



# Public Health Assessment for

**HATHEWAY AND PATTERSON COMPANY  
MANSFIELD, BRISTOL COUNTY, MASSACHUSETTS  
EPA FACILITY ID: MAD001060805  
OCTOBER 12, 2005**

**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.

Agency for Toxic Substances & Disease Registry ..... Julie L. Gerberding, M.D., M.P.H., Administrator  
Howard Frumkin, M.D., Dr.P.H., Director

Division of Health Assessment and Consultation..... William Cibulas, Jr., Ph.D., Director  
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Health Promotion and Community Involvement Branch ..... Lisa Calhoun Hayes, P.E., DEE, Acting Chief

Exposure Investigations and Consultation Branch..... Susan M. Moore, Ph.D., Chief

Federal Facilities Assessment Branch ..... Sandra G. Isaacs, B.S., Chief

Superfund and Program Assessment Branch ..... Richard E. Gillig, M.C.P., Chief

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Additional copies of this report are available from:  
National Technical Information Service, Springfield, Virginia  
(703) 605-6000

You May Contact ATSDR TOLL FREE at  
1-888-42ATSDR  
or  
Visit our Home Page at: <http://www.atsdr.cdc.gov>

**PUBLIC HEALTH ASSESSMENT**

HATHEWAY AND PATTERSON COMPANY  
MANSFIELD, BRISTOL COUNTY, MASSACHUSETTS  
EPA FACILITY ID: MAD001060805

Prepared by:

Environmental Toxicology Program  
Center for Environmental Health  
Massachusetts Department of Public Health  
Under Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

# TABLE OF CONTENTS

<b>SUMMARY .....</b>	<b>1</b>
<b>BACKGROUND .....</b>	<b>3</b>
A. PURPOSE .....	3
B. SITE DESCRIPTION AND HISTORY .....	3
C. SITE VISIT .....	8
D. DEMOGRAPHICS .....	9
E. COMMUNITY HEALTH CONCERNS .....	9
<b>ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS .....</b>	<b>9</b>
A. ON-SITE CONTAMINATION .....	10
B. OFF-SITE CONTAMINATION .....	19
C. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) .....	23
D. PHYSICAL AND OTHER HAZARDS .....	23
<b>PATHWAY ANALYSIS.....</b>	<b>24</b>
A. COMPLETED EXPOSURE PATHWAYS .....	24
B. POTENTIAL EXPOSURE PATHWAYS .....	26
C. ELIMINATED EXPOSURE PATHWAYS .....	27
<b>DISCUSSION .....</b>	<b>27</b>
A. EVALUATION OF POSSIBLE HEALTH EFFECTS .....	28
C. HEALTH OUTCOME DATA .....	36
D. CHILD HEALTH CONSIDERATIONS .....	39
<b>CONCLUSIONS .....</b>	<b>40</b>
<b>RECOMMENDATIONS.....</b>	<b>42</b>
<b>PUBLIC HEALTH ACTION PLAN.....</b>	<b>43</b>
<b>CERTIFICATION.....</b>	<b>45</b>
<b>TABLES.....</b>	<b>46</b>
<b>FIGURES.....</b>	<b>56</b>
<b>REFERENCES.....</b>	<b>73</b>
<b>APPENDICES .....</b>	<b>77</b>
APPENDIX A .....	78
APPENDIX B .....	80
APPENDIX C .....	85
APPENDIX D.....	101
APPENDIX E .....	104
APPENDIX F .....	107

## LIST OF TABLES

Table 1	Demographic Characteristics of Mansfield
Table 2	Summary of Surface Soil (0 through 2 ft.) contaminants of concern in the SE Quadrant.
Table 3	Summary of Surface Soil (0 through 1 ft.) contaminants of concern in the NE Quadrant.
Table 4	Summary of Surface Soil (0 through 1 ft.) contaminants of concern in the NW Quadrant.
Table 5	Summary of Surface Soil (0 through 1 ft.) contaminants of concern in the SW Quadrant.
Table 6	Summary of Surface Soil (0 through 2 ft.) contaminants of concern on the H&P property
Table 7	Summary of Off-Site Surface Soil Results at Five Residences and the Corner of County Street North of these Residences
Table 8	Summary of compounds of concern in fish samples collected by USEPA (September and October 2003)

## LIST OF FIGURES

- Figure 1 Hatheway and Patterson Site, Mansfield, MA
- Figure 2 Rumford River and Impoundments, Hatheway and Patterson Site
- Figure 3 Hatheway and Patterson Co. Property, Hatheway and Patterson Site
- Figure 4 Former Operations Area (Northern Portion), Hatheway and Patterson Site
- Figure 5 Northeast Quadrant (CCA and PCP Process Area): Ground Cover, Hatheway and Patterson Site
- Figure 6 Northwest Quadrant: (Dricon Process Area): Ground Cover, Hatheway and Patterson Site
- Figure 7 Southeast and Southwest Quadrants, Hatheway and Patterson Site
- Figure 8 Preliminary Assessment/Site Investigation Soil Samples from 1989, Hatheway and Patterson Site
- Figure 9 Site Map and Ground Cover from 1993-1994 Remedial Action, Hatheway and Patterson Site
- Figure 10 Locations of Off-site Soil Samples and Excavation, Hatheway and Patterson Site (Weston Solutions, Inc., 2004)
- Figure 11 Rumford River Backwash Sampling, Hatheway and Patterson Site (Keystone 1989)
- Figure 12a On- and Off-site Environmental Samples, Hatheway and Patterson Site (TRC 2004)
- Figure 12b Off-site Environmental Samples, Hatheway and Patterson Site (TRC 2004)
- Figure 13a On-site Environmental Samples, Hatheway and Patterson Site (TRC 2001)
- Figure 13b Off-site Environmental Samples, Hatheway and Patterson Site (TRC 2001)

## **List of Appendices**

Appendix A: MDPH and ATSDR Responses to Public Comments

Appendix B: Public Health Fish Consumption Advisories:

Letter to Mansfield Board of Health Re: Provisional Public Health Fish Consumption Advisory for Fulton, Kingman & Cabot ponds, and the Norton Reservoir (October 19, 1998)

Letter to Mansfield Board of Health Re: Updated Public Health Fish Consumption Advisory for Fulton, Kingman & Cabot ponds, and the Norton Reservoir (June 30, 1999)

Public Health Fish Consumption Advisory Poster (October, 1998/ Updated June 1999)

Appendix C: ATSDR Plain Language Glossary of Environmental Health Terms of Environmental Health Terms (Revised –17 Dec 2002)

Appendix D: Site Pictures

Appendix E: Chemical-Specific Toxicity Information

Appendix F: Risk Calculations and Exposure Pathways

## SUMMARY

The Hatheway & Patterson (H&P) property, approximately 44 acres, is located at 15 County Street in a mixed residential/industrial area in Mansfield, Massachusetts. The Hatheway and Patterson Company operated a wood preserving facility from 1953 to 1993, when they filed for bankruptcy. From the 1970s through the 1990s, the Massachusetts Department of Environmental Protection (MDEP) and the U.S. Environmental Protection Agency (EPA) required H&P to address and take some remedial actions related to contaminated soil and seeps flowing from their property to the Rumford River to adjacent properties and surrounding wetlands. In 1999 and 2001, the Massachusetts Department of Public Health (MDPH) issued two health consultations related to contamination on-site and off-site. MDPH issued a public health fish consumption advisory for several water bodies, including the Rumford River that is still in place at the time of this public health assessment. In January 2004, MDPH released this document as a draft public health assessment for public comment. The public was notified by MDPH of the document's availability for comment through local newspapers. This document addresses the comments received in writing and serves as the final public health assessment. Responses to comments may be found in Appendix A.

The site, intersected by the Consolidated Railway rail line and the Rumford River, has been divided into quadrants to facilitate discussion and management of remedial actions. The primary contaminants of concern in surface soil are arsenic, chromium, pentachlorophenol (PCP) and dioxins. The primary contaminants of concern in groundwater, sediment, surface water (i.e., the Rumford River and its off-site impoundments) and in fish are dioxins and PCP.

The most contaminated areas, where contaminants exceeded health-based comparison values and typical background levels, were in the northeast (NE) quadrant where the former process area was located, and in the southeast (SE) quadrant in the River and in the central area. Maximum concentrations of contaminants included arsenic at 1,860 milligrams/kilogram (mg/kg) in soil in the NE quadrant, chromium at 1,886 mg/kg in soil in the NE quadrant, PCP at 4,900 mg/kg in soil in the NE quadrant and dioxins at 44,951 nanograms/kg (ng/kg) in soil/sediment in the SE quadrant.

Opportunities for exposure in the past indicate that the site posed health concerns for past employees and trespassers, as well as the public that may have consumed fish from the Rumford River and its impoundments (Fulton, Kingman, and Cabot ponds). Institutional measures, such as covering areas contaminated with high levels of arsenic and other interventions, have been undertaken to minimize opportunities for exposure. Evidence of trespassing was noted at several site inspections, despite efforts to deter such activity. Concerns remain for contaminants migrating off-site via groundwater and the Rumford River that could potentially impact residences (e.g., basement flooding and/or seepage) and downstream fish. EPA recently completed a remedial investigation that addressed data gaps in earlier investigations (e.g., concerning on-site soil dioxin levels) (Weston Solutions, Inc., 2004; TRC 2004). Based on the review of environmental data at this site, the MDPH and the federal Agency for Toxic Substances and Disease Registry (ATSDR) considers the site a public health hazard under both

past and current conditions. MDPH recommends further characterization of groundwater flow by environmental regulatory agencies and intervention to prevent further discharge of groundwater contaminants into the River. Also, MDPH recommends periodic inspection of institutional controls and elimination of physical hazards at the site by environmental regulatory agencies. Education and outreach activities by MDPH associated with the public health fish consumption advisory should continue on an ongoing basis, and additional fish testing downstream of the site should be undertaken by environmental regulatory agencies to determine the extent of contamination.

## BACKGROUND

### A. Purpose

The Hatheway & Patterson (H&P) site, formerly used as a wood treatment facility, was proposed for listing on the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA) on September 13, 2001 (66 Federal Register 47612). When a site is proposed for listing, ATSDR is required by federal law to conduct a public health assessment for the site. The MDPH has a cooperative agreement with the ATSDR to conduct public health assessments at NPL and other sites in Massachusetts. This public health assessment evaluates available environmental data for the H&P site for public health implications.

### B. Site Description and History

The H&P site is located in Mansfield, Massachusetts (Figures 1 and 2), at 15-35 County Street and occupies approximately 44 acres in a mixed residential and industrial area. The H&P property is bordered to the north by County Street and residential properties; to the south and west by heavily wooded areas and wetlands and another residential neighborhood; and to the east by T.D. Verrochi Inc., a welding and masonry supply company. Before T.D Verrochi Inc. occupied the property in 1993, Conlon and Donnelly, a feed and grain supply company, was located east of H&P (Mansfield Assessors Office, 2002). The site is divided into quadrants by an active freight railroad system, formerly the Consolidated Rail Corp. (CONRAIL), that runs east-west and by the Rumford River which runs north-south (Figure 3). The southern property boundary extends along a shallow water body referred to as the Rumford River backwash channel. Wetlands abut the Rumford River backwash channel, and part of the southern section of the property is in a floodplain. Beyond the Rumford River backwash, the Rumford River flows south where Hencke Brook and Robinson Brook meet it. At this location the Rumford River is located several yards from residential properties. It then flows through Fulton, Kingman and Cabot Ponds in Mansfield. A mile and a half downstream of Cabot Pond, the River has been impounded to form the Norton Reservoir (Figures 1 and 2) 10 miles from H&P in Norton (EPA 2003).

The Hatheway and Patterson Company, Inc. was a wood preserving facility that operated from 1953 to 1993, when H&P filed for bankruptcy and ceased operations (Roy F. Weston 1995). Operations at the site included preserving wood, sheeting, planking, timber, piling, poles, and other wood products. Historical information indicates that H&P began operating on the property in 1927, but it is unknown what operations were conducted on the property from 1927 to 1953 (Roy F. Weston 1995). H&P used a variety of methods and materials in the process of preserving wood, which occurred in the NE and northwest (NW) quadrants. Treated wood was stored throughout the property, but primarily in the SE quadrant. Products used during operations included pentachlorophenol (PCP), creosote, fluoro-chrome-arsenate-phenol (FCAP)<sup>1</sup> salts and chromated-copper-arsenate (CCA). Wood was also infused with fire retardants, including Dricon

---

<sup>1</sup>Fluoro-chrome-arsenate-phenol (FCAP) - is made of 25% sodium fluoride, 25% sodium arsenate, 37.5% sodium chromate, and 12.5% 2,4 dinitrophenol).

(boric acid and anhydrous sodium tetraborate) on the property (Roy F. Weston 1993). The various wood-treating chemicals were stored in aboveground storage tanks, underground storage tanks, and sumps located inside and outside of buildings in the NE and NW quadrants (see Figure 4) (Roy F. Weston 1995).

A majority of the historical operational areas and buildings are located on the northern portion of the property, which is referred to as the “former operations area” (DynCorp Information and Engineering Technology 2001) (see Figure 4). The Rumford River bisects the northern portion of the site into NE and NW quadrants. The NE quadrant contains the cylinder 03 building where CCA processes occurred and the cylinder 01 and 02 building where PCP processes occurred (see Figure 4). Each process area contained storage tanks, sumps and a drip pad. The stacker building, kiln building, a small boiler room, a wood storage area, the mill building as well as the office are also in the NE quadrant. The NW quadrant contained the process areas for Dricon consisting of the former cylinder 04 building, a large recovery sump, a drip pad, a laboratory, a boiler room, a wood storage area and large tanks that once contained Dricon. To prevent or reduce contact with contaminated soils, EPA covered most of both the NE (Figure 5) and the NW (Figure 6) quadrants with asphalt or gravel in 1994.

Areas of the H&P property south of the railroad tracks are generally level as a result of filling activities and were used for storing treated wood (see Figures 7 & 8). The southwest (SW) portion of the property is mostly wooded and contained a wood storage area. Two former wood storage buildings were located in the SE portion of the property. Much of the SE quadrant is densely wooded, contains wetlands, and is bounded by the Rumford River backwash channel. Extensive filling of the wetlands on the site also included the rerouting of the Rumford River from its previous course in the eastern portion of the property to its present southerly course, also shown in Figure 7 (Roy F. Weston 1993). Massachusetts Department of Environmental Protection (MDEP) officials noted that geologic conditions associated with the filled riverbed facilitate preferential contaminant flow through these filled areas. This is reportedly evident by seep outbreaks observed along the southern central site areas, and historical outbreaks of tar mats along the Rumford River as it now passes by former flow paths (see Figure 8) (Roy F. Weston 1993). Small portions of the SE and SW sections have been covered with gravel (see Figure 9).

### History of Contamination and Remedial Actions

In 1972, the town of Mansfield and MDPH discovered a tar mat approximately 62 feet long and 6 inches deep on the southern portion of the H&P property, and residents complained of “oily water” and dead waterfowl in Fulton Pond downstream of the Rumford River (Roy F. Weston 1995). H&P installed deep-water booms and sorbents to prevent leachate from entering the Rumford River (MDEQE 1973). H&P in subsequent years attempted other remediation efforts, such as a groundwater collection trench (Keystone 1988), but contamination was still evident from the site.

In 1982, more effective cleanup methods were requested (MDEQE 1982). In May 1987, following an on-site reconnaissance, the Massachusetts Department of Environmental Quality

Engineering (MDEQE)<sup>2</sup> issued a Notice of Non-compliance to H&P (Keystone 1988) which required H&P to complete a Phase I Initial Site Investigation<sup>3</sup> (Phase I) (Roy F. Weston 1993) which was conducted in November 1987 (Keystone 1988).

After a review of the Phase I report, MDEQE issued a Notice of Responsibility letter to H&P in August 1988, which required H&P to conduct a complete Phase II Site Investigation (Phase II), a risk assessment, and an alternative evaluation. In addition, H&P was added to the Massachusetts Hazardous Waste site list (MDEQE 1988). During the Phase II investigation, several drums of recovered oil collected during groundwater pumping from the 1970s, were found. These had been stored on the H&P property along the eastern bank of the Rumford River,<sup>4</sup> but at some point, vandals reportedly shot holes in the drums, tipped them over, and allowed the oils to seep into the ground and the River (EPA 2003).

In June 1990, following a period of heavy rainfall, a “release of product along the left bank of the Rumford River” was again reported by a resident and confirmed by MDEP, which issued a request that H&P implement a Short Term Measure to address the imminent hazard (MDEP 1990). See Figure 7 for location of seep and the Short Term Measure. In the fall of 1990, Keystone conducted a Short Term Measure investigation, which included sampling of the visibly stained soil along the riverbank and reported that the major constituent of the seepage was semi-volatile organic compounds (SVOCs), including PCP, and other phenols (Keystone 1991). In the fall of 1991, H&P constructed a collection trench along the eastern bank of the Rumford River (see Figure 7) that was designed to intercept groundwater and oils migrating to the River from the oil-contaminated portion of the riverbank (Keystone 1992). All recaptured oil and water recovered from this trench was reused by H&P in the plant process (Keystone 1989).

In February 1992, Penney Engineering, Inc. began monthly monitoring of the collection trench and retrofitted the trench to include a groundwater treatment system consisting of activated carbon canisters prior to discharging the groundwater to the Rumford River (Penney Engineering 1992). Other problems were identified by environmental regulatory agencies (Roy F. Weston 1995) and as a result, MDEP requested that H&P conduct additional assessment and development plans for corrective action on the property. In February 1993, H&P filed for bankruptcy protection and the H&P facility closed in May (Roy F. Weston 1993).

In June 1993, EPA Region I Emergency Planning and Response Branch (EPRB), MDEP and Weston-TAT (Technical Assistance Team) personnel initiated a Preliminary Assessment/Site Investigation at the H&P property. TAT personnel reported finding: 20 55-gallon drums; eight above-ground storage tanks located in various process buildings, containing a total of approximately 45,000 gallons of wood-treating chemicals (e.g., PCP, CCA, Dricon™); one above-ground storage tank (unknown volume) containing fuel oil; indoor pits and sumps with

---

<sup>2</sup> Massachusetts Department of Environmental Quality Engineering (MDEQE) is the former name of MDEP. This change occurred in 1989 (MDEP 2003b).

