is the New Hartford Water Company municipal supply well. The estimated population served by this well is 1,740. The water is mixed with surface water, prior to distribution (9). The surface water is obtained from the Barkhamsted Reservoir located about 2.3 miles from the site. There are approximately 800 homes located within a three mile radius of the site that have private wells (9).

ENVIRONMENTAL CONTAMINATION

The sampling collected and compiled most recently was conducted by O'Brien and Gere as part of the remedial investigation (1). The sampling period was from 1992-1993. During this investigation, ground water, private wells, soil, surface water, leachate seep, sediment, landfill gases, soil gases, and air sampling were conducted. In April of 1988, the EPA also sampled private well water at nine residences and the Barkhamsted Town garage. Sampling of groundwater, surface water, sediment and leachate seeps quarterly by O'Brien and Gere began in August of 1995. Additional locations are also sampled quarterly by Fuss and O'Neill under a State of Connecticut Solid Waste Permit.

The discussion and tabulation of the results which follow present the contaminants of concern. Contaminants of concern are presented by media (*i.e.*, water, soil, air, etc.) in which they were detected. The contaminants are also divided into on-site and off-site. The term on-site refers to sampling locations within the boundaries of the Barkhamsted Landfill property, and the term off-site refers to sampling locations outside the Barkhamsted Landfill property.

These contaminants will be examined in detail in sections which follow. This examination will be done to determine if exposure to these contaminants have any public health significance. The contaminants of concern were selected on the basis of the following characteristics:

- Concentrations of contaminants on-site and off-site.
- Comparison of on-site and off-site concentrations with health comparison values¹ for non-carcinogenic and carcinogenic adverse health outcomes.
- Community health concerns.
- Data quality.

The listing of one or more contaminant does not indicate that an adverse health outcome is likely to result from exposure. The list indicates which contaminants will be discussed in more detail in this public health assessment.

Comparison values for health assessments are contaminant concentrations in specific media that are used to select contaminants for further evaluation. These values include Environmental Media Evaluation Guides (EMEGs), Cancer Risk Evaluation Guides (CREGs), and other relevant guidelines. EMEGs are calculated from Minimal Risk Levels (MRLs). An MRL is an estimate of daily human exposure to a chemical that is likely to be without appreciable risk of an adverse, non-carcinogenic risk. CREGs are estimated contaminant concentrations based on one excess cancer in a million people similarly exposed over a lifetime. Reference Dose Media Evaluation Guides (RMEGs) are used when EMEGs or CREGs are not available for a specific medium. RMEGs are calculated from the EPA Reference Dose (RfD) which are estimates of the daily exposure to a contaminant that is unlikely to cause adverse health effects. A concentration is calculated from RfDs making certain assumptions about human intake of water or ambient air. Maximum Contaminant Levels (MCLs) represent concentrations that the EPA deems protective of public health (considering the availability and economics of water treatment technology) over a 70 year period of exposure drinking two liters (0.53 gallons) of water per day. A Lifetime Health Advisory (LTHA) is a concentration the EPA has determined to be without public health risk over a lifetime at an exposure rate of two liters of water per day.

To further evaluate whether the contaminants will cause adverse health effects, the following are examined: concentration of the contaminant(s), route(s) and duration of exposure, and exposed population(s). This evaluation is presented in the Toxicological Evaluation Section on page 29.

A. ON-SITE CONTAMINANTS

The on-site sampling included the following media: groundwater from monitoring wells, groundwater from drinking water wells, surface water, surface soil, subsurface soil, ambient air, leachate seepage, landfill gases, and subsurface soil gases. In September of 1992, O'Brien and Gere identified twelve potential contaminant source areas for the site (1). The listing of the potential source areas is presented in Figure 2 below. (Appendix B depicts the locations of these potential source areas.)

Figure 2
Potential Waste Source Areas

Potential Source Area
Former metal grindings area
Drum crushing area
Landfill disposal area
Liquid waste disposal area
Sedimentation basin #2
Stained soil area
Metal grindings waste cell
Metal grindings waste interim storage
Southwestern slope of landfill
Access road
Potential landfill activity area
Leach field from building

Ground Water

The BLS is located by the west branch of the Farmington River Basin (1). Ground water occurs in two aquifers²: (overburden³, and bedrock). The bedrock formations act as a single aquifer, however the RI examined the bedrock aquifer as three units (shallow, intermediate, and deep bedrock zones)

Ground water migrates vertically downward from the overburden aquifer to the bedrock in the area north of the landfill disposal area. The maximum downward flows occur by the northern section of the landfill (1). Contaminated ground water may therefore move in a downward direction from the overburden

² Aquifers are water bearing geologic features such as rock formations and areas of unconsolidated soils.

³ Overburden consists of loose material including rock fragments, clay, sand, and other materials above the more solid bedrock formations.

aquifer into the bedrock aquifer. The groundwater flow is toward the unnamed brook in a north easterly direction.

Ground Water Monitoring Wells

The ground water monitoring conducted on the site used fifteen monitoring wells installed in the bedrock aquifer and seven monitoring wells installed in the overburden aquifer. On-site ground water monitoring data from the RI, which encompasses the years of 1992 through 1993, were reviewed for this document.

Twenty-six contaminants were detected in monitoring wells located in the BLS property. Nine VOCs, five semivolatile organic compounds⁴ (SVOCs), and eleven metals, and one pesticide were detected above health comparison values. The complete list including contaminant name, range of detected values, and health comparison values is presented in Table 1.

⁴ SVOCs are like volatile organic compounds in their chemical composition, but SVOCs do not evaporate as fast at common temperatures we encounter every day. These compounds are therefore less mobile.

Table 1
On-Site Ground Water Monitoring Wells

Contaminant	Concentration Minimum	Range (ppb) Maximum	Comparison ppb	Value Source
1,1,2,2-Tetrachloroethane	ND	6	0.2	CREG
1,2-Dichloroethane	ND	3	0.4	CREG
2,4-Dimethylphenol	ND	3,100	700	RMEG
2-Butanone	ND	30,000	20,000	RMEG
2-Methylphenol	ND	2,600	2,000	RMEG
Acetone	ND	13,000	4,000	RMEG
Antimony	ND	35.8	3	LTHA
Arsenic	ND	37.6	0.02	CREG
Barium	ND	4,830	2,000	RMEG
Benzene	ND	21	1	CREG
Beryllium	ND	13.5	0.008	CREG
Bis(2-ethylhexyl)phthalate	ND	10,000	3	CREG
Chromium total	ND	466	100	LTHA
cis-1,2-Dichloroethylene	ND	190	70	LTHA
Heptachlor Epoxide	ND	0.026	0.004	CREG
Lead	ND	862	15	MCL
Manganese	ND	28,000	200	RMEG
Nickel	ND	449	100	LTHA
Pentachlorophenol	ND	4	0.3	CREG
Phenol	ND	6,900	4,000	LTHA
Silver	ND	110	100	LTHA
Thallium	ND	9.1	0.4	LTHA
Toluene	ND	11,000	700	EMEG
Trichloroethylene	ND	66	3	CREG
Vanadium	ND	811	100	EMEG
Vinyl chloride	ND	29	0.7	EMEG

CREG Cancer Risk Evaluation Guide
EMEG Environmental Media Evaluation Guidelines
LTHA Lifetime Health Advisory for drinking water
MCL Maximum Contaminant Level
ND None detected. The minimum concentration was below the detection limit.
ppb parts per billion
RMEG Reference Dose Media Evaluation Guide

Ground water monitoring data indicate VOCs are present at the highest concentrations in the following areas: former metal grindings area, drum crushing area, landfill disposal area, and liquid waste disposal area. The ground water is migrating primarily to the northeast in the overburden and bedrock formations.

Ground Water - Landfill Office Well

The landfill office well was sampled on October 12, 1977, as part of a semi-annual sampling program (10). There were no volatile organic compounds detected in the water and the well water met all requirements for a potable water source. The landfill office well was sampled in November of 1980 by the Farmington Valley Health District (FVHD) (10). No volatile organic compounds were detected at that time and the well water continued to meet all requirements for a potable water source. Resampling conducted in September of 1982, by the FVHD, detected VOCs including the following: trichloroethylene (6.4 ug/L⁵), tetrachloroethylene (less than 1.0 ug/L), and benzene (less than 1.0 ug/L). The next sampling, also collected by the FVHD, was conducted in May of 1983, and indicated that the number of contaminants increased as did the concentrations (11). Four VOCs and one metal (manganese) were detected in the landfill office well at levels above health comparison values. Subsequent to this sampling, the landfill office well was closed in 1984. The contaminants detected above health comparison values are presented in Table 2.

Table 2
Landfill Office Well Maximum Contaminant Concentration

Contaminant	Maximum Concentration ppb	Comparison Value ppb	Source
Benzene	2	1	CREG
Manganese	14,000	200	RMEG
Methyl chloride (chloromethane)	180	3	LTHA
Tetrachloroethylene	1.0*	0.7	CREG
Trichloroethylene	8.2	3	CREG

* This compound was detected at a concentration of less than 1 ug/L, however the concentration was not quantified.

CREG Cancer Risk Evaluation Guide
LTHA Lifetime Health Advisory for drinking water
ppb parts per billion
RMEG Reference Dose Media Evaluation Guide

Surface Water

Sixteen surface water samples were collected from Beaver Pond, the unnamed brook, an unnamed pond, and two sedimentation basins. The surface water samples were collected in two phases. The first phase was conducted from October 29, 1992, through December 11, 1992. The second phase was conducted from September 29, 1993, through October 7, 1993. All samples were collected by O'Brien and Gere as part of the RI (1). The samples were selected to determine the concentrations in surface water located upgradient, adjacent, and downgradient of the landfill. The results of the surface water sampling

⁵ ug/L represents a concentration of a compound in micrograms (one millionth of a gram) per liter of liquid.

indicates that there were no VOCs detected above health comparison values. Five metals and one SVOC were detected in surface waters at levels above health comparison values. The complete list including contaminant name, range of detected values, and health comparison values is displayed in Table 3.

Table 3
Surface water

Contaminant	Concentration Range (ppb)		Comparison ppb	Value Source
	Minimum	Maximum		
Bis(2-ethylhexyl)phthalate	ND	5	3	CREG
Chromium *	ND	50.9	3	CREG
Lead	ND	68.3	15	MCL
Manganese	ND	2,270	50	RMEG-Child
Thallium	ND	5.8	0.4	LTHA
Vanadium	ND	73	30	EMEG-Child

* The chromium(VI) health comparison value was used.

CREG Cancer Risk Evaluation Guide
EMEG-Child Environmental Media Evaluation Guidelines for a child
LTHA Lifetime Health Advisory for drinking water
MCL Maximum Contaminant Level
ND None detected. The minimum concentration was below the detection limit.
ppb parts per billion
RMEG-Child Reference Dose Media Evaluation Guide for a child

Surface Soil

Twenty-four soil samples were collected and analyzed for VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), and metals (1). These samples were collected by O'Brien and Gere as part of the RI. Surface soil samples were collected on October 29, 1992, and three intervals in 1993: (October 30, November 3, and November 4). Two of the samples were taken from two off-site adjacent properties. (The off-site samples are discussed in the off-site contaminant section.) The samples were taken in the first six inches below the surface. The former metal grindings area contained soil with the most exceedences above health comparison values. There were no VOCs detected above comparison values in any surface soil sample. The contaminants detected in the surface soil included three metals, five pesticides, and two SVOCs. Tables 4a and 4b list the contaminant name, range of detected values, and health comparison values.

