ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

GENERAL ELECTRIC SITE-LYMAN STREET
(a/k/a GE-HOUSATONIC RIVER)
PITTSFIELD, BERKSHIRE COUNTY, MASSACHUSETTS
EPA FACILITY ID: MAD002084093
JUNE 18, 2003

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
GENERAL ELECTRIC SITE
LYMAN STREET
PITTSFIELD, BERKSHIRE COUNTY, MASSACHUSETTS
CERCLIS NO. MAD002084093

Prepared by

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Preface

The Massachusetts Department of Public Health (MDPH) prepared this public health assessment as part of its cooperative agreement with the U.S. Agency for Toxic Substances and Disease Registry. In addition MDPH points out that this is only one of 10 General Electric sites for which public health assessments or health consultations are being or have been prepared. Thus any conclusions presented here cannot be extrapolated to any other area of the General Electric site or to the entire General Electric site as a whole. Finally, MDPH has attempted to gather available data for the General Electric site through many visits to the U.S. Environmental Protection Agency and the Massachusetts Department of Environmental Protection offices for file reviews or document retrieval. MDPH is preparing a Summary Public Health Assessment that will address health and exposure concerns for the GE sites as a whole. That document will be released for public review and comment.

SUMMARY

The Lyman Street site of the General Electric (GE) site in Pittsfield, Massachusetts is one of 10 areas being evaluated in separate public health assessments and health consultations.[1] In addition, the Massachusetts Department of Public Health (MDPH) is conducting or has conducted other health activities (e.g., descriptive analysis of cancer incidence data, ongoing serum polychlorinated biphenyl [PCB] analyses for Pittsfield area residents), the results of which will be incorporated into the summary public health assessment for the GE sites.

In the early 1940s, some Housatonic River oxbows and low-lying areas were separated from the active course of the river and subsequently filled with materials from GE and other unknown sources. Lyman Street site comprises Former Oxbows D and E of the Housatonic River. It includes a parking lot, two GE lots, and a Western Massachusetts Electric Company (WMECO) parcel that contains an electrical tower. Some past commercial or industrial uses existed on the site prior to the mid-1950s. Since that time until recently, the site has been used primarily for employee parking. The site is currently vacant and access is very limited.

The main compounds and environmental medium of concern at the site are PCBs in soil. Individuals with the greatest opportunities for exposure in the past were employees utilizing facilities located on the site those doing maintenance work on the site, or possibly neighborhood residents. However, evidence of trespassing (e.g., dirt paths) or recreational uses were not observed during site visits, and MDPH is not aware of similar frequent uses in the past. Prior to a remedial soil removal in the mid-1990s, concentrations of PCBs averaged approximately 100 parts per million (ppm) and ranged as high as 3,600 ppm in the unpaved areas of the site (e.g., WMECO area). These conditions may have presented health concerns to individuals (e.g., workers) who accessed the site on a frequent long-term basis prior to the removal action. However, various aspects of the site (e.g., steep riverbank, fences, vegetation, other institutional controls) have considerably reduced the exposure opportunities to contaminants in soil. Concentrations of PCBs in ambient air at the site average 0.0023 micrograms per cubic meter ($\mu g/m^3$).[2] These levels are higher than background, but they do not exceed comparison values levels. Estimated cancer risks for opportunities for exposure to these levels fall below a range that environmental regulatory agencies generally target for remedial actions to achieve.

Under current conditions (e.g., limited use, current institutional controls) opportunities for exposure (e.g., intermittent visits to check on monitoring equipment) to contaminants at the site are not likely to result in adverse health effects and thus, the Lyman Street site as a whole poses no apparent public health hazard under these present conditions. Past opportunities for exposure to contaminated soil may have posed a greater public health hazard than present opportunities for exposure. Nonetheless, if the use of the site (e.g., residential development) or its physical characteristics were to change (e.g., paving removed from parking lot), the site might pose a public health hazard in the future, depending on the extent to which opportunities for exposure (e.g., PCBs in subsurface soil) increase. However, remedial actions being overseen by EPA for the GE sites under the Consent Decree of 2000 should help to prevent these future concerns.

[1] For a discussion of the difference between public health assessments and risk assessments, see Appendix B.
[2] $\mu g/m^3$ concentrations are most closely consistent with parts per billion (ppb) range levels.

BACKGROUND

A. Purpose and Health Issues

The Lyman Street site is one of 10 areas that comprise the GE site in Pittsfield, Massachusetts. On September 25, 1997 the GE site was proposed by the U.S. Environmental Protection Agency (EPA) for the National Priorities List (NPL) (EPA 1997). When a site is proposed for listing, the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) is required by federal law to conduct a public health assessment for the site. MDPH has a cooperative agreement with ATSDR to conduct public health assessments at NPL or other sites in Massachusetts. Thus, public health assessments for nine of the 10 areas of the GE site are being conducted by MDPH under its cooperative agreement with ATSDR. The tenth area, Allendale School Property, was evaluated by ATSDR in a health consultation. A health consultation was also conducted by ATSDR for Silver Lake. Negotiations between EPA and GE resulted in EPA's decision not to add the site to the NPL contingent on various cleanup actions agreed to by GE. In October 2000, a court-ordered Consent Decree was signed by EPA and GE, and it was agreed that GE would perform remediation actions to U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (MA DEP) performance standards (e.g., an average of less than 10 parts per million (ppm) PCBs in recreational surface soils, and an average of less than 2 ppm PCBs in residential soils). However, remediation does not eliminate past exposures and exposures occurring at parts of the site that may not yet have been remediated.

The 10 areas evaluated as part of the GE site are as follows:

1. Newell Street Area I
2. Newell Street Area II
3. East Street Area 1
4. East Street Area 2
5. Unkamet Brook Area
6. Hill 78 Area
7. Lyman Street
8. Allendale School Property
9. Housatonic River and Silver Lake
10. The Former Oxbows

Because each site has unique characteristics and opportunities for exposure, separate evaluations were developed for each of the 10 sites listed above. In addition, MDPH is also preparing a summary document for the GE site as a whole that will contain MDPH's overall assessment of public health implications for the entire site.

The GE site has a long history in terms of community health concerns. MDPH has been involved in addressing public health issues in the area since the early 1980s, when it issued a fish consumption advisory for the Housatonic River based on elevated PCB levels in fish. These final public health assessments will address public health concerns related to contaminants found at the GE site, as well as health studies or exposure investigations that have been conducted or are ongoing by MDPH in the area. These studies include a PCB exposure assessment study completed in 1997 (The information booklet from this report is included as appendix E), a descriptive assessment completed in 2002 of cancer incidence for the Housatonic River area for a 13-year period, an ongoing evaluation of serum PCB levels among residents who called the MDPH PCB Hotline concerned about their opportunities for exposure to PCBs in the Housatonic River area, and a 2000 expert panel report on non-occupational PCB health effects, (The information booklet from this report is included as appendix F).

The public health assessments or health consultations for the GE site review environmental data for the 10 areas mentioned above. They do not consider opportunities for past worker exposures within the GE facilities themselves (e.g., handling of materials containing PCBs), although they do consider opportunities for exposure to contaminants found in outdoor air, soil, or surface water bodies (including biota) for all potentially affected populations, including workers. Exposures to groundwater and sediments of the Housatonic River and its tributaries will be discussed in the public health assessment for the river.

These public health assessments also do not include evaluations of specific residential properties throughout Pittsfield (with the exception of properties evaluated as part of the site investigations for the 10 areas of the site). As part of the Residential Fill Property Project, the Massachusetts Department of Environmental Protection (MA DEP) and EPA have sampled residential properties suspected of containing elevated PCB levels in soil due to past use of fill material. As a result of public health concerns following the discovery of the use of PCB-contaminated soil for residential fill, MDPH has offered and continues to offer to any resident concerned about their opportunities for exposure to PCBs the exposure assessment questionnaire and, as warranted, having their blood tested for PCB levels as a service.

B. Site Description and History

In the early 1940s, the U.S. Army Corps of Engineers straightened some sections of the Housatonic River flowing through the city of Pittsfield to minimize the occurrence and impact of flood events. Some river oxbows and low-lying areas were separated from the active course of the river and subsequently filled with various materials from GE and other unknown sources. These fill materials were also used to elevate ground surface depressions in the area (Blasland, Bouck and Lee, 1996).

The Lyman Street site consisted of Oxbows D and E before the rechannelization. The site includes four areas: a parking lot, GE lot number 1, GE lot number 2, and a Western Massachusetts Electric Company (WMECO) parcel (see Figure 1)[3]. Immediately after the rechannelization in the early 1940s, Former Oxbow D was paved for use as the existing Lyman Street parking lot. The parking lot occupies a main portion in the south central area of the site. GE lots number 1 and 2 are located northwest of the parking lot. The WMECO parcel is located east of the parking lot and includes Former Oxbow E. All four areas inside the site are surrounded on the perimeter by locked, chain-link fences except for the northern portion of the WMECO parcel and along the riverbank. The whole site is zoned for general industrial use.

[3] These boundaries have changed somewhat after the Consent Decree. These public health assessment documents describe the sites and the site boundaries as they existed prior to the signing of the Consent Decree in 1999.

The site is bounded to the north by East Street, to the east by the East Street Area II site, to the south by the Housatonic River, and to the west by Lyman Street (see Figure 1). Within the Lyman Street site, the parking lot is also fenced on all sides except at the south along the steep riverbank where a guardrail is present. GE employees used the parking lot until April 1992 when it was closed and locked to restrict access. It was paved in the 1940s except for some narrow grass strips along the fence line (Blasland, Bouck and Lee 1997). GE lots number 1 and 2, which are located immediately to the north of the parking lot, have the northwestern portions paved. Lot number 1 had many small buildings in 1942, although all but one of them were removed before 1956. That one small building in lot number 1 was removed shortly after 1956. Lot number 2 was vacant from 1942 to 1974, received limited commercial use from 1974 to 1979, and was leased to the July Associates for parking space from 1986 to 1990 (Blasland, Bouck and Lee 1996). Both lots are currently vacant and fenced. MDPH is not aware of the specific activities that might have taken place in these buildings historically. Along the stretch of Lyman Street west of the site (see Figure 1), there are a few commercial businesses but no residences. However, there are some residences along Lyman Street south of the River. There are also some residences on East Street north of the site.

The WMECO parcel east of the parking lot, which includes Former Oxbow E, is vacant, unpaved, and covered by grass and brush. The Former Oxbow D beneath the Lyman Street parking lot was solid waste management unit (SWMU) G-21. A SWMU, as defined by the Resource Conservation and Recovery Act (RCRA), is any distinct unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. These units include any area at a facility at which solid wastes have been routinely and systematically released. At the GE sites SWMUs are considered to be sources or potential sources of hazardous waste release. Former drum storage areas, oil/water separators, drainage pits and sumps, chemical transfer areas/unloading stations, baghouses, underground storage tanks, underground pipes and tunnels, scrap yards and landfills are examples of SWMUs found at these sites (MA DEP 1995).

There are no known records for materials disposed of at Former Oxbows D and E. The coal gasification facility operated by the Berkshire Gas Company until the early 1970s in the adjacent East Street Area II site might also have contributed to the coal gasification byproducts (e.g., PAHs) found in soil or groundwater at the Lyman Street site (Blasland, Bouck and Lee 1996). Based on different surface covers, the Lyman Street site is grouped into three areas: the riverbank, the paved area, and the unpaved area. The riverbank area is south of the parking lot, the paved area includes the parking lot and the northern sections of GE lots number 1 and 2, and the unpaved area includes the WMECO property east of the parking lot and the southern sections of GE lots number 1 and 2 north of the parking lot (see Figure 1).

In August 1990, seepages of small amounts of nonaqueous phase liquid (NAPL) such as oil were observed entering the Housatonic River in the vicinity of the Lyman Street site (Blasland, Bouck and Lee 1996). NAPLs are liquid contaminants that do not mix with water. Light nonaqueous phase liquids (LNAPLs) are NAPLs that are lighter than groundwater and exist as a separate layer floating on the water table. Dense nonaqueous phase liquids (DNAPLs) are NAPLs that are denser than groundwater. These liquids sink through the aquifer and exist as a separate liquid phase below the water table (MA DEP 1995). The source of the NAPL plumes at this site is thought to be the material used to fill the Former Oxbow D (MA DEP 2000a).

As a MA DEP-approved short-term measure (STM), GE installed an oil-absorbent boom along the riverbank in this area in 1990. Additionally, LNAPL was detected in two monitoring wells, primarily in the southern corner of the site in the vicinity of Lyman Street and the river (Blasland, Bouck and Lee 1996). Recovery wells were installed by GE as a DEP-approved STM in April 1991 and November 1992, and, more recently, in July of 1996 and September of 1998 to minimize the intermittent oil seepages along the edge of the Housatonic River (HSI GeoTrans, Inc. 1999a). An on-site mobile groundwater treatment system was also installed as part of the STM in 1992. During 1994 and 1995, to replace the mobile groundwater treatment system, a water pipe was installed to convey groundwater pumped at the Lyman Street parking lot to the groundwater treatment facility located at Building 64 within the GE site. The extent of the LNAPL plume appears to contour the Former Oxbow D, which is beneath the Lyman Street parking lot, and head south toward the Housatonic River (HSI GeoTrans, Inc. 1999a). In 1996, DNAPL was detected in a monitoring well. The DNAPL plume is contained in Oxbow D and appears to be L-shaped, beginning at the Lyman Street parking lot, heading southeast toward the Housatonic River, and southwest toward Lyman Street, outside the western boundary of the site (MA DEP 2000a, HSI GeoTrans 1999a). Both LNAPL and DNAPL have been observed in monitoring wells primarily in the southern corner of the site. DNAPL has also been observed mainly in the western portion of the site.

In 1995, a release abatement measure (RAM) and an immediate response action (IRA) were completed at the site. The RAM included soil sampling, removal and disposal of PCB-containing soil, installation of a pipeline which transfers groundwater from on-site recovery wells to the groundwater treatment system, and backfill of the trench with clean soil (Blasland, Bouck and Lee 1997). The IRA included additional soil sampling and construction of a fence to restrict access to the WMECO and Lyman Street site properties. An area approximately 250 feet long and 4 feet wide was excavated for the pipeline route across the WMECO property (see Figure 2). Soil samples along the pipeline route contained PCBs and, therefore, this contaminated soil was disposed of, and clean soil used to backfill the route (Blasland, Bouck and Lee 1997). The site is currently vacant and not in use for any purpose. There is no evidence of trespassing. GE has installed an oil recovery system on the riverbank to prevent the migration of NAPL into the river (MA DEP 2001).

C. Site Visit

For purposes of this public health assessment, MDPH staff conducted five site visits: one on March 13, 1998, with EPA Region I and ATSDR representatives; one on April 9, 1998, with MA DEP and GE representatives; one on August 20, 1998; and one on July 27, 1999. A site visit conducted on June 21, 2001, following initiation of remedial activities outlined in the Consent Decree[4], provided an update of on-going activities at the GE sites. It was noted that the site is vacant and fenced to restrict public access. The only parts of the site that are not fenced are north of the WMECO parcel near East Street and along the riverbank. A worker wearing

[4] The Consent Decree was signed by several regulatory agencies, GE, and the city of Pittsfield.

protective clothing engaged in monitoring activities was observed during one site visit. There were no activities observed at the site except for sporadic checks of the recovery wells at the parking lot by site workers. Oil-absorbent booms and testing equipment were noted along the river.

D. Demographics

The Lyman Street site is located southeast of Silver Lake in the eastern section of Pittsfield. The 1980 U.S. Census indicated that 51,974 persons lived in the city of Pittsfield. The 1990 U.S. Census showed a population of 48,622, which is a 6.5% decrease from the 1980 population. The 2000 U.S. Census totaled a population of 45,793, which is a 5.8% decrease from 1990 and an 11.5% decrease from 1980. The sex, race, and age breakdowns for Pittsfield are presented in Table 1 (U.S. Census 2001). Within a one-half mile radius of the site boundary, there are approximately 1,920 persons with approximately 800 homes (Blasland, Bouck and Lee 1996).

Within the city of Pittsfield, the Lyman Street site is located in three census tracts (i.e., census tracts 9002, 9010, and 9012). In 1990, the census tract 9012 was newly created and separated from census tract 9010. It now abuts census tract 9010 along the opposite bank of the Housatonic River and primarily comprises the GE property itself. The site also abuts census tract 9002. The 2000 U.S. Census showed that 5,226 persons lived in census tract 9010; 4,674 persons lived in census tract 9002; and 66 persons lived in census tract 9012 (U.S. Census 2001). The sex, race, and age breakdowns are presented in Table 1.

E. Health Outcome Data

Cancer incidence as reported by the Massachusetts Cancer Registry (MCR) for the city of Pittsfield is described in Table 2. To determine whether Pittsfield experienced elevated cancer rates, standardized incidence ratios (SIRs) were calculated[5]. For the years 1995 through 1999, the most recent years for which cancer incidence data are available, no cancers were statistically significantly elevated (MDPH 2002b).