<sup>3</sup> The Phase I Initial Site Investigation is conducted pursuant to Massachusetts General Law (MGL), Chapter 21E, Sections 4 and 5

<sup>4</sup> J.E. Gould, of the MDEQE, wrote of concerns about “eight open 55-gallon drums of retrieved oil” ... “stored unprotected against vandalism or spilling” (4/17/75).

water and sludge from former wood-treatment processes; and six underground storage tanks located in the vicinity of the former cylinder 01 and 02 buildings that contained various wastes.

Weston-TAT personnel collected five surface soil samples (from a depth of 0 to 2 feet) from areas of the H&P property suspected to have the highest levels of contamination-- two from the NE and three from seep areas in the SE quadrants (see Figure 8). The primary contaminants detected were PCP, two polycyclic aromatic hydrocarbons (PAHs) (i.e., pyrene and fluoranthene), and arsenic. From these samples, EPA determined that a Removal Action was necessary (EPA 1993).

MDEP also discovered via monitoring well data that a PCP- and CCA-contaminated groundwater plume was moving south into adjacent wetlands and the Rumford River backwash channel. In addition, non-aqueous phase liquid (NAPL) was observed in monitoring wells that had previously been free of NAPL (MDEP 1994). However, this occurrence may have been related to a "major fire" on July 14, 1993 at the Conlon and Donnelly grain warehouse, on the eastern boundary of the H&P property. An estimated one million gallons of water were discharged near the NE portion of the site, which may have caused an unusual oil migration on and after August 26, 1993. Prior to that (on July 21), wells were gauged and did not have significant amounts of oil (Penney Engineering 1993).

In December 1993, EPA initiated an Emergency Removal Action (Roy F. Weston 1995). Approximately 100,000 gallons of liquid and solid wastes were removed from the site. Laboratory analysis of the wastes indicated the presence of SVOCs, volatile organic chemicals (VOCs), metals, dioxin and furans (Roy F. Weston 1995). Areas that exceeded 300 mg/kg<sup>5</sup> arsenic in soil were covered with asphalt in August 1995 (Figure 9). The process areas in the NE quadrant had the highest arsenic levels at up to 3,000 mg/kg. Emergency Removal Action continued through September 1995 and included repair and installation of the fence (and barbed wire) around the perimeter of the property, installation of locks on the tanks and buildings, filling potholes and applying Petromat (a combined layer of tar and fabric) to some areas and placing gravel along roadsides. Also, additional warning signs were posted and efforts were made to ensure that overland water flow would be directed toward the Rumford River (Roy F. Weston 1995).

On April 10, 1998, EPA-START (Superfund Technical Assessment Response Team) personnel conducted on-site reconnaissance of the H&P property and observed oily sheens breaking out into the Rumford River (see Figure 8). Oily seepage was also observed on soil in the south-central portion of the property along the southern edge of the fill line. On June 11, 1998, MDEP contracted Clean Harbors Environmental Services Inc. to collect samples that were analyzed for dioxins and furans. The results indicated that dioxins were present in surface water (4.2 picograms per liter (pg/L)) and sediment (44,951 nanograms per kilogram (ng/kg)) collected from the Rumford River and adjacent wetlands (Clean Harbors 1998).

---

<sup>5</sup> Milligrams per kilogram (mg/kg) = parts per million (ppm)

Due to the dioxin detections, MDEP requested that the Massachusetts Division of Fisheries and Wildlife (MDFW) postpone fish stocking of area ponds (MDEP 1998). Also in October 1998, the Bureau of Environmental Health Assessment/Environmental Toxicology Program (BEHA/ETP) of MDPH issued a provisional public health fish consumption advisory due to the elevated level of dioxins identified in surface water near H&P and because dioxins have a high potential to bioconcentrate in fish (MDPH 1999). MDPH also recommended that MDEP arrange with EPA to design a fish sampling protocol to test fish for dioxins (MDPH 1999). On November 23, 1998, EPA Removal Branch personnel collected seven fish tissue samples downstream and tested the fish (whole and fillets) for PCP, dioxin/furan congeners and arsenic. PCP and a total of seven dioxin/furan congeners were detected at levels of health concern in fish tissue samples, but no arsenic was found. Based on this information MDPH issued a public health fish consumption advisory for the Rumford River, Fulton, Kingman and Cabot ponds, as well as the Norton Reservoir in June 1999 and released a public health consultation for the Rumford River (MDPH 1999). Because elevated levels of dioxins were found upstream of H&P, one of MDPH's recommendations was to test the fish from Glue Factory Pond in Foxboro. Additional samples (seven fish and four sediment) were collected for EPA's Preliminary Assessment/Site Investigation on October 15, 1999. Dioxins/furan congeners were detected in the fish tissue. These results and their potential threat to public health were evaluated in a second health consultation: "Glue Factory Pond/Rumford River" (MDPH 2001).

In the fall of 1998, the town of Mansfield worked with the EPA to obtain a Brownfields development grant and conducted sampling to consider the feasibility of using primarily Area 2 for a parking lot for the Massachusetts Bay Transit Authority (MBTA) and possibly part of Area 1 for an access road (Resource Controls 1997; Figure 9). At the same time efforts were underway to propose H&P for NPL listing.

In the fall of 2001, Metcalf & Eddy and TRC Environmental Corporation, under contract with EPA, initiated sampling of 15 existing groundwater wells, surface water/sediment sampling from 19 locations in the Rumford River, and two vernal pools (pools seasonally present in the spring). Results indicated the presence of a ground water plume containing arsenic and PCP extending from the process area to the Rumford River, and a possible second ground water plume emanating from the southern portion of the site. Elevated concentrations of arsenic, lead, PCP and dioxin were detected in sediment adjacent to the site and elevated concentrations of PCP were detected in surface water at the site.

H&P became an NPL site on September 5, 2002 (67 Federal Register 56757).

In July and August 2003, EPA collected and analyzed 136 surface soil samples outside of the perimeter fence on County Street and across the street (on five abutting residential properties) to determine whether there was any off-site arsenic contamination (above MDEP's action level of 30 mg/kg) (see Figure 10). Because some samples exceeded the action level for arsenic, EPA Removal Branch initiated an Emergency Removal Action in August 2003 to address the contaminated soil. By September 2003, over 375 tons of soil was removed from both sides of

County Street (including the residential properties). Geotextile fabric was applied to the excavated areas in order to isolate the soil below and reduce erosion. These areas were then backfilled with clean soil (Weston Solutions, Inc., April 2004).

In June 2005, EPA announced proposed clean-up plans for the site. The plans include demolition of the all the buildings in the Operations Area and excavation of soils contaminated with arsenic, PCP, and SVOCs. The soils will be consolidated and stored on-site under a low-permeability cover. Soils containing dioxin and oily material will be disposed of off-site at a licensed facility. The plans also include long term monitoring of groundwater migration. Institutional controls will prohibit the use of site groundwater and restrict residential land uses. EPA wants to begin demolition of the buildings in 2006.

### **C. Site Visit**

On March 10, 1999, MDPH participated in a site visit of the Rumford River with MDEP, EPA, and the Mansfield Health Department, including the perimeter of the H&P site. MDEP staff described seeing trespassers on the property, as well as evidence of trespassing, such as a campfire ring, broken fences, and vandalism. One of the smaller gates to the property was unlocked and open. An oily sheen was observed on the River near the groundwater extraction wells. It was noted that vegetation was absent from areas where treated lumber was dried. Downstream of the H&P site, the River was inaccessible due to fences, but was accessible again near Fulton Pond.

On July 1, 2002, MDPH participated in a site visit with EPA, ATSDR, the Mansfield Health Department, and several consultants (MDPH 2002a). There are fences surrounding much of the property, although evidence of trespassers (e.g., beer bottles, vandalism, graffiti) was found in each of the four site quadrants. The gate at the front entrance leaves a gap large enough for children to breach at the bottom of the gate to the ground. A 5 foot high chain link fence with barbed wire runs the length of County Street across from the residences. However, the barbed wire is rusted at several locations and has been pushed back in some sections, allowing trespassers possible access to the site. Several of the buildings (e.g., Dricon building boiler room, laboratory building, cylinder 03 building) were unlocked and accessible. The Dricon building boiler room contained heavy equipment, which could pose a physical hazard. At the end of the cylinder 03 building, where it meets the CCA drip pad, there is an open entrance to the building. Before this entrance, there is a pit covered over with aging, unsafe wooden boards that could pose a physical hazard. The Dricon sump is filled with at least 12 inches of water and is accessible to trespassers, which is a hazard. There is a pile of wood near the sump that could be a fire hazard. The wooden bridges that cross the Rumford River are in poor condition, with holes and rotting sections that pose a physical hazard.

On July 19, 2005, MDPH participated in a site visit with EPA and ATSDR (MDPH 2005). Some evidence of trespassing and, as observed in previous site visits, remain (e.g., Dricon sump filled with water, broken wooden bridges that cross the Rumford River, broken glass). The town of Mansfield police and fire departments are presently using the former H&P office building and

their presence may be serving as a deterrent to trespassers. However, gaps in the boundary fence remain, making it possible for trespassers to enter the site. See Appendix D for some photos from this site visit.

#### **D. Demographics**

The H&P site is located within the town of Mansfield, Massachusetts. The 2000 U.S. Census showed a population of 22,414. Within the town, the H&P site is located in U.S. Census Tract 6101. The 2000 U.S. Census showed that 5,000 individuals reside in this census tract. The sex, race, and age breakdowns for Mansfield and U.S. Census Tract 6101 are presented in Table 1 (U.S. Census 2001). According to 2000 census block data, approximately 1,000 individuals reside within a half mile of the site.

#### **E. Community Health Concerns**

A public information meeting, sponsored by EPA was held in July 2002 to provide information about prior environmental sampling, outline future plans for the remedial investigations, and address community concerns (MDPH 2002b). Community members expressed concerns about the use of private wells for gardening, oily discharge from a culvert, and a bridge near the H&P site where water overflows during flooding. Members of the community also expressed interest in meeting with the EPA more frequently, in order to be informed of planned sampling, sampling results, risk assessments, and the progress of remediation activities.

### **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 available media (e.g., soil, surface water, groundwater, air, and biota). A plain language glossary of environmental health terms can be found in Appendix C.

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 are published by ATSDR and/or EPA. The MDEP 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 Region III risk-based concentrations (RBCs) were used.

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 life time 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.

CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million ( $10^{-6}$ ) persons exposed during their lifetime (70 years). ATSDR's CREGs are calculated from EPA's cancer slope factors for oral exposures or unit risk values for inhalation exposures. These values are based on EPA evaluations and assumptions about theoretical cancer risks at low levels of exposure.

Many metals occur naturally in the environment, and information is available in the scientific literature on typical (background) levels at which these metals occur in soil. In addition, PAHs and some other organic compounds are ubiquitous in the environment due to their widespread use in many industrial, commercial, transportation, and other processes. As with metals, typical levels of PAHs are available from the scientific literature. For this public health assessment, metals and PAH compounds detected at the site were compared to typical background levels for the eastern U.S. or Massachusetts. If site concentrations were within or lower than typical background concentrations, then the metal or compound was not further evaluated in the health assessment. For metals, the sources of background concentrations were Shacklette and Boerngen (1984), MDEP (1995a, 2002) and the ATSDR toxicological profiles for the specific chemical/compound under review. For PAHs, the source of typical background levels was the ATSDR toxicological profile for PAHs (Table 5-3 in ATSDR 1995).

A summary of historical data is provided in the following discussion of on-site contamination. Data tables are provided only for those environmental media with contaminants that have been detected at concentrations that exceed their respective comparison values and typical background levels.

### **A. On-Site Contamination**

Surface soil<sup>6</sup>, subsurface soil, sediment, surface water, and groundwater and fish tissue data from environmental sampling conducted at the H&P site from 1988 through 2003 were reviewed

---

<sup>6</sup> Surface soil, from an exposure perspective, is considered to be the top 3 inches of soil; however, analysis of soil from this depth often was not available. Thus, analysis of surface soils included levels of contaminants at depths from 0 to 2 feet.

(Keystone 1988, 1989; Roy F. Weston 1993, 1994; Clean Harbors 1998, Hydraulic and Water Resources Engineers 1999; Resource Control Associates and Vanasse Hangen Brustlin Inc. 2000; TRC 2002 and TRC 2004). Some limited environmental data for soil, sediment and surface water as well as fish tissue collected by EPA in 1998 and 1999 were previously evaluated in two health consultations (MDPH 1999 and MDPH 2001).

## Surface Soil/Sediment

### *Southeast quadrant*

In the SE quadrant there are three main sections where soils (0 to 2 feet) have been collected: the backwash area, the south central area and the upper SE area. Each of these sections has distinct geographical characteristics that affect the contaminants detected (see Figure 7). The backwash area includes the Rumford River backwash channel and is characterized by wetlands, woodlands and thick vegetation that extend towards the south central area. The south central area includes the former location of the large wood storage building, south of the large bedrock outcrop and several former wood storage areas (see Figure 3). The upper SE area of the SE quadrant runs parallel to the railroad tracks and includes the former location of a smaller wood storage building by the tracks. Contaminants of concern in surface soil from the three sections of the SE quadrant are summarized in Table 2, but discussed separately below.

The backwash area was sampled in 1989 and involved collection of 10 surface soil samples. Nine samples in the backwash area were collected in a grid pattern (see Figure 11) and analyzed for SVOCs and VOCs (Keystone 1989). One soil boring (0 to 2 feet) was analyzed for SVOCs, VOCs, and metals. Six of the 10 samples contained PCP at levels that exceeded the CREG screening value of 6 mg/kg with a maximum concentration of 8 mg/kg. The single sample analyzed for metals did not have concentrations that exceed typical background levels for metals.

The south central area surface soils were tested in 1993 for PCP, PAHs and metals. The samples with the highest levels of PAHs on site (chrysene [50 mg/kg], fluoranthene [194 mg/kg], pyrene [268 mg/kg] and PCP [18 mg/kg]) were collected along the southern edge of the fill line where seeps had been reported (station 002 in Figure 8), and these compounds exceeded their comparison values and typical background levels. Also the maximum concentration of arsenic (151 mg/kg) exceeded comparison values and typical background levels (Roy F. Weston 1993).

A comprehensive surface soil investigation was conducted between 1994 and 1995, to characterize surface soil and determine areas to cover with asphalt and gravel (Roy F. Weston 1994). Samples were screened on site for PCP and PAHs using immunoassay kits, and a field portable X-ray Fluorescence (XRF) instrument was used to screen for arsenic, copper and chromium. However, since XRF overestimates the concentration of metals in soil by nearly twice that of more quantitative laboratory analyses,<sup>7</sup> metal concentrations based on a linear regression analysis between XRF and ICAP (Inductively Coupled Argon Plasma) data were used to screen for arsenic, copper and chromium. Of 13 samples screened in the south central area,

---

<sup>7</sup> Ten percent of the samples screened for metals were sent for confirmatory analysis using EPA 6010 TAL for metals and ten percent of the samples screened for PCP and PAHs were analyzed by GC mass spectroscopy.

arsenic (257 mg/kg; maximum) from a sample collected north of the former wood storage building exceeded comparison values for metals. The area north of the former wood storage building was covered with gravel (Roy F. Weston 1994; see Figure 9). In the south central area, one soil sample was analyzed for EPA 6010 TAL (Target Analyte List) metals. It had levels of thallium (24 mg/kg) that were less than the EPA Region III's industrial soil comparison value, and levels of arsenic (9 mg/kg) and chromium (15 mg/kg) that did not exceed typical background levels for metals.

In 1998, two surface soil/sediment samples (SED-2 and SOIL-1) in the south central area were analyzed for dioxins and four surface soil samples were analyzed for metals, SVOCs and dioxins/furans by MDEP and EPA (Clean Harbors 1998, Hydraulic and Water Resources Engineers 1999; See Figures 12a & 13a for sample locations). The maximum concentration of arsenic was estimated to be 369 mg/kg. The dioxin/furan levels exceeded 50 ng/kg, which is the EMEG for children for 2,3,7,8-TCDD (tetra chlorinated dibenzo-p-dioxins) and the 2,3,7,8-TCDD TEQ.<sup>8</sup> The concentration ranged from ND to 80 ng/kg for 2,3,7,8-TCDD and from 56 ng/kg to 44,951 ng/kg for the 2,3,7,8-TCDD TEQ in the south central area. No SVOCs exceeded comparison values or typical background. The seep area near MW-12 was covered with gravel (Roy F. Weston 1995); however, product continues to seep through at this location (MDEP 2003a). In November 2002, results for four samples collected from the south central area and analyzed for SVOCs, metals, and dioxins were below comparison levels (TRC 2004).

The upper SE area includes one surface soil sample collected in 1993 that was tested for SVOCs and metals; it had a concentration of benzo(a)pyrene (0.4 mg/kg), which was above the CREG of 0.10 mg/kg and slightly above the typical background level of 0.165 to 0.220 mg/kg. Of 13 samples analyzed by XRF linear regression analysis (including one sample analyzed for EPA 6010 TAL metals), one sample, collected near the former wood storage building, contained the highest levels of thallium (68 mg/kg) and chromium (470 mg/kg) detected in the SE quadrant. These contaminants as well as arsenic at 160 mg/kg, were all above comparison values. However, total chromium was above comparison values for hexavalent chromium, and since hexavalent chromium is associated with the CCA process that occurred on the site, total chromium will remain a contaminant of concern. This area was covered with gravel (Figure 9). A sample north of the bedrock outcrop had arsenic at 284 mg/kg; however, this area was covered with gravel (Roy F. Weston 1995). Of two samples collected in the upper south section and analyzed for dioxins, one sample exceeded comparison values. It had a concentration of 165 ng/kg for 2,3,7,8-TCDD TEQ, which exceeds the chronic child EMEG of 50 ng/kg. Although the location from which this sample was taken was covered with gravel, product continues to seep through this area. Two of four soil samples collected from the upper SE section in November

---

<sup>8</sup> 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. Previous ATSDR guidance included using the 2,3,7,8-TCDD comparison value of 50 ng/kg to screen for the TCDD TEQ. Recent ATSDR guidance suggests using 1000 ng/kg, however the more conservative comparison value, 50 ng/kg, was used for screening.

2002 and analyzed for metals also showed concentrations of arsenic slightly above the chronic child EMEG of 20 mg/kg but within typical background levels (30 mg/kg and 24 mg/kg) (TRC 2004). Two of three samples analyzed for dioxins were estimated to exceed the chronic child EMEG of 50 ng/kg for 2,3,7,8-TCDD TEQ (685 ng/kg and 79 ng/kg).