Table 4a
Surface Soil (non metals)

Contaminant	Range (ppb)		Comparison Value (ppb)	Source
	Concentration Minimum	Maximum		
Aldrin	ND	7.2	0.04	CREG
Benzo(a)pyrene	ND	2,100	0.1	CREG
Bis(2-ethylhexyl)phthalate	ND	920	50	CREG
Dieldrin	ND	0.97	0.04	CREG
P, P'-dichlorodiphenyl dichloroethane (DDD)	ND	26	3	CREG
P, P' dichlorodiphenyldichloroethylene (DDE)	ND	25	2	CREG
P,P'-dichlorodiphenyltrichloroethane (DDT)	ND	6.1	2	CREG

CREG Cancer Risk Evaluation Guide

ND None detected. The minimum concentration was below the detection limit

ppb parts per billion

Table 4b
Surface Soil (metals)

Contaminant	Range (ppm)		Comparison Value (ppm)	Source
	Concentration Minimum	Maximum		
Arsenic	ND	88	0.5	CREG
Beryllium	ND	51	0.2	CREG
Chromium *	6	5,620	60	CREG

* The chromium(VI) health comparison value was used.

CREG Cancer Risk Evaluation Guide

ND None detected. The minimum concentration was below the detection limit

ppm parts per million

Subsurface Soil

Thirty-two subsurface soil samples were collected and analyzed for VOCs, SVOCs, PCBs, and metals (1). These samples were collected by O'Brien and Gere as part of the RI. Subsurface soil samples were collected from October 28, 1992, through December 11, 1992. The samples were taken at depths ranging from two to sixteen feet below the surface. The subsurface soil samples were collected from the following areas: former metal grindings area, drum crushing area, landfill disposal area, liquid waste disposal area, sedimentation basin number two, stained soil area, metal grindings waste cell, southwestern slope of landfill, access road, and the leach field from the landfill office. The metal grindings waste, interim storage location, as well as potential landfill activity area was not included in the subsurface sampling, since there were no indications from soil gas measurements that contamination was present.

Sedimentation basin number two contained two of the four samples that were detected above health comparison values. The subsurface soil analysis indicated that three metals and one SVOC were detected above health

comparison values. Chromium was the highest detected metal, at 4,150 ppm. This contaminant may occur in many different forms, such as chromium(III) and chromium(VI). The most toxic form is chromium (VI). Since the report did not specify which form of chromium was detected, the most toxic form, chromium (VI), was assumed. There were no VOCs detected above health comparison values in any subsurface soil sample. Tables 5a and 5b list the contaminant name, range of detected values, and health comparison values.

Table 5a
Subsurface Soil (non metal)

Contaminant	Concentration Range (ppb)		Comparison Value ppb	Source
	Minimum	Maximum		
Benzo(a)pyrene	ND	0.74	0.1	CREG

CREG Cancer Risk Evaluation Guide

ND None detected. The minimum concentration was below the detection limit
ppb parts per billion

Table 5b
Subsurface Soil (metals)

Contaminant	Concentration Range (ppm)		Comparison Value ppm	Source
	Minimum	Maximum		
Arsenic	ND	20.3	0.5	CREG
Beryllium	ND	0.47	0.2	CREG
Chromium *	6.4	4,150.0	60.0	CREG

* The chromium(VI) health comparison value was used.

CREG Cancer Risk Evaluation Guide

ND None detected. The minimum concentration was below the detection limit
ppm parts per million

Ambient Air Monitoring

Air sampling was conducted at two separate times. The first sampling occurred during October 23, 1992 through October 27, 1992. This occurred when there were no site activities. The second sampling was conducted during November 16, 1992 through November 17, 1992. This occurred at the same time as the installation of a monitoring well. These samples were all collected by O'Brien and Gere as part of the RI (1).

The average air temperature measured during the two samples obtained in October of 1992, was 50 degrees Fahrenheit (F), and the average temperature during the November of 1992, sampling was 32 degrees F. The ambient air sampling was conducted to determine the impact of the landfill on the ambient air both on-site and off-site. Sampling locations included: the landfill surface, seepage areas, and adjacent residential properties. Sampling of the ambient air was conducted over two day periods for eight hours per day. Seven sampling locations were selected. A brief description of the sampling locations is highlighted in Table 6.

Table 6
Air Sampling Locations

Location	Purpose
Adjacent to residence north of site	Air quality impact determination at residential location
Adjacent to residence south-east of site	Air quality impact determination at residential location
Center of landfill	Air quality impacts from disposal area
Near monitoring well	Provide potential worst case, by proximity to potential point source
Near seepage area north-west of landfill	Determine air quality impacts from seepage area
Near seepage area west of landfill	Determine air quality impacts from seepage area
South side of landfill	Provide upwind and down wind air quality (based on wind direction)

The only contaminants detected during the ambient air sampled during October and November of 1992, above health comparison values were three VOCs. The maximum concentration of benzene was detected at the center of the landfill. This location, however, may have had additional sources of benzene including a portable generator and one or more trucks running in the vicinity. Table 7 presents the contaminant name, range of detected values, and health comparison values. Contaminants detected above health comparison values were sampled from the center of the landfill and from two sections near the unnamed brook. There were no exceedences near adjacent residences.

Table 7
Air Sampling Results

Contaminant	Concentration Range (ug/m ³)		Comparison Value ug/m ³	Source
	Minimum	Maximum		
Benzene	ND	16.0	0.1	CREG
Carbon tetrachloride	ND	1.9	0.07	CREG
Trichloroethylene	ND	1.1	0.6	CREG

CREG Cancer Risk Evaluation Guide

ND None detected. The minimum concentration was below the detection limit.

ug/m³ Micrograms of contaminant per cubic meter of air

Leachate Seepage- On-Site

Leachate is a liquid that is produced when rain or surface water enters the landfill, contacts the buried waste, dissolves some of the contaminants, and exits through the soil. There were nine leachate seepage samples collected. These samples were all collected by O'Brien and Gere as part of the RI, and were collected in two phases. The first phase was conducted from October 29, 1992 through December 11, 1992. The second phase was conducted from September 29, 1993 through October 7, 1993. The leachate sampling was conducted to describe the contaminants in the leachate, as well as to ascertain possible impacts leachate may have on surface waters in the area.

When the leachate seepage did not have sufficient flow rates for adequate sampling, a hole was dug to allow the leachate to aggregate. After the leachate pooled, a sample was then collected. Eleven contaminants detected in the leachate seepage were above health comparison values. Three VOCs, and seven metals, and one pesticide were detected above health comparison values.

Table 8 illustrates the contaminants present in the leachate seep that exceeded drinking water health comparison values. This table also lists the name and concentration range of the contaminants present in the leachate seeps.

Table 8
Leachate Seep On-Site

Contaminant	Concentration Range (ppb)	
	Minimum	Maximum
Antimony	ND	16.1
Arsenic	ND	6.5
Barium	87.4	3,900
Benzene	ND	36
Beryllium	ND	1.3
Chloromethane	ND	9
Dieldrin	ND	0.087
Lead	ND	116
Manganese	292	10,300
Thallium	ND	24.7
Toluene	ND	4,700

ND None detected
ppb parts per billion

Sediment Sampling from Leachate Seeps

Sediment sampling was conducted at the six leachate seep locations. The sediments from the leachate seep were collected in two phases. The first phase was conducted from October 29, 1992 through December 11, 1992. The second phase was conducted from September 29, 1993 through October 7, 1993. All samples were collected by O'Brien and Gere as part of the RI (1). The samples were selected to determine the concentrations in the sediment at a leachate seep locations. The results of the sediment sampling from leachate seeps indicates that there were no VOCs detected above health comparison values. There were ten contaminants known as polycyclic aromatic hydrocarbons (PAHs) detected in the sediment. These contaminants were grouped by carcinogenic classification, (either probable human carcinogens or not classified). Two metals were detected in the sediment above health comparison values. Tables 9, 10, and 11 lists the range of contaminants detected in the sediment. Tables 9 and 10 depict PAHs stratified by their carcinogenic classification. Table 11 lists the two metals. Since there are few health comparison values for PAHs, the CT DPH combined the non-carcinogens, and carcinogens

separately. The combined values listed in the tables were used in all subsequent risk estimation calculations.

Table 9
Non-Carcinogenic PAHs Detected in the Sediment From Leachate Seeps

Chemical name	Concentration Minimum	Range (ppm) Maximum	Comparison ppm	Value Source	EPA Group
2-methylnaphthalene	ND	0.09	#	#	not classified
Acenaphthylene	ND	0.045	#	#	not classified
Benzo(g,h,i)perylene	ND	0.097	#	#	not classified
Naphthalene	ND	0.092	#	#	not classified
Phenanthrene	ND	0.42	#	#	not classified
Total non-carcinogenic PAHs		0.744			

There are no health comparison values for these compounds

ND None detected

ppm parts per million

Table 10
Carcinogenic PAHs Detected in the Sediment From Leachate Seeps

Chemical name	Concentration Minimum	Range (ppm) Maximum	Comparison ppm	Value Source	EPA Group
Benzo(a)anthracene	ND	0.34	#	#	B2
Benzo(a)pyrene	ND	0.27	0.1	CREG	B2
Benzo(b)fluoranthene	ND	0.77	#	#	B2
Chrysene	ND	0.31	#	#	B2
Indeno(1,2,3,-c,d)pyrene	ND	0.1	#	#	B2

There are no health comparison values for these compounds

B2 Probable human carcinogen

CREG Cancer Risk Evaluation Guideline

ND None detected

ppm parts per million

Table 11
Metals Detected in Sediment from the Leachate Seeps

Chemical name	Concentration Minimum	Range (ppm) Maximum	Comparison ppm	Value Source
Arsenic	ND	3.3	0.5	CREG
Beryllium	ND	0.4	0.2	CREG

CREG Cancer Risk Evaluation Guideline

ND None detected

ppm parts per million

Landfill Gas Monitoring

A landfill gas survey was conducted during November and December of 1992. These samples were all collected by O'Brien and Gere as part of the RI. The landfill gas survey was done to determine the presence of landfill produced flammable gases (mainly methane). In addition, this sampling assisted in determining the potential off-site migration of these explosive gases. The landfill gas sampling was collected at 200 foot distances around the primary fill areas. The gases were sampled using soil probes driven into the soil three feet. Methane gas was sampled at eighteen locations around the periphery of the landfill excluding the west side. The western periphery was omitted based upon the assumption that the unnamed brook would act as a barrier for the migration of landfill gases. The sample locations were initially placed at two hundred foot intervals, however whenever methane was detected at greater than two percent, two more sample points were located one hundred feet on either side of the location where methane was detected. The eastern portion of the landfill, which is near several residences, indicated that there were no detectable levels of methane gas.