MDPH evaluated cancer incidence data for Pittsfield, Lenox, Lee, Stockbridge, and Great Barrington and for smaller geographic areas within each community for the period from 1982 through 1994. Cancers evaluated include bladder, liver, breast, non-Hodgkin’s lymphoma, thyroid and Hodgkin’s disease. Results of this analysis were presented in a separate health consultation report released in April 2002. Cancer information relevant to the GE sites was examined for patterns that might indicate an environmental exposure pathway (MDPH 2002a).

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

To evaluate whether a site poses an existing or potential hazard to an exposed or potentially exposed population, health assessors review all available on-site and off-site environmental contamination data for all media (e.g., soil, surface water, groundwater, air). The quality of the environmental data is discussed in the Quality Assurance and Quality Control section. Physical

[5] A detailed explanation of SIRs is presented in Appendix D.

conditions of the contaminant sources and physical hazards, if any, are discussed in the Physical and Other Hazards section. A plain language glossary of environmental health terms can be found at the end of this document (Appendix C).

A. On-Site Contamination

Available data for surface soil, soil boring, groundwater, and air data from environmental sampling at the Lyman Street site from 1990 through 1999 were reviewed[6]. Data for unfiltered groundwater, air, and soil samples collected at 0 to 0.5 ft, 0 to 1 ft, and 0 to 2 ft were tabulated and screened for this site. The soil and groundwater samples were analyzed for PCBs, dioxins, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides/herbicides and inorganics. Data for subsurface soil were qualitatively reviewed.

Health assessors use a variety of health-based screening values, called comparison values, to help decide whether compounds detected at a site might need further evaluation. These comparison values include environmental media evaluation guides (EMEGs), reference dose media evaluation guides (RMEGs), cancer risk evaluation guides (CREGs), maximum contaminant levels for drinking water (MCLs), or other applicable standards. These comparison values have been scientifically peer reviewed or derived using scientifically peer-reviewed values and published by ATSDR and/or EPA. The MA DEP has established Massachusetts's maximum contaminant levels (MMCL) for public drinking water supplies. EMEG, RMEG, MCL, and MMCL values are used to evaluate the potential for noncancer health effects. CREG values provide information on the potential for carcinogenic effects. For chemicals that do not have these comparison values available for the medium of concern, EPA risk-based concentrations (RBCs) developed by EPA regional offices, are used. For lead, EPA has developed a hazard standard for residential soil (EPA 2001).

If the concentration of a compound exceeds its comparison value, adverse health effects are not necessarily expected. Rather, these comparison values help in selecting compounds for further consideration. For example, if the concentration of a chemical in a medium (e.g., soil) is greater than the EMEG for that medium, the potential for exposure to the compound should be further evaluated for the specific situation to determine whether noncancer health effects might be possible. Conversely, if the concentration is less than the EMEG, it is unlikely that exposure would result in noncancer health effects. EMEG values are derived for different durations of exposure according to ATSDR's guidelines. Acute EMEGs correspond to exposures lasting 14 days or less. Intermediate EMEGs correspond to exposures lasting longer than 14 days to less than one year. Chronic EMEGs correspond to exposures lasting one year or longer. CREG values are derived assuming a lifetime duration of exposure. RMEG values also assume chronic exposure. All the comparison values (i.e., CREGs, EMEGs, RMEGs, and RBCs) are derived assuming opportunities for exposure in a residential setting.

For this site, soil data were evaluated by the riverbank, paved and unpaved areas. Tables 3a through 3h show the minimum, mean, and maximum values of soil compounds that exceeded their respective health-based comparison values or, in the case of PAHs and inorganic

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[6] Most data considered in this public health assessment are pre-Consent Decree.

compounds, typical background values. Of the compounds that were detected for soil from 0 to 0.5 ft and 0 to 2 ft at this site, the ones that exceeded health comparison values or typical background levels were PCBs, dioxins, and three PAHs (i.e., benzo(a)pyrene, dibenz(a,h)anthracene, and chrysene) (Shacklette 1984, ATSDR 1993).

Tables 3a through 3h summarize the results of PCB surface soil samples which were collected at the riverbank, and paved and unpaved areas. Six surface soil samples were collected for the riverbank area. The average concentration was 21 ppm and the maximum concentration was 56 ppm for 0 to 0.5 ft. For the 0 to 2-ft depth, the average concentration was 17 ppm and the maximum was 32 ppm. For the paved areas, 21 surface soil samples at 0- to 2- ft depths were collected and analyzed for PCBs. The averaged concentration was 74 ppm and the maximum concentration was 890 ppm.

PCB hot spots were located along the pipeline in the unpaved WMECO area with levels of 3,600 ppm and 1,020 ppm. The next highest PCB concentrations for the unpaved areas were found in two samples at 130 ppm and 150 ppm, also collected along the pipeline. Of 57 total surface soil samples collected at unpaved areas of the Lyman Street site prior to pipeline soil excavation, besides the four highest values described above, 19 additional samples had PCB concentrations ranging from 13 ppm to 62 ppm, and these were located in the unpaved WMECO area north of the pipeline. The rest of the samples had PCB levels ranging from nondetectable to 6.5 ppm, and were collected from the unpaved WMECO area and the unpaved southern sections of GE lots number 1 and 2. The overall average concentrations for unpaved areas prior to the 1995 excavation were 22 ppm with a maximum of 150 ppm at 0 to 0.5-ft and 427 ppm with a maximum of 3,600 ppm at a depth of 0 to 2 ft.

After the RAM and IRA in 1995, excavated soil with elevated PCB levels along the pipeline in the unpaved WMECO area was removed and the excavated area was replaced with clean soil. Thus, the concentrations of PCBs in surface soil at the unpaved areas were lower after the STM, RAM, and IRA. Following these actions, PCB concentrations in surface soil at the unpaved areas of the site averaged 13 ppm with a maximum of 100 ppm at 0 to 0.5 ft and 5 ppm with a maximum of 20 ppm at a depth of 0 to 2 ft.

Four surface soil samples were collected at 0 to 0.5 ft at the riverbank area and analyzed for compounds other than PCBs (dioxins, VOCs, SVOCs pesticides/herbicides, and inorganics). These had levels above comparison values for dioxins, and two PAH (i.e., dibenz(a,h)anthracene, and chrysene). These four samples were collected at the riverbank south of the Former Oxbow D in the Lyman Street parking lot in 1990 and 1995 (See Table 3a).

Three surface soil samples were collected in 1995 at a depth of 0 to 0.5-ft at other unpaved areas and had levels above comparison values for dioxins, and two PAHs (i.e., benzo(a)pyrene, and dibenz(a,h)anthracene). Two of these samples were collected at the unpaved WMECO area and one sample was collected at the unpaved area of the GE lot number 2. Three other surface soil samples were collected in 1995 at a depth of 0 to 2 ft in the unpaved areas of the Lyman Street site away from the riverbank, and also had levels above comparison values for dioxins and one PAH (i.e., dibenz(a,h)anthracene). These samples were collected at the WMECO area.

Surface soil sampling was performed in 1999 as a part of the GE source control investigations. Throughout 1999, seven 0 to 1 ft samples were taken from the paved area. PCBs were detected in all seven samples, with five at concentrations at or above the comparison value. Eight samples were taken from the unpaved areas. The sample taken east of the parking lot had a PCB concentration above the comparison level for PCBs, at 200 ppm.

For the riverbank area, approximately 15 subsurface soil samples were collected at depths ranging from 2 to 24 ft at 2-ft intervals and analyzed for PCBs, dioxins, VOCs, SVOCs pesticides/herbicides, and inorganics. The PCB levels ranged from nondetectable to 3.5 ppm. The levels for the other compounds ranged from nondetectable to less than 1 ppm or within their respective background levels (ATSDR 1995, Shacklette 1984).

For the paved areas, subsurface soil samples were collected at depths ranging from 2 to 30 ft at 2-ft intervals, and analyzed for PCBs, dioxins, VOCs, SVOCs, pesticides/herbicides, and inorganics. Of 155 subsurface samples from the parking lot area, 121 samples had PCB detections. Except for 39 samples collected from six soil borings at the Former Oxbow D under the parking lot with PCB concentrations ranging from 70 ppm to 290,000 ppm, the rest of the samples had PCB concentrations ranging from nondetectable to 10 ppm. Out of these 155 samples, approximately 39 samples were analyzed for dioxins, VOCs, SVOCs, pesticides/herbicides, and inorganics. The levels for these compounds ranged from nondetectable to less than 1 ppm or within their respective background levels (ATSDR 1995, Shacklette 1984).

For the unpaved areas, subsurface soil samples were collected at depths ranging from 2- to 22- ft at 2-ft intervals, and analyzed for PCBs, dioxins, VOCs, SVOCs, pesticides/herbicides, and inorganics. Forty-two of 65 samples collected from soil borings at the WMECO area had PCB detections. Except for three samples collected along the pipeline with PCB concentrations of 15 ppm, 300 ppm, and 610 ppm, the rest of the samples had PCB concentrations ranging from nondetectable to 7 ppm. Out of these 65 samples, approximately 12 samples were analyzed for dioxins, VOCs, SVOCs, pesticides/herbicides, and inorganics. The levels for these compounds ranged from nondetectable to less than 1 ppm or within their respective background levels.

The general soil PCB distribution throughout the site (surface and subsurface) is shown in Figure 3. The figure indicates that PCB concentrations are highest at the area from the parking lot to the riverbank with levels exceeding 1,000 ppm. Generally, PCB concentrations throughout the site decreased as distance from the parking lot increased (e.g., 50 ppm to 1,000 ppm, 10 ppm to 50 ppm, and 1 ppm to 10 ppm).

At the commercial area along the stretch of Lyman Street west of the site, soil samples were analyzed from three soil borings taken during the installation of monitoring wells and one additional soil boring taken in 1996 as part of the potential DNAPL assessment in this area (Blasland, Bouck, and Lee 1996). Subsurface samples from these four soil borings were analyzed for PCBs, dioxins, VOCs, SVOCs, pesticides/herbicides and inorganics. Forty of 53 samples collected from soil borings at depths ranging to 26 ft had PCB detections. The highest PCB level (i.e., 260 ppm) was found at a depth of 24- to 26- ft. Of these 53 samples approximately four samples (i.e., one sample from each soil boring) were analyzed for dioxins, VOCs, SVOCs, pesticides/herbicides and inorganics. The levels for these compounds were either nondetectable or within their respective background levels.

Additional sampling of the commercial area west of Lyman Street was performed throughout 1999. Six samples were collected at depths of 0- to 0.5- and 0- to 1- ft. Four samples had PCB levels at or above the comparison value (HSI 1999a, HSI 1999b, HSI 1999c). Subsurface samples of the soil borings were analyzed for PCBs, VOCs, SVOCs, inorganics, and dioxins. Arsenic, PCBs, and PAHs (i.e., benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene) were detected above comparison values. Dioxin concentrations were above the comparison value at 25-27 ft below surface. The maximum PCB concentration was detected at the same location and depth, measuring 2900 ppm.

For unfiltered groundwater outside the plume areas, 22 samples were collected throughout the site and analyzed for PCBs. The PCB levels ranged from nondetectable to 51.6 ppm. The same samples were also analyzed for dioxins, VOCs, SVOCs, pesticides/herbicides, and inorganics. Four more groundwater samples were collected at GE lots number 1 and 2 and analyzed for VOCs. The levels of all dioxins, VOCs, SVOCs, pesticides/herbicides, and inorganics analyzed in all of these samples ranged from nondetectable to less than 1 ppm or less than the ATSDR comparison values for drinking water except for one chlorobenzene sample with a concentration of 14 ppm and one naphthalene sample with a concentration of 9.5 ppm.

Air monitoring for PCBs was conducted at two monitoring stations: one in the east central portion of the Lyman Street parking lot and one along the bank of the Housatonic River (Blasland, Bouck and Lee 1996). Some samples were taken with a high-volume sampler, while others were taken with a low-volume sampler. High-volume samplers are usually used for outdoor sampling where there is a large amount of air movement while low-volume samplers are usually used for indoor sampling because the samplers are easier to handle than the high-volume samplers. There is no major difference in sampling techniques between high- and low-volume samplers (MA DEP 1998). The low-volume samples were placed near the ground, while the high-volume samples were placed two to six meters above ground. In general, the high-volume samples had lower detection limits (Blasland, Bouck and Lee 1997). Results from the low-volume samples were higher than for the high-volume samples.

The sampling was conducted as part of the site assessment work during the following periods:

- August 1991 through August 1992, high-volume sampling one to three times per month at the beginning, middle, and end of the month, except for June 1992 with four sampling times; and
- May 1993 through August 1993, high-volume and low-volume sampling twice per month at the beginning and middle of the month.

For all the sampling periods combined, 38 high-volume sample results were available for review. Of these, 18 samples were taken during the summer months (i.e., mid-May through mid-September). For sampling period of May 1993 through August 1993, eight low-volume sample results were available for review. Table 4 summarizes these results:

- 24 of 38 high-volume results showed PCB detections, with a mean concentration, including nondetectables calculated at one-half the detection limit, of 0.0023 $\mu g/m^3$;
- 17 of 18 high-volume results from the summer months showed PCB detections, with a mean concentration of 0.0042 $\mu g/m^3$;
- 7 of 20 high-volume results from the months of 1991 and 1992 excluding the summer months of these two years showed PCB detections, with a mean concentration of 0.0006 $\mu g/m^3$;
- 5 of 8 low-volume results available for the summer months only showed PCB detections, with a mean concentration of 0.0501 $\mu g/m^3$.

An ambient air monitoring station to establish background concentrations was set up at the Berkshire Community College 3.5 miles west of the GE sites. The sampling was conducted during the following periods:

- August 1991 through August 1992, high-volume sampling one to three times per month at the beginning, middle, and end of the month, except for June 1992 with four sampling times;
- May 1993 through August 1993, high-volume sampling twice per month at the beginning and middle of the month;
- June 1995 through August 1995, high-volume sampling twice per month at the second and last weeks of the month; and
- July 1996 through September 1996, high-volume sampling once per month.

Table 4 shows the results from the background sampling for PCBs:

- 19 of 48 results showed PCB detections, with a mean concentration of 0.0007 $\mu g/m^3$;
- 15 of 27 results taken in the summer showed PCB detections, with a mean concentration of 0.001 $\mu g/m^3$;
- four of 21 results taken in the months other than the summer months (i.e., mid-May through mid-September) showed PCB detections, with a mean concentration of 0.0004 $\mu g/m^3$.

Thus, the background concentrations generally averaged about three to four times lower than those detected at the Lyman Street site. Both monitoring programs at the site and at the background location indicate that ambient PCB concentration increase when temperature rises, starting at about 60º F (Blasland, Bouck and Lee 1996). PCB concentrations in air during the summer months, though less than ATSDR comparison values, averaged approximately four to 50-fold higher at the Lyman Street site than at the background site. Thus, it is likely that there is a contribution of ambient PCBs in the general vicinity of the GE sites during the summer season in particular.

B. Off-Site Contamination

The GE site comprises 10 different areas, for which separate public health assessments or health consultations are being developed. Those 10 areas are the Housatonic River/Silver Lake, the Former Oxbows (Oxbows A,B,C,J, and K), East Street Area I, East Street Area II, Newell Street Area I, Newell Street Area II, the Unkamet Brook Area, Lyman Street, Hill 78 Area, and the Allendale School Property. Environmental data for the Housatonic River, which borders the Lyman Street site, typically would be considered off-site from the Lyman Street site. However, these data will be addressed in a separate public health assessment for the Housatonic River rather than be included as off-site contamination for the Lyman Street site.

Some residences located along Lyman and East Streets might have concentrations of PCBs in ambient air which closely approximate concentrations measured at the Lyman Street site. In addition, the DNAPL plume extends beneath the commercial property at 10 Lyman St and is likely to extend below Lyman St. itself (MA DEP 2000b). Some PCBs did occur on the commercial area along Lyman St. (See Figure 3 and the previous section).

C. Quality Assurance/Quality Control (QA/QC)

The reports on GE facilities were also associated with a sampling and analysis plan that included information on QA/QC (Blasland, Bouck and Lee 1994). The information shows that QA/QC was performed appropriately for the samples. The validity of the conclusions made in this health assessment depends on the accuracy and reliability of the data provided in the cited reports.

For surface and subsurface samples, some of the VOCs and SVOCs were reported as estimated values that were less than the contract laboratory program required quantitation limit. A limited number of PAH surface soil samples were reported as nondetectable but had high detection limits due to interference. Some soil samples had dioxin results reported as estimated values that were below the quantitation limit but above the target detection limit. A few other soil samples had some inorganic results reported as less than the contract required detection limit but greater than the instrument detection limit. Approximately 10 surface and subsurface soils samples had high detection limits for Aroclor 1254 due to interference. However, the total Aroclor results reported for these samples were consistent with QA/QC requirements. All data have been approved by EPA pursuant to the Field Sampling Plan/Quality Assurance Project Plan (EPA 2000).

