Public Health Assessment

Final Release

BENFIELD INDUSTRIES NPL SITE

WAYNESVILLE, HAYWOOD COUNTY, NORTH CAROLINA

EPA FACILITY ID: NCD981026479

Prepared by the
North Carolina Department of Health and Human Services

MARCH 11, 2011

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR's Cooperative Agreement Partner 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's Cooperative Agreement Partner 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's Cooperative Agreement Partner 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's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

PUBLIC HEALTH ASSESSMENT

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EPA FACILITY ID: NCD981026479

Prepared by:

North Carolina Department of Health and Human Services
Division of Public Health
Occupational and Environmental Epidemiology Branch
Under Cooperative Agreement with the
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Agency for Toxic Substances and Disease Registry

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Acronyms

AF	Attenuation factor
AT	Averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Center for Disease Control and Prevention
CF	Conversion factor
cm	Centimeter
CREG	ATSDR Cancer Risk Evaluation Guide
CR	Contact rate
CV	Comparison Value
DAF	Dermal absorption efficiency
DPH	N.C. DHHS Division of Public Health
DWM	N.C. DENR Division of Waste Management
DWQ	N.C. DENR Division of Water Quality
ED	Exposure duration
EF	Exposure frequency
EMEG	ATSDR Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
HG	Health Guideline value
IRi	Inhalation rate
IUR	Inhalation Unit Risk factor
Kg	Kilogram
L	Liter
LOAEL	Lowest Observed Adverse Effect Level
MCLG	EPA Maximum Contaminant Level Goal
MCL	EPA Maximum Contaminant Level
M	Meter
mg	milligram
$\mu g/m^3$	microgram per cubic meter
µg	microgram
ng	nanogram
NA	Not applicable
N.C. DENR	North Carolina Department of the Environment and Natural Resources
N.C. DHHS	North Carolina Department of Health and Human Services
NIOSH	National Institute for Occupational Safety and Health
NOAEL	No Observed Adverse Effect Level
ppm	Parts per million
ppb	Parts per billion
RfC	Reference Concentration
RfD	Reference Dose
SVOC	Semi-volatile organic compound
VOC	Volatile organic compound

*** These acronyms may or may not be used in this report**

SUMMARY

INTRODUCTION

The N.C. Division of Public Health's (DPH) top priority is to make sure the community near the site has the best science information available to safeguard its health.

Benfield Industries (Riverbend Street, Waynesville, NC) mixed and packaged bulk materials for resale from 1976 until fire destroyed the facility in 1982. Products handled by Benfield Industries included: paint thinners, solvents, sealants, cleaners, de-icing solutions and wood preservatives. The 6-acre site was placed on the National Priorities List (NPL, or "Superfund") in 1989. During the Superfund process, soil and groundwater contamination with a variety of organic and metal substances was identified on the site. Clean-up operations on the site have been approved and monitored by the U.S. Environmental Protection Agency (EPA). Soil cleanup began in 1997 and continued until 2000. Active groundwater cleanup began on site in 2001 and continued until 2007. In 2008, EPA asked the Agency for Toxic Substances and Disease Registry (ATDSR) to update the original Public Health Assessment (PHA) published in 1990. N.C. DPH evaluated soil, groundwater, surface water and sediment data collected on the site from 1990 through 2008. In 2002, Haywood County sold the 6-acre property to Haywood Vocational Opportunities, Inc (HVO). HVO redeveloped the property in 2004 and currently operates a manufacturing facility on the property. The property deed includes deed restrictions that prevent the property from being developed for residential use or other activities that could disturb residual contamination.

On February 18, 2008 N.C. DPH's findings and recommendations were published through our Co-operative Agreement Program partner (ATSDR) as a "Public Comment Release" draft PHA, which requested comments from the public and other agencies. The comments received and N.C. DPH's responses are included as an Appendix F in this document, the "Final PHA".

In February 2010, EPA initiated an additional groundwater investigation on the site that addressed N.C. DPH's concerns and recommendations identified in the February 2010 draft PHA. This Final PHA lists those concerns and recommendations and has been amended to include a discussion of the impact of EPA's February 2010 groundwater investigation on N.C. DPH's original findings.

OVERVIEW

N.C. DPH has reached two important conclusions about the former Benfield Industries NPL site that is now the location of the Haywood Vocational Opportunities, Inc. manufacturing facility.