Sampling for combustible gases (*i.e.*, methane) is conducted with one of several instruments. One commonly used measuring device is a combustible gas indicator. The combustible gas indicator is an instrument that measures the percentage of gases that can be burned in the atmosphere. The results are often presented as percentages of lower explosive limit (LEL) of methane. The LEL is the minimum amount of gas by volume required to sustain combustion in air. The Federal Occupational Safety and Health Administration (OSHA) has developed a set of guidelines designed to protect workers entering confined spaces where there is the potential to be exposed to explosive gases. Specifically, the OSHA guidelines state that confined spaces should not be entered, and if occupied, should be evacuated, if flammable gases reach or exceed 25 percent of the lower explosive limit. Therefore, the 25 percent lower explosive limit is considered a health comparison value for workplace as well as residential settings.

Combustible gases (principally methane) were detected in the northern portion of the landfill (west of the landfill office) at levels ranging from 10 percent to 90 percent by volume of methane in air. These values exceeded the health comparison values (25 percent LEL). This indicates that a condition of gas entrapment, methane migration or both is present beneath the ground surface. There was an elevated gas measurement near the landfill office.

Subsurface Soil Gas

A soil gas survey was conducted at 11 locations throughout the BLS site. These locations were from the areas landfill gases were collected. A soil gas survey is often used to determine the quantity of landfill produced gases present in the spaces between soil particles. Landfill produced gases often include methane, carbon dioxide, as well as other VOCs produced during the decomposition of buried landfill waste. The sampling was conducted using probes inserted into the soil and a pump to draw the sample.

Multiple samples were collected from each of the 11 locations. This represented a total of 165 samples collected throughout the BLS site. These samples were all collected by O'Brien and Gere as part of the draft work plan limited field investigation in 1992 (12). Detectable VOCs were found within the BLS site in subsurface soils (1,12). Although the survey was conducted at eleven locations, only two locations contained contaminants above health comparison values. Within these two locations seven VOCs were detected above health comparison values. Four of these samples were collected from the area on the landfill on which liquid waste was disposed. The remaining samples were collected from the metal grindings waste cell. The results of the soil gas survey are presented in Table 12.

Table 12
Soil Gas Measurements (Maximum values)

Contaminant	Maximum Concentration (ppmv)
Benzene	15.8
Methyl ethyl ketone	11.6
Methyl isobutyl ketone	183.9
Toluene	115.7
trans-1,2-Dichloroethylene	16.3
Trichloroethylene	4.9
Xylenes	10.6

ppmv parts per million by volume

B. OFF-SITE CONTAMINANTS

The off-site contaminant sampling included groundwater from private drinking water wells (Town Garage and private residences), sediment from the unnamed brook, the gravel pit in the Town Garage, and surface soil from adjacent residences. There was one monitoring well located off-site that was found to be contaminated with trace amounts of VOCs in 1984. Subsequent sampling did not detect further contamination.

Ground water - Private Drinking Water Wells

In 1988, a domestic well sampling program was initiated for private wells located adjacent to the Barkhamsted landfill. The wells were selected to examine the potential impacts from the landfill (13). Domestic water samples were taken from ten private drinking water wells. This was implemented as part of the recommendations presented in the Interim PHA to evaluate the impacts on residential well water from ground water contamination by BLS. There were no VOCs detected in the private wells sampled in 1990 and 1993. The contaminants detected above health comparison values and the maximum concentrations are listed in Table 13. These samples were taken in January of 1993. Antimony, arsenic, and selenium were detected in three private wells. Lead was detected in the water from five homes, although only one sample exceeded the MCL of 15 ppb.

Table 13
Private Residential Drinking Water Wells

Contaminant	Maximum Concentration (ppb)	Comparison ppb	Value Source
Antimony	16.3	3.0	LTHA
Arsenic	1.4	0.02	CREG
Lead	29.2	15.0	MCL
Selenium	38.0	20.0	EMEG- Child

CREG Cancer Risk Evaluation Guide
 EMEG-Child Environmental Media Evaluation Guide for Children
 LTHA Lifetime Health Advisory for drinking water
 MCL Maximum Contaminant Level
 ppb parts per billion

Ground water - Barkhamsted Town Garage Well

The Barkhamsted Town Garage well was sampled by EPA (13,14) in April of 1988. Two VOCs were detected above health comparison values. The VOCs are cis-1,2-dichloroethylene and trichloroethylene. The two contaminants detected and their respective health comparison values, along with their maximum concentrations, are highlighted in Table 14.

Table 14
Barkhamsted Town Garage Well Maximum Contaminant Concentrations

Contaminant	Maximum Concentration (ppb)	Comparison ppb	Value Source
cis-1,2-dichloroethylene	160	70	LTHA
trichloroethylene	52	3	CREG

CREG Cancer Risk Evaluation Guide
 LTHA Lifetime Health Advisory for drinking water
 ppb parts per billion

Surface Soil Sampling

Two residential properties adjacent to the site, were included in the surface soil sampling conducted at BLS. This sampling was conducted by O'Brien and Gere as part of the RI (1). The surface soil from these residences was analyzed for VOCs, SVOCs, pesticides, and metals (1). The samples were collected from the first six inches below the surface. This sample was only analyzed for VOCs. Metals, SVOCs, PCBs, and pesticides were analyzed from a sample that included the first twelve inches of soil⁶. There were no VOCs, SVOCs, or pesticides detected above health comparison values in any off-site surface soil samples. Five metals were detected above health comparison values. Table 15 displays all five contaminants detected during these sampling events above health comparison values, along with the range of detected values.

Table 15
Surface soil (residential)

Contaminant	Concentration Minimum	Range (ppm) Maximum	Comparison ppm	Value Source
Arsenic	1.5	2.5	0.5	CREG
Beryllium	0.58	0.62	0.2	CREG
Chromium *	19.2	29.4	10.0	RMEG-Pica
Manganese	379.0	387.0	300.0	RMEG-Pica
Vanadium	36.2	38.8	6.0	Int EMEG-Pica

* Chromium(VI) health comparison values were used.

CREG Cancer Risk Evaluation Guide

Int EMEG-Pica Reference Dose Media Evaluation Guidelines for young children who exhibit pica behavior (placing objects in their mouth).

ppm parts per million

RMEG-Pica Environmental Media Evaluation Guidelines for young children who exhibit pica behavior (placing objects in their mouth).

Leachate Seepage - Off-Site

One leachate seep sample was collected from the gravel pit at the Town Garage. This sample was collected by O'Brien and Gere as part of the RI. Seven contaminants detected in the leachate seepage were above health comparison values. All contaminants are metals.

Table 16 illustrates the contaminants present in the leachate seep that exceeded drinking water health comparison values. This table also lists the name and concentration range of the contaminants present in the leachate seeps.

⁶ If non-VOC contaminants were located near the surface (from 0 to 3 inches), then this analysis of the first twelve inches of soil would have underestimated the actual concentrations of contaminants.

Table 16
Leachate seep (Town Garage)

Contaminant	Concentration Range (ppb)	
	Minimum	Maximum
Arsenic	ND	5.5
Barium	2,790	3,620
Lead	111	197
Manganese	27,300	52,900
Silver	ND	127
Thallium	ND	55.4
Vanadium	182	242

ND None detected
ppb parts per billion

Sediment Sampling from the Unnamed Brook

Sediment sampling was conducted at each surface water location. A total of sixteen sediment samples were collected from Beaver Pond, the unnamed brook, an unnamed pond, and two sedimentation basins. The samples were collected in two phases. The first phase was conducted from October 29, 1992 through December 11, 1992. The second phase was conducted from September 29, 1993 through October 7, 1993. All samples were collected by O'Brien and Gere as part of the RI (1). The samples were selected to determine the concentrations in the sediment below the surface water located upgradient, adjacent, and downgradient of the landfill. The results of the sediment sampling indicates that there were no VOCs detected above health comparison values. There were nine contaminants known as PAHs detected in the sediment. These contaminants were grouped by carcinogenic classification, (either probable human carcinogens or not classified). Three metals were detected in the sediment above health comparison values. Tables 17, 18, and 19 lists the range of contaminants detected in the sediment.

Table 17
Non-Carcinogenic PAHs Detected in Sediment from the Unnamed Brook

Chemical name	Concentration Range (ppm)		Comparison Value ppm	EPA Group
	Minimum	Maximum		
Acenaphthylene	ND	0.17	#	not classified
Benzo(g,h,i)perylene	ND	0.34	#	not classified
Naphthalene	ND	0.019	#	not classified
Phenanthrene	ND	0.73	#	not classified
Total non-carcinogenic PAHs		1.26		

There are no health comparison values for these compounds
ND None detected
ppm parts per million

Table 18
Carcinogenic PAHs Detected in Sediment from the Unnamed Brook

Chemical name	Concentration Range (ppm)		Comparison Value ppm	Source	EPA Group
	Minimum	Maximum			
Benzo(a)anthracene	ND	0.67	#	#	B2
Benzo(a)pyrene	ND	0.85	0.1	CREG	B2
Benzo(b)fluoranthene	ND	2.1	#	#	B2
Chrysene	ND	0.68	#	#	B2
Indeno(1,2,3,-c,d)pyrene	ND	0.33	#	#	B2

There are no health comparison values for these compounds
 B2 Probable human carcinogen
 CREG Cancer Risk Evaluation Guideline
 ND None detected
 ppm parts per million

Table 19
Metals Detected in Sediment from the Unnamed Brook

Chemical name	Concentration Range (ppm)		Comparison Value ppm	Source
	Minimum	Maximum		
Arsenic	ND	5.8	0.5	CREG
Beryllium	ND	2	0.2	CREG
Manganese	53.3	9,450	7,000	RMEG-Child

CREG Cancer Risk Evaluation Guideline
 ND None detected
 ppm parts per million
 RMEG-Child Reference Dose Media Evaluation Guide for Children

C. QUALITY ASSURANCE AND QUALITY CONTROL

The consulting firm conducting the RI was monitored by EPA oversight personnel, both in field and laboratory procedures. However, the procedures used by these firms or other consultants who have conducted historic sampling at the site were not evaluated by the Connecticut Department of Public Health. Therefore, the conclusions drawn for this health assessment were determined by the availability and reliability of the referenced information and it is assumed that adequate quality assurance and quality control measures were followed with regard to chain of custody, laboratory procedures and data reporting.

D. TOXIC RELEASE INVENTORY

To identify possible facilities that could contribute to contamination near the site, the Toxic Release Inventory (TRI) was searched for the years: 1987 - 1994. The toxics release inventory contains information on total releases of certain chemicals from certain industries. The toxics release inventory does not identify all facilities which may have in the past or may currently be contributing to contamination near the site. There were no releases reported in Barkhamsted, CT, for the years 1987 - 1994.

PATHWAY ANALYSES

To determine whether nearby residents have been or are being exposed to contaminants migrating from the site, the CT DPH and the ATSDR evaluate the environmental contamination and human exposure and an exposed population. The pathway analysis consists of five elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and an exposed population. The exposure pathways discussed here are air, ground water, soil, and sediment. The ATSDR categorizes exposure pathways as either completed or potential pathways. For an exposure pathway to be completed all five elements of the pathway must be present. Potential pathways are those where there is not sufficient evidence to show that all the elements are present now, could be present in the future, or were present in the past.