D. Physical and Other Hazards

There are no known physical hazards to the general public at this site. A steep riverbank might be a physical hazard for those who might attempt to trespass the site via the Housatonic River. The site visits did not reveal any evidence of trespassing.

PATHWAY ANALYSIS

To determine whether nearby residents and people on-site were, are, or could be exposed to contaminants, an evaluation was made of the environmental and human components that lead to human exposure. 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 a receptor population.

Exposure to a chemical must first occur before any adverse health effects can result. Five conditions must be met for exposure to occur. First, there must be a source of that chemical. Second, a medium (e.g., water) must be contaminated by either the source or by chemicals transported away from the source. Third, there must be a location where a person can potentially contact the contaminated medium. Fourth, there must be a means by which the contaminated medium could enter a person's body (e.g., ingestion). Finally, the chemical must actually reach the target organ susceptible to the toxic effects from that particular substance at a sufficient dose for a sufficient time for an adverse health effect to occur (ATSDR 1993).

A completed exposure pathway exists when all of the above five elements are present. A potential exposure pathway exists when one or more of the five elements is missing and indicates that exposure to a contaminant could have occurred in the past, could be occurring in the present, or could occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will not likely be present. The discussion that follows incorporates only those pathways that are important and relevant to the site.

A. Completed Exposure Pathways

Surface Soil

At the time of this health assessment, there are some opportunities for exposure to contaminated soil on the site because a portion of the site boundary on the East Street side is not fenced. While the southern boundary of the site that abuts the Housatonic River is also not fenced, because of the very steep riverbank and river current, which is strong during winter and spring, at this location, it would be unlikely that the site would be entered by trespassers from this direction other than very sporadically.

Past opportunities for exposure would likely have been greater because of more intense use of the site (e.g., activities that might have taken place in the buildings previously on the site that were removed by 1956, use of parking lots) and because the PCB-contaminated soil that was removed from the WMECO area during pipeline installation in the mid-1990s resulted in lower average PCB soil levels on the Lyman Street site after that time. Because the parking lot (i.e., paved areas) above Former Oxbow D was paved for many decades, past exposure opportunities to the highest concentrations of PCBs in soil at the Lyman Street site would not have occurred.

The unpaved areas of the site including the WMECO area have always been vegetated at least to some degree, thereby somewhat limiting direct contact with contaminated soil. Therefore, past and present opportunities for exposure to soil contaminants at the site include workers, occasional trespassers, and possibly neighborhood children using the site for recreational purposes. At this time no plans are in pace to change the current status of the site. Exposures might have occurred as a result of incidental ingestion of contaminated soil or skin absorption of PCBs through direct contact with PCB-contaminated soil at the site in the past and occasionally in the present.

Ambient Air

A substantial amount of air data is available for the Lyman Street site. Past and present opportunities for exposure to PCBs in ambient air might occur to employees who worked at the site, occasional trespassers who might have accessed the site via the steep riverbank in this area or entered the site at the unfenced location, and residents living or working in neighborhoods on Lyman and East streets adjacent to the site through daily inhalation.

B. Potential Exposure Pathways

Subsurface Soil

Future exposures to contaminated soils might occur to persons who might contact the soil during or after possible excavation or construction activities. For example, opportunities for exposures up to 290,000 ppm of PCBs might happen should excavation or construction activities occur in the parking lot area (i.e., Former Oxbow D). Exposure to PCBs through contact with this soil would mostly happen through incidental ingestion or skin absorption. At this time, the MDPH is not aware of excavation or construction activities (e.g., new buildings, change of parking lot use) planned for the site.

Surface Water

Groundwater from this site discharges into the Housatonic River (Blasland, Bouck and Lee 1996). However, because of limited sampling data and other sources in the area, it is difficult to assess the extent to which groundwater from the Lyman Street site might contribute to contamination in the Housatonic River. Groundwater in the area is not a drinking water resource. Thus, although this might be considered a potential exposure pathway (e.g., via ingestion of fish contaminated with PCBs or incidental ingestion and dermal contact with surface water), this public health assessment will not attempt to quantify the possible role of groundwater as a contributor of PCBs, NAPL, or other substances for the Housatonic River. Also, surface water, sediment, and fish chemical concentration data exist for the Housatonic River itself. The public health assessment document being developed for the Housatonic River will evaluate opportunities for exposures to PCBs or other contaminants in the river utilizing all available data from the river and relevant environmental data from the individual GE sites.

C. Eliminated Exposure Pathways

Groundwater

Past, present, and future opportunities for exposure to chemicals in groundwater are not likely to occur at this site because residences in the neighborhoods adjacent to the Lyman Street site, as well as Pittsfield as a whole, are on a municipal water supply. Residents are not likely to use this groundwater for drinking. It is possible that residents may have private wells for irrigation purposes, but MDPH has no evidence of such wells.

DISCUSSION

MDPH has summarized the available environmental data and exposure pathways for the Lyman Street site in this public health assessment. Completed exposure pathways included surface soil and ambient air. The main compounds of concern at the site are PCBs. Other compounds that exceeded comparison or typical background values in at least some surface soil samples were dioxins and three PAH compounds (benzo[a]pyrene, dibenz[a,h]anthracene and chrysene).

Opportunities for exposure to these compounds are primarily via incidental ingestion of surface soil at the site, skin absorption of PCBs through direct contact with PCB-contaminated soil, or inhalation of PCBs detected in ambient air. Groundwater at the site has not been and is not being used for drinking water or other industrial purposes and hence, groundwater does not present a completed exposure pathway. Although groundwater likely discharges into the Housatonic River, it is more appropriate to use actual chemical concentration data for the river surface water and sediment in estimating public health effects. Public health implications from opportunities for exposure to chemicals in the river will be covered in a separate public health assessment.

In evaluating the public health implications of opportunities for exposure to PCBs, MDPH has been conducting a variety of activities in the Housatonic River area. MDPH previously completed an exposure assessment study of the Housatonic River area (MDPH 1997). Residents of eight communities that live within one-half mile of the Housatonic River were randomly chosen to participate in the exposure assessment study. In addition, residents who were not chosen for the study but who were concerned about exposure to PCBs were offered the opportunity to volunteer to participate in a separate effort.

The exposure assessment study found that although the participants generally had serum PCB levels within the reported background range for non-occupationally exposed individuals (ATSDR 2000), those who engaged in high-risk activities (e.g., high frequency and duration of consumption of contaminated fish) had higher serum PCB levels.

Because of the discovery during summer 1997 of widespread residential PCB soil contamination, MDPH is conducting a separate study of residents who might be at risk of exposure through contact with residential soil. MDPH set up a hotline number for individuals to call in with health-related concerns, complete exposure questionnaires, and request serum PCB testing. Since August of 1997 over 150 individuals have had their serum tested for PCBs. This is an ongoing community service by MDPH. Results of serum PCB testing and evaluation of the community health concerns resulting from the hotline calls will be reported in the summary public health assessment for the GE sites.

MDPH has also been conducting ongoing outreach with the local health community to inform them of activities in the area. For example, MDPH held Grand Rounds in 1993, 1996, 1997, September 2000, and December 2000 at the Berkshire Medical Center or North Adams Hospital to discuss MDPH activities, particularly those related to serum PCB testing, with health professionals at these facilities. During 1999, MDPH staff have spoken at a number of other health-related forums sponsored by local health professionals and community groups.

Other activities performed or ongoing by MDPH include the following:

1. MDPH conducted a descriptive cancer incidence analysis of selected cancer types (i.e., bladder cancer, liver cancer, non-Hodgkin's lymphoma, breast cancer, thyroid cancer and Hodgkin's disease) in Pittsfield, Lenox, Lee, Stockbridge, and Great Barrington that occurred from 1982 through 1994, utilizing data from the Massachusetts Cancer Registry. This analysis included evaluations of temporal and geographic trends (e.g., analysis of smaller geographic areas, or census tracts).

2. The Executive Office of Health and Human Services (EOHHS) convened an independent panel of national experts to advise MDPH on the most up-to-date information on possible health effects from non-occupational exposure to PCBs. A public meeting attended by the panel chair was held in Pittsfield in January 1999, prior to the first panel meeting. The panel prepared a written report that was submitted to EOHHS and released to the public in October 2000 (MDPH 2000). A public meeting attended by most of the panel members was held in Pittsfield in December 2000. In addition, panel members along with MDPH met with MDPH's advisory committee and with physicians at the Berkshire Medical Center.

3. MDPH established its Housatonic River Area Advisory Committee on Health in 1995. This committee is comprised of local residents, representatives from the local medical community, environmental and health professionals, representatives from the offices of elected officials and local health departments. MDPH staff hold meetings with committee members to report on the status of various activities and to discuss and get feedback on the conduct of MDPH health activities (e.g., education and outreach) in the area.

Information gathered from these additional activities improve MDPH's ability to assess the public health implications of PCB contamination in the Pittsfield area. The following discussion of potential public health implications is based on available information. A summary public health assessment incorporating all available information from the individual GE site PHAs and addressing public health and exposure concerns will be developed and released for public comment.

A. Chemical-Specific Toxicity Information

As noted earlier in this public health assessment, PCBs, dioxins, and three PAH compounds exceeded either comparison or typical background levels in surface soil at the site. In addition, PCBs were detected in ambient air samples at the site at levels higher than background levels for the area.

In order to evaluate possible public health implications, estimates of opportunities for exposure to compounds (e.g., in soil) must be combined with what is known about the toxicity of the chemicals. ATSDR has developed minimal risk levels (MRL) for many chemicals. An MRL is an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse noncancer health effects over a specified duration of exposure. MRLs are derived based on no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs) from either human or animal studies. The LOAELs or NOAELs reflect the actual levels of exposure that are used in studies. ATSDR has also classified LOAELs into "less serious" or "serious" effects. "Less serious" effects are those that are not expected to cause significant dysfunction or whose significance to the organism is not entirely clear. "Serious" effects are those that evoke failure in a biological system and can lead to illness or death. When reliable and sufficient data exist, MRLs are derived from NOAELs or from less serious LOAELs, if no NOAEL is available for the study. To derive these levels, ATSDR also accounts for uncertainties about the toxicity of a compound by applying various margins of safety to the MRL, thereby establishing a level that is well below a level of health concern.

PCBs

For PCBs, the rhesus monkey is the most sensitive animal species in terms of health effects resulting from exposure to PCBs, and studies in this species form the basis of ATSDR's screening values for PCBs. ATSDR derived a chronic oral MRL of 0.00002 milligrams per kilogram per day (mg/kg/day) for chronic exposure to PCBs. The MRL was based on a LOAEL for immunological effects (e.g., decreased IgM and IgG antibody levels in response to sheep red blood cells) in female rhesus monkeys administered 0.005 mg/kg/day aroclor 1254 by gavage for 55 months (Tryphonas et al. 1989, 1991a; as cited in ATSDR 2000). A LOAEL of 0.005 mg/kg/day for 37 months also induced adverse dermatological effects (e.g., prominent toe nail beds, elevated toe nails, separated toe nails) in adult monkeys (Arnold et al. 1993a; as cited in ATSDR 2000) as well as in their offspring (Arnold et al. 1995; as cited in ATSDR 2000). A LOAEL of 0.005 mg/kg/day for 37 months in adult monkeys also induced effects (e.g., inflammation of tarsal glands, nail lesions, and gum recession) in their offspring.

An uncertainty factor of 300 was used to derive the chronic oral MRL (10 for extrapolation from a LOAEL to a NOAEL, 10 for human variability and 3 for extrapolation from animals to humans). These effects at the LOAELs discussed above are considered by ATSDR to be "less serious" effects. Other effects ("less serious" or "serious") were generally reported to occur at levels approximately four times greater than those that form the basis for the lowest LOAELs (ATSDR 2000). A panel of international experts cited support for this chronic oral MRL from human studies (ATSDR 2000).

ATSDR has also developed an intermediate oral MRL of 0.00003 mg/kg/day. The MRL was based on a LOAEL of 0.0075 mg/kg/day for neurobehavioral effects in infant monkeys that were exposed to a PCB congener mix representing 80% of the congeners typically found in human breast milk (ATSDR 2000).

ATSDR has not developed an MRL for the inhalation route of exposure because of a lack of sufficient data on which to base an MRL. The chronic MRL will be used for evaluating human health concerns associated with opportunities for exposure to PCBs at this site, regardless of duration or route of exposure. This is a conservative assumption.

While the above health effects were the most sensitive health effects (forming the basis of the MRL), a number of human and animal studies have suggested that other effects include liver damage, neurological effects, reproductive and developmental effects, and cancer. Also, the International Agency for Research on Cancer (IARC) has classified PCBs as "probable human carcinogens" based on sufficient evidence of carcinogenicity in animals and limited evidence in humans. Because it is difficult to show that a chemical causes cancer in humans, animal studies are used to identify chemicals that have the potential to cause cancer in humans. PCBs do cause cancer in animals. Thus, it is assumed that exposure to PCBs over a period of time might pose a risk for humans. The degree of risk depends on the intensity and frequency of exposure.

Dioxins

The compound 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is one of 75 different congeners of chlorinated dibenzo-p-dioxins (CDDs). Dioxins are not intentionally manufactured but can be formed in the manufacturing process of chlorophenols (e.g., herbicides and germicides). The main environmental sources of dioxins are herbicides, wood preservatives, germicides, pulp and paper manufacturing plants, incineration of municipal and certain industrial and medical wastes, transformer/capacitor fires involving PCBs, exhaust from automobiles using leaded gasoline, chemical wastes from improper disposal, coal combustion, and residential wood burning stoves.

ATSDR has developed an MRL for TCDD of 1x10-9 mg/kg/day, or 1 picogram per kilogram per day (pg/kg/day) (ATSDR 1998). This was based on an LOAEL for developmental effects in rhesus monkeys. This MRL is similar to what ATSDR has estimated as a background exposure level of approximately 0.7 pg/kg/day for TCDD. ATSDR notes that the primary route of exposure to dioxin compounds for the general population is the food supply (e.g., fish), which is the main contributor to the background exposure. The EPA has estimated that greater than 90 percent of the human body burden of dioxins is derived from foods. If one considers exposure to all CDD and chlorinated dibenzofuran congeners, the background exposure level increases to as much as 2.75 pg/kg/day (ATSDR 1998).

The EPA has determined that TCDD is a "probable human carcinogen" based on sufficient animal and limited or inadequate evidence in human studies. IARC has classified TCDD as carcinogenic to humans (Group 1) (ATSDR 1998).

PAH Compounds

PAHs are ubiquitous in soil. Combustion processes release PAHs into the environment. Therefore, the major sources of PAHs in soils, sediments, and surface water include fossil fuels, cigarette smoke, industrial processes, and exhaust emissions from gasoline engines, oil-fired heating, and coal burning. PAHs are also found in other environmental media and in foods, particularly charbroiled, broiled, or pickled food items, and refined fats and oils (ATSDR 1995).

No MRLs are available for benzo(a)pyrene or dibenz(a,h)anthracene. The primary health concern for these compounds is carcinogenicity, and EPA considers both compounds to be "probable human carcinogens," based on sufficient evidence in animal studies and inadequate evidence for human studies.

B. Evaluation of Possible Health Effects

For the Lyman Street site, populations that could have had opportunities for exposure to compounds in soil or PCBs in ambient air include employees of GE, WMECO or other businesses that might have been located on the site in the past, and nearby residents in areas adjacent to the site, who may have accessed the site directly in the past. At the present time, the entire site is vacant and fenced, except for one area on the northern boundary along East Street, and along the riverbank adjacent to the site. At this area, PCB concentrations approximate 1 ppm, hence they do not present health concerns.

The Housatonic River borders one side of the site. The banks of the river at this point are very steep and difficult to access, and therefore, opportunities for exposure to contaminants in soil on the riverbank at the Lyman Street site are expected to be limited. The majority of the Lyman Street site is paved, primarily as parking lots, and has been paved since the 1940s, when the site was formed during rechannelization of the river. The WMECO parcel on the Lyman Street site has an electrical tower and is grass-covered or heavily vegetated. MDPH is not aware of any reports of frequent recreational use by nearby residents in the past or currently. However, for many years the site was not fenced, hence, it is possible that this might have occurred. No observations or evidence of trespassing (e.g., dirt paths) or other use by local residents were made during site visits. Workers periodically visit the site to check on monitoring equipment or other site structures.