In summary, for all three parts of the SE quadrant the potential contaminants of concern are arsenic, chromium, PCP, and dioxins. Although some PAHs exceeded screening values, the exceedances were mainly in two of 32 samples across this quadrant. One of the samples had benzo(a)pyrene slightly above background. The other sample was in the location that also had elevated PCP concentrations. Hence given the low frequency of exceedances of comparison values and the more widespread presence of PCP, PAHs were not considered primary contaminants of concern for this area. Thallium was below EPA Region III's industrial soil screening value, and thus will also not be considered a contaminant of concern for this area.

### *Northeast quadrant*

Weston screened 12 surface soil samples in the NE quadrant from the (upper) CCA process area and the (lower) PCP process areas using XRF linear regression analysis and confirmatory analyses to test for metals, PCP and PAHs (six samples were analyzed for SVOCs; Weston 1994). The maximum values of contaminants that exceeded comparison and background values were arsenic (1,388 mg/kg), chromium (1,886 mg/kg), PCP (4,900 mg/kg) and thallium (67 mg/kg). Thallium was below EPA Region III's industrial soil comparison value, and thus will not be further discussed. Benzo(a)pyrene was detected in one of six samples with a maximum concentration of 1.8 mg/kg, which did not exceed typical background levels of up to 14 mg/kg in urban soil and thus will not be further discussed (ATSDR 1995). As one would expect, the highest levels of arsenic and chromium were in the CCA process areas and the highest level of PCP was in the PCP process area. Six of the 12 samples analyzed for metals exceeded the comparison values for hexavalent chromium and typical background levels of 1,000 mg/kg for total chromium (Roy F. Weston 1994; Shacklette and Boerngen 1984). Analysis of four soil samples collected in November 2002 (TRC 2004) showed concentrations of arsenic exceeding comparison values and dioxins were estimated to exceed comparison values (soil samples from this quadrant were not analyzed for dioxins in earlier investigations). The maximum concentration of arsenic was 1860 mg/kg. The maximum concentration of 2,3,7,8-TCDD TEQ was estimated to be 11,000 ng/kg.

In 1995, 85 surface soil samples obtained from various locations on the H&P property and from the perimeter were collected and analyzed for arsenic to identify areas greater than 300 mg/kg<sup>9</sup> to pave with asphalt (MDEP 1995b). In the NE quadrant, the periphery of the process areas was covered with gravel, and a large area behind the CCA drip pad was covered with asphalt (see Figure 9; Roy F. Weston 1995). However, the integrity of areas covered with gravel or asphalt may diminish over time.

---

<sup>9</sup> The 300 mg/kg standard was the Massachusetts Contingency Plan (MCP) Upper Concentration Limit (UCL) for arsenic. The current reportable concentration for groundwater soil is 30 mg/kg for residential and industrial areas.

Table 3 summarizes the contaminants of concern for the NE quadrant, which include arsenic, chromium, PCP and dioxins.

### ***Northwest quadrant***

In the NW quadrant surface soil samples were collected from two areas: a small area north of the Rumford River along County Street and the area south of the River where Dricon (a fire retardant) processes occurred. The contaminant that exceeded comparison values (in its maximum concentrations) in the NW quadrant was arsenic (630 mg/kg) (Table 4; Roy F. Weston 1994). The highest concentration of arsenic (630 mg/kg) was from a sample collected at the far west end of the NW quadrant near the tracks; it was covered with asphalt. In fact, most of the NW quadrant, from the Dricon drip pad to the north and west property boundary was covered with asphalt. A small area along County Street (inside the fence) within 30 feet of residential property also had levels of arsenic (300 mg/kg) and chromium (460 mg/kg) that exceeded comparison values and was covered (see Figure 9). Of the four samples analyzed for PCP in this area, the maximum concentration was 1.9 mg/kg, which is below ATSDR's CREG (6 mg/kg).

Fifteen soil samples collected and analyzed for metals and dioxins in November 2002 showed exceedances of comparison values (TRC 2004). The maximum concentration of arsenic was 62.5 mg/kg, which exceeds the chronic child EMEG of 20 mg/kg but is within typical background levels. The maximum concentration of total chromium was 460 mg/kg, which was above comparison values for hexavalent chromium, which is often associated with the CCA process that occurred at the site. The maximum concentration of 2,3,7,8-TCDD TEQ was estimated at 330 ng/kg, which exceeded the chronic child EMEG value (50 ng/kg).

Table 4 summarizes the contaminants of concern for the NW quadrant, which include arsenic, chromium and dioxins.

### ***Southwest quadrant***

The SW quadrant is the smallest area and is located south of the railroad. Arsenic exceeded comparison and background values in this quadrant (Table 5; Roy F. Weston 1994). The maximum concentration detected was 413 mg/kg in a sample collected south of the tracks towards the middle of the quadrant. PCP was not detected in the SW quadrant. This area was covered with gravel. In November 2002, nine soil samples were collected and analyzed for metals and dioxins (TRC 2004). The maximum concentration of arsenic was 15 mg/kg that is above the CREG but below the chronic child EMEG of 20 mg/kg. The maximum concentration of total chromium was 318 mg/kg, which was above comparison values for hexavalent chromium, which is often associated with the CCA process that occurred at the site. The maximum concentration of 2,3,7,8-TCDD TEQ was estimated at 64 ng/kg, which was above the chronic child EMEG value (50 ng/kg).

Table 5 summarizes the contaminants of concern for the SW quadrant, which include arsenic, chromium, and dioxin.

A summary table (Table 6) lists the maximum concentrations of contaminants of concern in surface soil for each quadrant. The contaminants of concern in surface soil are arsenic, chromium, PCP and dioxins. It is important to note that the occurrence of PAHs that exceeded comparison values and typical background levels, were either primarily from one sample in the SE quadrant or infrequently detected at levels just above comparison values. Similarly, thallium was detected infrequently in all cases and was below EPA Region III's industrial soil comparison value. Consequently PAHs and thallium will not be discussed further in this PHA.

### Subsurface Soil

On December 5, 1972, five samples (i.e., one from "the embankment of the River" and four from tanks on the H&P property) were collected and analyzed for percent PCP by weight by MDPH's Lawrence Experimental Station (Foster 1972).<sup>10</sup> Although the specific locations are not identified, the highest level, 3.66% PCP by weight, was recorded for the sample from the embankment of the Rumford River.

Twenty-nine subsurface soil samples were collected on the H&P property from 2 to 10 foot depths, including several soil borings completed as monitoring wells (see Figure 14) (Keystone 1988; 1989). Of these 29 samples, there were three from the NW quadrant, 10 from the NE quadrant, three from the SW quadrant and 13 from the SE quadrant. Soil samples were analyzed for VOCs, PCP, PAHs, metals, pesticides, and polychlorinated biphenyls (PCBs). The maximum concentrations of arsenic (140 mg/kg), and PCP (490 mg/kg) exceeded comparison values and were from the NE quadrant process areas, where the maximum concentrations of these compounds also occurred in surface soil on the H&P property.

In November 2002, 12 subsurface soil samples (either 1 to 4 or 4 to 10 feet deep, three samples from each quadrant) were collected and analyzed for VOCs, SVOCs, metals, and dioxins (TRC 2004). Samples exceeded the comparison values for arsenic and PCP and were estimated to exceed comparison values for dioxins. The maximum concentrations of arsenic (55 mg/kg) PCP (490 mg/kg), and 2,3,7,8-TCDD TEQ (estimated at 2600 ng/kg) were all detected in samples taken from the SE quadrant. In general, subsurface samples were considerably lower in contaminant concentrations than the surface samples.

### Groundwater

In December 1981, a third party performed percolation tests in anticipation of purchasing the H&P property and found oily soils/groundwater. Groundwater samples were taken and analyzed from six test wells located in the SE quadrant. PCP was identified in a sample of the oily mixture taken from a test well located near the previous recovery operation (Fitzgerald 1982). From 1988 until 2004, six groundwater sampling events took place (Keystone 1988; Clean Harbors 1998; TRC 2002; TRC 2004). Over 150 samples of groundwater were collected and analyzed from test wells located in the NE, SW, and SE quadrants. The wells were sampled at varying

---

<sup>10</sup> The Lawrence Experiment Station is now the Wall Experiment Station and is the state's environmental laboratory located in MDEP.

depths and the analytes tested for included dioxins, metals, SVOCs, and VOCs. PCP, dioxins, arsenic, chromium, benzene, 2,3,5,6-tetrachlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, and 2,4-dinitrophenol were all detected at concentrations above comparison values. The maximum concentration of PCP was 69,000 micrograms per liter ( $\mu\text{g/L}$ ) in a sample collected from the upper SE quadrant which is considerably higher than the MCL ( $1 \mu\text{g/L}$ ) and the chronic child EMEG ( $10 \mu\text{g/L}$ ). A sample from another test well in the upper SE quadrant analyzed for dioxins showed the presence of 2,3,7,8-TCDD TEQ at a concentration of  $3 \mu\text{g/L}$  which substantially exceeds the MCL of  $0.00003 \mu\text{g/L}$  and the chronic child EMEG of  $0.00001 \mu\text{g/L}$  for dioxins in drinking water. The maximum concentration of arsenic ( $956 \mu\text{g/L}$ ) was detected in a sample collected from the central SE quadrant which also exceeded the MCL ( $10 \mu\text{g/L}$ ), the CREG ( $0.02 \text{ ppb}$ ), and the chronic child EMEG ( $3 \mu\text{g/L}$ ). In a sample from the same quadrant, the maximum concentration of 2,4-dinitrophenol was detected at  $2,240 \mu\text{g/L}$  which exceeded the chronic child RMEG ( $20 \mu\text{g/L}$ ). As noted above, other compounds were a potential concern.

The sampling event in 2003 also included the collection and analysis of groundwater samples from six bedrock wells in the SE quadrant. Samples were analyzed for SVOCs and metals. The concentrations of arsenic and PCP were detected above comparison levels (TRC 2004). The highest concentration of arsenic detected was  $37 \mu\text{g/L}$  and the highest concentration of PCP detected was  $3,100 \mu\text{g/L}$ .

Groundwater flow east of the Rumford River is toward the southwest and toward the River (Resource Control Associates and Vanasse Hangen Brustlin Inc. 2000). Discharge of groundwater to the River is evident by seeps along the banks of the River at the site. Bedrock water table elevation contours are similar to the overburden water table contours. Based on comparison of groundwater elevation in the bedrock/overburden monitoring well couplets collected in 1999, the general trend across the site was thought by the environmental consultants to be for bedrock groundwater to discharge to overburden groundwater and overburden groundwater, in turn, to discharge to the Rumford River. However, groundwater elevations measured in a well located in the upper SE quadrant exhibited overburden groundwater discharging to bedrock (Keystone 1989). Subsequently, TRC concluded that insufficient data exist for evaluation of bedrock groundwater flow direction or water quality (TRC 2002).

In summary, groundwater data collected from 1981 to 2004 revealed high concentrations of dioxins, phenols (including PCP), arsenic, and other compounds in both overburden and bedrock groundwater, particularly in the SE quadrant. This groundwater discharges to the Rumford River and as noted elsewhere in this document, represents a concern for bioaccumulation in fish.

### Sediment

In June 1998, one sediment sample (SED-1) was collected from the interceptor trench in the Rumford River<sup>11</sup> (see Figure 14; Clean Harbors 1998). Analysis of interceptor trench involved

---

<sup>11</sup> Sample SED-1 was one of six samples collected on June 11, 1998 and tested for dioxins: Two surface soils (SED-2 and Soil-1), one surface water (SW-1, near SED-1), one ground water (from MW-5a) and one product (NAPL from MW-12) (Clean Harbors 1998). Dioxin TEQs were  $44,951 \text{ ng/kg}$  in SED-2,  $7,211 \text{ ng/kg}$  in Soil-1,  $4.2 \text{ pg/L}$  in SW-1 and  $3,300 \text{ pg/L}$  in MW-5a.

analysis of a solid sample for dioxins and a surface water sample analyzed for metals, base neutral extractables (BNE), PCP and dioxins. The concentration of 2,3,7,8-TCDD TEQ in the sediment sample was 7,211 ng/kg, which far exceeds the screening value of 50 ng/kg, the child EMEG for dioxins in soil.

Four on-site sediment samples (RRHP01 from the NW quadrant; RRHP02, RRHP03 and RRHPSB from the SE quadrant) were collected in October and November 1998 from the River by EPA Removal Branch and analyzed for dioxin, PCP, metals, VOCs, SVOCs, pesticides, and PCBs, and evaluated in the Rumford River Health Consultation in 1999 (see Figure 12a; Hydraulic & Water Resource Engineers 1999; MDPH 1999). The compounds that exceeded comparison values and typical background levels included 2,3,7,8-TCDD TEQ (maximum 3,260 ng/kg in RRHP02) and PCP (maximum 51 mg/kg in RRHP03). The levels of 2,3,7,8-TCDD TEQ in three on-site samples (i.e., RRHP01 at 152 ng/kg; RRHP02 at 3,260 ng/kg and RRHP03 at 1,300 ng/kg) exceeded the child EMEG of 50 ng/kg. Only RRHP03 at 51 mg/kg exceeded the comparison values for PCP, including the CREG of 6 mg/kg, the child EMEG of 50 mg/kg, but was well below the adult EMEG of 700 mg/kg. Nine on-site sediment samples were collected in March 1999 from depths ranging from 0.5 to 2.5 feet and analyzed for extractable petroleum hydrocarbons (EPHs)<sup>12</sup> and target PAH analytes (Resource Control Associates and Vanasse Hangen Brustlin Inc. 2000). Only PCP exceeded comparison values and was detected at a maximum of 9.5 mg/kg.

Nine on-site<sup>13</sup> sediment samples, three in the NW quadrant (i.e., SD-11, SD-12, SD-14) and six in the SE quadrant (SD-3, SD-7, SD-8, SD-9, SD-10, SD-15) were collected in November 2001 at depths ranging between 0 and 2 feet and analyzed for dioxins and furans, metals, pesticides, PCBs, VOCs, and SVOCs (TRC 2002; see Figure 13a and 13b). Although all the sediment samples exceeded the CREG (0.5 mg/kg) for arsenic, ranging from 1 to 21 mg/kg, and slightly above the child EMEG of 20 mg/kg, these samples are considered within the range of background for arsenic in soil (0.1 to 73 mg/kg) (Shacklette and Boerngen 1984). The maximum levels of contaminants detected that exceeded comparison values were for dioxin TEQ (1,800 ng/kg) and PCP (27 mg/kg) both from SD-9 in the Rumford River passing through the SE quadrant. One other sediment sample (SD-3 at 23 mg/kg) also had levels of PCP that exceeded the CREG of 6 mg/kg but not the child EMEG for soil of 50 mg/kg. Four other on-site sediment samples (SD-7 at 50 ng/kg, SD-10 at 180 ng/kg, SD-11 at 100 ng/kg and SD-15 at 110 ng/kg) also had levels of 2,3,7,8-TCDD that exceeded the child EMEG for soil of 50 ng/kg.

In November 2002, three sediment samples were collected from the SE quadrant (by the Rumford River backwash channel) and were analyzed for SVOCs, metals, and dioxins (TRC 2004). All three samples exceeded the CREG for arsenic (0.5 mg/kg) but were below the chronic EMEG

---

<sup>12</sup> EPHs (extractable petroleum hydrocarbons) are a subset of petroleum hydrocarbons that include three groups of compounds: C9 to C18 (aliphatics), C19 to C36 (aliphatics) and C11 to C22 (aromatics). TPH includes these three EPH fractions plus target PAH analytes (MDEP 2003e).

<sup>13</sup> Most sediment samples collected by TRC were collected at two depths (0 to 0.5 ft and 0.5 to up to 2ft), but only surface sample results are discussed. SD-3 was collected in the backwash area, parallel to MW-10 (but is not shown in Figures 13a/b). The on-site samples include, SD-15, SW of the confluence of the backwash channel and the Rumford River (in Figure 13b). It has evidence of contamination from the H&P site.

values for children and adults and were within typical background levels. The maximum concentration of arsenic was estimated at 12 mg/kg. The maximum concentration of PCP and 2,3,7,8-TCDD did not exceed comparison values. The maximum concentration of 2,3,7,8-TCDD TEQ was estimated at 100 ng/kg which exceeds the chronic soil EMEG for children (50 ng/kg) but not the chronic EMEG for adults (700 ng/kg). In October 2003, one sample from the SW quadrant was analyzed for the same analytes (TRC 2004). The concentration of arsenic, 65 mg/kg, exceeded comparison values but was within typical background levels. The maximum concentration of PCP and 2,3,7,8-TCDD did not exceed comparison values. The maximum concentration of 2,3,7,8-TCDD TEQ was estimated at 200 ng/kg which exceeds the chronic EMEG for children (50 ng/kg) but not the chronic EMEG for adults (700 ng/kg).

In summary, of these 27 on-site sediment samples, the compounds that exceeded comparison values and typical background levels were 2,3,7,8-TCDD TEQ in the NW and SE quadrants and PCP in the SE quadrant. It is important to note that all these exceedances of the comparison values for dioxins and PCP are based on exposure to soil, not sediment, and thus are conservative since these samples were collected from sediment in the River, which typically is not as accessible as surface soil. However, because of the high potential for dioxins to accumulate in fish tissues, its detection in sediment samples raises concern about bioaccumulation in fish.

### Surface Water

In June 1998, surface water samples were collected in the SE quadrant from the interceptor trench (SW-1 in Figure 14), the Rumford River backwash, the bridge and the County Road Bridge (Clean Harbors 1998). Surface water from the interceptor trench was analyzed for dioxins, base/neutral extractables (BNE) and PCP. Samples from the Rumford River backwash were analyzed for BNE and PCP. Surface water samples from the bridge, the County Road bridge and interceptor trench were analyzed for metals and reported as non-detect for arsenic, (method detection limit [MDL] 5 µg/L). The surface water sample from the interceptor trench had a concentration of PCP at 75,000 µg/L, which greatly exceeds the MMCL of 1 µg/L and the CREG of 0.3 µg/L. The concentration of 2,3,7,8-TCDD TEQ at the interceptor trench was 4.2 pg/L (the sediment sample at the interceptor trench was 7,211 ng/kg). In October 1998, MDEP requested that MDFW postpone stocking ponds with trout due to these high levels of dioxins in surface water and sediment from the Rumford River (on-site) and adjacent wetlands (MDEP 1998).<sup>14</sup>

In October 1998, surface water samples were taken from the following four locations: (1) upstream of the H&P property, (2) the point where free product from the H&P property has intermittently discharged to the River (RRHP03), (3) Fulton Pond and (4) Kingman Pond by EPA Removal Branch (see Figure 12a and 12b; Hydraulic Resources 1999). These samples were analyzed for dioxin, PCP, metals, VOCs, SVOCs, pesticides, and PCBs. One sample, RRHP03, was collected on-site. The maximum concentration of PCP detected in the on-site surface water

---

<sup>14</sup> Calculations of the 2,3,7,8-TCDD TEQ in SW-1 by MDEP was 40 pg/L, exceeding the fresh water acute ambient water quality criteria of 10 pg/L, and prompted MDFW to postpone stocking fish in ponds downstream of the Rumford River (MDEP 1998).

sample was 21 µg/L, which exceeded the MMCL of 1 µg/L. The other contaminants were detected below comparison values for drinking water. This includes dioxin 2,3,7,8 TEQ at 3 pg/L, which was below the drinking water standard of 30 pg/L.