The exposure pathways are presented in Table 20. This table lists the pathway name, source of contamination, environmental media, point of exposure, route of exposure, population at risk of exposure and pathway status and time frame.

Table 20
Exposure Pathways

Pathway Name	Exposure Pathway Elements					Pathway Status and Time Frame
	Source	Environmental Media	Point of Exposure	Route of Exposure	Population at risk of Exposure	
Groundwater landfill office well	BLS	water	landfill office well	ingestion	workers	completed past
Groundwater Town Garage well	BLS	water	Town Garage well	ingestion	workers	completed past
Groundwater As, Sb, Se: private residential wells	BLS or naturally occurring	water	private well	ingestion (As, Sb, Se) dermal (As)	residents children adults	completed past present potential future
Groundwater Pb: private residential wells	Plumbing	water	private well	ingestion	residents children adults	completed past present potential future
Surface soil: off-site Private yards	Contaminants on BLS were also present on the off-site residences	soil	off-site exposed surface soil residential yards	ingestion dermal	pica children children adults	completed past present potential future
Surface soil: on-site	BLS	soil	on-site exposed surface soil	ingestion dermal	workers trespassers	potential past present future
Sediment: off-site	BLS	sediment	off-site sediment	ingestion dermal	children adults	potential past present future
Sediment: on-site	BLS	sediment	on-site sediment	ingestion dermal	workers trespassers	potential past present future
Ambient Air: on-site	BLS	air	on-site-center of landfill	inhalation	workers trespassers	potential present future
Indoor Air of Landfill Office	BLS	air	landfill office	explosion hazard	workers	potential present future

	Source	Environmental Media	Point of Exposure	Route of Exposure	Population at risk of Exposure	
Subsurface soil Surface soil in Town Garage Gravel Pit	BLS	soil	Town Garage gravel pit	ingestion dermal	workers trespassers	potential present future

A. COMPLETED EXPOSURE PATHWAYS

Ground Water - Landfill Office

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): People who drank or used water from the landfill office well

People who drank or used water from the contaminated well servicing the landfill office were exposed to volatile organic compounds and metals. These exposures ceased after the contaminated well was shut down. The exposures may have included ingestion, dermal absorption and/or inhalation of VOCs, and ingestion of metals. People drank or used water from the landfill office well were exposed to contaminated water for up to four years from 1980 to 1984.

Ground Water - Town Garage Well

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): People who drank or used water from the Barkhamsted Town Garage well

People who drank or used water from the Barkhamsted Town Garage well were exposed to contaminated water for up to four years from 1986 to 1990. The Barkhamsted Town Garage well water was contaminated with volatile organic compounds. The exposures may have included ingestion, dermal absorption and/or inhalation of VOCs.

Ground Water - Off-Site Private Wells

Contamination Source: Barkhamsted Landfill Site⁷/or Naturally Occurring

Exposed Population(s): People who drink or use water from three private residential wells

People who drink or use water from three private residential wells are currently exposed to antimony, arsenic, and selenium. Exposures may occur through ingestion and skin contact (arsenic) with contaminated water.

⁷ The groundwater plume which contains VOCs has been characterized, and does not extend to these wells. The groundwater plume which contains metals has not been characterized. Consequently, the metals detected in the private wells may be the result of landfill contamination or a natural source unrelated to the landfill.

Ground Water - Off-Site Private Wells (continued)

Contamination Source: Household plumbing *(including one or more of the following: lead based solder, brass fixtures, lead pipes)*

Exposed Population(s): People who drink or use water from five private residential wells

People who drink or use water from five private residential wells are currently exposed to lead. Exposures may occur through ingestion of the contaminated water.

Surficial Soil -Off-Site Private Residences

Contamination Source: Contaminants present on the Barkhamsted Landfill were also present on the off-site private residences

Exposed Population(s): Young children, older children and adults living on two private residential properties

Residents of two properties adjacent to the landfill may have in the past and may now be receiving exposure to contaminated soil via ingestion and dermal absorption. Inhalation of airborne soil particles is a possible route of exposure, however, the CT DPH lacks sufficient information to characterize this exposure scenario. The CT DPH does not know whether there are any young children who often place objects in their mouths (pica behavior) living at either residence. However, these sensitive populations were examined in detail in the Toxicological Evaluation Section.

B. POTENTIAL EXPOSURE PATHWAYS

Surficial Soil - On-site

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): Landfill workers and trespassers

Exposures to contaminated soils may occur to individuals who work at the landfill. The exposures may include ingestion and dermal absorption of contaminants from soil. These exposure routes may occur particularly if the soil is disturbed during excavation for landscaping, construction, or road work purposes. Trespassers may gain access to areas within the Barkhamsted Landfill that are contaminated. Inhalation of airborne soil particles is also a possible route of exposure, however, the CT DPH lacks sufficient information to characterize this exposure scenario.

Surficial Soil - Off-site Town Garage

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): Workers at the Barkhamsted Town Garage gravel pit and trespassers

Workers at the Town Garage gravel pit may have in the past, and may now be receiving exposure to contaminated soil via ingestion and dermal absorption. Inhalation of airborne soil particles is a possible

route of exposure, however, the CT DPH lacks sufficient information to characterize this exposure scenario.

One seepage location was identified in the gravel pit during the remedial investigation. However, during the 1994 site visit representatives of the CT DPH and CT DEP identified another area of discoloration that may indicate a seepage zone that was inactive during the identification phase of the remedial investigation. Because this is an active sand and gravel pit, the CT DPH considers exposure to surface soil possible. Moreover, the CT DEP expressed concerns about leachate contaminated soil in the gravel pit in a correspondence (15) to the First Selectman of the Town of Barkhamsted. This concern is also shared by the CT DPH as a potential exposure route to leachate contaminated surface soil in the gravel pit. Specifically, excavation activities at the gravel pit may expose workers as well as trespassers who enter the gravel pit. Sand and gravel at the gravel pit adjacent to the BLS have been excavated since 1981 (16). Apparently, this activity will continue, and areas excavated may include those currently contaminated with leachate.

Sediment -Unnamed Brook (sections of this brook are both on-site and off-site)

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): Trespassers

Exposure to sediment may occur to older children and adults who come in contact with the sediment of the Unnamed Brook. Older children may wade in water and contact the contaminated sediment. However, in order for an older child or adults to access the Unnamed Brook, one would have to travel across a busy high speed road (Route 44), walk down a steep gradient (thirty feet), and then travel through a heavily wooded area. These three factors suggest that access and exposure are unlikely. Children may, however, access the discharge point of the Unnamed Brook located directly east of Route 44 after passing underneath the road.

Leachate\Sediment - On-Site

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): Landfill workers and trespassers

Exposure to leachate and sediment may occur to workers and older children who trespass on the site. Exposure may occur through direct skin contact, and potential incidental ingestion.

Physical Hazard - On-site Landfill Office: Methane Gas

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): Landfill workers

Present and future physical hazard exposures are possible for methane gas on-site. Methane gas may accumulate in enclosed structures on-site and lead to an explosion or fire hazard.

Outdoor Air - On-Site

Contamination Source: Barkhamsted Landfill Site

Exposed Population(s): Landfill workers and trespassers

Present and future inhalation exposures are possible to landfill workers and trespassers who enter the center of the landfill where elevated VOCs were measured.

PUBLIC HEALTH IMPLICATIONS

A. TOXICOLOGICAL EVALUATION

Completed and potential exposure pathways have been identified for the groundwater, and soil pathways. In this section, the potential health effects associated with exposure to contaminants of concern will be discussed.

To evaluate health effects, the ATSDR has developed Minimal Risk Levels (MRLs) for contaminants commonly detected at hazardous waste sites. The MRL is an estimate of daily human exposure to a contaminant below which non-cancerous, adverse health effects are unlikely to occur. MRLs are developed for each route of exposure such as ingestion, inhalation, and dermal absorption. MRLs are also developed for the length of exposure, such as acute (less than 15 days), intermediate (15 to 364 days), and chronic (greater than 364 days).

We used ATSDR Toxicological Profiles in our review of the potential health effects associated with site contaminants. The ATSDR Toxicological Profiles are chemical-specific reports that provide information on health effects, environmental transport and human exposures (17, 18, 19, 20, 21, 23, 25, 27).

Exposure Assumptions

The exposure pathways examined in the following section include the incidental ingestion of contaminated soil for young children, ages 1 to 3 years old, who often place objects in their mouth (5,000 mg soil per day), older children over 3 years old, who do not place objects in their mouth (200 mg soil per day), and adults (100 mg soil per day). Additionally, dermal absorption of contaminants from soil adhering to the skin was examined for children.

The exposure pathways also included ingestion of drinking water. The daily drinking water consumption rates are one liter (about one quart) for children, and two liters (about two quarts) for adults.

An exposure dose calculated for adults and children is commonly represented as an amount of contaminant per body weight per day. The contaminant is often listed in milligrams⁸ (mg). The body weight is often listed as kilograms⁹ (kg). The quantity of contaminant per quantity of body weight per day is thus written as follows: mg/kg/day. This number is defined as an ingestion exposure. These values are then compared to a minimal risk level (MRL). When an MRL is unavailable the comparison is often to a reference dose (RfD). The RfD is an estimated daily intake of a chemical that is likely to be without an appreciable risk of health effects, and has been developed by the EPA.

Residential Soil Exposure Route:

Since the soil collected from the residences adjacent to the landfill was analyzed for metals, pesticides, and PCBs from a combined sample of the first twelve inches below the surface, the concentrations may have underestimated the actual contaminant concentrations. This underestimation would have occurred if contaminants were located in the first three or six inches of soil.

Antimony

Antimony was detected in one private residential well at 16.3 ppb. Exposures to antimony occurred in the past and are still occurring for persons who drink water from the antimony contaminated private well. Exposures to antimony have occurred for an undetermined period of time. The first sampling of private wells was in 1988. However, there were no metals analyzed for at that time. The first off-site well, (Town Garage), contaminated by site-related contaminants was shortly after 1986. The residential exposure period is unlikely to have started prior to that time.

Non-cancerous Effects - Residential Well

Non-cancerous health effects determination was based on the highest antimony concentration. We assume that adults drink two liters (about two quarts) of tap water each day, and weigh 70 kg (154 pounds) and children drink one liter (about one quart) of tap water each day, and weigh 10 kg (22 pounds). Using the highest antimony concentration detected (16.3 ppb) the ingestion exposures were calculated for adults (0.00047 mg/kg/day) and children (0.0016 mg/kg/day). Since there is no chronic MRL, the calculated dose has been compared to a reference dose. Using the RfD (0.0004 mg/kg/day) as a comparison the non-carcinogenic health risks for an adult exposed to antimony may be characterized as minimal. Although the exposure dose for children exceeded the RfD, the EPA has established a longer-term health advisory for children. The longer-term health advisory is a concentration that children could be exposed to for up to seven years without any adverse health effects. Since the EPA longer-term health advisory was not exceeded, non-cancerous adverse health effects are also considered minimal for children who drank water contaminated with antimony at the maximum concentration for up to seven years.