As with other areas of the GE site in Pittsfield, the primary compounds of concern at the Lyman Street site are PCBs in surface soil and ambient air. PCB data in surface soil were summarized according to three main types of areas on the property—the riverbank, paved areas, and unpaved areas. For paved areas of the site, the pavement prevents contact with PCBs or other compounds in the soil under the pavement (e.g., for 0- to 2-ft samples, the average PCB concentration is 74 ppm and the maximum concentration is 890 ppm). One soil-boring sample at the south side of the parking lot had a PCB concentration of 290,000 ppm at a four-to-six ft depth. However, without past or present opportunities for exposure to compounds in soil beneath paved areas, adverse health effects would not be expected.

Unpaved areas of the site could, in the past and at the time of this health assessment, present opportunities for exposure to compounds in the soil. It is likely that persons would have had or have limited, if any, direct contact with the soils on the riverbank due to its steepness and the strong river current at this location. Thus, with limited opportunities for exposure to these soils (i.e., 20 ppm average) under past and present conditions, adverse health effects would not be expected. The highest concentrations of PCBs in surface soils (i.e., 100 ppm average ranging as high as 3,600) in unpaved areas outside of the riverbank were on the WMECO parcel in the area where a pipeline was installed in the mid-1990s. As part of remediation conducted in 1995, contaminated soils along the pipeline in the WMECO parcel were removed and replaced with clean soil. PCB concentrations in surface soils remaining after the remediation were much lower (i.e., 12 ppm average ranging as high as 100 ppm). Therefore, persons who worked or had contact with the Lyman Street site prior to the removal action (e.g., maintenance workers, construction workers, possibly neighborhood children who might have engaged in recreational activities on the site) would be expected to have had greater opportunities for exposure to PCBs in soil.

A substantial amount of ambient air monitoring for PCBs is available for the Lyman Street site. As with some other areas of the GE site, PCB concentrations in ambient air measured on the Lyman Street site showed levels higher than the background location at Berkshire Community College (see Table 4). Some residences and businesses are located adjacent to the Lyman Street site, and thus, it is reasonable to assume that PCB concentrations measured on the site itself would likely be similar to concentrations occurring in residential and commercial areas adjacent to the site. Assuming daily lifetime exposure to the average PCB concentration of about 0.0023 $\mu g/m^3$ for adjacent residents, it is not expected that an elevated cancer risk would result.[7]

Assuming that a site maintenance worker might have spent up to five days each week during the year for many years on the site, they could have incidentally ingested soil during their activities, and also absorbed some PCBs through their skin from direct contact with soil. It is possible that such exposure might have resulted in health impacts (e.g., immunological) for some individuals, particularly if those individuals had frequent contact with the soil that had the highest concentration of PCBs prior to the removal action. A worker that came into contact with average concentrations in site soil (i.e., 100 ppm), five days per week over the course of the year, prior to the removal action could still have an estimated exposure higher than ATSDR's MRL but probably lower than the lowest reported LOAEL. For workers who would have had contact with average soil concentrations prior to the removal action, a low increased concern for cancer may have resulted[8]. Ambient air opportunities for exposure to PCBs did not significantly add to the surface soil PCB exposure concerns. Although the assumptions used are conservative (e.g., ingestion over a lifetime prior to removal action), the site could have presented health concerns to some exposed individuals. Following the removal action, it would be expected that workers or other individuals who come in contact with the site soil (i.e., 12 ppm average) under current

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[7] Lifetime average daily dose (LADD) = $\frac{(\text{Air concentration mg/m}^3)\ (\text{Intake rate m}^3\text{/d})\ (\text{Exposure duration yr})}{(\text{Body weight kg x Lifetime yr})}$

0.64×10^{-6} mg/kg-d = $\frac{(0.0000023\ \text{mg/m}^3)\ (23\ \text{m}^3\text{/d})\ (59\ \text{yr})}{(70\ \text{kg x } 70\ \text{yr})}$

Cancer Risk = Exposure Dose x EPA's oral slope factor = (0.64×10^{-6} mg/kg/d) x 2 $(\text{mg/k-d})^{-1}$ = 1.28×10^{-6}

[8] Cancer Risk = Exposure Dose x EPA's oral slope factor.

Exposure Dose = $\frac{(\text{max. contaminant concentration})\ (\text{ingestion rate})\ (\text{exposure factor})\ (1\ \text{kg}/10^6\ \text{mg})}{\text{Body weight}}$

Exposure Factor (employee) = $\frac{(5\ \text{days/week})\ (52\ \text{weeks/year})\ (50\ \text{years})}{(70\ \text{years})\ (365\ \text{days/year})}$ = 0.51

Exposure Dose = $\frac{(100\ \text{mg/kg})\ (100\ \text{mg/day})\ (0.51)\ (1\ \text{kg}/10^6\ \text{mg})}{70\ \text{kg}}$ = 7.29×10^{-05} (mg/kg/day)

Cancer risk (employee) (PCB) = 7.29×10^{-05} (mg/kg/day) x 2.0 $(\text{mg/kg/day})^{-01}$= 1.46×10^{-4}

site conditions would not likely experience opportunities for exposure that would be of health concern.

With regard to children's opportunities for exposure, assuming that an older child or teenager might have spent up to five days per week in summer and two days per week in spring and fall playing on the site for a number of years during their childhood, before the higher soil concentrations (i.e., 100 ppm average PCB levels) were removed, they might have experienced an estimated exposure that exceeded ATSDR's MRL. However, this estimated exposure was lower than the lowest reported LOAEL. For this frequency of contact with soil, cancer risks for trespassers who had direct contact with site soils may have indicated a low increased concern for cancer[9]. Ambient air opportunities for exposure to PCBs did not significantly add to the surface soil PCB exposure concerns. Although the assumptions used are conservative (e.g., ingestion and dermal contact over a lifetime), the site could have presented health concerns to some individuals exposed prior to but not following the remedial action.

Dioxins and three PAH compounds also exceeded comparison values for soil. However, it appears that the amount of these substances to which a person routinely working on this site might have had opportunities for exposure, would not appreciably increase cancer or noncancer risks beyond those already considered for site-related PCB compounds.

Overall a number of aspects of the Lyman Street site appear to limit opportunities for exposure to contaminated site soil. Since the rechannelization of the river to create the Lyman Street parking lot, pavement precludes exposure to the site's most contaminated area (i.e., subsurface soils that comprise Former Oxbow D). Other unpaved areas of the site (i.e., the WMECO area) where soil contamination was found to be highest are heavily vegetated, thereby considerably reducing both past and present exposure opportunities. Today the site has some access but it is limited due to institutional controls (i.e., fences).

Thus, estimated opportunities for exposure to PCBs and other compounds at the Lyman Street site under current conditions are not expected to result in adverse health effects. This is due in part to implementation of various institutional controls (e.g., fences) and to limited opportunities for exposure to compounds in soil. Past site conditions may have presented health concerns to individuals (e.g., workers) who accessed the site on a frequent, long-term basis prior to the removal action. However, various aspects of the site (e.g., vegetation) likely limited opportunities for exposure such that under past conditions, adverse health effects would not necessarily have occurred. In addition, evidence of trespassing or recreational use was not observed, and MDPH is not aware of similar frequent uses in the past. Should institutional

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[9] Cancer Risk = Exposure Dose x EPA's oral slope factor.

$$\text{Exposure Dose} = \frac{\text{(avg. contaminant concentration) (ingestion rate) (exposure factor) } (1\ \text{kg}/10^6\ \text{mg})}{\text{Body weight}}$$

$$\text{Exposure Factor (child)} = \frac{\text{(5 days/week) (39 weeks/year) (18 years)}}{\text{(70 years) (365 days/year)}} = 0.14$$

$$\text{Exposure Dose} = \frac{(100\ \text{mg/kg})\ (200\ \text{mg/day})\ (0.14)\ (1\ \text{kg}/10^6\ \text{mg})}{35\ \text{kg}} = 8.0 \times 10^{-05}\ \text{(mg/kg/day)}$$

$$\text{Cancer risk (child) (PCB)} = 8.0 \times 10^{-05}\ \text{(mg/kg/day)} \times 2.0\ \text{(mg/kg/day)}^{-01} = 1.6 \times 10^{-04}$$

controls currently in place be removed or not be maintained, should construction activities occur at the site that would disturb soil (e.g., particularly on Former Oxbow D) or remove pavement, or should the use of the site change (e.g., residential development), the site could be a potential public health hazard in the future, depending on the extent to which opportunities for exposure increase.

Furthermore, the MDPH's 1997 Exposure Assessment Study concluded that serum levels of the non-occupationally exposed participants from communities surrounding the Housatonic River including Pittsfield were generally within background levels. The 2000 Expert Panel on the Health Effects of Non-Occupational Exposure to PCBs agreed that the available data indicate that serum PCB-levels for non-occupationally exposed populations from MDPH's Exposure Assessment Study are generally similar to the background exposure levels in recent studies (MDPH 2000). However, MDPH notes that serum PCB levels tended to be higher in older residents of the Housatonic River Area who were frequent and or long-term fish eaters or who reported opportunities for occupational exposure. In addition, there was some indication that other activities (e.g., fiddlehead fern consumption, gardening) may have contributed slightly to serum PCB levels.

The MDPH 2002 Assessment of Cancer Incidence Health Consultation showed that, for the majority of cancer types evaluated, residents of the Housatonic River Area did not experience excessive rates of cancer incidence during the period 1982-1994. For most primary cancer types evaluated, the incidence occurred at or below expected rates, concentrations of cancer cases appeared to reflect the population density, and, when reviewed in relation to the GE sites, the pattern of cancer incidence did not suggest that these sites played a primary role in this development. While Pittsfield did experience more cancer elevations than the other communities; and the pattern of some cancer types showed elevations that were statistically significantly higher than expected in certain areas or during certain time periods, no pattern among those census tracts with statistically significant elevations was observed. Specifically, although two of the three census tracts in Pittsfield adjacent to the GE site experienced statistically significant elevations in cancers of the bladder, breast, and non-Hodgkin's lymphoma (NHL), a pattern suggesting that a common environmental exposure pathway played a primary role in these census tracts was not observed nor were cases distributed more toward the vicinity of the GE sites. It is important to note however, that it is impossible to determine whether exposure to GE site contaminants may have played a role in any individual cancer diagnosis. Further review of the available risk factor and occupational information suggested that workplace exposures and smoking may have been potential factors in the development of some individuals' cancers (e.g., bladder cancer). However, the pattern of cancer in this area does not suggest that environmental factors played a primary role in the increased rates in this area (MDPH 2002a).

As noted earlier in this PHA, more recent cancer incidence data for the period 1995- 1999 shows that for Pittsfield as a whole, no cancer type was statistically significantly elevated. Although bladder cancer among males for Pittsfield as a whole was statistically significantly elevated during 1982 – 1994 (MDPH 2002a), this cancer type occurred less often than expected among males during 1995 – 1999 (28 cases observed vs. approximately 36 cases expected).

C. ATSDR Child Health Initiative

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

MDPH evaluated the likelihood of exposures to children from compounds in ambient air or surface soil at the Lyman Street site and the adjacent residential neighborhood. See Section B ("Evaluation of Possible Health Effects") for a discussion of these exposure scenarios.

CONCLUSIONS

MDPH has conducted public health activities in the past for Pittsfield and the Housatonic River area. These included the MDPH Housatonic River Area Exposure Assessment Study, which concluded that serum levels of the non-occupationally exposed participants from communities surrounding the Housatonic River including Pittsfield were generally within background levels, the MDPH Expert Panel on the Health Effects of Non-occupational Exposure to PCBs, which generally agreed with these findings, and the MDPH Assessment of Cancer Incidence Health Consultation, which concluded that the pattern of cancer in this area does not suggest that environmental factors played a primary role in increased rates in this area.

MDPH is currently conducting ongoing public health activities (e.g., exposure assessment survey and serum PCB testing, as warranted, on an individual basis as a public service). Information gathered from these additional activities will continue to improve MDPH's ability to assess the public health implications of PCB contamination at all sites being evaluated in public health assessments for the GE site. Thus, MDPH evaluation of potential public health implications related to the Lyman Street site is based on currently available information. An extensive sampling effort, including additional work on the site by the environmental agencies to better define the nature and extent of contamination (surface, subsurface, PCBs, and other constituents) at the site will generate new information regarding the site. Information from this health assessment will be included in the summary public health assessment for all of the GE sites.

The main compounds and environmental medium of health concern at the site are PCBs in soil. Persons likely to have had the greatest opportunities for exposure were workers on the site and any trespassers accessing the site, prior to the soil removal in the mid-1990s. For these individuals, exposure opportunities likely exceeded the MRL but were lower than the lowest LOAEL. Hence, the site is considered to have presented a public health hazard in the past. However, given the limited opportunities for exposure (e.g., vegetation, pavement), adverse health effects would not necessarily have occurred under past conditions. Although it is possible that neighborhood residents might have accessed the site, particularly in the past, MDPH does not have any information that would indicate that this actually occurred. Concentrations of PCBs in ambient air at the site do not present health concerns for residents living near the site. Under current site conditions (e.g., current institutional controls), opportunities for exposure to contaminants at the site are not likely to result in adverse health effects. At the time of this health assessment, the Lyman Street site poses no apparent public health hazard under these current conditions.

ATSDR requires that one of five conclusion categories be used to summarize findings of health consultations and health assessments. These categories are: 1) Urgent Public Health Hazard, 2) Public Health Hazard, 3) Indeterminate Public Health Hazard, 4) No Apparent Public Health Hazard, 5) No Public Health Hazard. A category is selected from site-specific conditions such as the degree of public health hazard based on the presence and duration of human exposure, contaminant concentration, the nature of toxic effects associated with site-related contaminants, presence of physical hazards, and community health concerns.

Under current site conditions (e.g., fences, vegetation, pavement, steep riverbank), ATSDR would classify the Lyman Street site as a "No Apparent Public Health Hazard" because current exposure opportunities are limited, and below a level of health concern. Under past site conditions, long-term opportunities for exposure to high concentration of PCB-contaminated soil at the site by workers performing maintenance activities may have posed a greater health hazard than present opportunities for exposure. Based on ATSDR criteria, the site could pose a "Public Health Hazard" in the future if site conditions change (e.g., pavement removed) such that exposure opportunities increase. However, remedial actions being overseen by EPA for the GE sites under the Consent Decree of 2000 should help to prevent these future concerns.

RECOMMENDATIONS

1. MDPH recognizes that there have been multiple opportunities for exposure to PCBs throughout Pittsfield and the Housatonic River area and supports ongoing remedial efforts to reduce opportunities for exposure to PCBs throughout Pittsfield and the Housatonic River Area.

2. MDPH supports ongoing site characterization efforts, including collection of additional samples and remedial activities, by the environmental regulatory agencies, in order to reduce opportunities for exposure to PCBs throughout the Pittsfield and Housatonic River area.

PUBLIC HEALTH ACTION PLAN

1. Due to the discovery during summer 1997 of widespread residential PCB soil contamination, MDPH is conducting a separate study of residents who were concerned about this exposure. MDPH set up a hotline number for individuals to call in with health-

related concerns, complete exposure questionnaires, and request serum PCB testing. Results of these more recent analyses of serum PCB levels and evaluation of the community health concerns expressed on the hotline calls are being developed as part of the summary public health assessment for the GE sites.

2. MDPH will continue to offer to evaluate any resident's opportunities for past exposure to PCBs and, if warranted, have their serum PCB levels determined.

3. As previously stated in the Health Consultation's Assessment of Cancer Incidence, Housatonic River Area, 1982-1994, MDPH will continue to monitor bladder cancer incidence in Pittsfield through the Massachusetts Cancer Registry to determine whether the pattern of bladder cancer changes.

4. MDPH established its Housatonic River Area Advisory Committee on Health in 1995. This committee is comprised of local residents, representatives from the local medical community, environmental and health professionals, representatives from the offices of elected officials and local health departments. MDPH staff will continue to hold meetings with committee members to report on the status of various activities and to discuss and get feedback on the conduct of MDPH health activities (e.g., education and outreach) in the area.

5. MDPH will incorporate information from the Lyman Street site public health assessment into the summary public health assessment for the GE sites.

6. Upon receipt from EPA of any additional data that EPA believes may warrant further public health assessment, MDPH will review this information and determine an appropriate public health response (e.g., health consultation, technical assistance).

This document was prepared by the Bureau of Environmental Health Assessment of the Massachusetts Department of Public Health. If you have any questions about this document, please contact Suzanne K. Condon, Director of BEHA/MDPH, 7th Floor, 250 Washington Street, Boston, Massachusetts 02108.