Seven surface water samples (SW-7, SW-8, SW-9, SW-10, SW-11, SW-12 and SW-14) were collected from within the site boundary in November 2001 (TRC 2002). Three samples were analyzed for dioxins and furans, metals, VOCs, and SVOCs; three samples were analyzed for metals, VOCs, and SVOCs; and one sample was tested for metals. Only PCP at 28 µg/L at SW-7 exceeded its comparison value for drinking water.

## **B. Off-Site Contamination**

### Soil

In 1989, Keystone collected a soil boring (0 to 2 feet deep) from MW-11, located off-site near King Street (see Figure 14). The sample was tested for SVOCs and metals. Results were below comparison values (Keystone 1989).

In 1998, one soil sample was collected from Robinson Park on Fulton Pond and analyzed for dioxins and PCP (see Figure 12b). The concentrations of 2,3,7,8-TCDD TEQ and PCP in this sample (2 ng/kg and 0.1 mg/kg, respectively) were less than health-based screening values for residential properties (50 ng/kg and 6 mg/kg, respectively). Robinson Park is the first open space downstream where the public can readily contact soil or sediment that might have been affected by releases from the site.

EPA conducted an initial extent of contamination survey in April of 2003. These initial samples included 10 samples, one outside the site's perimeter fence on the shoulder of County Street (i.e., a 10 foot wide strip adjacent to the property) and nine on the abutting residential properties across County Street. In July/August 2003, EPA reported that initial investigations confirmed the presence of arsenic in surface soil outside of the site's perimeter fence along the shoulder of County Street and at five abutting residential properties on the other side of County Street (Figure 10). Arsenic in surface soil on both sides of County Street were above MDEP's regulatory action level of 30 mg/kg, which is above ATSDR's CREG of 0.5 mg/kg, and ATSDR's chronic child EMEG of 20 mg/kg. Chromium was also present above ATSDR comparison values on the shoulder of County Street.

Following review of these results, EPA then proceeded to plan for excavation and removal of soil in areas that exceeded 30 mg/kg arsenic in soil. In planning for excavation, EPA proceeded with another round of sampling in July/August of 2003. For this second round of sampling, EPA collected and analyzed 136 pre-excavation surface soil samples (0 to 3 inches) from both residential areas and areas outside the perimeter fence along County Street. Samples from the residential properties were collected from the front yards and areas between the properties (Figure 10). In deciding where to sample in the residential area, EPA considered topography and collected samples from areas where soil contaminants from across the street would most likely migrate and settle (e.g., front yards, low lying areas, driveways, and turnarounds) (EPA 2004b). Of these 136 soil results, 119 results were detectable. The maximum concentration of arsenic

detected was 140 mg/kg in a sample collected from a low-lying area between two of the residences tested. All of the pre-excavation sampling results were in exceedance of the CREG for arsenic (0.5 mg/kg); however, all but two results were within known background soil levels for arsenic (0.1-73 mg/kg) (Shacklette and Boerngen 1984). Eighty-four results exceeded the chronic child EMEG (20 mg/kg). No results exceeded the chronic adult EMEG (200 mg/kg).

Upon review of each individual property's soil data (Table 7), the lowest arsenic levels were detected in surface soil at a property that had a retaining wall such that the soil in the front of the property was at a higher ground elevation relative to the neighboring properties. EPA believes that these data suggest that the elevated arsenic levels observed on the residential side of the County Street may have resulted from movement of dirt from the other side of County Street due to passing traffic and snow plowing, and that overall, off-site arsenic-contaminated soil did not migrate far from the site (EPA 2004a). Soil data for non-residential samples collected from the east side of County Street just north of the residential properties (Figure 10 and Table 7) support this idea as the results were even lower than the residential test results (maximum level was 21 mg/kg). South of the southernmost property is a paved parking lot (Figure 10).

In August/September 2003, EPA excavated soil in those locations on either side of County Street where arsenic in surface soil exceeded 30 mg/kg (see Figure 10). After excavating the soil, EPA then conducted post-excavation (subsurface) soil testing prior to adding clean soil. Ninety-three samples were collected from the walls and floors of the residential and non-residential excavated areas that ranged in depth from 6 inches to 2 feet. All 93 samples were analyzed for arsenic and a subset of 22 samples were also analyzed for 20 metals. The latter were all located in the area outside the site's perimeter fence along the shoulder of County Street. With regard to the 93 samples analyzed for arsenic, 77 results were detectable. The maximum concentration was 290 mg/kg in a sample collected at a depth of 2 feet from the west side of County Street (outside of the site's perimeter fence). All results exceeded the CREG for arsenic (0.5 mg/kg); however, all but three results were within known background soil levels for arsenic (0.1-73 mg/kg). Nine results exceeded the chronic child EMEG (20 mg/kg) for arsenic. One result exceeded the chronic adult EMEG (200 mg/kg) for arsenic. With regard to the 22 soil samples analyzed for other metals, arsenic, cadmium, chromium, copper and lead were detected above ATSDR comparison values. However, clean soil was backfilled over these areas and subsurface soil at this depth is not readily accessible. Thus, these contaminants do not pose health concerns and will not be further discussed (Weston Solutions, Inc., 2004).

No data were available pre-excavation for other contaminants, such as SVOCs, PAHs, and dioxins. However, after the excavation and backfilling with clean soil, in November of 2003, EPA sampled the two residences with the highest and lowest pre-excavation arsenic levels in surface soil for SVOCs, PAHs, dioxins, and metals including arsenic. PAHs and dioxins were detected above comparison values. Benzo(a)pyrene was detected on one property at 3 mg/kg, and the TEQ of all PAHs in terms of benzo(a)pyrene was 6 mg/kg. On the other property, benzo(a)pyrene was detected at 4 mg/kg, and the total TEQ of all PAHs in terms of benzo(a)pyrene was 7 mg/kg. Dioxin TEQ in terms of 2,3,7,8-TCDD was detected at one property at 290 ng/kg (actual 2,3,7,8-TCDD value was 2 ng/kg), and on the other property at 170 ng/kg (actual 2,3,7,8-TCDD value was 2 ng/kg). It should be noted that PCP and chromium

were not detected above comparison values, and arsenic was detected at 17 mg/kg on one property, and at 8 mg/kg on the other property, both above ATSDR's CREG of 0.5 mg/kg, but below ATSDR's chronic child EMEG of 20 mg/kg and within typical background ranges for soil.

### Sediment

Eight off-site sediment samples from the Rumford River at locations upstream (at RRUS in Figure 12a) and downstream of the H&P property (including Fulton and Kingman Pond) were collected in October and November 1998 (Hydraulic Resources 1999; Figure 12b). The samples were analyzed for dioxin, PCP, metals, VOCs, SVOCs, pesticides and PCBs, and evaluated in the Rumford River Health Consultation in 1999. PCP was not detected and the maximum concentrations of 2,3,7,8-TCDD (1 ng/kg) and dioxin 2,3,7,8-TCDD TEQ (27 ng/kg) did not exceed comparison values for residential soil.

Four off-site sediment samples were collected in September 1999, analyzed for dioxins and PCP, and evaluated in the Glue Factory Pond/Rumford River Health Consultation in June 2001 (MDPH 2001). PCP was detected at a maximum of 0.5 mg/kg, 2,3,7,8-TCDD was detected at a maximum of 35 ng/kg, and 2,3,7,8-TCDD TEQ was detected at a maximum of 553 ng/kg downstream from the bleachery near Glue Factory Pond on the Rumford River. The concentration of 2,3,7,8-TCDD TEQ exceeded the screening value for soil of 50 ng/kg, the EMEG for children, but is less than 700 ng/kg, the EMEG for adults. However, direct contact with sediment is not likely, particularly since the area is overgrown with vegetation.

Nine off-site sediment samples, four upstream (SD-16, SD-17, SD-18 and SD-19), one across from County St. (SD-13) and four downstream of H&P (north of Fulton Pond) (SD-1, SD-2, SD-4 and SD-6) were collected in November 2001, at depths ranging between 0 and 2 ft and analyzed for dioxins and furans, metals, pesticides, PCBs, VOCs, and SVOCs (TRC 2002; Figures 13a and 13b). The maximum levels of 2,3,7,8-TCDD TEQ and PCP did not exceed the comparison values, and no 2,3,7,8-TCDD was detected, and no other compounds exceeded comparison values.

Four off-site sediment samples were collected and analyzed for SVOCs, metals, and dioxins in October 2003 (TRC 2004). Three of the samples were taken from Fulton Pond. The fourth sample was collected north of the site and south of Glue Factory Pond. All four samples slightly exceeded comparison values but were within typical background soil levels for arsenic. The maximum concentration of arsenic was 26 mg/kg.

### Surface Water

In 1998, four surface water samples were collected off-site: two upstream of the site and two downstream in Fulton and Kingman ponds (Figure 12a and 12b; Hydraulic Water Resources 1999). Samples were analyzed for dioxins, PCP, metals, VOCs, pesticides, and PCBs. No compound exceeded screening values for drinking water.

Five surface water samples were collected downstream of H&P: three north of Fulton Pond (near Hencke Brook and Robinson Brook SW-004, SW-005, SW-006), one at Fulton Pond (SW-001) and one across from County Street (SW-014) in November 2001 (TRC 2002; Figures 13a and 13b). All five samples were analyzed for SVOCs and metals. PCP was detected at a maximum of 11 µg/L (at SW-004), which was slightly above the chronic child EMEG of 10 µg/L, and also at SW-001 at 1 µg/L, well below the chronic child EMEG. No other compounds exceeded screening values.

In October 2003, six surface water samples were collected from two locations on three different days (TRC 2004). Three of these samples were collected upstream or north of the site (and south of Glue Factory Pond). The other three samples were collected downstream or south of the site (and north of Fulton Pond). The samples were analyzed for SVOCs, PAHs, and metals. PCP was detected in two of the three downstream samples at 9 µg/L and at an estimated level of 9 µg/L, which were both less than the chronic child EMEG for PCP (10 µg/L). Arsenic was not detected in these samples. Neither PCP nor arsenic was detected in the three upstream samples.

In summary, one off-site sediment sample (at Glue Factory Pond) contained 2,3,7,8-TCDD above soil comparison values, and no off-site sediment samples exceeded comparison values for PCP in soil. Also, no off-site surface water sample exceeded dioxin comparison values, and one sample at 11 µg/L slightly exceeded the PCP comparison value. Thus, contamination of sediment appears to be primarily on-site, and contamination of surface water (from the Rumford River) appears to be both on-site and off-site downstream or south of the site.

### Fish

In June 1999, MDPH completed a health consultation for the Rumford River (MDPH 1999). MDPH had earlier recommended that a provisional fish consumption advisory be issued in 1998, prior to fish tissue data becoming available, based on elevated dioxin levels in fish. Analysis of fish samples for the 1999 health consultation revealed that of the seven fish samples collected and analyzed for arsenic, PCP and dioxins, arsenic was not detected, PCP was detected above the EPA-generated screening value (0.33 ppm) and all of the fish samples exceeded the background fish tissue concentrations for dioxin in North America of approximately 1 ng/kg (EPA 1994; ATSDR, 1998). Thus, MDPH issued a regular fish consumption advisory that stated that the public should not consume fish in the Rumford River from the dam below Glue Factory Pond in Foxborough to and including the Norton Reservoir in Norton (MDPH 1999 and MDPH 2001).

Because of concerns that upstream sources of dioxin might also be present, MDPH recommended additional fish testing upstream from Glue Factory Pond. In September 1999, EPA tested fish and sediment from Glue Factory Pond as well as sediment from the Rumford River and submitted these results to MDPH for evaluation. MDPH issued a second health consultation in June 2001 and determined that the concentrations of dioxin in fish sampled from Glue Factory Pond were not at levels of health concern and that no modification of the current MDPH public health fish consumption advisory was necessary (MDPH 2001).

In September and October 2003, a total of ten fish were collected from Glue Factory Pond, Fulton Pond, Kingman Pond, and from sections of the Rumford River located on-site (south of the former process area) and upstream of the site (south of Glue Factory Pond) (TRC 2004). The fish from Glue Factory Pond, Fulton Pond, and Kingman Pond were filleted and analyzed for metals, PAHs, chlorophenols, and dioxins/furans (see Table 8). The fish from the sections of the Rumford River were analyzed as whole fish for metals, PAHs, chlorophenols, and dioxins/furans (see Table 8). To help decide whether compounds detected in fish may need further evaluation, health assessors also use comparison values that were derived by using EPA methods (EPA 2000). Comparison values for non-carcinogenic health effects were derived using EPA's reference doses (RfDs) for each compound. Comparison values for carcinogenic health effects were derived using EPA's oral slope factor for each compound, assuming an excess lifetime cancer risk of 1:100,000. It is also assumed that the body weight of an adult is 70 kilograms (kg), the body weight of a child is 35 kg, and the consumption rate of fish and shellfish for the general population is 0.0175 kilograms per day (kg/day) (or 4.4 ounces per week) and for subsistence fishermen is 0.142 kg/day. 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. PCP was detected above comparison levels (0.33 mg/kg) in fish collected from Fulton Pond. However, the fish collected from the Rumford River itself were analyzed as whole fish instead of fillets. This type of analysis is useful when evaluating ecological risks rather than human health risks and hence, will not be further evaluated for this health assessment. Regardless, the MDPH public health fish consumption advisory currently in effect applies to the Rumford River system based on previous fish fillet sampling. In addition, PCP detected in downstream surface water samples represents a bioaccumulation risk for PCP in fish.

Currently, the 1999 public health fish consumption advisory remains in effect for the public not to consume fish in the Rumford River from the dam below Glue Factory Pond in Foxborough, to and including the Norton Reservoir in Norton. MDFW is interested in stocking fish again in the future after health and environmental concerns for the H&P site have been addressed.

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

Analysis of some PAHs, chemicals often found in gasoline/fuel, did not have a low enough MDL (Roy F. Weston 1993). The MDL is necessary to determine the sensitivity of the method in detecting low levels of toxic chemicals, such as dibenz(a,h)anthracene, with a CREG of 0.02 mg/kg. For these analytes, more sensitive MDLs would be desirable to evaluate their potential health concerns. For this reason, several contaminants (i.e., PAHs) could not be completely evaluated in this report, particularly for analysis conducted prior to 1998.

### **D. Physical and Other Hazards**

During the July 1, 2002, MDPH personnel noted several hazards to workers and trespassers on the property (MDPH 2002a). In between the cylinder 03 building and the CCA drip pad, and in front of an entrance to the cylinder 03 building, there is a pit covered with wooden boards. The boards did not appear to be able to support a person's weight. The two wooden bridges that

cross the Rumford River in the middle of the property had holes in them, and several of the boards were rotting. The boiler room in the northwest section of the property was unlocked and accessible. Some of the windows had been broken and glass was lying on the floor. Located inside the room are the boiler, pieces of heavy equipment, and electrical switch boxes, all of which may pose physical and electrical hazards. The Dricon sump is at least 3 feet deep and contained at least 12 inches of standing water, which poses a physical hazard. Near the sump, is a pile of wood that could pose a fire hazard. Past fires have occurred on site and there is evidence that trespassing is occurring. During a more recent site visit on July 19, 2005, the above physical and other hazards are still present.

## **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, someone must contact the chemical and 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**

A completed exposure pathway existed in the past for workers and for trespassers in contact with soil before areas of contamination were covered. Presently, opportunities for exposure exist for trespassers on the site who come into contact with exposed soil (e.g., not covered with pavement or vegetation) containing contaminants. A completed exposure pathway also existed in the past and likely continues today for individuals who consume fish from the Rumford River and its impoundments.

## Surface Soil

Past opportunities for exposure to contaminants in surface soil at this site began around 1953, when wood treatment operations began. Opportunities for exposure likely occurred for former workers who handled treated wood in the northern process areas and transported wood to various storage areas throughout the property. Additional opportunities for exposure are evident from observations made during the July 1, 2002 site visit (MDPH 2002a; Appendix D). Thus, opportunities for past exposure existed for workers through dermal contact with contaminants on treated wood and possibly incidental ingestion from contact with of contaminated soils and handling treated wood.

Past opportunities for exposure likely occurred for trespassers before areas of contamination were paved or covered with gravel, and exist presently for areas with contaminants that exceed comparison values for soil. Remedial actions by EPA in 1994 and 1995, reduced, but did not eliminate, opportunities for exposure. Trespassers are still able to access the site and contact surface soil on areas of the site not covered with asphalt or gravel and presently exceed comparison values for surface soil. Evidence of trespassing on site includes: a 4 by 4 foot wooden shed containing soda cans and an inverted bucket (for sitting) on the banks of the River in the NW quadrant and graffiti and empty bottles near the bedrock outcrop in the SE quadrant (Appendix D). These areas are near places where contaminants have been elevated. Past opportunities for exposure to these areas existed for trespassers; however, present opportunities for exposure are reduced by thick vegetation that limits contact (e.g., near the campfire ring and the shed). Also, the fact that vegetation currently surrounds the campfire ring and shed and that most of the cans observed on site were rusted, suggests that these areas, while accessible, may not have been used recently. There is also thick vegetation in areas of the SE quadrant, along the edge of the filled areas where the highest levels of dioxins have been detected. Thus, a completed exposure pathway existed for trespassers in the past and exists currently at a reduced level in areas of the site that are accessible and still have contaminants that exceed comparison values.

Because site contaminants were detected in off-site soil samples collected in 2003 on County Street outside of the site's perimeter fence and across the street at five abutting residences, past opportunities for exposure were likely for County Street residents living adjacent to the H&P site. That same year, soil was excavated in those areas where arsenic was detected at levels exceeding MDEP's action level of 30 mg/kg.