There are one thousand milligrams in one gram.

One kg equals one thousand grams.

Exposures beyond seven years may represent a low increased risk of non-carcinogenic health effects in children.

Carcinogenicity Classification:

Antimony has not been classified by the EPA regarding its carcinogenicity. Consequently, we were unable to estimate cancer risks for children or adults.

Brief Description of Chemical:

Antimony is a naturally-occurring metal that is silvery white. Antimony is present in small quantities in the earth's crust. This element is mixed with other metals such as lead and zinc to increase the strength of the resultant metal alloy. These alloys have many uses including: lead storage batteries, solder, sheet metal, castings, and pewter. Antimony oxide is mixed with textiles and plastics as a fire retardant (17).

Arsenic

Arsenic was detected in one private residential well at 1.4 ppb, in the *surface soil* of two off-site residential locations at concentrations ranging from 1.5 to 2.5 ppm, and in the *sediment* of the Unnamed Brook at 5.8 ppm. The off-site residential location with the highest arsenic contaminated surface soil was also the location where arsenic was detected in the drinking water well. Exposures to arsenic have occurred in the past, and are occurring to persons who drink water from the arsenic contaminated private well, who come in contact with the contaminated soil located on the off-site residential locations, and or who contact the contaminated sediment.

Non-cancerous Effects - Drinking Water

Using the highest arsenic concentration detected in private well water (1.4 ppb) the ingestion exposures were calculated for adults (0.00004 mg/kg/day) and children (0.00014 mg/kg/day). These exposure levels are below the chronic MRL of 0.0003 mg/kg/day. Consequently, non-cancerous adverse health effects may be characterized as minimal for persons who consumed arsenic contaminated water for more than one year at this concentration.

Non-cancerous Effects - Soil (Pica Children¹⁰)

Exposures to arsenic may have occurred in the past and could be occurring presently to residents who contact and ingest arsenic contaminated surface soil in two off-site residential locations. Using the highest arsenic concentration detected off-site in surface soil (2.5 ppm) the ingestion exposure was calculated for pica children. Pica children are children one to three years old who often place objects in their mouth. They represent the population of greatest risk of exposure to contaminated surface soil. The exposure dose calculated for pica children was 0.0013 mg/kg/day and exceeds the chronic MRL of 0.0003 mg/kg/day. Chronic ingestion studies in humans exposed to arsenic identified skin effects at elevated levels. Those levels were higher than the levels found here at the off-site residential locations. Consequently, the occurrence of non-

¹⁰ Children one to three years old who often place objects in their mouths are referred to as *pica children*.

cancerous health effects in the pica child is low. Since non-cancerous health effects are characterized as low for pica children, they are minimal for older children and adults.

Non-cancerous Effects - Sediment from Unnamed Brook & Leachate Seeps (Older Children and Adults)

Exposures to arsenic may have occurred in the past, and could be occurring presently to older children and adults who come in contact with arsenic contaminated sediment in either the Unnamed Brook or the leachate seeps. Using the highest arsenic concentration detected in the sediment (5.8 ppm) the ingestion exposure was calculated for older children (0.0000038 mg/kg/day) and adults (0.0000022 mg/kg/day). Both are below the chronic MRL of 0.0003 mg/kg/day. Consequently, non-cancerous adverse health effects may be characterized as minimal for older children and adults who are exposed to arsenic contaminated sediment in the Unnamed Brook at this concentration.

Carcinogenicity Classification: drinking water

Arsenic has been classified by the EPA as a known human carcinogen (EPA group A). When people are exposed to high levels of arsenic through drinking water over extended durations (many years), there is an increased risk for developing skin cancer. The cancer risk estimates using the highest arsenic concentration detected off-site (1.4 ppb) for children and adults for a 20 year period indicate that there is no apparent increased risk for developing skin cancer.

Carcinogenicity Classification: Soil

The cancer risk estimates using the highest arsenic concentration detected in the surface soil of off-site residential locations (2.5 ppm) for pica children, older children, and adults for a 20 year period indicate that there is an insignificant risk for developing skin cancer.

Background Levels Measured in Soil

The average background level of arsenic in soils located in the eastern United States is 4.8 ppm (29). Although the residential soil samples were obtained from the first twelve inches of soil, and therefore may have underestimated the actual arsenic concentration if the arsenic was in the first six inches of soil, a comparison with the background level indicates that the detected concentrations (1.5 ppm to 2.5 ppm) may be within normal background levels in eastern United States.

Carcinogenicity Classification: combined estimation for soil and drinking water

Cancer risk estimates were calculated using the highest arsenic concentration detected in the surface soil of off-site residential locations (2.5 ppm) and the highest detected level in a private drinking water well (1.4 ppb). The CT DPH calculated a combined cancer risk estimation for a child exposed to arsenic in the drinking water year round, and exposed to arsenic in the surface soil for a maximum of 20 years. The results indicate that there is no apparent risk for developing skin cancer from the combined exposure to water and surface soil.

Carcinogenicity Classification: Sediment from the Unnamed Brook and Leachate Seeps
The cancer risk estimates using the highest arsenic concentration detected in the sediment (5.8 ppm) for older children for a 15 year period indicate that there is no apparent increased risk for developing skin cancer.

Brief Description of Chemical:

Inorganic arsenic is used mainly to preserve wood and formulating insecticides and weed killers. Inorganic arsenic is a naturally-occurring element found in higher concentrations in the bedrock in some areas within Connecticut.

Benzene

Benzene was detected in the landfill office well. The maximum concentration was 2 ppb. The duration of potential exposure may have been four years from 1980 through 1984. In 1984, the landfill office well was closed and exposure to this contaminant ended. No benzene was detected in any private residential well.

Carcinogenicity Classification:

Benzene has been classified by the EPA as a known human carcinogen (EPA group A). The cancer risks were calculated for employees who drank from the landfill office well contaminated with benzene. We used the maximum benzene concentration (2 ppb), and conclude that there is an insignificant risk for developing cancer for the four years of potential exposure.

Brief Description of Chemical:

Benzene is a colorless liquid with a sweet odor. This compound dissolves in water easily and evaporates readily into the air. Benzene is a highly flammable liquid and is a component of gasoline (18).

Beryllium

Beryllium was detected in the surface soil of two off-site residential locations at a concentrations ranging from 0.58 ppm to 0.62 ppm, and in the sediment of the Unnamed Brook at a maximum of 2 ppm. Exposures to beryllium may have occurred in the past, and could be occurring presently to persons who contact the beryllium contaminated surface soil and or sediment.

Non-cancerous Effects - Soil (Pica Children)

Exposures to beryllium may have occurred in the past, and could be occurring presently to residents who contact and ingest beryllium contaminated surface soil in two off-site residential locations. Using the highest beryllium concentration detected off-site in surface soil (0.62 ppm) the ingestion exposure was calculated for pica children (0.0003 mg/kg/day). Pica children are at greatest risk of exposure to contaminated surface soil. Since there is no chronic MRL, the calculated dose from the maximal concentration of 0.62 ppm has been compared to a reference dose. Using the RfD (0.005 mg/kg/day) as a comparison the non-carcinogenic health risks for pica children exposed to beryllium may be characterized as minimal. Since non-cancerous health effects are minimal for pica children, they are also minimal for older children and adults.

Non-cancerous Effects - Sediment from Unnamed Brook & Leachate Seeps (Older Children and Adults)

Exposures to beryllium may have occurred in the past, and could be occurring presently to older children and adults who contact contaminated sediment. Using the highest beryllium concentration detected (2 ppm) the ingestion exposure was calculated for children (0.0000013 mg/kg/day), and adults (0.0000007 mg/kg/day). Using the RfD (0.005 mg/kg/day) as a comparison the non-carcinogenic health risks for older children and adults exposed to beryllium in the sediment of the Unnamed Brook may be characterized as minimal.

Carcinogenicity Classification - Soil

Beryllium has been classified by the EPA as a probable human carcinogen (EPA group B2). The cancer risk estimates using the highest beryllium concentration detected in off-site surface soil (0.62 ppm) for pica children, older children, and adults for a 20 year period indicate that there is no apparent risk for developing cancer.

Carcinogenicity Classification: Sediment from the Unnamed Brook and Leachate Seeps

The cancer risk estimates using the highest beryllium concentration detected in the sediment (2 ppm) for older children for a 15 year period indicate that there is no apparent risk for developing cancer.

Background Levels Measured in Soil

The average background level of beryllium in soils located in the eastern United States is 0.55 ppm (29). Although the residential soil samples were obtained from the first twelve inches of soil, and therefore may have underestimated the actual beryllium concentration if the beryllium was in the first six inches of soil, a comparison with the background level indicates that the detected concentrations (0.58 ppm to 0.62 ppm) may be within normal background levels in eastern United States.

Brief Description of Chemical

Beryllium is a mineral that is found in rocks, coal, oil, soil, and volcanic dust (19). Beryllium is found in the gemstone quality mineral known as beryl. Beryllium does not have any particular odor. Combustion of coal and fuel oil releases compounds containing beryllium into the atmosphere (19).

Chromium

Chromium was detected in the surface soil of two off-site residential locations at concentrations from 19.2 ppm to 29.4 ppm. Exposure to chromium may have occurred in the past, and may be occurring now to persons who come in contact with contaminated surface soil. The principal individual for whom exposure to contaminated soils may be of most concern is the child.

Non-cancerous Effects - Soil (Pica Children)

Exposures to chromium in soil may have occurred in the past, and could be occurring presently to residents who contact and ingest chromium contaminated surface soil in two off-site residential locations. Using the highest chromium concentration detected (29.4 ppm) the ingestion exposure was calculated for pica children (0.015 mg/kg/day). Since there is no chronic MRL, the calculated dose has been compared to a reference dose. The RfD is 0.005 mg/kg/day. This value was exceeded. However, at this exposure level it is not expected that health effects would occur. The occurrence of non-carcinogenic health effects would be characterized a low. This was based upon a continuous daily exposure. However, if the exposure were not continuous, perhaps twice a week, the ingestion exposure would then be 0.004 mg/kg/day. In addition, we assumed the most toxic form of chromium was present making the estimate even more conservative. The risks of non-carcinogenic health effects would then be characterized a minimal. Pica children are the most sensitive population potentially exposed. Since non-cancerous health effects are minimal for pica children, they are also minimal for older children and adults.

Carcinogenicity Classification:

Chromium(VI) has been classified by the EPA as a known human carcinogen (EPA group A) only via inhalation. However, there is insufficient information to determine cancer risk estimations for individual's exposure through inhalation of chromium in contaminated soil.

Background Levels Measured in Soil

The average background level of chromium in soils located in the eastern United States is 33 ppm (29). Although the residential soil samples were obtained from the first twelve inches of soil, and therefore may have underestimated the actual chromium concentration if the chromium was only in the first six inches of soil, a comparison with the background level indicates that detected concentrations (19.2 ppm to 29.4 ppm) may be within normal background levels in eastern United States.