CONCLUSION 1	**The N.C. DPH concludes that the chemicals in surface soil and groundwater within the boundaries of the former Benfield Industries NPL site will not harm people's health.**
BASIS FOR DECISION	The potential to come into contact with contaminated surface soils or groundwater has been eliminated on the site.
CONCLUSION 2	**The N.C. DPH can not currently conclude whether drinking chemicals in groundwater traveling away from the former Benfield Industries NPL site have the potential to harm people's health.** ***Update: EPA's February 2010 investigation confirms that there are no private wells in use in the path of the contamination. As a result, it can be concluded, with the additional information, that people's health can not be adversely affected by the groundwater because it is not being used as a drinking water source.***
BASIS FOR DECISION	Concentrations of metals greater than health guidelines were detected in the shallow groundwater samples collected through 2003, but no metals analyses have been done since that time. The deeper bedrock aquifer that is thought to likely serve as the source of private well water in the area has not been evaluated analytically. Verification that no private wells exist down gradient from the site has not been done since 1992.
NEXT STEPS	The DPH makes the following recommendations: ▪ Verify that no private wells in the vicinity of the site or down gradient are being used as drinking water sources. If located, test the wells for site-related contaminants. If contaminants are found at levels greater than regulatory or health guideline levels immediately supply alternative water sources, followed by connection to the municipal water system. ▪ Consider testing the bedrock aquifer to confirm that site contaminants have not affected the bedrock aquifer. ***Update: In their February 2010 investigations EPA verified there are no private wells in use in the vicinity of the site. All residents were connected to the municipal supply in 1996 when the area was annexed to the Town of Waynesville. Also at that time, EPA tested a closed private well that was drilled in the bedrock aquifer in the direction of flow away from the site. Very low levels of chemicals not associated with the site were found.*** To protect current or future users of the groundwater moving away from the site:

- Continue to monitor the effectiveness of the natural process being employed for groundwater clean-up. Monitor for volatile and semi-volatile organic compounds.
- Re-implement metals analysis of the groundwater to protect current or future users.

Update: Effective with the February 2010 groundwater investigation EPA has re-implemented testing for metals along with organic compounds associated with the site as part of their continued groundwater monitoring efforts.

FOR MORE INFORMATION	If you have concerns about your health as it relates to this site you should contact your health care provider. You can also call the N.C. Division of Public Health at (919) 707-5900, or send an e-mail to nchace@dhhs.nc.gov, and ask for information on the Benfield Industries NPL Site Public Health Assessment.

PURPOSE AND HEALTH ISSUES

The Benfield Industries Site (EPA ID: NCD981026479) is located at 112 through 124 Riverbend Street in Waynesville, Haywood County, NC (Appendix A, Figure 1). Benfield Industries mixed and packaged bulk materials for resale from 1976 until fire destroyed the facility in 1982. In 1982 following the fire, the NC Department of Human Resources ordered Benfield Industries to remove all chemicals and debris from the site and cover the site with clean fill material. The NC Department of Natural Resources investigated contamination on the site in 1985. The site was placed on the National Priorities List (NPL, or “Superfund”) in 1989 and the Superfund was used to finance cleanup of the site. Clean-up operations on the site have been approved and monitored by the U.S. Environmental Protection Agency (EPA). During the Superfund process, soil and groundwater contamination with a variety of organic and metal substances was identified on the site. Soil cleanup began in 1997 and continued until 2000. Active groundwater cleanup began on site in 2001 and continued until 2007.

In 2003, the EPA conducted their initial 5-year review of site clean-up activities (EPA 2003), followed by a second 5-year review in 2008 (EPA 2008a). The Agency for Toxic Substances and Disease Registry (ATDSR) completed a Public Health Assessment (PHA) of the Benfield Industries Site in 1990 in response to the original Superfund listing (ATSDR 1990). In 2008 a second 5-year review was conducted by the U.S. Army Corps of Engineers (USACE). Their review found the site remediation efforts were protective of public health and recommended changing continued groundwater remediation efforts to a monitored natural attenuation process. That recommendation is currently being evaluated by EPA. Also in 2008, the EPA asked ATSDR to provide an updated PHA to coincide with the second 5-year site review and subsequent meetings to provide site status updates to the community. That request was passed on to the N.C. Department of Public Health (DPH) Health Assessment, Consultation, and Education Program (HACE) which operates under a cooperative agreement with ATSDR. This document presents the findings of the follow-up Public Health Assessment.