## Fish

Ponds downstream of the site were stocked with fish by the MDFW until 1998, when dioxins were found in environmental samples taken from the River and downstream of the site. Subsequent sampling in fish confirmed the presence of dioxins in fish. Thus, opportunities for exposure existed in the past for those who consumed fish from the Rumford River and ponds downstream of H&P. Although MDPH issued a public health fish consumption advisory and MDFW stopped stocking the downstream ponds in 1998 (Appendix B; MDEP 1998), opportunities for exposure to contaminated fish still exist for those who do not heed the advisory.

While signs to deter fishing are posted at some access points to the River and at ponds south of H&P, many of the signs have faded and are illegible. Additionally, it is possible that some individuals choose to continue to fish.

## **B. Potential Exposure Pathways**

A potential exposure pathway existed in the past for household contacts of former H&P workers and workers who may have tracked some contaminated soil/dust to their households. A potential exposure pathway also existed in the past for residents and trespassers who may have had contact with contaminated River sediment and surface water. The latter is also a potential concern in the future if site conditions deteriorate, leading to enhanced releases to off-site sediment or surface water. Future opportunities for exposure to contaminated soil are also possible for site workers if proper precautions are not followed. No potential pathway for other contaminants of concern (besides arsenic) exists in the present for the off-site residences that abut County Street across from the site, but a potential pathway did exist for other contaminants of concern in the past. It is impossible to quantify this pathway since samples for other contaminants were taken after soil contaminated with arsenic was excavated and replaced with clean soil on the residential properties in 2003. In addition, there was a potential past pathway of exposure to arsenic in surface soil for off-site passersby on the strip of land adjacent to and outside of the perimeter fence along County Street. However, this potential pathway was removed when soil was removed and replaced in 2003.

### Sediment

Past and present opportunities for exposure to contaminants (e.g., dioxins, PCP) in sediment may have occurred or be occurring. However, this is unlikely because much of the site area and the River is wetlands and has thick vegetation, briars, and poison ivy. Although access is possible, frequent contact with sediments along the banks of the Rumford River on site appears unlikely because access is deterred by thick vegetation, woods and a fence along most of the property boundary. In addition, the River itself on the site is shallow and no evidence or information is available that suggests frequent contact with the River in this area.

### Surface Water

Past opportunities for exposure to contaminants in surface water (e.g., PCP) may have occurred for trespassers on the site or off-site for residents, including children playing in the River at locations downstream. However, contact with surface water is unlikely to have occurred more than sporadically. On-site, the River is shallow and generally inaccessible (e.g., briars, poison ivy). One resident provided information during the August 2002 EPA Public Information meeting that when occasional flooding occurs, children play in the water near a bridge downstream. However, this does not appear to be a concern at the present time, since surface water sampling indicates that nearly all results were below comparison values for drinking water and/or chronic child EMEGs, both on- and off-site. Future releases, however, are a potential concern if on-site contamination in soil, sediment, and groundwater is not remediated and depending upon long-term site conditions (e.g., future development of the site).

## Groundwater

For nearby residents south of the site, there may have been past opportunities for exposure to contaminants in groundwater via basement flooding events and/or seepage. Because the most recent groundwater testing at the site continues to indicate the presence of a contaminated plume moving south, present and future opportunities for chemical exposure via basement flooding events and/or seepage remain a potential exposure pathway.

## Subsurface Soil

There may have been past opportunities for exposure to contaminants (e.g., arsenic, PCP, dioxins) in subsurface soil for workers on the site, particularly during construction of the retaining wall and the groundwater treatment system. Exposure may have occurred primarily through incidental soil ingestion, dermal contact, or inhalation of soil or dust. Future exposures to contaminated soils (surface and subsurface) might occur during site remediation activities (e.g., excavation) if proper precautions are not followed. Data for subsurface soil were qualitatively analyzed and found to have contaminant concentrations lower than surface soil, and contact with these contaminants under current conditions is not likely.

It is possible that there may have been sporadic exposure opportunities for nearby residents and passers by to off-site subsurface soil in the past as a result of certain activities (e.g., roadwork or construction of a well, house addition). However, it would be expected that these limited exposure opportunities would have been unlikely to have resulted in health concerns.

## **C. Eliminated Exposure Pathways**

### Drinking Water

The Mansfield Board of Health conducted a well water survey in September and October of 1992 involving residents of adjacent areas (Highland Avenue, Morrow Street and Chauncy Street). Of the 20 homes surveyed, 13 responded. All respondents reported that they were connected to town water. One resident reported having a private well designed for lawn watering, but he reported that he had not used it at the time the survey was conducted. The nearest public drinking water supply in Mansfield is approximately 1.2 miles east-northeast, or upgradient of the H&P property. The Rumford River and Norton Reservoir are not drinking water supplies.

## **DISCUSSION**

MDPH has summarized the available environmental data and exposure pathways for the H&P site in this public health assessment. Completed exposure pathways included past and present contact with surface soil on and off-site and consumption of fish from the Rumford River, its impoundments (i.e., Fulton, Kingman, and Cabot ponds) and the Norton Reservoir. The primary

compounds of concern at the site are arsenic, PCP, chromium and dioxins. Opportunities for exposure to these compounds are primarily via incidental ingestion of surface soil at the site or consumption of fish contaminated with dioxins. Because of remedial actions in the early 1990s, and issuance of the public health fish consumption advisory in the late 1990s, opportunities for exposure were likely to be substantially greater in the past. Chemical-specific toxicity information for the compounds of concern (arsenic, PCP, chromium, and dioxins) is summarized in Appendix E.

### **A. Evaluation of Possible Health Effects**

Populations that could have had opportunities for exposure to compounds in surface soil include H&P workers before it shut down in 1993, other workers such as those who installed the groundwater treatment in 1973, and persons trespassing on the site, particularly children and teens. Also, those who consume or may still be consuming contaminated fish have exposure opportunities to contaminants in fish. The site, which encompasses about 44 acres of woodlands and wetlands, is fenced, and several efforts have been made to maintain and repair sections of fence that were in disrepair or damaged by felled trees. However there is a gap under a gate on County Street, across from residences. Warning signs have been posted; yet evidence of trespassing throughout the site (e.g., graffiti, broken bottles) has been observed by MDPH staff. This presents on-going opportunities for exposure.

Most of the northern process areas and sections of southern property were covered with asphalt or gravel in 1994/1995. While this intervention likely reduced opportunities for exposure considerably, concerns remain regarding opportunities for exposure to arsenic (and possibly other compounds) in soil that has not been covered. Of particular concern in the south central area are opportunities for exposure to dioxins at several locations along the edge of the filled areas and in the estimated location of the river bed (See Figures 7 and 8) where dioxin appears to have been intermittently discharging to the River. In 1998, when dioxins were first detected, the seep area with 2,3,7,8-TCDD TEQ at 44,951 ng/kg was covered with gravel; however, product is still seeping through the gravel (MDEP 2003b). At the time of this public health assessment, thick vegetation limited access to most areas where dioxins have been detected, reducing opportunities for exposure to contaminated soils.

#### **On-Site Surface Soil**

Surface soil concentrations of arsenic, chromium, and 2,3,7,8-TCDD TEQ exceeded health-based screening and background levels in all quadrants, and PCP exceeded health-based screening and background levels in the NE and SE quadrants. Opportunities for exposure and risk calculations for workers and trespassers (including children) are evaluated for these contaminants (Appendix F).

Non-cancer health concerns for workers<sup>15</sup> were estimated by assuming that a worker may have spent 5 days per week, 50 weeks per year for 40 years at the site. During that time they may have incidentally ingested soil during site activities and also absorbed some contaminants through their skin from direct contact with treated wood and soil. Estimated past exposure opportunities for workers to maximum concentrations of PCP (4,900 mg/kg in the NE) and 2,3,7,8-TCDD TEQ (44,951 ng/kg in the SE) exceeded their respective MRLs, but did not exceed their respective LOAELs. Estimated past exposure opportunities for workers to maximum concentrations of chromium (1,886 mg/kg in the NE) did not exceed the EPA's chronic oral RfD for hexavalent chromium. Thus, non-cancer health effects are not likely from exposure to maximum concentrations of PCP, chromium, or 2,3,7,8-TCDD TEQ. The exposure opportunity resulting from the maximum concentration of arsenic<sup>16</sup> (1860 mg/kg), however, exceeded its MRL and its LOAEL. Thus, it is possible that exposure to arsenic may have resulted in health concerns (e.g., skin lesions<sup>17</sup>) for some workers in the past if they were exposed primarily to maximum concentrations. However, since it is unlikely that individuals on this site spent time only in the areas of maximum concentration, it is more plausible that workers may have been exposed to average amounts of contaminants. Estimated exposure opportunities for workers to the average concentration of arsenic (223.1 mg/kg) did not exceed the LOAEL, and thus are not likely to result in non-cancer health concerns. Efforts to remediate areas of arsenic contamination will also help to reduce any potential opportunities for exposure to hexavalent chromium as these two compounds are closely associated in the CCA process.

Non-cancer health concerns were evaluated for those trespassing<sup>18</sup> on the site. Oral exposure may have occurred primarily through incidental ingestion of soil and dust following dermal

<sup>15</sup> Exposure Dose (worker)	=	$\frac{(\text{Contaminant Concentration}) (\text{IR}) (\text{EF}) \times 10^{-6} \text{kg/mg}}{\text{Body Weight}}$		
Ingestion Rate (IR)	=	Adult: 100 mg/day		
Body Weight (adult)	=	70 kg		
Non-cancer (adult) Exposure Factor			$\frac{(5 \text{ days/week}) (50 \text{ weeks/year}) (40 \text{ years})}{(40 \text{ years}) (365 \text{ days/year})} = 0.68$	
<sup>16</sup> Arsenic Max Exposure Dose = (worker)	=	$\frac{(1860 \text{mg/kg}) (100 \text{mg of soil/day}) (0.68) \times 10^{-6}}{70 \text{ kg}}$	= 0.0018 mg/kg/day	$\frac{\text{NOAEL}}{\text{LOAEL}} = \frac{0.0003}{0.00065}$

<sup>17</sup> The MRL is based the occurrence of skin lesions in humans exposed to 0.0008 mg/kg/day of arsenic in well water. An uncertainty factor of 3 was added for human variability (ATSDR 2000a).

<sup>18</sup> Exposure Dose (child trespassing)	=	$\frac{(\text{max. contaminant concentration}) (\text{IR}) (\text{EF}) \times 10^{-6}}{\text{Body Weight}}$
Non-cancer (child) Exposure Factor (EF)	=	$\frac{(2 \text{ days/week}) (39 \text{ weeks/year}) (18 \text{ years})}{(18 \text{ years}) (365 \text{ days/year})} = 0.21$
Ingestion Rate (IR)	=	200 mg/day
Body Weight (child)	=	35 kg

contact with soil and treated wood. Estimated exposure opportunities were calculated for children (2 days per week for 39 weeks for 18 years) and for adults (2 days per week for 39 weeks for 40 years) who trespassed on the site before remediation. (However, only the more conservative estimates for children are discussed here.) Estimated exposure for children trespassing on the site and in contact with maximum concentrations of chromium (1,886 mg/kg) did not exceed the EPA's chronic oral RfD for hexavalent chromium. Estimated exposure for children trespassing on the site and in contact with maximum concentrations of PCP (4,900 mg/kg) and 2,3,7,8-TCDD TEQ (44,951 ng/kg) exceeded their respective MRLs; but did not exceed their respective LOAELs. The estimated opportunities for children exposed to the average concentration of 2,3,7,8-TCDD TEQ also exceeded the MRL, but was below the LOAEL. Thus contact with maximum concentrations of chromium, PCP and dioxin are not likely to be associated with non-cancer health effects. The estimated exposure opportunities for children to the maximum concentration of arsenic<sup>19</sup> (1,860 mg/kg) before remediation, however, did exceed the LOAEL; and thus, although unlikely, could have resulted in exposures that were of health concern (e.g., skin lesions [ATSDR 2000a]) under the above exposure assumptions.

With regard to cancer concerns for workers<sup>20</sup>, past opportunities for exposure estimated over 40 years to maximum concentrations of arsenic<sup>21</sup> and 2,3,7,8-TCDD TEQ<sup>22</sup> presented a moderate increased cancer risk ( $10^{-3}$ ). Exposure opportunities over 40 years to the maximum

---

<sup>19</sup> Arsenic Max.			<u>Expo. Dose</u>	<u>MRL</u>	<u>LOAEL</u>
Exposure Dose	$(1860\text{mg/kg}) (200\text{mg/day}) (0.21) \times 10^{-6} \text{ kg/mg}$		= 0.00223	0.0003	0.00065
(child trespasser)	35 kg		mg/kg/day	mg/kg/day	mg/kg/day

<sup>20</sup> Exposure Dose	=	$\frac{(\text{max. contaminant concentration}) (\text{IR}) (\text{EF}) \times 10^{-6} \text{ kg/mg}}{\text{Body Weight}}$
(worker)		
EF		
Cancer Risk (worker)		$\frac{(5 \text{ days/week}) (50 \text{ weeks/year}) (40 \text{ years})}{(70 \text{ years}) (365 \text{ days/year})} = 0.39$

<sup>21</sup> Arsenic		<u>Exposure</u>	x	<u>OSF</u>	<u>Cancer Risk</u>
Max.		<u>Dose</u>			
Cancer	$\frac{(1860\text{mg/kg}) (100\text{mg/day}) (0.39) \times 10^{-6} \text{ kg/mg}}{70 \text{ kg}}$		= 0.00104	1.5	= 0.00156
Risk =			mg/kg/d	$(\text{mg/kg/day})^{-1}$	$(1.56 \times 10^{-3})$
(worker)					

<sup>22</sup> Dioxin		<u>Exposure Dose</u>	x	<u>OSF</u>	<u>Cancer Risk</u>
Max.					
Cancer Risk	$\frac{(0.045\text{mg/kg}) (100\text{mg/day}) (0.39) \times 10^{-6} \text{ kg/mg}}{35 \text{ kg}}$		= 0.000000022	150,000	= 0.00334
= (worker)			$(2.2 \times 10^{-8})$	$(\text{mg/kg/day})^{-1}$	$(3.34 \times 10^{-3})$
			mg/kg/d		

concentration of PCP<sup>23</sup> and average concentrations of arsenic<sup>24</sup> and 2,3,7,8-TCDD TEQ<sup>25</sup> were associated with a low increased cancer risk ( $10^{-4}$ ). However, such an exposure opportunity is unlikely considering the conservative assumptions (i.e., contact with maximum contaminants 5 days per week over 40 years). Nonetheless, past exposure opportunities may have been at levels associated with health concerns for workers particularly in the NE process area or the south central area.

With regard to cancer concerns, estimated exposure opportunities for children trespassing<sup>26</sup> on-site prior to remediation are associated with a low increased cancer risk ( $10^{-4}$ ) for those who may have had regular contact with areas of maximum concentrations of PCP<sup>27</sup> and arsenic<sup>28</sup>, and the

$$\begin{array}{l}
 \text{Cancer Risk} = \frac{(4900\text{mg/kg}) (100\text{mg/day}) (0.39) \times 10^{-6}}{70 \text{ kg}} \times \frac{\text{Exposure Dose}}{70 \text{ kg}} \times \text{OSF} = \text{Cancer Risk} \\
 \text{(worker)} \\
 = 0.00027 \text{ mg/kg/day} \times 0.18 \text{ (mg/kg/day)}^{-1} = 0.00491 \text{ (} 4.91 \times 10^{-4} \text{)}
 \end{array}$$

$$\begin{array}{l}
 \text{Cancer Risk} = \frac{(191\text{mg/kg}) (100\text{mg/day}) (0.39) \times 10^{-6}}{70 \text{ kg}} \times \frac{\text{Exposure Dose}}{70 \text{ kg}} \times \text{OSF} = \text{Cancer Risk} \\
 \text{(worker)} \\
 = 0.00011 \text{ mg/kg/day} \times 1.5 \text{ (mg/kg/day)}^{-1} = 0.000165 \text{ (} 1.65 \times 10^{-4} \text{)}
 \end{array}$$

$$\begin{array}{l}
 \text{Cancer Risk} = \frac{(0.005\text{mg/kg}) (100\text{mg/day}) (0.39) \times 10^{-6}}{70 \text{ kg}} \times \frac{\text{Exposure Dose}}{70 \text{ kg}} \times \text{OSF} = \text{Cancer Risk} \\
 \text{(worker)} \\
 = 0.0000000028 \text{ (} 2.8 \times 10^{-9} \text{ mg/kg/d)} \times 150,000 \text{ (mg/kg/day)}^{-1} = 0.000418 \text{ (} 4.18 \times 10^{-4} \text{)}
 \end{array}$$

$$\begin{array}{l}
 \text{Exposure Dose} = \frac{(\text{max. contaminant concentration}) (\text{IR}) (\text{EF}) \times 10^{-6} \text{ kg/mg}}{\text{Body Weight}} \\
 \text{(child trespasser)}
 \end{array}$$

$$\begin{array}{l}
 \text{EF for cancer} = \frac{(2 \text{ days/week}) (39 \text{ weeks/year}) (18 \text{ years})}{(70 \text{ years}) (365 \text{ days/year})} = 0.05
 \end{array}$$

$$\begin{array}{l}
 \text{Ingestion Rate (child)} = 200 \text{ mg/day} \\
 \text{Body Weight (child)} = 35 \text{ kg}
 \end{array}$$

$$\begin{array}{l}
 \text{Cancer Risk} = \frac{(4900\text{mg/kg}) (200\text{mg/day}) (0.05) \times 10^{-6}}{35 \text{ kg}} \times \frac{\text{Exposure Dose}}{35 \text{ kg}} \times \text{OSF} = \text{Cancer Risk} \\
 \text{(child trespasser)} \\
 = 0.0014 \text{ mg/kg/d} \times 0.18 \text{ (mg/kg/day)}^{-1} = 0.000252 \text{ (} 2.52 \times 10^{-4} \text{)}
 \end{array}$$

$$\begin{array}{l}
 \text{Cancer Risk} = \frac{(1860\text{mg/kg}) (200\text{mg/day}) (0.05) \times 10^{-6}}{35 \text{ kg}} \times \frac{\text{Exposure Dose}}{35 \text{ kg}} \times \text{OSF} = \text{Cancer Risk} \\
 \text{(child trespasser)} \\
 = 0.00053 \text{ mg/kg/d} \times 1.5 \text{ (mg/kg/day)}^{-1} = 0.000795 \text{ (} 7.95 \times 10^{-4} \text{)}
 \end{array}$$

average concentration of 2,3,7,8-TCDD TEQ<sup>29</sup>. Estimated exposure opportunities for children in contact with the maximum concentration of 2,3,7,8-TCDD TEQ,<sup>30</sup> are associated with a moderate increased cancer risk at  $1.03 \times 10^{-3}$ . Again, it seems unlikely that trespassers would have contacted only areas with maximum concentration. Thus, for children trespassing on the site prior to remediation, the exposure opportunities seem unlikely to have resulted in unusual cancer concerns.