Brief description:

Chromium is an element that occurs naturally in rocks and soil. This element exists in several different forms, chromium(0), chromium(III), and chromium(VI). None of these forms have any known taste or odor. Chromium compounds are used for chrome plating, the manufacture of dyes, and in wood preservatives (20).

cis-1,2-Dichloroethylene

Exposure to *cis*-1,2-dichloroethylene occurred in the past to persons who drank from the contaminated Barkhamsted Town Garage well for as long as four years. Using the highest *cis*-1,2-dichloroethylene concentration detected in that well (160 ppb) the ingestion exposures were calculated for adults (0.003 mg/kg/day). This value does not exceed the ATSDR intermediate MRL (0.3 mg/kg/day). Although the intermediate MRL is designed for an exposure duration of up to one year, non-cancerous adverse health effects are characterized as minimal in those persons who drank *cis*-1,2-dichloroethylene contaminated water from that well for up to one year. Based on the above information, the non-cancerous health effects are characterized as minimal for a duration of four years.

Carcinogenicity Classification:

There is insufficient information regarding human carcinogenicity for *cis*-1,2-dichloroethylene.

Brief Description of Chemical:

cis-1,2-Dichloroethylene is a flammable, colorless liquid with a pungent odor. This compound is man-made, and has no natural sources. *cis*-1,2-Dichloroethylene is a breakdown product of trichloroethylene and tetrachloroethylene.

Lead - household plumbing

Lead was detected in the water from six private residences. The maximum concentration was 29.2 ppb. There are no regulations for lead in private wells, however, the EPA has developed an action level of 15 ppb.

The lead detected in the private drinking water is probably due to lead plumbing fixtures in individual homes and is unlikely to be site-related. Although not likely to cause adverse health effects alone, long term exposure to lead in drinking water could contribute significantly to the overall body burden of lead. This could increase the lead exposure in individuals at risk for lead toxicity due to other sources (lead-based paint, food, and soil). Children under the age of six are at greatest risk for lead poisoning.

Studies indicate that long term exposure to low levels of lead can cause brain damage and lowered Intelligence Quotient (I.Q.). Lead exposure can increase blood pressure in middle-aged men. If a pregnant woman is exposed to lead in drinking water it can be carried to the unborn child and may have an adverse effect on the mental development of the fetus.

Carcinogenicity Classification:

Lead has been classified by the EPA as a probable human carcinogen (EPA group B2). There is insufficient information to calculate cancer risk estimates for individuals potentially exposed to lead in contaminated drinking water.

Brief Description of Chemical:

Lead is a naturally occurring gray metal detected in small quantities in the earth's crust. This compound has no taste or odor. Lead is used in the manufacture of batteries and in lead solder. However, as of 1986, the U.S. Congress banned the use of lead solder containing more than 0.2 percent lead. When water stays in pipes containing lead or lead containing plumbing systems for several hours the lead in the pipes or solder may dissolve into the drinking water¹¹.

Manganese

Manganese was detected in the landfill office well at a maximum concentration of 14,000 ppb, in the surface soil of two off-site residential locations at concentrations ranging from 379 ppm to 387 ppm, and in the sediment of the Unnamed Brook at 9,450 ppm.

Non-cancerous effects- Landfill Office Drinking Water Well

Exposure to manganese occurred in the past to persons who drank from the contaminated landfill office well for as long as four years. The maximum concentration detected was 14,000 ppb. Since there is no chronic MRL, the calculated dose from the maximal concentration of 14,000 ppb has

Lead enters drinking water primarily as a result of the corrosion (*i.e.*, wearing away) of lead-containing materials in the household plumbing. These materials include lead-based solders used to connect copper pipe and brass and chrome-plated brass faucets. In 1986, the U.S. Congress banned the use of lead solder containing greater than 0.2% lead, and restricted the lead content of faucets, pipes and other plumbing materials to 8%. You may reduce the concentration of lead in your water by flushing your household plumbing. To flush, let the water run until the water gets noticeably colder, usually about 15 to 30 seconds. You may want to repeat this procedure any time the water in a faucet has gone unused for more than six hours. Additionally, you may want to avoid cooking with, or drinking water from the hot water tap. Hot water dissolves more lead more quickly than cold water. If you need hot water, draw water from the cold tap and then heat it on the stove.

been compared to a reference dose. Using the highest manganese concentration detected in the landfill office well (14,000 ppb), an ingestion exposure was calculated for adults (0.27 mg/kg/day). The risks of developing health effects for adults may be characterized as low.

Non-cancerous Effects - Surface Soil

Exposures to manganese may have occurred in the past, and could be occurring presently to residents who contact and ingest manganese contaminated surface soil in two off-site residential locations. The maximum concentration detected was 387 ppm. Since there is no chronic MRL, the calculated dose from the maximal concentration of 387 ppm has been compared to a reference dose. Using the highest manganese concentration detected in the surface soil (387 ppm), the ingestion exposures were calculated for pica children (0.194 mg/kg/day). Pica children are the most sensitive population potentially exposed. The RfD for manganese is 0.14 mg/kg/day. Although this value exceeds the RfD, the occurrence of non-cancerous effects may be characterized as low in pica children exposed to manganese contaminated surface soil. Since the occurrence of non-cancerous health effects are low for pica children, they may be classified as minimal for older children and adults.

Non-cancerous Effects - Sediment from the Unnamed Brook (Older Children and Adults)

Exposures to manganese may have occurred in the past, and could be occurring presently to older children and adults who contact manganese contaminated sediment in the Unnamed Brook. Using the highest manganese concentration detected (9,450 ppm) the ingestion exposure was calculated for older children (0.0062 mg/kg/day), and adults (0.0035 mg/kg/day). Using the RfD (0.14 mg/kg/day) as a comparison, the non-carcinogenic health risks for older children and adults exposed to manganese in the surface soil may be characterized as minimal.

Background Levels Measured in Soil

The average background level of manganese in soils located in the eastern United States is 260 ppm (29). Since the residential soil samples were obtained from the first twelve inches of soil, the actual manganese concentration may have been underestimated. The concentration of manganese was slightly higher than background levels measured in the eastern United States.

Carcinogenicity Classification:

Manganese is not currently classified by the EPA regarding its carcinogenicity.

Brief Description of Chemical:

Manganese is a naturally occurring compound detected in many rock formations. This element is similar in chemical and physical properties to iron. Manganese has numerous industrial uses including the formation of batteries and ceramics (21).

Methyl chloride (chloromethane)

Methyl chloride was detected in the landfill office well. The maximum concentration was 180 ppb. The duration of potential exposure may have been up to four years from 1980 through 1984. Using the highest methyl chloride concentration detected in the landfill office well (180 ppb), the ingestion exposures were calculated for adults (0.005 mg/kg/day). Since there is no chronic MRL, the calculated dose from the maximal concentration of 180 ppb has been compared to a reference dose. The RfD is 0.004 mg/kg/day (22). The non-carcinogenic health risks for an adult exposed to methyl chloride may be characterized as minimal.

Carcinogenicity Classification:

Methyl chloride is not currently classified by the EPA regarding its carcinogenicity.

Brief Description of Chemical:

Methyl chloride is a colorless gas, that has a faintly sweet odor. This naturally occurring chemical is produced in large quantities in the ocean. This is also produced by rotting wood and by some plants. When grass, wood, charcoal, or coal are burnt this chemical is produced. Methyl chloride is used in industry to make other compounds such as: agricultural chemicals, butyl rubber, and silicones (23).

PAHs

Exposure to carcinogenic and non-carcinogenic PAHs may have occurred in the past and may be occurring now to persons who contact contaminated sediment located below the surface water on-site in the leachate seeps and off-site in the Unnamed Brook.

Non-cancerous Effects - Sediment from Unnamed Brook & Leachate Seeps (Older Children and Adults)

Using the combined non-carcinogenic PAH concentration (1.26 ppm), the ingestion exposure was calculated for older children (0.00003 mg/kg/day) and adults (0.00002 mg/kg/day). Non-carcinogenic PAHs do not have a health comparison value. However, naphthalene, one of the non-carcinogenic PAHs does have an RfD. Consequently, the non-carcinogenic PAHs were compared as an aggregate to that RfD. The combined value does not exceed the RfD for naphthalene (0.004 mg/kg/day). Therefore non-carcinogenic health effects for older children or adults exposed to non-carcinogenic PAHs in sediment may be characterized as minimal.

Carcinogenicity Classification:

Benzo(a)pyrene (BaP) has been classified by the EPA as a possible human carcinogen. This was the only PAH detected in any sediment sample. BaP is the only carcinogenic PAH for which there is carcinogenic risk information. Since BaP is also the most toxic PAH, the remaining carcinogenic PAHs were converted into BaP equivalents. To reach the BaP equivalent values, each concentration was multiplied by a value. This value incorporates the potency of each compound relative to BaP. For example, if one compound is ten times less toxic than BaP, then the concentration of that compound was multiplied by 0.10.

Carcinogenicity Classification: Sediment from the Unnamed Brook and Leachate Seeps

Cancer risk estimations were based on the combined maximum carcinogenic sediment PAH concentration from table 21 (1.15 ppm). The cancer risk estimations indicate that there is a low increased risk of developing cancer among children or adults who contact the contaminated sediment over a period of 15 years. The CT DPH does not consider this a likely exposure scenario. Cancer risk estimations were based on worst case exposure scenarios. The actual cancer risk is likely to be lower.

Table 21

Calculations for Carcinogenic PAHs Detected in Sediment From the Unnamed Brook

Chemical name	Concentration Minimum	Range (ppm) Maximum	BaP relative potency	Concentration based on BaP relative potency (ppm)
Benzo(a)anthracene	ND	0.67	0.1	0.067
Benzo(a)pyrene	ND	0.85	1.0	0.85
Benzo(b)fluoranthene	ND	2.1	0.1	0.2
Chrysene	ND	0.68	0.001	0.0007
Indeno(1,2,3,-c,d)pyrene	ND	0.33	0.1	0.0330
Total carcinogenic PAHs		(equivalent to BaP)		1.1507

ND None detected
ppm parts per million

Selenium

Non-cancerous effects - Drinking Water

Selenium was detected in one private residential well at 38 ppb. Exposures to selenium may have occurred in the past and could be occurring presently to persons who drink water from the selenium contaminated private well. The first sampling of private wells was in 1988. However, there were no metals analyzed for at that time. The first off-site well, (Town Garage), contaminated by site-related contaminants was identified shortly after 1986. The well water residential exposure period is unlikely to have started prior to that time. The maximum concentration detected was 38 ppb. The chronic MRL for selenium is (0.002 mg/kg/day). Using the highest selenium concentration detected in the private well (38 ppb), an ingestion exposure was calculated for adults (0.0011 mg/kg/day) and children (0.0038 mg/kg/day). The non-carcinogenic health risks for an adult exposed to selenium may be characterized as minimal. There are several scientific investigations examining humans exposed to selenium in their diet. From these investigations chronic ingestion exposure to selenium may lead to brittle finger nails (27). The risks for developing brittle nails in children may be characterized as low.

Carcinogenicity Classification:

Selenium has not been classified as a human carcinogen.