TABLES

Table 1. Demographic Characteristics of Pittsfield (2000 U.S. Census)

	Pittsfield		Census Tract 9010		Census Tract 9012		Census Tract 9002	
Characteristics	Persons	%	Persons	%	Persons	%	Persons	%
Age[1]								
Under 5	2719	5.9	298	5.7	2	3.03	322	6.89
5 – 14	6072	13.2	705	13.5	8	12.12	644	13.78
15 – 44	17924	39.1	1988	38.04	25	37.88	2366	50.62
45 – 64	10540	23.0	1262	24.15	13	19.7	803	17.18
65 and over	8538	18.6	973	18.61	18	27.27	539	11.53
Sex								
male	21,765	47.5	2,485	47.55	31	43.8	2,371	47.0
female	24,028	52.5	2,741	52.45	35	56.2	2,303	53.0
Race	Persons	%	Persons	%	Persons	%	Persons	%
Not Hispanic or Latino:	44,859	97.96	5,191	99.33	66	100.0	4,527	96.9
White alone	41,951	91.61	5,036	96.36	61	0.92	4,050	86.64
Black or African American alone	1,592	3.48	68	1.30	3	0.05	253	5.41
American Indian and Alaska Native alone	57	0.12	1	0.02	2	0.03	8	0.17
Asian alone	525	1.15	43	0.82	0	0	109	2.33
Native Hawaiian and Other Pacific Islander alone	18	0.04	1	0.02	0	0	3	0.06
Some other race alone	70	0.15	11	0.21	0	0	15	0.32
Two or more races	646	1.41	31	0.59	0	0	89	1.9
Hispanic or Latino:	934	2.04	35	0.67	0	0	147	3.14
White alone	444	0.97	25	0.48	0	0	50	1.06
Black or African American alone	82	0.18	3	0.06	0	0	6	0.13
American Indian and Alaska Native alone	8	0.02	0	0.00	0	0	1	0.02
Asian alone	8	0.02	0	0.00	0	0	0	0
Native Hawaiian and Other Pacific Islander alone	2	0.0	2	0.04	0	0	0	0
Some other race alone	284	0.6	4	0.08	0	0	62	1.33
Two or more races	106	0.2	1	0.02	0	0	28	0.6

[1] Within Census Tracts 9002, 9010, and 9011, the total numbers of persons by race are higher than the total numbers of persons by sex and by age because many people might come from more than 2 different racial origins.

Table 2. Pittsfield Cancer Incidence: Expected and Observed Case Counts, with Standardized Incidence Ratios, 1995-1999

	Exp	Obs	SIR
Bladder, Urinary			
Male	36.46	28	77
Female	15.43	14	91
Total	51.88	42	81
Brain and Other Central Nervous System			
Male	9.65	9	93
Female	8.51	6	71
Total	18.15	15	83
Breast			
Male	1.65	1	NC*
Female	217.96	226	104
Total	219.61	227	103
Cervix Uteri			
Female	11.32	13	115
Colon / Rectum			
Male	89.61	85	95
Female	97.11	75	77 #–
Total	186.72	160	86
Esophagus			
Male	12.24	9	74
Female	4.74	3	NC*
Total	16.98	12	71
Hodgkin's Disease (Hodgkin Lymphoma)			
Male	4.64	4	NC*
Female	3.83	1	NC*
Total	8.47	5	59
Kidney and Renal Pelvis			
Male	19.90	13	65
Female	13.83	9	65
Total	33.72	22	65 #–
Larynx			
Male	11.24	10	89
Female	3.09	4	NC*
Total	14.34	14	98
Leukemia			
Male	16.23	15	92
Female	13.77	6	44 #–
Total	29.99	21	70
Liver and Intrahepatic Bile Ducts			
Male	7.72	3	NC*
Female	3.82	3	NC*
Total	11.54	6	52
Lung and Bronchus			
Male	111.39	94	84
Female	96.82	83	86
Total	208.21	177	85 #–
Melanoma of Skin			
Male	22.34	16	72
Female	17.80	12	67
Total	40.14	28	70
Multiple Myeloma			
Male	6.88	10	145
Female	6.68	4	NC*
Total	13.56	14	103
Non-Hodgkin('s) Lymphoma			
Male	27.40	18	66
Female	27.74	17	61 #–
Total	55.14	35	63 ~–
Oral Cavity and Pharynx			
Male	20.47	15	73
Female	11.24	3	NC*
Total	31.71	18	57 #–
Ovary			
Female	25.16	28	111
Pancreas			
Male	14.81	21	142
Female	17.81	10	56
Total	32.62	31	95
Prostate			
Male	215.29	168	78 ^–
Stomach			
Male	15.06	10	66
Female	10.52	8	76
Total	25.58	18	70
Testis			
Male	6.82	4	NC*
Thyroid			
Male	4.09	3	NC*
Female	11.18	11	98
Total	15.28	14	92
Uteri, Corpus and Uterus, NOS			
Female	42.36	34	80
All Sites / Types			
Male	701.74	584	83 ^–
Female	715.26	606	85 ^–
Total	1417.00	1190	84 ^–

Table 2 (continued). Pittsfield Cancer Incidence: Expected and Observed Case Counts, with Standardized Incidence Ratios, 1995-1999

Exp = expected case count, based on the Massachusetts average age-specific incidence rates for this cancer
Obs = observed case count

SIR = standardized incidence ratio [(**Obs** / **Exp**) X 100]

* = **SIR** and statistical significance not calculated when **Obs** < 5

+ indicates number of observed cases is statistically significantly higher than the expected number of cases
- indicates number of observed cases is statistically significantly lower than the expected number of cases

# indicates statistical significance at the **p** <= 0.05 level
~ indicates statistical significance at the **p** <= 0.01 level, as well as at the **p** <= 0.05 level
^ indicates statistical significance at the **p** <= 0.001 level, as well as at the **p** <= 0.05 and **p** <= 0.01 levels

Table 3a. Summary of 0 through 0.5-ft surface soil contaminants of concern from the riverbank areas of the Lyman Street site in 1990 and 1995

Compounds	Detects/ Samples	Minimum (mg/kg)	Mean[1] (mg/kg)	Maximum (mg/kg)	Comparison Values	Background Levels
Total PCBs	4/4[2]	1.2	20.88	56	CREG = 0.4	N/A
Dioxin Toxicity Equivalence[3] (µg/kg)	4/4	0.0235 (µg/kg)	0.9296 (µg/kg)	2.5423 (µg/kg)	EMEG(child) = 0.05 µg/kg[4] EMEG(adult) = 0.7 µg/kg[4]	N/A
Dibenz(a,h)anthracene	2/2	*	*	*	*CREG = 0.02	N/A
Chrysene	4/4	0.58	10.045	21	*CREG = 10	0.251-0.64[5]
Sulfide	2/4	ND(202)	162	264	RMEG (child) = 200[6] RMEG (adult) = 2,000[6]	N/A

ND Not Detected
N/A Not Available
EMEG Environmental Media Evaluation Guide (ATSDR)
RMEG Reference Dose Media Evaluation Guide (ATSDR, based on EPA Reference Dose)
CREG Cancer Risk Evaluation Guide (ATSDR)
*CREG Values were calculated by using TEFs in relative to CREG = 0.1 ppm given to benzo(a)pyrene in ATSDR guideline.
* Some samples were affected by interference; hence, a reliable minimum and mean could not be determined

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[1] Mean values calculated using one half the method detection limit for samples in which the compound was below detection. Concentrations in parts per million (ppm) unless otherwise noted.
[2] One out of these four samples did not have depth indication but was considered surface soil sample
[3] Toxicity equivalents (TEQ) represent 2,3,7,8-TCDD toxic equivalents for mixtures of dioxin-like chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs). Since limited data on toxicity exist for many of the CDDs and CDFs, toxic equivalency factors (TEFs) were developed and validated in animals. TEFs compare the relative toxicity of individual congeners to that of 2,3,7,8-TCDD. The 2,3,7,8-TCDD congener is used as the basis of the TEFs because it appears to be the most toxic of the CDDs to mammals. The TEQ is calculated by calculating the sum of the products of the TEFs for each congener and its concentration in the mixture. The unit for dioxin toxicity equivalence is ppb or µg/kg.
[4] Comparison value for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)
[5] From Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs), August 1995, ATSDR
[6] Comparison values for hydrogen sulfide

Table 3b. Summary of 0 to 2-ft surface soil contaminants of concern from the riverbank areas[1]

Compounds	Detects/ Samples	Minimum (mg/kg)	Mean[2] (mg/kg)	Maximum (mg/kg)	Comparison Values
Total PCBs	2/2[3]	2.8	17.4	32	CREG = 0.4

CREG Cancer Risk Evaluation Guide (ATSDR)

[1] Concentrations are listed as parts per million, ppm, by dry weight unless otherwise noted.
[2] Mean values calculated using one half the method detection limit for samples in which the compound was below detection
[3] One out of these two samples had a duplicate and values shown were the averaged values of the sample and its duplicate

Table 3c. Summary of 0 through 2-ft surface soil contaminants of concern from the paved areas[1]

Compounds	Detects/ Samples	Minimum (mg/kg)	Mean[2] (mg/kg)	Maximum (mg/kg)	Comparison Values
Total PCBs	19/21[3]	ND	74.36	890	CREG = 0.4

CREG Cancer Risk Evaluation Guide (ATSDR)
ND Not Detected

[1] Concentrations are listed as parts per million, ppm, by dry weight unless otherwise noted.
[2] Mean values calculated using one half the method detection limit for samples in which the compound was below detection
[3] Four out of these 21 samples were collected west of Lyman Street outside the site boundary
One out of these 21 samples was collected at depth of 0-1 ft

Table 3d. Summary of 0 through 0.5-ft surface soil contaminants of concern from the unpaved areas[1]

Compounds	Detects/ Samples	Minimum (mg/kg)	Mean[2] (mg/kg)	Maximum (mg/kg)	Comparison Values	Background Levels
Total PCBs	43/46[3]	ND	22.40	150	CREG = 0.4	N/A
Dioxin Toxicity Equivalence[4] (µg/kg)	3/3[5]	0.001 (µg/kg)	0.501 (µg/kg)	1.002 (µg/kg)	EMEG(child) = 0.05 µg/kg[6] EMEG(adult) = 0.7 µg/kg[5]	N/A
Benzo(a)pyrene	3/3	0.038	0.509	0.86	CREG = 0.1	0.165-0.22[7]
Dibenz(a,h)anthracene	2/3	*	*	0.1	*CREG = 0.02	N/A

See next page for key to abbreviations used in this table.

[1] Concentrations are listed as parts per million, ppm, by dry weight unless otherwise noted.
[2] Mean values calculated using one half the method detection limit for samples in which the compound was below detection
[3] Out of these 46 samples, 10 samples were collected at 0-0.3 ft, two samples were collected at 0-0.33 ft, and 34 samples were collected at 0-0.5 ft
[4] Toxicity equivalents (TEQ) represent 2,3,7,8-TCDD toxic equivalents for mixtures of dioxin-like chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs). Since limited data on toxicity exist for many of the CDDs and CDFs, toxic equivalency factors (TEFs) were developed and validated in animals. TEFs compare the relative toxicity of individual congeners to that of 2,3,7,8-TCDD. The 2,3,7,8-TCDD congener is used as the basis of the TEFs because it appears to be the most toxic of the CDDs to mammals. The TEQ is calculated by calculating the sum of the products of the TEFs for each congener and its concentration in the mixture. The unit for dioxin toxicity equivalence is ppb or µg/kg.
[5] One out of these three samples had a duplicate and values shown were averaged values of the sample and its duplicate
[6] Comparison value for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)
[7] From Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs), August 1995, ATSDR

CREG	Cancer Risk Evaluation Guide (ATSDR)
*CREG	Values were calculated by using TEF's in relative to CREG = 0.1 ppm given to benzo(a)pyrene in ATSDR guideline.
EMEG	Environmental Media Evaluation Guide (ATSDR)
ND	Not Detected
N/A	Not Available
*	Some samples were affected by interference; hence, a reliable minimum and mean could not be determined

Table 3e. Summary of 0- through 2-ft surface soil contaminants of concern from the unpaved areas[1].

Compounds	Detects/ Samples	Minimum (mg/kg)	Mean[2] (mg/kg)	Maximum (mg/kg)	Comparison Values	Background Levels
Total PCBs	11/11[3]	0.33	426.96	3,600	CREG = 0.4	N/A
Dioxin Toxicity Equivalence[4] (µg/kg)	3/3	0.196 (µg/kg)	1.615 (µg/kg)	3.070 (µg/kg)	EMEG(child) = 0.05 µg/kg[5] EMEG(adult) = 0.7 µg/kg[4]	N/A
Dibenz(a,h)anthracene	2/3	ND(0.38)	0.36	0.50	*CREG = 0.02	N/A

CREG Cancer Risk Evaluation Guide (ATSDR)
*CREG Values were calculated by using TEFs in relation to CREG = 0.1 ppm given to benzo(a)pyrene in ATSDR guideline.
EMEG Environmental Media Evaluation Guide (ATSDR)
ND Not Detected
N/A Not Available

[1] Concentrations are listed as parts per million, ppm, by dry weight unless otherwise noted.
[2] Mean values calculated using one half the method detection limit for samples in which the compound was below detection
[3] Five out of these 11 samples were collected at 0 through 1.75 ft
[4] Toxicity equivalents (TEQ) represent 2,3,7,8-TCDD toxic equivalents for mixtures of dioxin-like chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs). Since limited data on toxicity exist for many of the CDDs and CDFs, toxic equivalency factors (TEFs) were developed and validated in animals. TEFs compare the relative toxicity of individual congeners to that of 2,3,7,8-TCDD. The 2,3,7,8-TCDD congener is used as the basis of the TEFs because it appears to be the most toxic of the CDDs to mammals. The TEQ is calculated by calculating the sum of the products of the TEFs for each congener and its concentration in the mixture. The unit for dioxin toxicity equivalence is ppb or µg/kg.
[5] Comparison value for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

Table 3f. Summary of 0 through 0.5-ft surface soil contaminants of concern from the unpaved areas of the Lyman Street site after the pipeline soil excavation[1].

Compounds	Detects/ Samples	Minimum (mg/kg)	Mean[2] (mg/kg)	Maximum (mg/kg)	Comparison Values
Total PCBs	32/35	ND(0.05)	12.88	100	CREG = 0.4

CREG Cancer Risk Evaluation Guide (ATSDR)
ND Not Detected

[1] Concentrations are listed as parts per million, ppm, by dry weight unless otherwise noted.
[2] Mean values calculated using one half the method detection limit for samples in which the compound was below detection

Table 3g. Summary of 0- through 2-ft surface soil contaminants of concern from the unpaved areas of the Lyman Street site after the pipeline soil excavation[1].

Compounds	Detects/ Samples	Minimum	Mean[2]	Maximum	Comparison Values
Total PCBs	6/6	0.33	5.15	20.5	CREG = 0.4

CREG Cancer Risk Evaluation Guide (ATSDR)

[1] Concentrations are listed as parts per million, ppm, by dry weight unless otherwise noted.
[2] Mean values calculated using one half the method detection limit for samples in which the compound was below detection

Table 3h. Summary of PCB Levels Detected in 0-1 and 0-0.5 ft Surface Soil from the Paved and Unpaved Areas sampled in 1999.

Location	Detects/ Samples	Minimum (mg/kg)	Mean[1] (mg/kg)	Maximum (mg/kg)	Comparison Values (mg/kg)
Paved areas	7/7	0.24	31.01	146	CREG = 0.4
Unpaved areas	7/8	ND	32.18	200	

[1] Mean values calculated using one half the method detection limit for samples in which the compound was below detection.