Currently, it is possible for trespassers, particularly older children and teens, to access the site through the gap under the gate along County Street, or in the south by walking upstream along the banks of the River and around the edge of a fence. Daily contact with the sediments and soils along the River present health concerns given the elevated levels. However, current site conditions may mitigate this as the area where dioxin levels were highest is surrounded by thick vegetation. Also, it is unlikely that anyone would trespass on the property and spend time exclusively where contaminants are highest on a daily basis for a sustained time. While trespassers on the property have been witnessed, it appears that site access is intermittent and not limited to areas with contamination. Therefore, under current use conditions, it is unlikely that opportunities for exposures to onsite contaminants are at levels and durations that would present health concern. However, if the use of the property changes, such as for redevelopment, the physical characteristics of the property change or the conditions of institutional controls of fences, signs or the asphalt/gravel coverings deteriorate or become obsolete, then the contamination on the H&P property may pose a public health concern in the future depending on the extent to which opportunities for exposure increase. It should be noted that physical hazards (e.g., demolition debris, Dricon sump filled with water) currently exist on the site and pose safety concerns for trespassers. This is discussed further in the physical hazard section.

### **Off-Site Surface Soil**

Off-site soil concentrations of arsenic exceeded health-based screening and background levels on both sides of County Street. Opportunities for exposure and risk calculations for nearby residents

<sup>29</sup> Dioxin Ave. Cancer Risk = (child trespasser)	$\frac{(0.005\text{mg/kg}) (200\text{mg/day}) (0.05)}{35 \text{ kg}} \times 10^{-6}$	<u>Exposure Dose</u> x 0.000000014 mg/kg/d	x <u>OSF</u> 150,000 (mg/kg/day) <sup>-1</sup>	<u>Cancer Risk</u> = 0.000214 ( $2.14 \times 10^{-4}$ )
<sup>30</sup> Dioxin max. Cancer Risk = (child trespasser)	$\frac{(0.045\text{mg/kg}) (200\text{mg/day}) (0.21)}{35 \text{ kg}} \times 10^{-6}$	<u>Exposure Dose</u> x 0.000000011 mg/kg/d	x <u>OSF</u> 150,000 (mg/kg/day) <sup>-1</sup>	<u>Cancer Risk</u> = 0.00171 ( $1.71 \times 10^{-3}$ )

were evaluated for arsenic (Appendix F). Non-cancer health concerns for children<sup>31</sup> were estimated by assuming that a child plays outside for a certain number of hours per day that varies with the change in the seasonal temperatures (i.e., 1 hour for the winter months, 4 hours for the summer months). During that time, children may have incidentally ingested soil and/or had direct dermal contact with soil. Estimated past exposure opportunities for children to the maximum concentration of arsenic detected in off-site soil (140 mg/kg) did not exceed either the MRL or LOAEL for arsenic.<sup>32</sup> Thus, contact with soil with the maximum concentration of arsenic is not likely to be associated with non-cancer health effects for arsenic. With respect to cancer concerns for children<sup>33</sup>, past opportunities for exposure estimated over 18 years to the maximum concentration of arsenic<sup>34</sup> was not associated with any unusual cancer concerns. However, since it is unlikely that residents spent time only in the area of the maximum concentration, it is more plausible that they may have been exposed to the average amount of arsenic detected in off-site soil (about 25 mg/kg for the set of pre-excavation soil data). Past opportunities of exposure estimated over 18 years to the average concentration of arsenic was not associated with any unusual cancer concerns. Dioxin (2,3,7,8-TCDD 2 ng/kg maximum, 2,3,7,8-TCDD TEQ 290 ng/kg maximum) and PAHs (benzo(a)pyrene 4 mg/kg maximum, benzo(a)pyrene TEQ 7 mg/kg maximum) were also present above ATSDR comparison values on two residential properties. However, opportunities for exposure (i.e., 1 hour soil contact per day every day in the colder months and 4 hours soil contact per day every day in the warmer months) to these maximum levels in soil in residential yards would not be expected to result in non-cancer or cancer health concerns for children or adults.

<hr/>				
<sup>31</sup> Exposure Dose (child resident)	=	$\frac{(\text{max. contaminant concentration}) (\text{IR}) (\text{EF}) \times 10^{-6} \text{ kg/mg}}{\text{Body Weight}}$		
Non-cancer (child) Exposure Factor (EF)	=	$\frac{(1 \text{ hr/day} \times 8 \text{ mo.} \times 30 \text{ days/mo.}) (4 \text{ hrs/day} \times 4 \text{ mo.} \times 30 \text{ days/mo.}) (18 \text{ years})}{(18 \text{ years}) (365 \text{ days/year})}$		
		= 0.08		
Ingestion Rate (child)	=	200 mg/day		
Body Weight (child)	=	35 kg		
 <sup>32</sup> Arsenic Max. Exposure Dose (child resident)	=	$\frac{(140 \text{ mg}) (200 \text{ mg/day}) (0.08) \times 10^{-6}}{35 \text{ kg}}$	Exposure Dose	<u>MRL</u> <u>LOAEL</u>
			0.000064 mg/kg/d	0.0003 (mg/kg/day)      0.00065 (mg/kg/day)
 <sup>33</sup> Exposure Dose (child resident)	=	$\frac{(\text{max. contaminant concentration}) (\text{IR}) (\text{EF}) \times 10^{-6} \text{ kg/mg}}{\text{Body Weight}}$		
EF for cancer	=	$\frac{(26 \text{ days/year}) (18 \text{ years})}{(70 \text{ years}) (365 \text{ days/year})} = 0.02$		
Ingestion Rate (child)	=	200 mg/day		
Body Weight (child)	=	35 kg		
 <sup>34</sup> Arsenic Max. Exposure Dose (child resident)	=	$\frac{(140 \text{ mg}) (200 \text{ mg/day}) (0.02) \times 10^{-6}}{35 \text{ kg}}$	Exposure Dose	X <u>OSF</u> <u>Cancer Risk</u>
			0.000016 mg/kg/d	1.5 (mg/kg/day) <sup>-1</sup> = 0.000024 (2.4 x 10 <sup>-5</sup> )

## Surface Water

In nearly all surface water samples in which PCP was detected, the detectable concentrations were at levels below the chronic child EMEG. Because water from the River as well as water from the adjacent downstream water bodies through which the River flows (i.e., Fulton, Kingman, Cabot Ponds, and Norton Reservoir) is not used for drinking water purposes nor is the water used regularly for recreational purposes (e.g., swimming), it is unlikely to pose health concerns as a result of exposure via oral ingestion. Although the River is not used regularly for recreational purposes (e.g., swimming), it is possible that individuals may occasionally swim in the water during the summer months (there is a park adjacent to the River downstream of the site). If a child were to swim for a total of 45 minutes once a week during the warmer summer months and assuming some water would be ingested during the swim as well as some skin absorption of PCP, this opportunity for exposure would not present either non-cancer or cancer health concerns (Appendix F).<sup>35</sup>

---

### <sup>35</sup> Oral Ingestion

$$\text{EF for non-cancer} = \frac{(0.5 \text{ day/year}) (8 \text{ years})}{(8 \text{ years}) (365 \text{ days/year})} = 0.0014$$

PCP Max.  
Exposure Dose =  $\frac{(11 \text{ ug/L}) (0.1 \text{ L./day}) (0.0014) \times (0.001 \text{ mg/ug})}{(17 \text{ kg})} = \frac{8.8 \times 10^{-8}}{8.8 \times 10^{-8}} \frac{0.001}{0.001} \frac{1}{1}$   
(child) mg/kg/day mg/kg/day mg/kg/day

### Dermal Absorption

$$\text{EF for non-cancer} = \frac{(12 \text{ hrs./year}) (8 \text{ years})}{(8 \text{ years}) (365 \text{ days/year})} = 0.033 \text{ hrs/day}$$

PCP Max.  
Exposure Dose =  $\frac{(11 \text{ ug/L})(0.16 \text{ cm/hr})(9190 \text{ cm}^2)(0.033 \text{ hrs/day})(0.001 \text{ L/cm}^3)(0.001 \text{ mg/ug})}{(17 \text{ kg})} =$   
(child)

$$= \frac{3.13 \times 10^{-5}}{3.13 \times 10^{-5}} \frac{0.001}{0.001} \frac{1}{1}$$

mg/kg/day mg/kg/day mg/kg/day

### Oral Ingestion

$$\text{EF} = \frac{(0.5 \text{ day/year}) (8 \text{ years})}{(70 \text{ years}) (365 \text{ days/year})} = 0.00016$$

Cancer Risk (child)

### PCP Max.

$$\text{Exposure Dose} = \frac{(11 \text{ ug/L}) (0.1 \text{ L/day}) (0.00016) \times (0.001 \text{ mg/ug})}{17 \text{ kg}}$$

(child)

$$= \frac{1.0 \times 10^{-8}}{1.0 \times 10^{-8}} \times 0.12 = \frac{1.2 \times 10^{-9}}{1.2 \times 10^{-9}}$$

mg/kg/day<sup>-1</sup>

### Dermal Absorption

$$\text{EF} = \frac{(12 \text{ hrs./year}) (8 \text{ years})}{(70 \text{ years}) (365 \text{ days/year})} = 0.0038 \text{ hrs./day}$$

Cancer Risk (child)

## Fish

The history of dioxin and PCP discharge to the River from the H&P property appears to be the likely source of dioxin and PCP in fish tissue found in Fulton Pond, which presents a public health hazard to fish consumers who do not heed or are not aware of the fish consumption advisory for the Rumford River and downstream water bodies. The concentrations of 2,3,7,8-TCDD TEQ previously found in fish from Fulton Pond (27 on average) were higher than mean background levels for fish tissue (approximately 1 ng/kg) (EPA 1994; ATSDR 1998). People who eat fish from this pond at the average rate of daily fish consumption for the country (0.0175 kg/day (or 4.4 ounces per week) (EPA 2000) would be exposed to approximately 6.8 pg/kg/d which is higher than ATSDR's chronic MRL of 1 pg/kg/d. Avid recreational fish consumers (i.e., people who consume 0.142 kg/day of fish) (EPA 2000) could be exposed to dioxin at levels more than fifty times greater than the MRL. Because of their lower body weight, exposures relative to body weight would be higher for children than for adults. Therefore, the concentrations of dioxin found in the fish from Fulton Pond was determined to constitute a public health hazard, and an MDPH public health fish consumption advisory was issued. The testing results also clearly demonstrate that the fish collected in areas in the vicinity of the H&P property have high levels of dioxin. According to MDFW, there are no barriers to fish migrating to downstream ponds or sections of the River (MDPH 1999).

Upstream of the H&P property, the first barrier to fish migration according to MDFW is the dam below Glue Factory Pond in Foxborough. Fish testing in Glue Factory Pond has indicated that dioxin is not present at levels of health concern in that pond (MDPH 2001). In 2003, EPA conducted additional testing of fish from Glue Factory Pond, Fulton Pond, Kingman Pond, and from sections of the Rumford River located on-site and upstream of the site. Testing of fish from Glue Factory Pond (upstream of the H&P site) was consistent with the health consult for this water body that was released in 2001 (MDPH 2001). Testing of fish from Fulton Pond (downstream of the H&P) was also generally consistent with advice previously issued by MDPH in 1999 (MDPH 1999), and again, confirmed the need to test fish downstream as no barriers to fish exist to prevent them from migrating downstream of the H&P site to as far as and including Norton Reservoir.

At the time of this public health assessment, additional testing of fish from the Rumford River system, particularly from Cabot Pond and Norton Reservoir, had not occurred. Therefore, the public health fish consumption advisory for the Rumford River, its impoundments, and Norton Reservoir, should be maintained. This includes the area from immediately below the dam at

---

(continued from previous page)

PCP Max.

Exposure Dose =  $\frac{(11 \text{ ug/L})(0.16 \text{ cm/hr})(9190 \text{ cm}^2)(0.0038 \text{ hrs/day})(0.001 \text{ L/cm}^3)(0.001 \text{ mg/ug})}{(17 \text{ kg})}$

$$= \frac{\text{Exposure Dose}}{3.6 \times 10^{-6}} \times \frac{\text{OSF}}{0.12} = \frac{\text{Cancer Risk}}{4.0 \times 10^{-7}} \text{ mg/kg/day}^{-1}$$

Glue Factory Pond to and including Norton Reservoir (MDPH 1999, Figure 1). Discharge from the site to the Rumford River has been noted in the past and is still occurring at the time of this public health assessment. This situation is one of continued concern with regard to contaminant uptake in fish.

## **B. Physical Hazards**

Physical hazards are a very important concern for the H&P site. As previously discussed, portions of the site at the time of this public health assessment contain physical hazards such as the Dricon sump filled with water, demolition debris, broken glass, and broken wooden bridges that cross the Rumford River. These could lead to injuries to site trespassers particularly, in light of evidence that trespassing does occur.

## **C. Health Outcome Data**

The primary compounds of concern at the H&P site include arsenic, chromium, PCP, and dioxin. These contaminants are all considered probable or possible human carcinogens, with cancer types most strongly associated with at least one of these contaminants being liver, lung, bladder, or kidney cancer, as well as non-Hodgkins's lymphoma (NHL). Thus, for purposes of this public health assessment, readily available cancer incidence data for Mansfield for these cancer types at the time of this health assessment were reviewed.

The observed number of cancer diagnoses reported for Mansfield residents was obtained from the Massachusetts Cancer Registry (MCR). These individuals were Mansfield residents diagnosed with a primary site cancer during 1995-2000 (MDPH 2004). Residence was determined based on the address reported to the hospital or reporting facility at the time of diagnosis. The MCR began collecting information in Massachusetts residents diagnosed with cancer in the state in 1982. All newly diagnosed cancer cases are required by law to be reported in the MCR within six months of the date of diagnosis (MGL, c. 111, s.111B). The 6-year period, 1995-2000, constitutes the period for which the most recent and complete cancer incidence data were available at the time of this analysis. Since the release of the public comment draft in early 2004, the MCR now has data available through 2000. Of the five cancers examined for this report, cancer incidence rates for the period 1995-2000 are consistent with those previously described for the period 1995-1999. Further, an evaluation of the geographical distribution for 1995-2000 also was consistent with the 1995-2000 time period.

The term "cancer" is used to describe a variety of diseases associated with abnormal cell and tissue growth. Primary site (location in the body where the disease originated) and histology (tissue or cell type) classify the different cancer types. Epidemiological studies have revealed that different types of cancer are individual diseases with separate causes, risk factors, characteristics and patterns of survival (Bang 1996).

To determine whether elevated numbers of cancer cases have occurred in a community, cancer incidence data are analyzed by age and gender to compare the observed number of cancer cases to the number that would be expected based on the statewide cancer experience. A Standardized Incidence Ratio (SIR) is an estimate of the occurrence of disease in a population in relation to what might be expected if the population in question had the same cancer experience as some larger population designated as the comparison population. 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 are not calculated where fewer than five cases are observed.

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 as 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 stability of the SIR itself. Two SIRs can have the same size but not have the same stability. An SIR of 150 based on six observed cases and four expected cases indicates a 50% excess in cancer, but this excess is actually two cases. Conversely, an SIR of 150 based on 600 observed cases and 400 expected cases represents the same 50% excess in cancer, but because the SIR is based on a greater number of cases, the estimate is more stable. It is unlikely that 200 excess cases of cancer would occur by chance alone.

In addition to calculating SIRs, the statistical significance of each SIR is also assessed. A 95% confidence interval (95% CI) is calculated for each SIR to determine if the observed number of cases is significantly different from the expected number or if the difference may be due solely to chance. A 95% CI is a method of assessing the magnitude and stability of an SIR. Specifically, a 95% CI is the range of estimated SIR values that have a 95% probability of including the true SIR for the population. If the 95% CI range does not include the value 100, then the study population is significantly different from the comparison or “normal” population. Significantly different means there is less than a 5% chance that the observed difference is the result of random fluctuation in the number of observed cancer cases.

For example, if a confidence interval does not include 100 and the interval is above 100 (e.g., 105-130), then this means statistically there is a significant excess in the number of cancer cases. Similarly, if the confidence interval does not include 100 and the interval is below 100 (e.g., 45-96), then statistically the number of cancer cases is significantly lower than expected. If the confidence interval range includes 100 then the true SIR may be 100, and it cannot be concluded with sufficient confidence that the observed number of cases is not a result of chance and reflects

a real cancer increase or decrease. Again, as a result of the instability of incidence rates based on small numbers of cases, statistical significance is not assessed when fewer than five cases are observed.

In addition to the range of the SIR estimates contained in the confidence interval, the width of the confidence interval also reflects the stability of the SIR estimate. For example, a narrow confidence interval (e.g., 103-115) allows a fair level of certainty that the calculated SIR is close to the true SIR for the population. A wide interval (e.g., 85-450) leaves considerable doubt about the true SIR, which could be much lower than or much higher than the calculated SIR. This would indicate an unstable statistic.

For Mansfield as a whole, during 1995-2000, no cases of liver cancer occurred among either males or females versus three expected. Lung cancer occurred among males close to the expected rate during 1995-2000 (32 observed versus about 30 expected; SIR=109; 95% CI=74-153). Among females, lung cancer occurred more often than expected (34 observed versus about 24 expected; SIR=141; 95% CI=98-197) but this elevation was not statistically significant. Eleven cases of bladder cancer were observed among males versus nine expected (SIR= 122; 95% CI=61-219). Three females were diagnosed with bladder cancer versus about three expected (no SIR calculated due to the observed number being less than 5). For NHL, eleven cases were observed among males versus about nine expected (SIR=118; 95% CI=59-212) and two cases were observed among females versus about eight expected cases. Finally, five males were diagnosed with kidney cancer versus about seven expected (SIR=77; 95% CI=25-180) and five females were diagnosed with kidney cancer versus about four expected (SIR=131; 95% CI=42-305). This elevation was not statistically significant.