The objective of the PHA is to determine if the site presents a potential health hazard to the community. Concentrations of substances contaminating a site are compared to standard values in the soil, groundwater, surface water and air at a site. This comparison is used to determine if the substances may present a potential health hazard if persons come into contact with the contaminated medium. An important component of a PHA is the determination of a person’s potential to come into contact with any potentially harmful substances, how that contact may occur, and for how long that contact may have continued in the past, or may occur in the future. This information is used to determine whether past, current, or future contact with the substances may have, or may in the future, result in adverse health effects. Highly health protective methods are used throughout the PHA process. These health protective measures include considering the most sensitive negative health impacts that may be caused by contact with the chemicals associated with the site, as well as considering the maximum contact indicated by site information the community may have with the chemicals. Special concern is considered for portions of the community that may be particularly susceptible to adverse health effects associated with the chemicals of concern, such as children or the elderly.

For this Benfield Industries NPL Site PHA, DPH evaluated soil, groundwater, surface water and sediment data collected from 1990 through 2008. The information reviewed for the PHA was taken from reports and analytical data generated by EPA and their contractors.

In February 2010, an EPA contractor collected additional groundwater samples from 14 wells on and off the site to determine if the selected groundwater clean-up method would be effective in removing the contamination. DPH received the report (EPA 2010) for this investigation in May 2010, after the publication on February 18, 2010 of the PHA as the Public Comment Release draft ("the draft PHA") (PHA 2010). The information included in EPA's report for the February 2010 groundwater investigation addressed DPH's the concerns and recommendations identified in the draft PHA. DPH reviewed the information provided in EPA's February 2010 investigations and published a Letter Health Consultation (LHC) on October 5, 2010 (LHC 2010) that discussed DPH's evaluation of the health implications of that data and its impact on the concerns and recommendations identified in the draft PHA

A **Letter Health Consultation** published on October 5, 2010 (LHC 2010) discussed the February 2010 groundwater investigation and included DPH's evaluation of the health implications of that data and its impact on the concerns and recommendations identified in the draft PHA. In this document, the "Final PHA", we discuss those findings and their implications to our concerns and recommendations identified in the draft PHA.

BACKGROUND

SITE DESCRIPTION AND HISTORY

The Benfield Industries NPL Site is located at 112 through 124 Riverbend Street, in what is now Waynesville, Haywood County, NC. The original address was in Hazelwood, NC. Appendix A, Figure 1 shows the site location. The original site covered approximately 6 acres. Benfield Industries covered approximately 3.5 acres of the site and included two storage buildings, a brick work building with a concrete storage area, and above ground storage tanks. Benfield Industries mixed and packaged bulk chemicals for resale. Products handled by Benfield Industries included: paint thinners, solvents, sealants, cleaners, de-icing solutions and wood preservatives. Benfield Industries operated on the site from 1976 until 1982 when a fire destroyed the plant. Prior to Benfield Industries, from 1904 to 1961, the site was owned and operated by Unagasta Furniture Company. Unagasta manufactured wooden bed frames. Waynewood, Inc., a mattress manufacturer, also occupied the site for a portion of this time, before they went out of business in the 1950s. Guardian Investment operated from the site from 1961 until 1975, but little information exists regarding their activities. After the 1982 fire, the State ordered Benfield Industries to remove all chemicals and debris, and cover the site with clean fill material. This was completed in 1982, and included covering most of the site with 6 to 18 inches of clean fill material. In 1985, the NC Department of Natural Resources (DENR) Solid and Hazardous Waste Branch investigated the site. After the fire, the owner of Benfield Industries was not capable of financing the cleanup of the site, and in 1989 it was added to the "National Priorities List (NPL)", commonly referred to as "Superfund", to provide a means to finance site clean-up activities. In 2002, Haywood County sold the 6-acre property to Haywood Vocational Opportunities, Inc (HVO). HVO operated a vocational training center on the property adjacent to the site and in 2004 re-developed the Benfield Industries site for a manufacturing facility (EPA 2008b).