Table 4. PCB concentrations in ambient air (µg/m^3) – Lyman Street

Location		**Total**	**Summer Months**[1]	**Non-Summer Months**	**Comparison Value**
Site[2]	High-volume	Mean = 0.0023 Max = 0.011	Mean = 0.0042 Max = 0.011	Mean = 0.0006 Max = 0.003	CREG = 0.01
	Low-volume	Mean = 0.05 Max = 0.011	Mean = 0.05 Max = 0.011	N/A	
Background[3]		Mean = 0.0007 Max = 0.0035	Mean = 0.001 Max = 0.0035	Mean = 0.0004 Max = 0.0014	

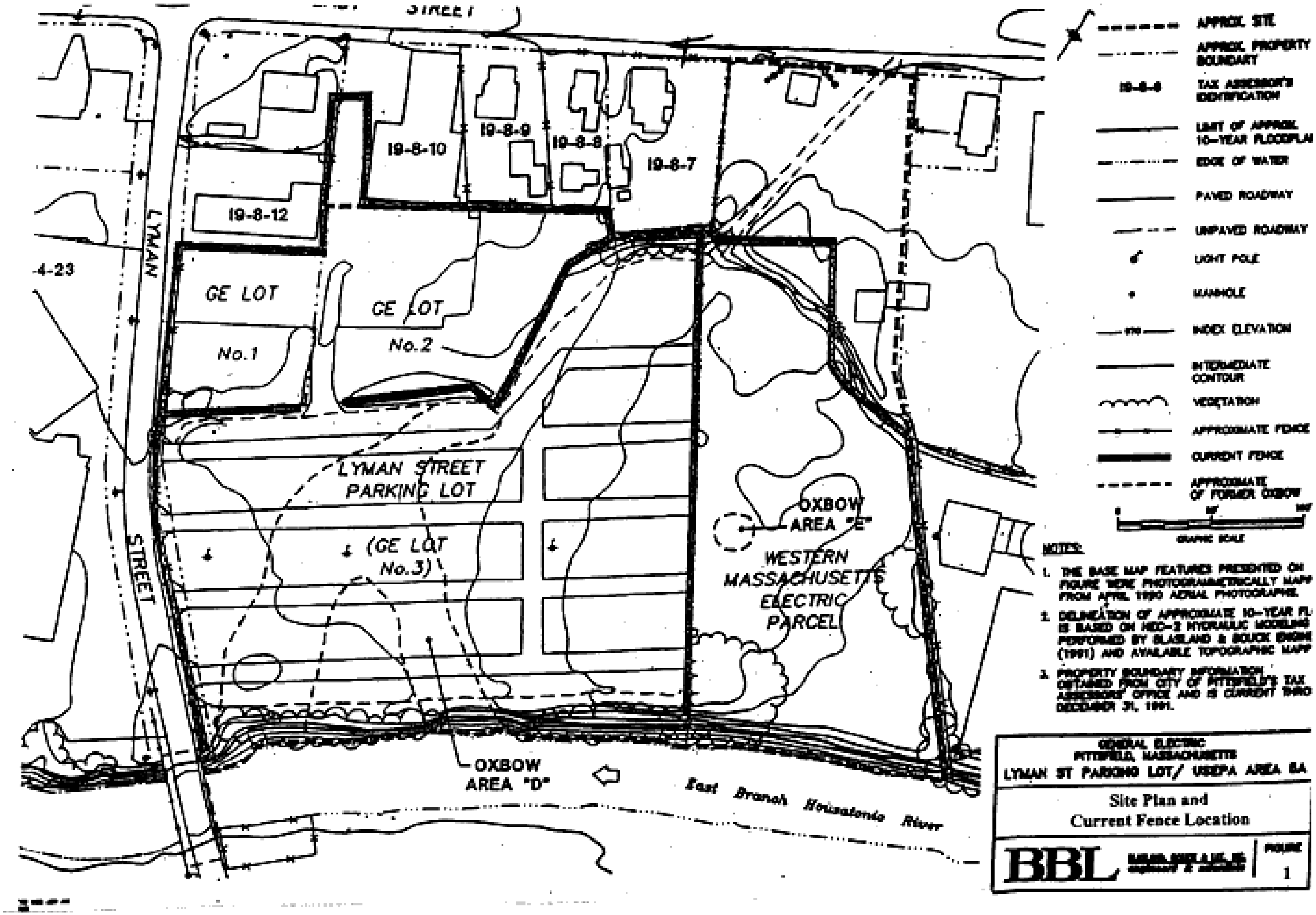
Mean Values calculated using one-half the method detection limit for samples in which the compound was below detection.

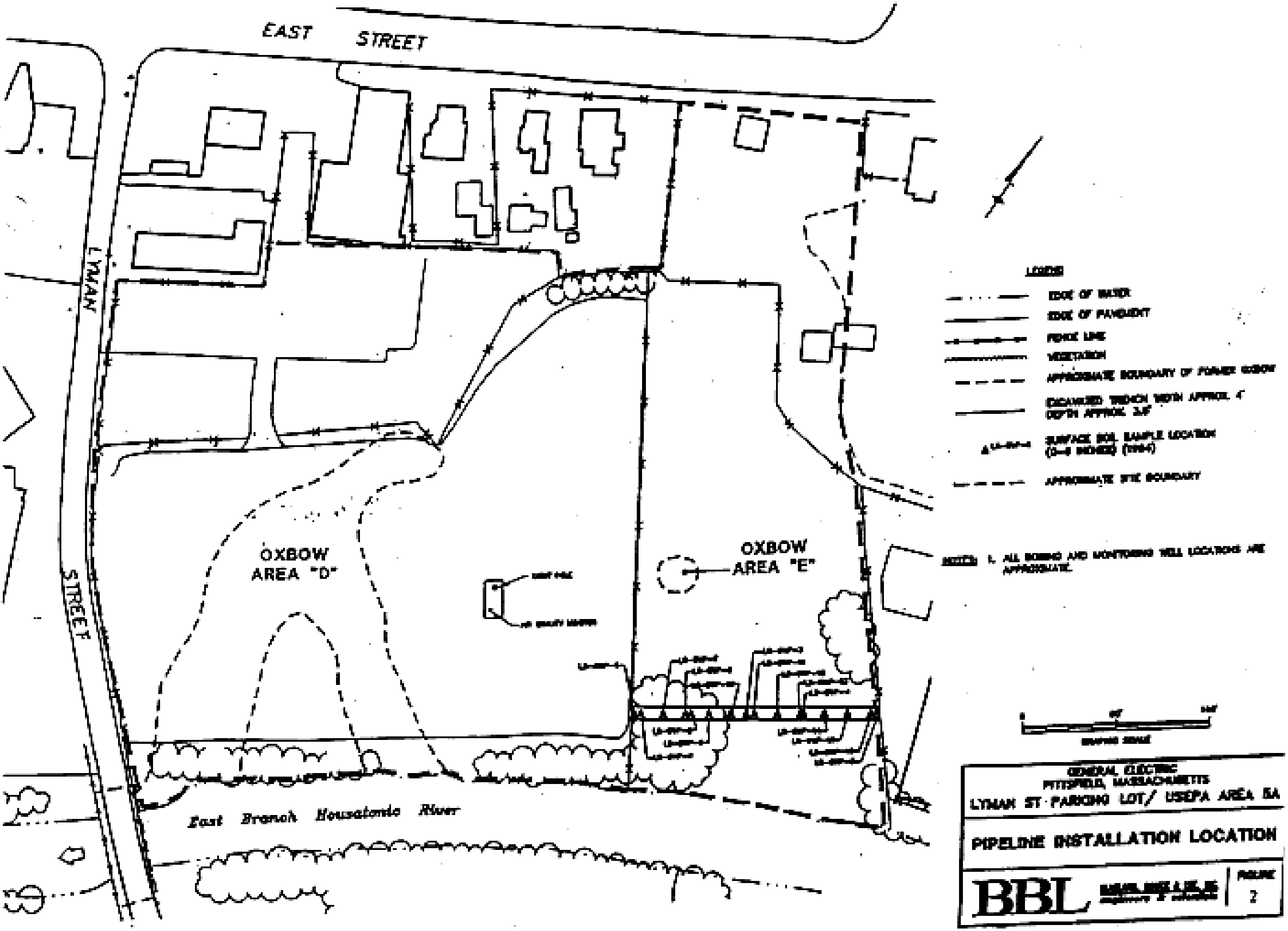
[1] Summer months are mid-May to early September. For low volume, samples were collected from May 1993 through August 1993, which were the summer months only.

[2] Site results are 24-hour high volume ambient mean PCB concentrations for the Lyman Street site (August 1992 and May 1993 through August 1993).

[3] Background location is Berkshire Community College; sampling periods August 1991 through August 1992; May 1993 through August 1993; June 1995 through August 1995; July 1996 through September 1996; 24-hour high volume ambient mean PCB concentrations.

FIGURES


STREET
LYMAN STREET
-4-23
19-8-12
19-8-10
19-8-9
19-8-8
19-8-7
GE LOT No.1
GE LOT No.2
LYMAN STREET PARKING LOT
(GE LOT No.3)
OXBOW AREA "E"
WESTERN MASSACHUSETTS ELECTRIC PARCEL
OXBOW AREA "D"
East Branch Housatonic River
APPROX. SITE
APPROX. PROPERTY BOUNDARY
TAX ASSESSOR'S IDENTIFICATION
LIMIT OF APPROX. 10-YEAR FLOODPLAI
EDGE OF WATER
PAVED ROADWAY
UNPAVED ROADWAY
LIGHT POLE
MANHOLE
INDEX ELEVATION
INTERMEDIATE CONTOUR
VEGETATION
APPROXIMATE FENCE
CURRENT FENCE
APPROXIMATE OF FORMER OXBOW
GRAPHIC SCALE
NOTES:
1. THE BASE MAP FEATURES PRESENTED ON FIGURE WERE PHOTOGRAMMETRICALLY MAPP FROM APRIL 1990 AERIAL PHOTOGRAPHS.
2. DELINEATION OF APPROXIMATE 10-YEAR FL IS BASED ON HEC-2 HYDRAULIC MODELING PERFORMED BY BLASLAND & BOUCK ENGIN (1991) AND AVAILABLE TOPOGRAPHIC MAPP
3. PROPERTY BOUNDARY INFORMATION OBTAINED FROM CITY OF PITTSFIELD'S TAX ASSESSORS' OFFICE AND IS CURRENT THRO DECEMBER 31, 1991.
GENERAL ELECTRIC
PITTSFIELD, MASSACHUSETTS
LYMAN ST PARKING LOT/ USEPA AREA 6A
Site Plan and
Current Fence Location
BBL
FIGURE
1

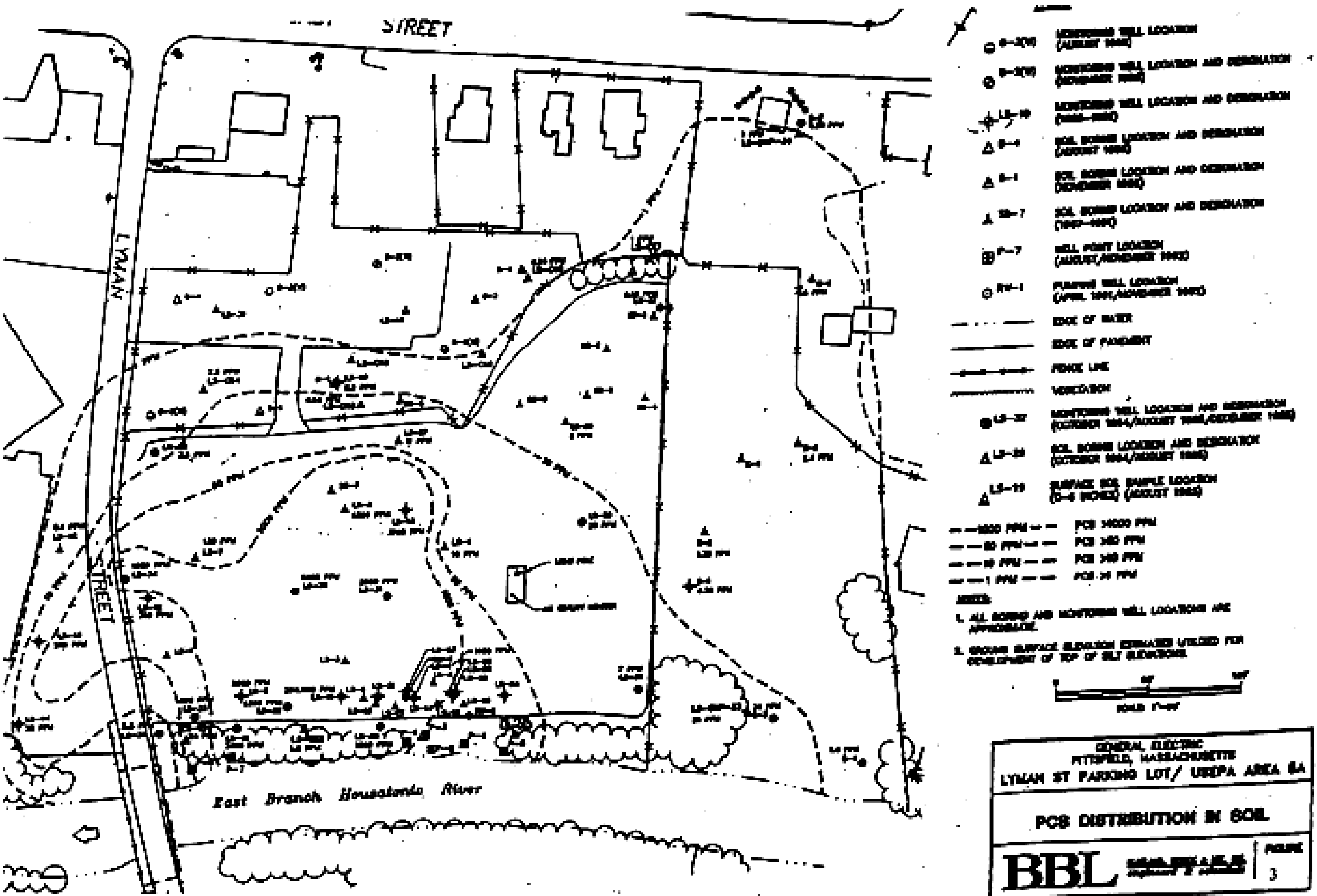


GENERAL ELECTRIC
PITTSFIELD, MASSACHUSETTS
LYMAN ST · PARKING LOT/ USEPA AREA 5A

PIPELINE INSTALLATION LOCATION

BBL

FIGURE 2


STREET
LYMAN
STREET
East Branch Housatonic River
GENERAL ELECTRIC
PITTSFIELD, MASSACHUSETTS
LYMAN ST PARKING LOT/ USEPA AREA 6A
PCB DISTRIBUTION IN SOIL
BBL
FIGURE
3

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APPENDICES

Appendix A:
Comments on General Electric Site – Lyman Street Public Health Assessment

The Massachusetts Department of Public Health (MDPH) Bureau of Environmental Health Assessment (BEHA) Environmental Toxicology Program (ETP) received and responded to the following comments for the General Electric Site – Lyman Street Public Health Assessment. Eleven comments were received from both the Housatonic River Initiative (HRI), a community group based in Pittsfield, and from General Electric (GE).

General Comments

1. **Comment:** More soil sampling is needed, GE initiated testing and EPA testing were inadequate, in particular a resident on Lyman Street was not satisfied with the sampling methods employed.

   Response: MDPH has incorporated all known and the most recent available data. MDPH feels the available data are sufficient to characterize exposure opportunities in areas tested because we have estimated exposures from maximum soil concentrations as well as average soil concentrations. It is important to note that the methods for evaluating exposures are a very conservative approach. Maximum concentrations are unlikely to be representative of the entire site. However, the recommendation section states that "MDPH supports ongoing site characterization efforts, including collection of additional samples and remedial activities, by the regulatory agencies, in order to reduce opportunities for exposure to PCBs throughout the Pittsfield and Housatonic River area." This additional site work is reportedly going to be done in accordance with the Consent Decree signed by EPA and GE in 2000 (see comment 3). Additional data from nearby residences are being generated as part of the Massachusetts Department of Environmental Protection (MA DEP) residential fill properties project and will be summarized in the summary PHA for the GE sites.

2. **Comment:** MDPH should take into account multiple exposure pathways (i.e., soil exposures at multiple sites, and eating fish from the Housatonic River).

   Response: Each site was evaluated separately in order to assess health concerns specific to a particular site. For those sites with multiple exposure pathways, these exposure opportunities were taken into account in developing the conclusions for that individual site. However, MDPH is working on putting together an executive summary for all the Public Health Assessments combined including the Housatonic River, that will summarize overall health concerns for the entire GE site that will include an evaluation of health concerns related to all applicable exposure opportunities and available health (e.g., cancer incidence) and biomonitoring information.

Background

3. **Comment:** The consent decree for remediation actions to EPA and MA DEP performance standards (i.e., average of < 2 ppm PCBs in residential soils) should be emphasized in all PHAs.

Response: MDPH has mentioned in the background section that there is an agreement between EPA and GE for various clean-up actions. This has been elaborated on and expanded in the text of the Background section under section A, Purpose and Health Issues by adding the following on page 2:

"In October 2000, a court-ordered consent decree was signed by EPA and GE, and it was agreed that GE would perform remediation actions to U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (MDEP) performance standards (e.g., an average of less than 10 parts per million (ppm) PCBs in recreational surface soils, and an average of less than 2 ppm PCBs in residential soils). However, remediation does not eliminate past exposures and exposures occurring at parts of the site that have not yet been remediated."

Discussion

4. **Comment:** The CREG is too conservative to use as a comparison value for PCBs and MDPH should use the 2-ppm EPA action level as a comparison value.

Response: MDPH has a cooperative agreement with the US ATSDR to conduct PHAs in Massachusetts. ATSDR has published health based comparison values to screen for possible health effects from exposure to a particular contaminant. A comparison value does not indicate that health effects occur at that particular level. This is explained in the Environmental Contamination and Other Hazards under section A, On-Site Contamination in paragraphs two and three. Comparison values are used to determine if a particular contaminant needs to be further evaluated for possible health effects that may or may not occur given the potential opportunities for exposure at the site. Regulatory action levels are set by environmental regulatory agencies for clean-up/remediation purposes and are not typically used by health agencies to evaluate possible health concerns based on site-specific exposure opportunities.