A qualitative evaluation of the spatial distribution of individual diagnoses at smaller geographic levels within the town of Mansfield (i.e., neighborhoods) was conducted using the 1995-2000 set of cancer incidence data. Using a computerized geographic information system (ESRI 2002), place of residence at the time of diagnosis was mapped for each individual diagnosed with bladder cancer, kidney cancer, lung and bronchus cancer, or NHL to assess any possible geographic concentrations of cases in relation to each other or in relation to the H&P site. The geographic pattern was determined using a qualitative evaluation of the point pattern of cancer diagnoses in Mansfield. Because cancer is one word that describes many different diseases, the geographic distribution of each cancer type was evaluated separately to determine whether an atypical pattern of any one type was occurring. For confidentiality reasons, it is not possible to include maps showing the locations of individuals diagnosed with cancer in this report.

Review of the geographic distribution of cancer for the years 1995-2000 in Mansfield did not reveal unusual spatial patterns of diagnoses relative to the H&P site that would suggest a common factor (environmental or non-environmental) related to cancer diagnoses among residents. Any patterns that were observed in the town were generally consistent with what would be expected based on the population distribution and areas of higher population density. For example, the majority of individuals with these cancer types were located in and around Mansfield Center where population and housing density are greater.

In general, the incidence of the five types of cancers reviewed here occurred about as often as expected among Mansfield residents. For those cancer types for which SIRs were calculated, no elevation observed was statistically significant. Thus, the observed cancer incidence pattern for these cancer types for Mansfield as a whole did not appear to be unusual. It is also important to note that these particular types of cancer have also been associated with behavioral factors. For example, the most well established risk factor for lung, bladder, and kidney cancers is cigarette smoking.

#### **D. Child Health Considerations**

ATSDR and MDPH 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 for all compounds analyzed for both on and off-site. The evaluation focused on the contaminants of concern in surface soil at the Hatheway and Patterson site, the adjacent residential neighborhood and off-site near impoundments of the Rumford River and contact with fish. The screening values used to assess risk were based on exposure to children. See section A above ("Evaluation of Possible Health Effects") for a discussion of these exposure scenarios.

## CONCLUSIONS

Based on a review of environmental health data at the H&P site, MDPH concluded that:

1. The primary compounds above levels of health concern in soil on-site at the H&P property are arsenic, chromium, PCP and dioxin.
2. While arsenic levels are elevated above levels of health concern in all four on-site quadrants, the highest levels are found in the NE quadrant, which is located on County Street. PCP is elevated above levels of health concern in the NE and SE quadrants. Dioxin and chromium are elevated above levels of health concern in all four quadrants.
3. Public health concerns were greater in the past for workers or trespassers than they are today largely due to institutional controls (e.g., covering of on-site arsenic-contaminated areas with asphalt in much of the NE and NW quadrants and installation of a fence around the perimeter of the site). If the conditions of the institutional controls should deteriorate, opportunities for exposure at the site may increase in the future.
4. Public health concerns were greater in the past. Remedial actions for residents living adjacent to the site or individuals going by the site on County Street (e.g., removal of contaminated soil outside the perimeter of the fence along County Street and at abutting residences across the street) have reduced many of these concerns.
5. Despite the presence of a fence around the perimeter of the H&P Property and periodic efforts to maintain the fence and security measures, there are still areas where the site is accessible. Evidence of trespassing (e.g., beer cans, graffiti) has been found on the site.
6. Physical hazards (e.g., Dricon sump filled with water, demolition debris, broken glass, wooden bridge in disrepair) have been noted in the past and currently exist on the site.
7. The compounds of public health concern in fish from the Rumford River and its impoundments (i.e., Fulton, Kingman, and Cabot ponds) are dioxin and PCP, which is a pesticide. This concern was evaluated in two previous health consultations that formed the basis of the current MDPH fish consumption advisory. Fish from Norton Reservoir as well as Cabot Pond have not been evaluated to date and no barrier exists between the Rumford River and these downstream water bodies. Thus, testing of downstream fish by environmental regulatory agencies as recommended in previous health consultations is still necessary.
8. There may be potential exposure concerns (e.g., flooding and/or seepage into basements), warranting further characterization of groundwater, for residents of the neighborhood south and adjacent to the H&P site from contaminated groundwater potentially flowing from the site towards their basements.

9. Discharge to the Rumford River from the H&P site may be ongoing and has not been completely prevented. As previously mentioned in the Rumford River health consultation (ATSDR 1999) and in the Off-Site Contamination section of this public health assessment, additional soil and sediment sampling for the Rumford River area downstream from the site would help confirm that exposure opportunities to these media do not present health concerns as a result of direct contact (e.g., due to recreational activities).

ATSDR requires that one of five conclusion categories be used to summarize findings of health consultations and public 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.

ATSDR would consider that under past conditions the site was a Public Health Hazard. Although efforts have been made to remediate the site and maintain security on and around the property, opportunities for exposure still may exist, particularly in the SE quadrant near areas where levels of contaminants exceeded health-based comparison values. Also, environmental data have indicated continuing migration of contaminants off-site. Physical hazards were still present on site at the time of this public health assessment. Consequently, ATSDR would consider the site currently as a Public Health Hazard.

## RECOMMENDATIONS

1. Further characterization of groundwater flow and quality in the area should be performed by environmental regulatory agencies. This is particularly true for areas off-site. This characterization is needed to better assess the potential for groundwater pathways with regard to whether nearby homes (e.g., in the backwash area on Highland Avenue, Morris Street, and Chauncy Street, see Figure 13b) might be potentially affected, such as during basement flooding events, or whether any private wells or garden wells could be affected (i.e., coordinate with environmental regulatory agencies and local health officials to increase awareness of homeowners in the neighborhood with regards to potential groundwater concerns).
2. Intervention to prevent further discharge of contaminants from groundwater into the River should be undertaken by environmental regulatory agencies.
3. Periodic inspection of institutional controls should be done by environmental regulatory agencies to identify and prevent opportunities of exposure in the future (e.g., maintaining the fence, asphalt-covered areas, etc.). Security at the site should be improved and maintained, particularly with regard to fence access points.
4. Physical hazards (e.g., Dricon sump filled with water, demolition debris, broken glass, wooden bridge in disrepair) should be eliminated by environmental regulatory agencies.
5. Education and outreach activities by MDPH in coordination with environmental regulatory agencies and local health officials, associated with the public health fish consumption advisory (e.g., periodic coordination with EPA and the Mansfield board of health regarding the upkeep of signs) should continue on an on-going basis.
6. Because testing of fish from a downstream water body (e.g., Fulton Pond) has confirmed the presence of dioxin and PCP in fish tissue, additional fish testing by environmental regulatory agencies from areas further downstream (e.g., Norton Reservoir) is recommended to confirm the extent of this contamination.
7. Because discharge to the Rumford River from the H&P site may be on-going, contaminant concentrations in various media downstream have the potential to increase. Hence, if site conditions change (i.e., worsen) environmental regulatory agencies should consider the need for additional environmental (e.g., soil and sediment) sampling.

## **PUBLIC HEALTH ACTION PLAN**

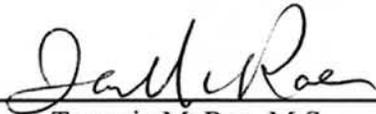
1. MDPH will continue to provide technical assistance to foster education and outreach activities to raise awareness of MDPH's public health fish consumption advisory, and other environmental health-related concerns associated with this site (e.g., fact sheets, posters, attend community meetings).
2. MDPH will send a letter to EPA and local health officials to coordinate the posting of new Public Health Fish Consumption Advisory signs, and to encourage EPA to plan fish testing for downstream portions of the Rumford River (e.g., Cabot Pond), and Norton Reservoir.
3. MDPH will continue, upon request, to review environmental data generated for the site, and provide public health interpretation and advice.
4. MDPH, in collaboration with EPA, local health officials, MDEP and MDFW, reviewed environmental data related to dioxin concerns, and issued a preliminary public health fish consumption advisory for the Rumford River in 1998. This fish advisory was updated and made permanent in 1999 after fish tissue data became available through EPA. The fish advisory is posted on the MDPH Center for Environmental Health's website. MDPH completed a health consultation for Glue Factory Pond/Rumford River in 2001 and for the Rumford River in 1999. These documents were made available to the public. MDPH also attended a community meeting, and performed site visits.

## **PREPARER OF PUBLIC HEALTH ASSESSMENT**

This document was prepared by the Environmental Toxicology Program, Center for Environmental Health of the Massachusetts Department of Public Health. If you have any questions about this document, please contact Suzanne K. Condon, Associate Commissioner, MDPH/CEH, 7<sup>th</sup> Floor, 250 Washington Street, Boston, Massachusetts 02108.

## CERTIFICATION

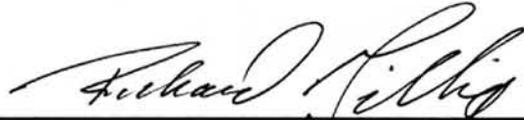
The Public Health Assessment for the Hatheway and Patterson site, Mansfield, Massachusetts was prepared by the Massachusetts Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time this public health assessment was initiated. Editorial review was completed by the Cooperative Agreement partner.



---

Tammie McRae, M.S.  
Technical Project Officer  
Cooperative Agreement Team  
Division of Health Assessment and Consultation  
ATSDR

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



---

Richard Kilgus  
Cooperative Agreement Team Leader  
CAT, DHAC, ATSDR

## **TABLES**

**Table 1: Demographic Characteristics of Mansfield (2000 U.S. Census)**

Characteristics	Mansfield		U.S. Census Tract 6101	
	Persons	%	Persons	%
Age				
Under 5	2,154	9.6	341	6.8
5 – 14	4,060	18.1	714	14.3
15 – 44	10,538	47	2,568	51.4
45 – 64	4,236	18.9	929	18.5
65 and over	1,426	6.3	448	8.9
Sex				
male	11,175	49.9	2,480	49.6
female	11,239	50.1	2,520	50.4
Race				
Not Hispanic or Latino:	22,097	98.6	4,937	98.7
White alone	20,894	93.2	4,733	94.7
Black or African American alone	482	2.2	85	1.7
American Indian and Alaska Native alone	41	0.2	11	0.2
Asian alone	432	1.9	65	1.3
Native Hawaiian and Other Pacific Islander alone	2	0	1	0
Some other race alone	52	0.2	9	0.2
Two or more races	194	0.1	33	0.7
Hispanic or Latino:	317	1.4	63	1.3
White alone	243	1.1	41	0.8
Black or African American alone	7	0	0	0
American Indian and Alaska Native alone	5	0	0	0
Asian alone	0	0	0	0
Native Hawaiian and Other Pacific Islander alone	2	0	2	0
Some other race alone	44	0.2	16	0.3
Two or more races	16	0	4	0

**Table 2:** Summary of surface soil (0 through 2 feet) contaminants of concern in the Southeast Quadrant. Concentrations are listed as milligrams per kilogram (mg/kg), unless otherwise noted.

Compound <sup>36</sup>	Detects/ Samples	Minimum (mg/kg)	Maximum (mg/kg)	Comparison Values (mg/kg)
Arsenic *	32/36	ND (.80)	369 J	CREG =0.5 Chronic EMEG (child) = 20 Chronic EMEG (adult) =200 Bkgd Range: <0.1-73; Mean: 7.4
Total Chromium	36/36	3	470	Hexavalent Chromium RMEG (child)- 200 RMEG (adult)- 2,000 Trivalent Chromium RMEG (child)- 80,000 RMEG (adult)- 1,000,000 Bkgd (Total): 1 – 1,000; Mean: 52
PCP	25/27	ND (0.100)	18	CREG = 6 Chronic EMEG (child) = 50 Chronic EMEG (adult) = 700
2,3,7,8 TCDD <sup>37</sup> (ng/kg)	10/13	ND	80	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg
2,3,7,8 TCDD TEQ <sup>38</sup> (ng/kg)	13/13	3 J	44,951	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg

\* Background (Bkgd) concentrations for metals for the Eastern United States from Shacklette and Boerngen (1984).

CREG	Cancer Risk Evaluation Guide (ATSDR)
EMEG	Environmental Media Evaluation Guide (ATSDR)
J	Quantitation is approximate due to limitations identified during quality control.
MCP	Massachusetts Contingency Plan
ND	Non-detect (associated with the method detection limit, shown in parenthesis)
RBC	Risk-Based Concentration (EPA Region III)
RMEG	Reference Dose Media Evaluation Guide (ATSDR)
mg/kg	milligrams per kilogram
ng/kg	nanograms per kilogram
PCP	Pentachlorophenol
TCDD	Tetra-chlorinated dibenzo-p-dioxins
TEQ	Toxicity Equivalents
<	Less than

<sup>36</sup> Results for As and Cr were obtained by BNA (base/neutral/acid) analyses (Weston 1993) and EPA 6010 Target Analyte List (TAL) metals analysis, or by linear regression analysis of XRF and ICAP (Inductively Coupled Argon Plasma) data (Weston 1994).

<sup>37</sup> The ATSDR action level for 2,3,7,8 TCDD in soil is 1,000 ng/kg.

<sup>38</sup> 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.

**Table 3:** Summary of surface soil (0 through 1 feet) contaminants of concern in the Northeast Quadrant.

Compound <sup>39</sup>	Detects/ Samples	Minimum (mg/kg)	Maximum (mg/kg)	Comparison Values (mg/kg)
Arsenic *	16/16	5	1,860	Chronic EMEG (child) = 20 Chronic EMEG (adult) =200 CREG =0.5 Bkgd Range: <0.1-73;Mean: 7.4
Total Chromium <sup>40</sup>	12/12	10	1,886	Hexavalent Chromium RMEG (child)- 200 RMEG (adult)- 2,000 Trivalent Chromium RMEG (child)- 80,000 RMEG (adult)- 1,000,000 Bkgd (total): 1 – 1,000; Mean: 52
PCP	9/9	46	4,900	Chronic EMEG (child) = 50 Chronic EMEG (adult) = 700 CREG = 6
2,3,7,8 TCDD <sup>41</sup> (ng/kg)	3/5	ND	9	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg
2,3,7,8 TCDD TEQ <sup>42</sup> (ng/kg)	5/5	130 J	11,000 J	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg

\* Background concentrations for metals for the Eastern United States from Shacklette and Boerngen (1984).

CREG	Cancer Risk Evaluation Guide (ATSDR)
EMEG	Environmental Media Evaluation Guide (ATSDR)
J	Quantitation is approximate due to limitations identified during quality control.
MCP	Massachusetts Contingency Plan
ND	Non-detect (associated with the method detection limit, shown in parenthesis)
RBC	Risk-Based Concentration (EPA Region III)
RMEG	Reference Dose Media Evaluation Guide (ATSDR)
mg/kg	Milligram per kilogram
ng/kg	Nanograms per kilogram
TCDD	Tetra chlorinated dibenzo-p-dioxins
TEQ	Toxicity Equivalents

<sup>39</sup> See footnote 34.

<sup>40</sup> Six of the 12 samples analyzed for metals exceeded the screening values and typical background levels of 1,000 mg/kg for total chromium (Roy F. Weston 1994; Shacklette and Boerngen 1984).

<sup>41</sup> The ATSDR action level for 2,3,7,8 TCDD in soil is 1,000 ng/kg.

<sup>42</sup> 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.

**Table 4:** Summary of surface soil (0 through 1 feet) contaminants of concern in the Northwest Quadrant.

Compound <sup>43</sup>	Detects/ Samples	Minimum (mg/kg)	Maximum (mg/kg)	Comparison Values (mg/kg)
Arsenic *	18/18	26	630	Chronic EMEG (child) = 20 Chronic EMEG (adult) =200 CREG =0.5 Bkgd Range: <0.1-73;Mean: 7.4
Total Chromium	18/18	7	460	Hexavalent Chromium RMEG (child)- 200 RMEG (adult)- 2,000 Trivalent Chromium RMEG (child)- 80,000 RMEG (adult)- 1,000,000 Bkgd (total): 1 – 1,000; Mean: 52
2,3,7,8 TCDD <sup>44</sup> (ng/kg)	1/5	ND	3	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg
2,3,7,8 TCDD TEQ <sup>45</sup> (ng/kg)	5/5	3 J	330 J	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg

\*Background concentrations for metals for the Eastern United States from Shacklette and Boerngen (1984)

CREG	Cancer Risk Evaluation Guide (ATSDR)
EMEG	Environmental Media Evaluation Guide (ATSDR)
J	Quantitation is approximate due to limitations identified during quality control.
MCP	Massachusetts Contingency Plan
ND	Non-detect (associated with the method detection limit, shown in parenthesis)
RBC	Risk-Based Concentration (EPA Region III)
RMEG	Reference Dose Media Evaluation Guide (ATSDR)
mg/kg	Milligram per kilogram
ng/kg	Nanograms per kilogram
TCDD	Tetra chlorinated dibenzo-p-dioxins
TEQ	Toxicity Equivalents

<sup>43</sup> See footnote 34.

<sup>44</sup> The ATSDR action level for 2,3,7,8 TCDD in soil is 1,000 ng/kg.

<sup>45</sup> 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.

**Table 5:** Summary of surface soil (0 through 1 feet) contaminants of concern in the Southwest Quadrant

Compound <sup>46</sup>	Detects/ Samples	Minimum (mg/kg)	Maximum (mg/kg)	Comparison Values (mg/kg)
Arsenic *	14/14	28	413	Chronic EMEG (child) = 20 Chronic EMEG (adult) =200 CREG =0.5 Bkgd Range: <0.1-73;Mean: 7.4
Total Chromium <sup>47</sup>	14/14	6	318	Hexavalent Chromium RMEG (child)- 200 RMEG (adult)- 2,000 Trivalent Chromium RMEG (child)- 80,000 RMEG (adult)- 1,000,000 Bkgd (total): 1 – 1,000; Mean: 52
2,3,7,8 TCDD <sup>48</sup> (ng/kg)	0/5	ND	ND	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg
2,3,7,8 TCDD TEQ <sup>49</sup> (ng/kg)	5/5	1 J	64 J	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg 2,3,7,8–TCDD Bkgd Range: 1 – 10 ng/kg

\*Background concentrations for metals for the Eastern United States from Shacklette and Boerngen (1984)

CREG	Cancer Risk Evaluation Guide (ATSDR)
EMEG	Environmental Media Evaluation Guide (ATSDR)
J	Quantitation is approximate due to limitations identified during quality control.
MCP	Massachusetts Contingency Plan
ND	Non-detect (associated with the method detection limit, shown in parenthesis)
RBC	Risk-Based Concentration (EPA Region III)
RMEG	Reference Dose Media Evaluation Guide (ATSDR)
mg/kg	Milligram per kilogram
ng/kg	Nanograms per kilogram
TCDD	Tetra chlorinated dibenzo-p-dioxins
TEQ	Toxicity Equivalents

<sup>46</sup> See footnote 34.