Brief Description of Chemical:

Selenium is a naturally occurring element distributed throughout the earth's crust. Selenium is an essential nutrient for both humans and animals.

Tetrachloroethylene (PCE)

PCE exposure occurred in the past to people who drank water from the contaminated landfill office well for up to four years. The highest PCE concentration detected in the well was reported as less than 1 ppb. For the purposes of this assessment, a concentration of 1 ppb was used in all calculations. Using the value of 1 ppb, the ingestion exposures were calculated for adults (0.000029 mg/kg/day). This value does not exceed the ATSDR intermediate MRL (0.1 mg/kg/day). Although the intermediate MRL is designed for an exposure duration of up to one year, non-cancerous adverse health effects are unlikely to occur in those persons who drank PCE contaminated water from the landfill office well for up to four years.

Carcinogenicity Classification:

PCE was classified as a probable human carcinogen (EPA group B2). Currently, however, this classification has been withdrawn, and a review of this compound is being conducted by the EPA (24). Although the review is not yet complete, cancer risks were calculated for adults using available information from the Environmental Criteria and Assessment Office of the U.S. EPA (Superfund Technical Support Center). The longest exposure duration to PCE was four years. Consequently, this value was utilized in cancer risk calculations.

The estimated cancer risks were calculated using the highest PCE concentration detected (1 ppb). The cancer risk estimates calculated for a four year period indicate that there is an insignificant risk for developing cancer.

Brief Description of Chemical:

PCE is a synthetic compound used as a metal degreaser and fabric dry cleaner. PCE is a nonflammable liquid with a sweet odor. There are no natural sources of PCE.

Trichloroethylene (TCE)

TCE exposure occurred in the past to people who drank water from the contaminated landfill office well for up to four years, and the Barkhamsted Town Garage well for up to four years. The maximum TCE concentration was detected in the Town Garage well. Therefore, we used that value, (52 ppb), to calculate the ingestion exposures. The ingestion exposure for adults is 0.0015 mg/kg/day. This value does not exceed the ATSDR intermediate MRL (0.7 mg/kg/day). Although the intermediate MRL is designed for an exposure duration of up to one year, non-cancerous adverse health effects are characterized as minimal in those persons who drank TCE contaminated water for up to four years.

Carcinogenicity Classification:

TCE was classified as a probable human carcinogen (EPA group B2). Currently, however, this classification has been withdrawn, and a review of this compound is being conducted by the EPA (24). Although the review is not yet complete, we calculated cancer risks for adults using available information from the Environmental Criteria and Assessment Office of the U.S. EPA (Superfund Technical Support Center). The longest period of time adults may have been exposed to TCE is four years. Consequently, we utilized this value in our estimates. The cancer risks listed below, were based on worst case scenarios.

These calculations were based on the maximum concentration of TCE detected, 52 ppb. On the basis of our conservative estimates, persons who drank water containing TCE at the maximum concentration detected in the Barkhamsted Town Garage well of 52 ppb for up to four years, have an insignificant increased risk for developing cancer.

Brief Description of Chemical:

TCE is a non-flammable liquid that has a sweet odor. This man-made compound is not detected naturally in the environment. TCE is used as a metal degreaser, paint thinner, spot remover and in the manufacture of adhesives.

Vanadium

Vanadium was detected in the surface soil of two off-site residential locations. The concentrations ranged from 36.2 ppm to 38.8 ppm. Exposure to vanadium may have occurred in the past, and may be occurring now to persons who come in contact with the contaminated surface soil.

Non-cancerous Effects - Surface Soil

Exposures to vanadium may have occurred in the past, and could be occurring presently to residents who contact and ingest vanadium contaminated surface soil in two off-site residential locations. The maximum concentration detected was 38.8 ppm. Since there is no chronic MRL, the calculated dose from the maximal concentration of 38.8 ppm has been compared to the intermediate MRL (0.003 mg/kg/day). Using the highest vanadium concentration detected in the surface soil (38.8 ppm), the ingestion exposure was calculated for pica children (0.02 mg/kg/day). This value exceeded the intermediate MRL. However, the highest value reported in the scientific literature at which there were no adverse health effects for an intermediate human exposures was 1.3 mg/kg/day. Consequently, non-cancerous effects are characterized as minimal in pica children exposed to vanadium contaminated surface soil for up to one year. Since non-cancerous health effects are minimal for pica children, they are also minimal for older children and adults.

Background Levels Measured in Soil

The average background level of vanadium in soils located in the eastern United States is 43 ppm (28). Although the residential soil samples were obtained from the first twelve inches of soil, and therefore may have underestimated the actual vanadium concentration if the vanadium was in the first six inches of soil, a comparison with the background level indicates that the detected concentrations (36.2 ppm to 38.8 ppm) may be within normal background levels in eastern United States.

Carcinogenicity Classification:

Vanadium is not currently classified by the EPA regarding its carcinogenicity. Consequently, no cancer risk estimations were calculated.

Brief Description of Chemical:

Vanadium is a naturally occurring element and is found in the earth's crust. This metal is white or gray, and is often found in crystal formations. Vanadium is released into the environment when fuel is burned. In addition, when rocks that contain vanadium are weathered, some vanadium dust may enter the air. Vanadium is used in the production of rubber, plastics, and ceramics (25).

B. EVALUATION OF COMMUNITY HEALTH CONCERNS

Area residents had complained of odors in the past.

Evaluation of the contaminants present in the ambient air indicated that the only contaminants detected above health comparison values were sampled from the center of the landfill and from two sections near the Unnamed Brook. There were no exceedences near adjacent residences. There is no historical air data to assess what may have caused the odor complaints in the past.

A resident complained of contaminants migrating off the site causing damage to his fruit trees.

We are unable to determine whether contaminants present in the soil would harm fruit trees or other vegetation. However, the contaminants detected in the soil of the two residences indicated that the soil pathway represents no apparent public health hazard to people who come in contact with the soil.

One citizen expressed concern that the contaminated plume may reach a school.

There is no indication that the contaminated plume has reached any nearby school (approximately 2 miles north of the landfill). The private well monitoring program is designed to detect plume migration.

Concern was raised about runoff coming through a resident's property and a resident was distressed about a cancer diagnosis

We examined the soil contamination on the two residences adjacent to the landfill. The levels of contaminants measured in the soil represent no apparent public health hazard. In addition, there were no carcinogenic contaminants detected above a level of concern in the adjacent residences' soil or well water.

One resident reported dizziness and loss of balance in their spouse. In addition, that resident reported having occasional severe diarrhea. The diarrhea was also noted in the spouse and an in-law.

The concentrations of contaminants detected in either the residential surface soil or private well water are not anticipated to lead to the reported illnesses.

CONCLUSIONS

Based on the information reviewed, the ATSDR has concluded that this site represents no apparent public health hazard.

1. Employees who drank water from either the Barkhamsted Landfill office well, or the Barkhamsted Town Garage, received exposures to site related compounds for up to four years. All exposures to site related contaminants in well water are below the levels reported to produce health effects, and represent no apparent public health hazard. The exposure period for the landfill office well was from 1980 through 1984. The Town Garage well exposure period was from 1986 to 1990. The exposure stopped when the wells were closed (1984-landfill office, 1990-Town Garage).
2. Residents may have been exposed in the past, and may now be exposed to site-related contaminants in private drinking water wells. However, all past and current exposures to site related contaminants in these wells represent no apparent public health hazard, because the exposures were/are not at levels expected to produce health effects.
3. Methane gas may be migrating into the Barkhamsted Landfill office, and this may present a physical hazard.
4. Residents who live adjacent to the landfill may have been exposed to site-related contaminants present in the surface soil of the two residential properties adjacent to the landfill. The site-related contaminants represent no apparent public health hazard to either young children who often place objects in their mouths, older children, or adults, because the levels of exposure were below levels that would produce health effects.
5. Lead was identified in several wells. The source of lead is probably from plumbing fixtures in the individual homes and not site-related. Exposure to lead in drinking water may increase an individuals total body burden of lead. Children under the age of six are at the greatest risk of exposure.

RECOMMENDATIONS

1. Sample methane gas from the Barkhamsted Landfill office.
2. Collect additional surface soil, subsurface, and sediment samples from new and existing leachate seepage zones within the gravel pit.
3. Identify the proper abandonment status of all unused wells located on-site.
4. Engage dust suppression methods if remedial activities will involve ground disturbing activities.
5. Inform the residents who have site-related soil contamination detected in their soil.
6. Educate residents who have lead in their drinking water about ways of reducing lead exposure from household plumbing.
7. The CT DPH will continue to review private well sampling data as provided by the CT DEP.

List of Abbreviations Used in this Document

BaP	Benzo(a)Pyrene
BLS	Barkhamsted-New Hartford Landfill Site
BRACE	Barkhamsted Residents Acting to Conserve the
CREG	Cancer Risk Evaluation Guide
CT	Connecticut
CT DEP	Connecticut Department of Environmental Protection
CT DPH	Connecticut Department of Public Health
DDD	P,P'-dichlorodiphenyl dichloroethane
DDE	P,P'-dichlorodiphenyldichloroethylene
DDT	P,P'-dichlorodiphenyltrichloroethane
EMEG	Environmental Media Evaluation Guide
F	Fahrenheit
FVHD	Farmington Valley Health District
HARP	Health Activities Recommendation Panel
I.Q.	Intelligence Quotient
kg	kilograms
LEL	Lower Explosive Limit
LTHA	Lifetime Health Advisory
MCL	Maximum Contaminant Level
mg	Milligrams
MRL	Minimal Risk Level
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PCE	Tetrachloroethylene
PHA	Public Health Assessment
ppb	Parts per billion
ppm	Parts per million
ppmv	Parts per million by volume
RfD	Reference Dose
RI	Remedial Investigation
RMEG	Reference Dose Media Evaluation Guide
RRDD #1	Regional Refuse Disposal District Number One
SVOC	Semivolatile Organic Compound
TCE	Trichloroethylene
TRI	Toxic Release Inventory

BaP	Benzo(a)Pyrene
VOC	Volatile Organic Compound

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REFERENCES

1. O'Brien & Gere Engineers, Inc. Remedial Investigation Barkhamsted-New Hartford Landfill Superfund Site Barkhamsted, Connecticut. February 1996.
2. ATSDR. Draft Interim Preliminary Health Assessment For Barkhamsted-New Hartford Landfill Site New Hartford, Litchfield County, Connecticut CERCLIS NO. CTD980732333. December 16, 1991.
3. Metcalf & Eddy. Human Health Risk Assessment Third Interim Deliverable Barkhamsted-New Hartford Landfill Superfund Site Barkhamsted, Connecticut. January 1995.
4. Correspondence from: Jane Dolan, Project Manager (US EPA Connecticut Superfund Section), to: Louise House, ATSDR Regional Representative (ATSDR Region I). May 18, 1995.
5. Personal Communication between: Gary D. Perlman, Epidemiologist (Connecticut Department of Public Health - Division of Environmental Epidemiology and Occupational Health), and Sally Roy, Administrative Assistant (Barkhamsted Landfill). October 14, 1994 3:04 pm.
6. Personal Communication between: Gary D. Perlman, Epidemiologist (Connecticut Department of Public Health - Division of Environmental Epidemiology and Occupational Health), and: Jim Hart, Landfill Manger (Barkhamsted Landfill). June 19, 1995 3:40 pm.
7. Personal Communication between: Gary D. Perlman, Epidemiologist (Connecticut Department of Public Health - Division of Environmental Epidemiology and Occupational Health), and: Richard Marr, contact person (Barkhamsted Residents Acting to Conserve the Environment). March 7, 1996 11:05 am.
8. U.S. Census Sample Count, Part A, Connecticut Population and Housing Characteristics, August 1991.
9. U.S. EPA. Final Hazard Ranking System Package. Barkhamsted-New Hartford Landfill Barkhamsted, Connecticut. September 25, 1987.
10. Correspondence from: Steven W. Peterson (Sanitarian), Farmington Valley Health District, to: Taylor Mills, (Chairman, Regional Refuse District One). November 17, 1982.
11. Correspondence from: Steven W. Peterson (Sanitarian), Farmington Valley Health District, to: Taylor Mills, (Chairman, Regional Refuse District One). June 15, 1983.