5. **Comment:** The exposure factors used in the risk calculations are too conservative and should be more realistic and clarified at least in the appendix.

Response: MDPH has used exposure factors reasonable for this area in evaluating site-specific information. MPDH used more conservative exposure factors than typically used because in Pittsfield, many people reportedly grew up playing near GE sites, have had jobs at GE as teenagers, and could have gone on to work at GE as adults and worked there throughout there working lifetime, as GE was the major Pittsfield employer. Hence, MDPH has used exposure factors consistent with the community-based history and discussions with individuals who reported such a history of contact with the GE sites.

6. **Comment:** MDPH should reference studies that assess the possible link between PCBs and cancer or non-cancer health effects that found no credible links to cancer or other serious health effects (i.e. *A Weight-of-Evidence Review of the Potential Human Cancer Effects of PCBs*, and *Non-Cancer- Effects of PCBs – A Comprehensive Review of Literature*).

Response: MDPH has relied on the ATSDR Toxicological Profile for PCBs (ATSDR 2000) and other scientifically peer-reviewed documents that discuss cancer and non-cancer health effects of PCBs. For example, PCBs are currently considered a probable human carcinogen by EPA, and the International Agency for Research on Cancer currently classifies PCBs as probable human carcinogens based on sufficient evidence in animals and limited evidence in humans as presented in the Discussion Section under section A Chemical-Specific Toxicity Information in this PHA. Also, discussed in this section of the PHA are the ATSDR derivations of Minimal Risk Levels (MRLs) for non-cancer health effects. In addition, the summary report of the Expert Panel on the Health Effects of Non-Occupational Exposure to PCBs convened by MDPH stated "While the panel cited some conflicting human studies, overall the panel members agreed that the evidence is clear that PCBs are a definitive carcinogen in animals. In humans, the evidence with regard to cancer is suggestive, but inconclusive," and stated "PCBs are thought to behave as tumor promoters in susceptible tissues. Therefore, the carcinogenic effects of PCBs are likely to be influenced by other carcinogens or toxins that may be present." Large epidemiological studies of GE workers were included in the Expert Panel's considerations. The Expert Panel also "agreed that there appears to be some developmental effects (e.g. subtle cognitive deficits) associated with exposures to PCB," and stated "The current research suggests that prenatal exposures to fetuses at near background levels of PCBs may subtly affect the mental development of children." These sources are referenced in the Public Health Assessments.

7. **Comment:** MDPH should use a revised higher MRL of 0.0002 mg/kg/d for PCBs developed by AMEC Earth and Environmental, Inc. in their study, *Development of a Revised Reference Dose for Polychlorinated Biphenyls (Aroclor 1254) Based on Empirical Data*.

Response: MDPH through its Cooperative Agreement with ATSDR will continue to use the ATSDR chronic MRL of 0.00002 mg/kg/d as derived and supported in the toxicological profile for PCBs, which was scientifically peer reviewed and put out for a public comment period prior to adoption (ATSDR, 2000). EPA's reference dose (Rfd) for chronic exposure is also 0.00002 mg/kg/d (EPA IRIS, 2002).

8. **Comment:** Page 20 of the Lyman Street PHA states average soil PCB concentrations were used in risk calculations, while the equation states the maximum value was used, which is it for the Lyman Street PHA as well as the other PHAs.

Response: Both maximum and average PCB concentrations were used in the risk calculations. Separate calculations were done for hotspot locations as well. The risk calculations have been reviewed by MDPH and references to them in the PHAs have been clarified.

Conclusions

9. **Comment:** No Public Health Hazard for the future should be declared because the site will be cleaned up according to EPA and MA DEP performance standards.

Response: MDPH cannot make conclusion contingent upon actions that have not been completed yet. There are also opportunities for future exposures that are not possible to define at this time (e.g., pavement on the site is torn up or a building on the site is demolished). However, it is expected that once the activities in the consent decree are fully implemented the likelihood that future exposures could be of public health concern should be considerably reduced or eliminated.

10. **Comment:** Health risk evaluations should be qualified by the fact that serum levels in the area were generally found to be in the background range for non-occupationally exposed people.

Response: MDPH has added the following text to the Discussion section on page 22:

"Furthermore, the MDPH's 1997 Exposure Assessment Study concluded that serum levels of the non-occupationally exposed participants from communities surrounding the Housatonic River including Pittsfield were generally within background levels. The Expert Panel on the Health

Effects of Non-Occupational Exposure to PCBs agreed that the available data indicate that serum PCB-levels for non-occupationally exposed populations from MDPH's Exposure Assessment Study are generally similar to the background exposure levels in recent studies (MDPH 2000). However, MDPH notes that serum PCB levels tended to be higher in older residents of the Housatonic River Area who were frequent and or long-term fish eaters or who reported opportunities for occupational exposure. In addition, there was some indication that other activities (e.g., fiddlehead fern consumption, gardening) may have contributed slightly to serum PCB levels."

11. **Comment:** The MDPH Cancer Incidence Report findings that any elevations in cancer had no statistically significant link to the GE site should be reiterated in all the conclusion sections.

Response: MDPH has added the following to the text of the Discussion section on page 22:

"The MDPH 2002 Assessment of Cancer Incidence Health Consultation showed that, for the majority of cancer types evaluated, residents of the Housatonic River Area did not experience excessive rates of cancer incidence during the period 1982-1994. For most primary cancer types evaluated, the incidence occurred at or below expected rates, concentrations of cancer cases appeared to reflect the population density, and, when reviewed in relation to the GE sites, the pattern of cancer incidence did not suggest that these sites played a primary role in this development. While Pittsfield did experience more cancer elevations than the other communities; and the pattern of some cancer types showed elevations that were statistically significantly higher than expected in certain areas or during certain time periods, no pattern among those census tracts with statistically significant elevations was observed. Specifically, although two of the three census tracts in Pittsfield adjacent to the GE site experienced statistically significant elevations in cancers of the bladder, breast, and NHL, a pattern suggesting that a common environmental exposure pathway played a primary role in these census tracts was not observed nor were cases distributed more toward the vicinity of the GE sites. It is important to note however, that it is impossible to determine whether exposure to GE site contaminants may have played a role in any individual cancer diagnosis. Further review of the available risk factor and occupational information suggested that workplace exposures and smoking may have been potential factors in the development of some individuals' cancers (e.g., bladder cancer). However, the pattern of cancer in this area does not suggest that environmental factors played a primary role in the increased rates in this area (MDPH 2002a).

As noted earlier in this PHA, more recent cancer incidence data for the period 1995- 1999 shows that for Pittsfield as a whole, no cancer type was statistically significantly elevated. Although bladder cancer among males for Pittsfield as a whole was statistically significantly elevated during 1982 – 1994 (MDPH 2002a), this cancer type occurred less often than expected among males during 1995 – 1999 (28 cases observed vs. approximately 36 cases expected) (MDPH 2002b)."

Appendix B:
Public Health Assessments vs. Risk Assessments

Public health assessments and risk assessments both investigate the impact or potential impact of hazardous substances at a specific site on public health. However, the two types of assessment differ in their goals and focus. Quantitative risk assessments are geared largely toward arriving at numeric estimates of the risk posed to a population by the hazardous substances found on a site. These calculations use statistical and biological models based on dose-response data from animal toxicologic studies and (if available) human epidemiological studies. Risk assessments estimate the public health risk posed by a site, and their conclusions can be used to establish allowable contamination levels, or to establish clean-up levels and select remedial measures to be taken at the site.

ATSDR public health assessments are also intended to determine the current or future public health implications of a specific site, but focus more than risk assessments do on the health concerns of the specific community. Public health assessments are based on environmental characterization information (including information on environmental contamination and pathways), community health concerns associated with the site, and community-specific health outcome data. They make recommendations for actions needed to protect public health (which may include the development and issuing of health advisories), and they identify populations in need of further health actions or studies.

Appendix C:
ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

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

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

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

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

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

Aerobic
Requiring oxygen [compare with **anaerobic**].

Ambient
Surrounding (for example, *ambient* air).

Anaerobic
Requiring the absence of oxygen [compare with **aerobic**].

Analyte

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

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

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

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

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

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

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

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

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

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

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

CAP
See **Community Assistance Panel**.

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

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

Carcinogen
A substance that causes cancer.

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

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

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

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

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

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

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

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

Community Assistance Panel (CAP)
A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

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

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

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

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

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

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

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

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

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

Disease prevention
Measures used to prevent a disease or reduce its severity.

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

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

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

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

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

EPA
United States Environmental Protection Agency.

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

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

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

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

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

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

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

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

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

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

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

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

Half-life ($t_{½}$)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

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

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Metabolite
Any product of **metabolism**.

mg/kg
Milligram per kilogram.

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

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

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

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

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

Mutagen
A substance that causes **mutations** (genetic damage).

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

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

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

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

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

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

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

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

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

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

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

ppb
Parts per billion.

ppm
Parts per million.

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

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

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

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

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

Public health action
A list of steps to protect public health.

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

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

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

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

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

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

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

Radionuclide
Any radioactive isotope (form) of any element.

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

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

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

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

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

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

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

RfD
See **reference dose**.

Risk
The probability that something will cause injury or harm.

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

Risk communication
The exchange of information to increase understanding of health risks.

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

Safety factor [see **uncertainty factor]**

SARA [see **Superfund Amendments and Reauthorization Act**]

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

Sample size
The number of units chosen from a population or environment.

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

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

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

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

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

Substance
A chemical.

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

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

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

Surveillance [see **epidemiologic surveillance**]

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

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

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

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

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

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

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

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

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

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

Other glossaries and dictionaries:
Environmental Protection Agency
http://www.epa.gov/OCEPAterms/
National Center for Environmental Health (CDC)

http://www.cdc.gov/nceh/dls/report/glossary.htm
National Library of Medicine
http://www.nlm.nih.gov/medlineplus/dictionaries.html

Appendix D:
Explanation of a Standardized Incidence Ratio (SIR)

In order to evaluate cancer incidence a statistic known as a standardized incidence ratio (SIR) was calculated for each cancer type. An SIR is an estimate of the occurrence of cancer in a population relative to what might be expected if the population had the same cancer experience as some larger comparison population designated as "normal" or average. Usually, the state as a whole is selected to be the comparison population. Using the state of Massachusetts as a comparison population provides a stable population base for the calculation of incidence rates. As a result of the instability of incidence rates based on small numbers of cases, SIRs were not calculated when fewer than five cases were observed.

Specifically, an SIR is the ratio of the observed number of cancer cases to the expected number of cases multiplied by 100. An SIR of 100 indicates that the number of cancer cases observed in the population evaluated is equal to the number of cancer cases expected in the comparison or "normal" population. An SIR greater than 100 indicates that more cancer cases occurred than expected and an SIR less than 100 indicates that fewer cancer cases occurred than expected. Accordingly, an SIR of 150 is interpreted of 50% more cases than the expected number; an SIR of 90 indicates 10% fewer cases than expected.

Caution should be exercised, however, when interpreting an SIR. The interpretation of an SIR depends on both the size and the stability of the SIR. Tow SIRs can have the same size but not the same stability. For example, a SIR of 150 based on four expected cases and six observed cases indicates a 50% excess in cancer, but the excess is actually only two cases. Conversely, an SIR of 150 based on 400 expected cases and 600 observed cases represents the same 50% excess in cancer, but because the SIR is based upon a greater number of cases, the estimate is more stable. It is very unlikely that 200 excess cases of cancer would occur by chance alone.

Source: Massachusetts Department of Public Health, Bureau of Environmental Health Assessment (December 1998)

Appendix E:

INFORMATION BOOKLET

for

THE FINAL REPORT ON THE HOUSATONIC RIVER AREA PCB EXPOSURE ASSESSMENT

and

RELATED HEALTH ISSUES

prepared by
MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH
BUREAU OF ENVIRONMENTAL HEALTH ASSESSMENT

September 1997

QUESTIONS AND ANSWERS

1. **Q. Why was the "Housatonic River Area PCB Exposure Assessment" conducted?**

   A. The assessment was conducted to identify the frequency of different activities that might lead to opportunities for PCB exposure, and to determine, through the use of blood testing, how various activities may have contributed to higher serum PCB levels among HRA residents.

2. **Q. What is meant by the "Housatonic River Area" (or "HRA")?**

   A. The Housatonic River Area or HRA comprises eight communities in Berkshire County, Massachusetts: Dalton, Great Barrington, Lanesborough, Lee, Lenox, Pittsfield, Sheffield, and Stockbridge.

3. **Q. What are PCBs?**

   A. PCBs or polychlorinated biphenyls are man-made, odorless chemicals. They do not evaporate and do not dissolve easily in water. In the HRA, PCBs were largely used in the manufacture of electrical transformers.

4. **Q. How did PCBs get into the Housatonic River and the surrounding communities?**

   A. PCBs were used in the manufacture of electrical and associated products in Pittsfield from 1932 to 1972, and they reached the Housatonic River in large quantities. This contamination was first discovered in the 1970s, in fish and sediments in lakes along the Housatonic. Extensive environmental sampling has revealed widespread contamination of Housatonic River sediments, floodplain soil, fish and other biota. Very recently, some residential properties were found to be contaminated with PCBs due to contaminated fills.

5. **Q. Who conducted the study?**

   A. The Housatonic River Area PCB Exposure Assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment, with support from the Massachusetts Department of Environmental Protection and the federal Agency for Toxic Substances and Disease Registry. The MDPH received input from local citizens or citizens' groups (e.g. Housatonic River Initiative), especially during the study design and protocol development. The MDPH also formed the Housatonic River Area Advisory Committee for Health Studies and MDPH staff held periodic meetings with committee members to report status and get feed back on the conduct of the study.

6. **Q. How were participants chosen for the Exposure Prevalence Study?**

   A. In the Exposure Prevalence Study, 800 households were randomly chosen from among all those located within one-half mile of the Housatonic River in the following eight communities: Dalton, Great Barrington, Lanesborough, Lee, Lenox, Pittsfield, Sheffield, and Stockbridge. Four hundred of those households were from Pittsfield, and four hundred were from the other seven communities.

7. Q. How were participants chosen for the Volunteer Study?

A. In the Volunteer Study, subjects were recruited by means of a Public Service Announcement in local newspapers and radio stations, and through a mass mailing to interested parties. The Volunteer Study allowed those residents who were concerned about PCB exposure, but who were not selected to participate in the Exposure Prevalence Study, to be scheduled for a blood test. MDPH arranged to administer questionnaires to the volunteers in person at three walk-in sites: the Great Barrington Senior Center, the Tri-town Health Department in Lee, and the Berkshire Athenaeum in Pittsfield. The questionnaire administered to the volunteers was the same as the one used in the Exposure Prevalence Study.

8. Q. How were opportunities for exposure to PCBs assessed?

A. A household screening questionnaire was administered to the 800 households. A representative of each household answered questions for all the members of his or her family. After the questionnaires were completed, the responses of every household member were weighted, with those activities more likely to lead to greater potential for PCB exposure weighted more heavily. Thus, those with the greatest potential for PCB exposure would receive the highest weights or scores.

9. Q. How were respondents selected to participate in blood testing?

A. In the Exposure Prevalence Study, individuals with the highest potential exposure to PCBs based on screening questionnaire scores were offered the opportunity for a blood test. Results of blood tests allowed MDPH to determine whether those individuals who were suspected to have had greater opportunities for exposure to PCBs did in fact have higher levels than those with lesser opportunities for exposure. All respondents in the Volunteer Study were offered blood testing.

10. Q. What was the range of serum PCB levels found in the Exposure Prevalence and Volunteer Studies?

A. Sixty-nine residents who participated in the Exposure Prevalence Study had serum PCB levels as follows:

Concentrations of PCBs in Parts Per Billion (ppb)	Number of Individuals
0-4	43
5-9	18
10-14	6
15-20	1
over 20	1

Seventy-nine residents who participated in the Volunteer Study had serum PCB levels shown as follows:

Concentrations of PCBs in Parts Per Billion (ppb)	Number of Individuals
0-4	32
5-9	25
10-14	15
15-20	2
over 20	5

The average serum PCB level in the Exposure Prevalence Study among non-occupationally exposed participants was 4.49 ppb, and in the Volunteer Study, the average was 5.77 ppb. These levels were generally within the normal background range for non-occupationally exposed individuals.

11. Q. Was occupational exposure related to serum PCB levels?

A. Yes. Among all participants who had blood testing, those who had had opportunities for occupational exposure had higher serum PCB levels than the rest.

12. Q. Was age related to serum PCB levels?

A. Yes. Age was found to be the prominent predictor of serum PCB level.

13. Q. Do most people in the United States have PCBs in their bodies?

A. PCBs have been measured in human blood, fatty tissue, and breast milk throughout the country. Ninety-five percent of the U.S. population have serum levels of less than 20 ppb. Ninety-nine percent of the U.S. population have serum levels of less than 30 ppb. The national average for serum PCB level in persons non-occupationally exposed is between 4 and 8 ppb. The greatest on-going source of public exposure to PCBs is from food, particularly fish.