<sup>47</sup> Six of the 12 samples analyzed for metals exceeded the screening values and typical background levels of 1,000 mg/kg for total chromium (Roy F. Weston 1994; Shacklette and Boerngen 1984).

<sup>48</sup> The ATSDR action level for 2,3,7,8 TCDD in soil is 1,000 ng/kg.

<sup>49</sup> 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.

**Table 6:** Summary of maximum concentrations of contaminants of concern in surface soil (0 through 2 feet) on the H&P property. For some compounds, data were not available (N/A).

Compound	NE (mg/kg)	SE (mg/kg)	NW (mg/kg)	SW (mg/kg)	Comparison Values (mg/kg)
Arsenic <sup>50*</sup>	1,860	369 J	630	413	CREG =0.5 Chronic EMEG (child) = 20 Chronic EMEG (adult) =200 Bkgd Range: <0.1-73;Mean: 7.4
Total Chromium	1,886	470	460	318	<u>Hexavalent Chromium</u> RMEG= 200-child; 2,000-adult <u>Trivalent Chromium</u> RMEG= 80,000-child; RMEG = 1,000,000-adult Bkgd (total): 1 – 1,000; Mean: 52
PCP	4,900	18	2	ND	CREG = 6 Chronic EMEG= 50 (child);700 (adult)
2,3,7,8-TCDD	9	80 ng/kg	3	ND	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg Intermediate EMEG (child) = 1,000 Intermediate EMEG (adult) = 10,000 2,3,7,8-TCDD Bkgd Range: 1 – 10 ng/kg
					Intermediate EMEG (child) = 1,000 Intermediate EMEG (adult) = 10,000

\*Background concentrations for metals for the Eastern United States from Shacklette and Boerngen (1984)

- CREG Cancer Risk Evaluation Guide (ATSDR)
- EMEG Environmental Media Evaluation Guide (ATSDR)
- J Quantitation is approximate due to limitations identified during quality control.
- MCP Massachusetts Contingency Plan
- ND Non-detect (associated with the method detection limit, shown in parentheses)
- RBC Risk-Based Concentration (EPA Region III)
- RMEG Reference Dose Media Evaluation Guide (ATSDR)
- mg/kg Milligram per kilogram
- ng/kg Nanograms per kilogram
- TCDD Tetra chlorinated dibenzo-p-dioxins
- TEQ Toxicity Equivalents

<sup>50</sup> See footnote 34.

<sup>51</sup> See note 42.

**Table 6:** Summary of maximum concentrations of contaminants of concern in surface soil (0 through 2 feet) on the H&P property. For some compounds, data were not available (N/A) (continued).

Several analytes found in soil, including some for which a comparison value is not available, were eliminated from the contaminants of concern list because they were less than average or within the range of background. Background concentrations for metals for the Eastern United States were from Shacklette and Boerngen (1984). Estimated CREGs for PAHs are based on the benzo(a)pyrene CREG and Toxicity Equivalence Factors (TEFs). Background levels of PAHs are from the PAH Toxicological Profile, Table 5-3 (ATSDR 1995).

The following analytes in soil, with their maximum concentrations (in mg/kg), were eliminated from each quadrant:

SE quadrant: calcium (530 mg/kg), magnesium (1,600 mg/kg), potassium (380 mg/kg) and sodium (30 mg/kg); 2,3,5,6-tetrachlorophenol (2 mg/kg), dibenzofuran (0.4 J mg/kg), fluoranthene (0.2 mg/kg), fluorene (0.4 J mg/kg), PCP (1 mg/kg), pyrene (0.2J mg/kg), antimony (3 mg/kg), copper (265 mg/kg), lead, and thallium(68 mg/kg). Some PAHs had method detection limits that were below comparison values (e.g., benzo(a)pyrene's CREG is 0.1 mg/kg but the MDL was 0.4 mg/kg).

NE quadrant: calcium (1300 mg/kg), iron (28,000 mg/kg), magnesium (2300 mg/kg), potassium (380 mg/kg) sodium (130 mg/kg), copper (875 mg/kg), and thallium (67 mg/kg); PAHs: benzo(a)anthracene (2 mg/kg), benzo(b)fluoranthene (2 mg/kg), benzo(k) fluoranthene (2 mg/kg), indeno (1,2,3-cd)pyrene (1 mg/kg), and 2-methylnaphthalene (2 mg/kg), benzo(a)pyrene (2 mg/kg), total petroleum hydrocarbons (34,000 mg/kg) and total PAHs (47 mg/kg).

NW quadrant: calcium (4000 mg/kg), iron (32,000 mg/kg), magnesium (2700 mg/kg), potassium (660 mg/kg) sodium (83 mg/kg), copper (443 mg/kg) and thallium (82 mg/kg). There was no MDL for dibenzo(a,h)-anthracene and benzo(a)pyrene had a MDL of 1 mg/kg, not sensitive enough for 0.1 mg/kg CREG.

SW quadrant: copper (447 mg/kg). Two samples were analyzed for PAHs, including PCP (1 mg/kg). For the following PAHs there were no MDLs: benzo(a)pyrene and dibenzo(a,h)anthracene.

**Table 7:** Summary of Off-Site Surface Soil (0 to 3 inches) Results at Five Residences and the Corner of County Street North of these Residences.

House	Contaminant	Detects/Sample	Minimum (mg/kg)	Mean (mg/kg)	Maximum (mg/kg)	Comparison Values (mg/kg)	Background Levels (mg/kg)
#1	Arsenic	23/23	8	27	40	CREG 0.5 Chronic EMEG (child) 20	0.1 – 73
#1	2,3,7,8-TCDD (ng/kg)	1/1	2	2	2	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg	1 – 10 ng/kg (2,3,7,8-TCDD)
#1	Dioxin TEQ (ng/kg)	1/1	290	290	290	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg	1 – 10 ng/kg (2,3,7,8-TCDD)
#1	Benzo(a)pyrene	1/1	4	4	4	CREG 1	0.002 – 1.3 (benzo(a)pyrene)
#1	Benzo(a)pyrene TEQ	1/1	7	7	7	CREG 1	0.002 – 1.3 (benzo(a)pyrene)
#2	Arsenic	18/18	5	39	140	CREG 0.5 Chronic EMEG (child) 20	0.1 – 73
#2	2,3,7,8-TCDD (ng/kg)	1/1	1 J	1 J	1 J	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg	1 – 10 ng/kg (2,3,7,8-TCDD)
#2	Dioxin TEQ (ng/kg)	1/1	290	290	290	Chronic EMEG (child) = 50 ng/kg Chronic EMEG (adult) = 700 ng/kg	1 – 10 ng/kg (2,3,7,8-TCDD)
#2	Benzo(a)pyrene	1/1	3	3	3	CREG 1	0.002 – 1.3 (benzo(a)pyrene)
#2	Benzo(a)pyrene TEQ	1/1	6	6	6	CREG 1	0.002 – 1.3 (benzo(a)pyrene)
#3	Arsenic	4/4	12	28	53	CREG 0.5 Chronic EMEG (child) 20	0.1 – 73
#4	Arsenic	25/25	5	25	83	CREG 0.5 Chronic EMEG (child) 20	0.1 – 73
#5	Arsenic	16/16	5	25	66	CREG 0.5 Chronic EMEG (child) 20	0.1 – 73
Corner of County Street north of residences	Arsenic	5/5	ND	10	21	CREG 0.5 Chronic EMEG (child) 20	0.1 – 73

mg/kg = milligrams per kilogram; CREG=Cancer Risk Evaluation Guide (ATSDR); EMEG=Environmental Media Evaluation Guide (ATSDR); J=Quantitation is approximate due to limitations identified during qualitycontrol; ND=Non-detect (associated with the method detection limit, shown in parentheses); ng/kg=Nanograms per kilogram;TCDD=Tetra chlorinated dibenzo-p-dioxins;TEQ=Toxicity Equivalents

**Table 8:** Summary of compounds of concern in fish samples collected by USEPA (September and October 2003).

Water Body Source	Glue Factory Pond	Glue Factory Pond	Glue Factory Pond	Fulton Pond	Fulton Pond	Kingman Pond	Rumford River – upstream of site	Rumford River – upstream of site	Rumford River – on-site	Rumford River – on-site	EPA Screening Value <sup>1</sup>	Background Level in Fish Tissue <sup>2</sup>
Sample Type	1 Filleted Fish	1 Filleted Fish	1 Filleted Fish	1 Filleted Fish	1 Filleted Fish	1 Filleted Fish	Whole Body	Whole Body	Whole Body	Whole Body		
Species	Large Mouth Bass	White Sucker	Yellow Perch	White Sucker	Yellow Perch	Large Mouth Bass	White Sucker	Pickereel	White Sucker	Pickereel		
Dioxin 2,3,7,8-TCDD (ng/kg)	ND (0.216U)	ND (0.202U)	ND (0.137UJ)	ND (0.684U)	ND (0.176UJ)	ND (0.119U)	ND (0.564U)	2	ND (0.285U)	ND (0.234UJ)	Cancer 0.27	1
Dioxin 2,3,7,8-TCDD TEQ (ng/kg)	ND (0.0UJ)	ND (0.0UJ)	0.003J	ND (0.0UJ)	1J	ND (0.0UJ)	ND (0.0UJ)	2J	0.4	3J	Cancer 0.27	1
Pentachlorophenol (mg/kg)	ND (0.39U)	ND (0.39U)	ND (0.39U)	1	1	0.2J	ND (0.38U)	ND (0.38U)	7	3	Cancer 0.33 Non-Cancer 120	ND - 50

ND = Not detected. The value in parentheses is the method detection limit.

mg/kg Milligrams per kilogram in fish tissue

ng/kg Nanograms per kilogram in fish tissue

U=undetected at the specified detection limit.

J=estimated value.

UJ=estimated non-detect.

<sup>1</sup>EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2, Risk Assessment and Fish Consumption Limits, Third Edition, U.S. Environmental Protection Agency, Washington, DC, November 2000.

<sup>2</sup> ATSDR. 1998. Toxicological profile for chlorinated dibenzo-p-dioxins. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.

ATSDR. 2001. Toxicological Profile for Pentachlorophenol. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.

## FIGURES

## REFERENCES

- ATSDR. 1992. Toxicological Profile for Thallium. July, 1992. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.
- ATSDR. 1993. Public Health Assessment Manual, Lewis Publishers, Boca Raton, FL.
- ATSDR. 1995. Toxicological profile for polycyclic aromatic hydrocarbons. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.
- ATSDR. 1998. Toxicological profile for chlorinated dibenzo-p-dioxins. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.
- ATSDR. 2000a. Toxicological Profile for Arsenic. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.
- ATSDR. 2000b. Toxicological Profile for Chromium. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.
- ATSDR. 2001. Toxicological Profile for Pentachlorophenol. U.S. Agency for Toxic Substances and Disease Registry, Atlanta. GA.
- Bang, K.M. 1996. Epidemiology of occupational cancer. *Journal of Occupational Medicine*. 11(3):467-85.
- Clean Harbors Environmental Services, 1998. Analytical data package, Volume I, Hatheway and Patterson Site. August 21, 1998.
- DynCorp Information and Engineering Technology, 2001. (Draft) Hazard Ranking System (HRS) Documentation Package (Volume I and II), prepared for EPA Region I, Boston. Alexandria, VA. July 2001.
- Environmental Systems Research Institute (ESRI). 2002. ArcGIS, Arcview license, ver. 8.3, Redlands, California.
- EPA. 1993. Letter from Mary Ellen Stanton (Site ERS I, site investigator) to William Haynes (Hatheway & Patterson, President). Re: Preliminary Assessment/Site Investigation Report and determination that a Removal Action is necessary. US EPA Reg. 1. August 5.
- EPA 1994. Estimating exposure to dioxin-like compounds, Volume II: Properties, sources, occurrence, and background exposures, External Review Draft. U.S. Environmental Protection Agency, Washington, DC, June 1994.

EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2, Risk Assessment and Fish Consumption Limits, Third Edition, U.S. Environmental Protection Agency, Washington, DC, November 2000.

EPA 2003. Fact sheet. Hatheway & Patterson Update. July/August 2003.

EPA 2004a. (Personal communication, Frank Gardner, August 24, 2004).

EPA 2004b. (Personal communication, Frank Gardner, October 29, 2004).

Federal Register. 2001. Environmental Protection Agency. 40 CFR 300. National Priorities List for Uncontrolled Hazardous Waste Sites. Proposed Rule No. 37. September 13; 66 (178): 47612-47618.

Federal Register. 2002. Environmental Protection Agency. 40 CFR 300. National Priorities List for Uncontrolled Hazardous Waste Sites. Final Rule. September 5; 67 (172): 56757-56765.

Fitzgerald, M.A. 1982. Assessment of Current Groundwater Conditions of the Rumford River and Recommendations for Immediate and Long Term Solutions. Report to Hatheway and Patterson. Prepared by M.A. Fitzgerald, Consulting Engineer. Franklin, MA. April, 1982

Hydraulic and Water Resources Engineers – START. 1999. Final Site Inspection Report for Hatheway and Patterson, Mansfield, Massachusetts. December 6, 1999.

Keystone Environmental Resources, Inc. 1988. A Soils and Hydrogeologic Investigation. Monroeville, PA. May, 1988.

Keystone Environmental Resources, Inc. 1989. Phase II site investigation and preliminary health and environmental assessment. Prepared for Hatheway and Patterson Company, Mansfield, MA. December, 1989.

Keystone Environmental Resources. 1991. Design report for short-term measure. Prepared for Hatheway and Patterson Company. Monroeville, PA. July 1991.

Keystone Environmental Resources. 1992. Completion report for short-term measure. Prepared for Hatheway and Patterson Company, Mansfield, MA. January, 1992.

MDEP. 1990. Mark J Begley. Letter to William Haynes (Hatheway & Patterson, President). Re: Release of product to Rumford River and Request for Short Term Measure (STM). July 5, 1990.

MDEP. 1994. Preliminary Assessment Report for Hatheway & Patterson Co. Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup, Boston. December, 1994.

MDEP. 1995a. Guidance for Disposal Site Risk Characterization, Tables 2.1 and 2.2. July, 1995.

MDEP. 1995b. Email from Julie Hutchinson (DEP-SERO) to Richard Packard (DEP-SERO) re: EPA proposed paving H&PP. May 8, 1995.

MDEP. 1998. Letter from Gerard Martin to Steve Hurley (Massachusetts Division of Fisheries and Wildlife, Southeast District Fisheries). Re: Request to postpone stocking. September 23, 1998.

MDEP. 2002. Anthropogenic Background Levels in Soil. Office of Research & Standards, MDEP. February, 2002.

MDEP. 2003a. (Personal communication, Scott Sayers, March 6, 2003).

MDEP. 2003b (Personal Communication, Brenda Chabot, March 7, 2003).

MDEQE. 1973. Letter from William Marhoffer to James Foster concerning discharge of oil pollution to the Rumford River. January 2, 1973.

MDEQE. 1982. Letter from Walter R. Walsh (Inspector of Public Health/Hazardous Waste Coordinator) to W. Haynes (Hatheway and Patterson, President). July 21, 1982.

MDEQE. 1988. Letter from Christopher Tilden (HWS Chief) to William Haynes (Hatheway & Patterson, President) re: Notice of Responsibility (NOR) and Phase II Investigation. August 16, 1988.

Mansfield Assessors Office. 2002. Sue Sellon, personal communication, July 23, 2002.

MDPH. 1999. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment. Health Consultation: Rumford River Site, Mansfield, Bristol County, Massachusetts.

MDPH. 2001. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment. Health Consultation: Glue Factory Pond/Rumford River, Foxborough, Bristol County, Massachusetts.

MDPH. 2002a. Hatheway and Patterson Site Visit Report, Memo to Elaine T. Krueger from Michael J. Celona. August 6, 2002.

MDPH. 2002b. Hatheway and Patterson Public Meeting Summary, Memo to Elaine T. Krueger from Rebecca A. Robateau. August 30, 2002.

MDPH 2004. Massachusetts Cancer Registry. Massachusetts Department of Public Health, Center for Health Information, Statistics, Research and Evaluation.

MDPH. 2005. Hatheway and Patterson Site Visit Report, Memo to Elaine T. Krueger from Marian Berkowitz. July 19, 2005.

Penney Engineering, Inc. 1992. Monthly updates to MDEP-SERO on activities at Hatheway Patterson Site, Mansfield, MA. February, 1992.

Penney Engineering, Inc. 1993. Re: Break in security/fence caused by a berm on H&P property designed to prevent fire-related runoff from entering the river. July 19, 1993.

Resource Controls. 1997. Letter from Robert C. Atwood to Barbara Kesner Landau, BWSC-DEP, re: MCP and Brownfields related issues. December 3, 1997.

Resource Control Associates and Vanasse Hangen Brustlin Inc. 2000. Brownfields Pilot Program Preliminary Comprehensive Site Assessment of Hatheway and Patterson Property. RCA, Pawtucket RI and VHB, Watertown, MA. Volume I. June.

Roy F. Weston, (Technical Assistance Team). 1993. Removal Program: Preliminary Assessment/ Site Investigation for Hatheway & Patterson Site, Mansfield, Massachusetts. TDD No. 01-9306-01A. August.

Roy F. Weston. 1994. Final Report Soil Sampling and Field Screening. USEPA Contract #68-C4-0022 Work Assn. 0-053. December.

Roy F. Weston, Superfund Technical Assistance Response Team (START). 1995. After action report for the Hatheway and Patterson site. December 1993 through September 1995. October.

Shacklette and Boerngen. 1984. Element concentrations in soils and other surficial materials of the conterminous United States. U.S. Geological Survey Professional Paper 1270.

TRC Environmental Corporation and Metcalf & Eddy, Inc. 2002. Data Report: Hatheway & Patterson Site, Mansfield, Massachusetts. June 4, 2002.

TRC Environmental Corporation and Metcalf & Eddy, Inc. 2004. Draft Remedial Investigation Report, Hatheway & Patterson Site, Mansfield, MA. April 2004.

U.S. Bureau of the Census. 2001. 2000 Census Population: Characteristics of the Population. Washington: US Department of Commerce.

Weston Solutions, Inc., April 2004. Removal Program After Action Report for the Hatheway & Patterson Site, Mansfield, Bristol County, Massachusetts, August 6, 2003 through October 16, 2003.

## APPENDICES