12. O'Brien & Gere Engineers, Inc. Draft Work Plan Limited Field Investigation (LFI) Summary Report. Remedial Investigation Barkhamsted-New Hartford Landfill Superfund Site Barkhamsted, Connecticut. February 1992.
13. U.S. EPA Technical Assistance Team. Barkhamsted Landfill Residential Tap Water Sampling, Barkhamsted, CT. Correspondence and Drinking Water Sampling results from: United States Environmental Protection Agency to: Barkhamsted Town Garage (Sir/Ms). April 13, 1988. April 13, 1988.
14. Correspondence and Drinking Water Sampling results from: United States Environmental Protection Agency to: Barkhamsted Town Garage (Mr. Richard Flint). August 20, 1990.
15. Correspondence from: Paul E. Jameson, Environmental Analyst II (Connecticut Department of Environmental Protection - Site Remediation & Closure Division, Waste Management Bureau), to: Carmella Lattizori, First Selectman (Town of Barkhamsted). September 6, 1990.
16. Correspondence from: Carmella Lattizori, First Selectman (Town of Barkhamsted), to: Paul E. Jameson, Environmental Analyst II (Connecticut Department of Environmental Protection - Site Remediation & Closure Division, Waste Management Bureau). September 19, 1990. Carmella Lattizori, First Selectman (Town of Barkhamsted). September 6, 1990.
17. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Antimony, September 1992.
18. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Benzene, August 1995.
19. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Beryllium, April 1993.
20. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Chromium, April 1993.
21. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Manganese, July 1992.
22. Office of Water. U.S. EPA. Drinking Water Regulations and Health Advisories. Washington, DC. February 1996.
23. Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Chloromethane", December 1990.

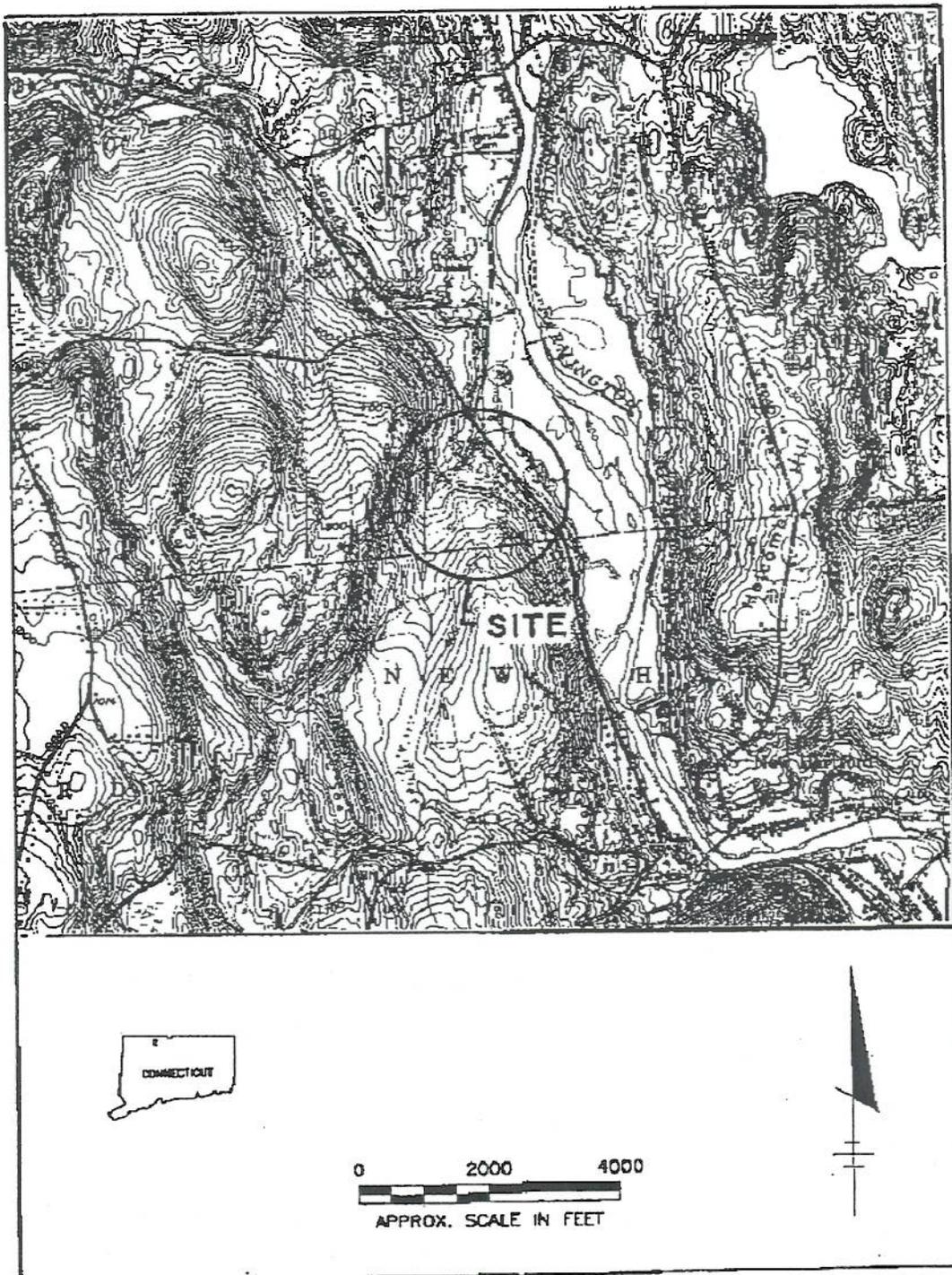
24. Correspondence from: Superfund Technical Support Center, Environmental Criteria and Assessment Office, U.S. Environmental Protection Agency, to: Gary D. Perlman, Epidemiologist (Connecticut Department of Public Health and Addiction Services - Division of Environmental Epidemiology and Occupational Health). January 23, 1996.
25. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Vanadium, July 1992.
26. U.S. EPA Region 1. Superfund Program Fact Sheet: Barkhamsted-New Hartford Landfill Superfund Site. September 1992.
27. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Selenium, August 1994.
28. Agency for Toxic Substances and Disease Registry, Public Health ASSESSMENT Guidance Manual. Lewis Publishers, Michigan. Page 5-7, Table 5.1. 1992.

PUBLIC COMMENTS

There were no written comments submitted to the CT DPH during the public comments period which began on October 21, 1996, and ended on November 25, 1996.

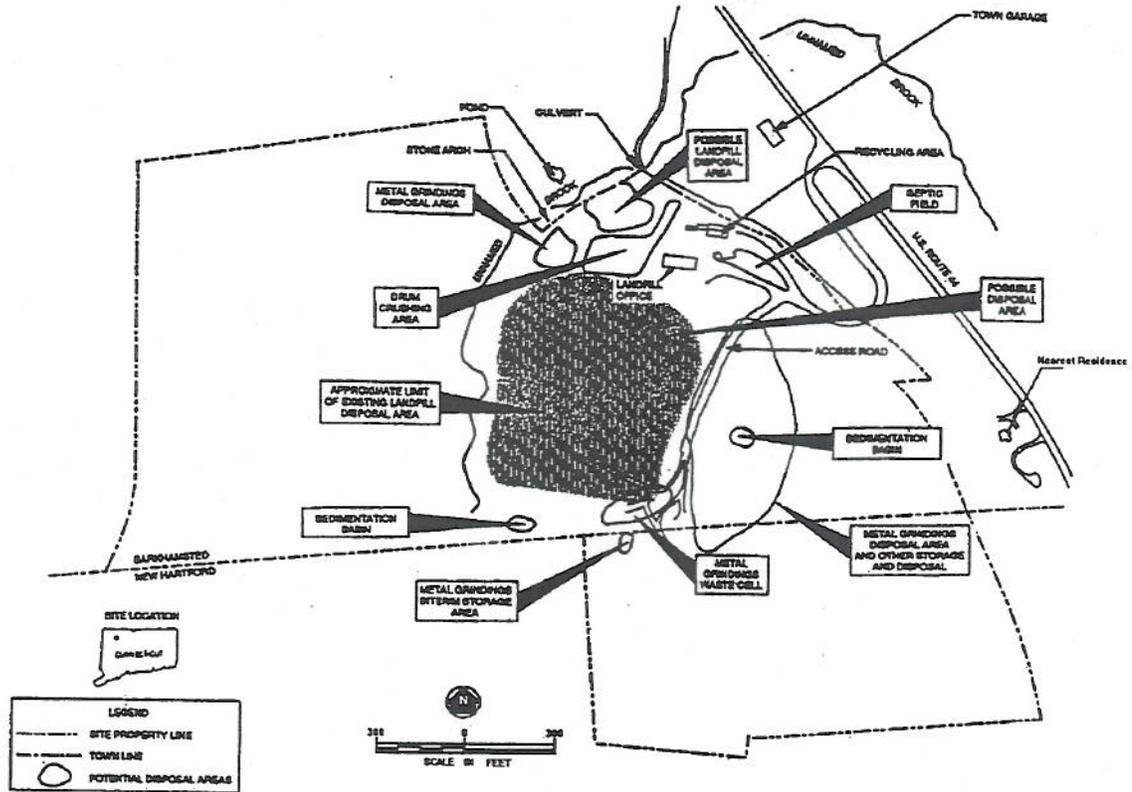
APPENDIX 1

Appendix A.- Site Location Map
Barkhamsted-New Hartford Landfill, Barkhamsted, Connecticut



Source (1)

Appendix B.- Site Diagram
 Barkhamsted-New Hartford Landfill
 Barkhamsted, Connecticut



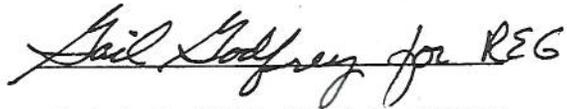
CERTIFICATION

The Barkhamsted-New Hartford Landfill Public Health Assessment was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Health Consultation was initiated.



Technical Project Officer, SPS, SSAB, DHAC

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



Chief, SPS, SSAB, DHAC, ATSDR