14. Q. Is there anything I can do to reduce PCB levels in my blood?

A. Currently, there is no treatment available to lower PCB blood levels. However, if an individual was exposed, PCB levels will decrease over time once exposure to PCBs has been reduced.

15. Q. Is it safe to eat fish from the Housatonic River and its tributaries?

A. No. In 1982, the MDPH restricted fish, frog, and turtle consumption in the Housatonic River and its tributaries. Because of continued evidence of PCB contamination, it is expected that PCB levels in these species still remain elevated.

Both the Exposure Prevalence Study and the Volunteer Study showed that study participants who had higher frequency and duration of contaminated fish consumption had higher serum PCB levels. Due to health effects that have been suggested as potentially related to PCB exposure, the MDPH maintains that the current ban on these activities in or near the river remain in effect.

16. Q. Is it safe to eat fish from restaurants, supermarkets, and local markets in the Housatonic River Area?

A. Yes. In general, fish caught in marine open and bay waters is the source of most commercial catches in New England and is not affected by PCB contamination from local and freshwater areas. State and federal health regulatory officials regulate fish sold for the commercial markets.

17. Q. Was consumption of fiddlehead ferns associated with higher serum PCB levels?

A. Individuals who reported greater frequency and duration of fiddlehead fern consumption had slightly higher serum PCB levels.

18. Q. If my only exposure to PCBs is through soil contact, should I be concerned?

A. Previous studies conducted by MDPH have not shown that exposure through soil contact alone has resulted in appreciable increases in serum PCB levels. MDPH continues to consider consumption of contaminated fish to be the most significant non-occupational exposure concern. However, due to the recent discovery of widespread residential PCB contamination, MDPH is coordinating a separate study of residents who may be concerned about exposure.

19. Q. If PCBs have been discovered in soils on my property, what can I do about getting my health concerns addressed or my blood tested?

A. MDPH has established a toll free hot-line to advise local area residents about any health related concerns or questions they may have. The exposure assessment questionnaire will be provided to all residents who wish to have their opportunities for exposure evaluated and a blood test taken. The hot-line number is 1-800-240-4266.

20. Q. What health effects are caused by exposure to PCBs?

A. PCBs are not very acutely toxic. Large amounts of PCBs are necessary to produce acute effects. These effects can include skin lesions or irritations, fatigue, and hyperpigmentation (increased pigmentation) of the skin and nails. Chronic effects occur after weeks or years of exposure or long after initial exposure to PCBs. A number of studies have suggested that these effects include immune system suppression, liver damage, neurological effects, and possibly cancer.

21. Q. What happens to PCBs in your body?

A. Once PCBs enter the body they are first distributed in the liver and muscles and then are stored in fatty tissues. PCBs can be stored in fat tissue for years. Also, breast milk may concentrate PCBs because of its fat content. The PCBs can then be transferred to children through breastfeeding.

22. Q. Are cancer rates elevated in the HRA?

A. According to the most recent data from the Massachusetts Cancer Registry, cancer rates during 1982-1986 and 1987-1992 for the eight communities (i.e., Dalton, Great Barrington, Lanesborough, Lee, Lenox, Pittsfield, Sheffield, and Stockbridge) showed that, with the exception of bladder cancer in Pittsfield males during the 1982-1986 period, no statistically significant elevation was noted.

23. Q. Do PCBs cause reproductive effects?

A. Studies have reported that infants born to mothers who were environmentally or occupationally exposed to PCBs had decreases in birth weight, gestational age, and neonatal performance. However, the strength of the association with PCBs is unclear. PCBs have been shown to cause these and other reproductive effects in a variety of mammalian species.

24. Q. Are there any problems with reproductive outcomes for the HRA?

A. According to 1990-1994 birth data from the MDPH Registry of Vital Records and Statistics, infant mortality and the proportion of low birth weight in the HRA were similar to those of the state averages.

Appendix F:
Commonwealth of Massachusetts
EXECUTIVE OFFICE OF HEALTH AND HUMAN SERVICES

Expert Panel on the Health Effects of Non-Occupational Exposure to Polychlorinated Biphenyls (PCBs)

Questions and Answers

1. **Q. Why was an expert panel convened?**

A. Because of continuing concerns relative to the health effects of PCBs among Pittsfield area residents, the Secretary of the Executive Office of Health and Human Services (EOHHS) called for a review of this topic by a panel of independent experts. It was hoped that this panel would establish consensus on the available health information where possible, reflect the range of scientific opinion, and report on the current state of the science and directions of current research.

2. **Q. Who was on the expert panel?**

A. The panel comprised 11 nationally and internationally recognized experts on the health effects of PCBs from a wide range of disciplines, including toxicology, epidemiology, public health, and analytical chemistry.

3. **Q. How and why were the panelists selected?**

A. The Secretary of EOHHS invited the public to nominate potential panel members who had expertise in one of the following disciplines: toxicology; epidemiology; environmental exposure assessment; laboratory science; medicine (including cancer and reproductive outcomes); environmental fate and transport; and organic chemistry. The public comment period for submission of nominations ran from August 2nd to August 21st, 1998. Nearly 40 individuals were nominated representing a variety of disciplines. In selecting the final 11 panelists, the Secretary made every effort to have a panel of individuals with the diversity of technical disciplines noted above and who were nominated by a variety of publicly interested parties.

4. **Q. What topics did the panel discuss? How were these topics selected?**

A. The role of the panel was to review, assess, and summarize the most up-to-date published and ongoing research on PCBs and public health, with special emphasis on:

- The latest information on typical levels in the U.S. of PCBs in blood serum and the public health significance of these levels;
- The adverse health outcomes associated with exposure to PCBs;
- The thoroughness of information on ways humans can be exposed to PCBs (such as via air, water, soil, food);
- The interactions between PCBs and other chemicals.

EOHHS compiled a preliminary list of questions for the panel based on the experiences of the Massachusetts Department of Public Health (MDPH) with PCB contamination in the Houstonic River Area and throughout the Commonwealth. Furthermore, EOHHS and the chairman of the panel held a public meeting in Pittsfield on the eve of the panel meeting to solicit additional questions and comments from the public in Berkshire County.

5. Q. **What were the findings of the expert panel with respect to typical background levels of PCBs in blood serum?**

A. The panel agreed that the information on typical background serum PCB levels for non-occupationally exposed people in the Toxicological Profile for PCBs[1] (i.e., 4-8 ppb) is not current. In addition, the panel concluded that the information that now exists suggests that the range is probably lower than 4-8 ppb, but that comparisons are difficult due to differences in the age of various study populations and whether or not they eat fish. Some recent studies have found background serum PCB levels for women of reproductive age around 2 ppb, while other researchers have observed levels around 6 ppb for elderly people who do not eat much fish. The recent studies provide valuable data points that must be shared within the context of all relevant factors. For example, studies have consistently shown that serum PCB levels increase with age and are correlated to factors such as fish consumption and exposures to PCBs at work.

The varied analytical and statistical methods used by different researchers often make comparisons between studies difficult or impossible. Therefore, the panel strongly recommended that an individual's serum PCB level be evaluated by comparisons to the distribution of levels within the local and other comparable populations, considering age, fish consumption habits, and occupational exposures.

6. Q. **How do the serum PCB levels from residents of the Housatonic River Area compare to the current estimates of typical background levels for non-occupationally exposed individuals?**

A. When comparing serum PCB levels between different studies, it is important to match populations with similar ages and opportunities for exposures to PCBs (e.g., occupation, fish consumption habits). Analytical and statistical methods (e.g., chromatographic and detection methods, detection limits, target congeners, treatment of non-detected samples) can also vary among studies, further complicating comparisons. Nevertheless, if the appropriate factors are considered, the serum PCB levels measured in recent studies may provide useful comparison data for the results from the Housatonic River Area.

7. Q. **How do the serum PCB levels from residents of the Housatonic River Area compare to the population in the study from The Netherlands?**

A. In a recent study from The Netherlands, 415 women of reproductive age (i.e., mid-20s to

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[1] Toxicological Profile for Polychlorinated Biphenyls, Draft for Public Comment, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia, December 1998.

mid-30s) were found to have median serum PCB levels around 2 ppb. Because of the analytical methods used in this study, this result may actually correspond to approximately 4 ppb of total serum PCBs as measured for MDPH's Exposure Assessment Study. This could be predicted with greater certainty if some samples are analyzed by both techniques. In contrast, non-occupationally exposed residents of the Housatonic River Area between 18 and 34 years old (n=8) had median serum PCB concentrations less than 2 ppb.

8. Q. How do the serum PCB levels from residents of the Housatonic River Area compare to people over 50 years old who do not each much fish?

A. A recently published study reportedly found that 180 people over 50 years old who do not eat much fish (i.e., less than 6 pounds per year) had serum PCB levels around 6 ppb. The median serum PCB levels for non-occupationally exposed, older (i.e., 50 years and older, including those greater than 70) participants in MDPH's Exposure Assessment Study were 3.70 (n=19) and 5.90 (n=12) ppb for the Exposure Prevalence and Volunteer phases, respectively.

9. Q. How do the serum PCB levels from residents of the Housatonic River Area compare to the population in the Great Lakes study?

A. A mixed-age population in the Great Lakes region who did not consume sport-caught fish had geometric mean (i.e., approximately median) serum PCB levels of 1.5 and 0.9 ppb for males (n=57) and females (n=42), respectively. For a similar population in the Housatonic River Area (i.e., non-occupationally exposed participants, 18-64 years old, who either never ate fish or ate only store-bought fish), the median serum PCB levels were 3.30 (n=10) and 1.66 (n=8) ppb in the Exposure Prevalence and Volunteer phases, respectively. Direct comparisons between these studies are hampered by the fact that the method detection limit for MDPH's Exposure Assessment Study (2 ppb) was greater than the median levels measured in the Great Lakes study.

10. Q. How do the serum PCB levels from residents of the Housatonic River Area compare to the populations in the New York breast disease studies?

A. Two studies of women with benign breast disease in the New York area reported average concentrations of serum PCBs of 2.15 (n=173) and 4.06 (n=19) ppb. The average serum PCB concentrations for non-occupationally exposed participants in MDPH's Exposure Assessment Study were slightly higher than this range, 4.49 (n=52) and 5.77 (n=53) ppb for the Exposure Prevalence and Volunteer phases, respectively. This may be because the women in the New York studies were on average about 10 years younger than the participants in MDPH's Exposure Assessment Study. Furthermore, the method detection limit for the larger of the New York studies (0.5 ppb) was four times lower than the detection limit for MDPH's Exposure Assessment Study (2 ppb).

11. Q. Overall, how do the serum PCB levels from residents of the Housatonic River Area compare to the populations in these recent studies?

A. Because of the complications discussed earlier, direct comparisons between studies are difficult. However, the available data indicate that serum PCB levels for the non-occupationally exposed population from MDPH's Exposure Assessment Study are generally similar to the background exposure levels reported in recent studies.

12. Q. What were the findings of the expert panel with respect to adverse health outcomes associated with PCB exposures?

A. While the panel cited some conflicting human studies, overall the panel members agreed that the evidence is clear that PCBs are a definite carcinogen in animals. In humans, the evidence with regard to cancer is suggestive but inconclusive.

Most of the panel agreed that there appears to be some developmental effects (e.g., subtle cognitive deficits) associated with exposure to PCBs. Developmental effects observed in animal studies have also been seen in humans. However, frank neurotoxic effects such as seizure disorders have not been seen. Many agreed that the most susceptible population to these effects seems to be fetuses *in utero*.

There is some suggestive, but not conclusive, evidence from animal and human studies that exposures to PCBs can affect the immune system. Dermal effects (e.g., chloracne) have been observed in workers who were exposed to PCBs on the job.

13. Q. What were the findings of the expert panel with respect to the public health implications of serum PCB levels near background levels?

A. The current research suggests that prenatal exposures to fetuses at near background levels of PCBs may subtly affect the mental development of children. Immunological and hormonal effects have also been seen following prenatal exposure, in addition to the neurological effects. Recent studies in The Netherlands observed that children born to mothers with greater than 3 ppb of serum PCBs scored slightly lower on tests of cognitive abilities than children whose mothers had serum PCB levels less than 1.5 ppb. While statistically significant for the study population, the panel agreed that these effects were probably not noticeable on an individual basis. Moreover, because of the analytical methods used in this study, the serum PCB measurements represent approximately one-half the total serum PCBs and, hence, should be doubled to be comparable to the test results from MDPH's Exposure Assessment Study.

Importantly, this same study also found that children who were breast fed scored better on cognitive tests than children who were fed formula, despite additional exposures to PCBs and dioxins in breast milk. This finding reinforces the beneficial properties of breast feeding and highlights that exposures to PCBs *in utero* are likely of greatest concern.

14. Q. Should I be concerned about the cognitive development of my children?

A. The results of recent studies from The Netherlands raise legitimate concerns about developmental effects as a result of near background exposures to PCBs for fetuses *in utero*. However, the cognitive effects observed are slight and many panelists felt they were not biologically significant on an individual basis. Furthermore, the panel felt that other factors that affect a child's aptitude for learning (e.g., parental involvement with the child's education, good nutrition, supportive family environment) probably play a much larger role than background PCB exposures. Nevertheless, these findings provide more justification for continuing to clean up PCB contamination to reduce opportunities for exposure as much as possible.

15. Q. What were the findings of the expert panel with respect to exposure routes for non-occupationally exposed populations?

A. The panel agreed that exposures to PCBs are possible through multiple routes (e.g., air, water, soil, and food), however, the vast majority of exposure typically occurs through eating food of animal origin (e.g., fish, meat, dairy).

16. Q. How can people avoid important opportunities for exposure to PCBs?

A. Observing fish consumption advisories and eating a healthy diet that is low in fatty foods is the most effective way to reduce overall exposures to PCBs. However, because even small exposures add incrementally to overall body burden, it is important to reduce exposures via all routes.

Because the bioavailability of PCBs in air, water, and soil is uncertain, the expert panel endorsed serum PCB tests as the best available measure of actual exposure for individuals who are concerned about their exposures to PCBs.

17. Q. What were the findings of the expert panel with respect to interactions between PCBs and other chemicals?

A. PCBs are thought to behave as tumor promoters in susceptible tissues. Therefore, the carcinogenic effects of PCBs are likely to be influenced by other carcinogens or toxins that may be present. It is hoped that ongoing research will reveal more about the toxicity of mixtures of PCBs and other chemicals in the future.

18. Q. The focus in the Housatonic River Area Exposure Assessment Study was on individuals living near the river. Is there a need for the MDPH to examine the PCB serum levels of a population further away from the river?

A: The Housatonic River Area Exposure Assessment Study was purposely aimed to select individuals with highest opportunity for exposure, therefore the focus was on individuals living near the river or engaging in a variety of activities that may increase their opportunities for exposure to PCBs (e.g., fish consumption, recreational activities near the river, gardening, construction activities, fiddlehead fern consumption). Since these people were largely found to have levels near typical background ranges, individuals living further away from the river would not be expected to have higher PCB levels.

19. Q. Will MDPH evaluate all the adverse health outcomes that have been associated with PCB exposures?

A. In addition to a large number of public health assessments, MDPH is conducting an analysis of cancer incidence from 1982 to 1994 in the Housatonic River Area using data from the Massachusetts Cancer Registry. For this project, the cancers most strongly associated with PCB exposures will be evaluated (i.e., liver cancer, breast cancer, non-Hodgkin's lymphoma, Hodgkin's disease, thyroid cancer, and bladder cancer). If environmental data indicate significant opportunities for exposure to other carcinogens (e.g., PCBs and smoking as co-carcinogens), or if the literature and further discussions with appropriate experts identifies additional cancers of concern (e.g., brain, testicular, lung cancer), the list of cancers under review may be expanded. The expert panel agreed that MDPH's approach for the health assessment and other public health activities, along with the continued clean-up efforts, were adequate measures to be taken at this time.

MDPH is also conducting a pilot study assessing the relationship between environmental exposures to PCBs and DDE and new diagnoses of breast cancer.

20. Q. What can I do if I am concerned about my exposures to PCBs?

A. MDPH has established a toll free hotline to advise local area residents about any health related concerns or questions they may have. An exposure assessment questionnaire has been and will continue to be provided to all residents who wish to have their opportunities for exposure evaluated and a blood test taken. The hotline number is (800) 240-4266.

21. Q. Where can I get additional information?

A. For information on the expert panel or MDPH health studies in the Housatonic River Area, contact the Bureau of Environmental Health Assessment of MDPH at (617) 624-5757 or (800) 240-4266.

Certification

The Public Health Assessment for the General Electric Site, Lyman Street, was prepared by the Massachusetts Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was initiated.

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

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