The current property deed includes perpetual land use restrictions recommended by N.C. DENR for the purpose of protecting public health and the environment. The deed restrictions prevent use of the property for residential purposes, prevent alteration or removal of existing soil and prevent disturbance of existing soil contours. The deed also restricts the use of any surface or groundwaters as drinking waters or for swimming (EPA 2008b).

Subsequent to adding the site to the NPL in 1989, the Agency for Toxic Substances and Disease Registry (ATSDR) published a Public Health Assessment (PHA) for the site in 1990. The PHA evaluated the potential for persons' health to be adversely effected by harmful substances on the site. ATSDR reviewed soil, water, and air samples collected in 1981, 1982, 1985 and 1986. On-site soils were contaminated with polynuclear aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs), two classes of organic chemicals of common use. PAHs and an herbicide were found in surface waters from Browning Branch in 1981 and 1982. Browning Branch is a stream adjacent to the west side of the Benfield Industries site, running from the south to the north-northwest. Stream samples collected in 1986 found only low levels of a single VOC in the sediment. No contaminants were found in on-site or off-site groundwaters. Air samples collected on-site were below levels of concern. No contaminants were detected in off-site air. Chlorine was detected in air samples collected during the 1982 fire. The ATSDR report indicated that the chlorine in the smoke may have resulted in temporary adverse health effects, including minor irritation to the eyes and respiratory tract. ATSDR also noted that PAH levels in some of the soils on-site could potentially result in skin irritation with direct contact, or prolonged inhalation exposure could result in more long-term effects. ATSDR recommended eliminating the potential for exposure to these soils. ATSDR indicated the site was not a public health concern because of the low potential for human exposure to the remaining contamination at the site. ATSDR's recommendations included surveys for buried drums or containers on the site and further delineation of the extent and type of on-site soil contamination. ATSDR also recommended further investigation of groundwater contamination associated with the site (ATSDR 1990).

Following addition of the site to the Superfund list in 1989, the U.S. Environmental Protection Agency (EPA) conducted additional studies to determine the type and extent of substances contaminating the site. Subsequently, plans were developed to further clean-up the site to prevent adverse impacts to humans or the environment resulting from contact with the potentially hazardous substances found in the soil and groundwater.

Beginning in 1992, additional soil, groundwater, surface water and sediment samples were collected. Release of site contaminants to the air was not considered likely and air samples were not collected. The EPA report indicated that no private wells using groundwater were located in the vicinity, or in the path of the groundwater flow traveling away from the site ("down gradient"). Three levels of groundwater ("aquifers") were identified in the area of the site, with the deepest of the three in bedrock. EPA reported the bedrock aquifer would most likely have been used as the source of groundwater for private drinking water wells in the area. Groundwater samples collected for the EPA study were taken from the upper two aquifers identified on the site. The EPA did not believe the deeper bedrock aquifer to be contaminated. No samples were collected from the bedrock aquifer to confirm it was not contaminated.

In 1997 the EPA and its contractors began activities on the site to clean-up and control exposures to the remaining contaminated soil and groundwater. Soil remediation was aimed at removing residual contamination in subsurface soils to prevent continued contamination of the groundwater.

Subsurface contaminated soil was excavated and treated on-site with naturally-occurring micro-organisms to break-down the contamination into harmless compounds. During treatment of the soil on-site, the air was monitored to prevent the release of potentially harmful vapors. No harmful vapors were detected during the treatment process. The treated soil was returned to the excavated areas on-site. Approximately 28,000 tons of soil were excavated, cleaned, and replaced on-site. Approximately 5,200 cubic yards of soils contaminated with pentachlorophenol (PCP) were excavated and disposed of in a landfill off-site because PCP is not effectively broken down by microorganisms. After cleaned soils were returned to the excavated areas the site was graded and re-seeded. Soil clean-up activities were completed in 2000. Figures 2 and 3 (Appendix A) are satellite views of the site in 1995 showing all structures have been removed from the site, and a 1998 view in which soil excavations are visible.

During soil excavation two unknown underground storage tanks (USTs) were encountered in the northwest corner of the site. Numerous holes were noted in the side of the tanks and they were filled with groundwater. Testing indicated the tanks had likely held fuel. The tanks were removed and disposed of off-site.

Groundwater clean-up commenced in 2001. Contaminated groundwater was extracted from the top two aquifers (above the bedrock aquifer) flowing through the site. The extracted groundwater was placed in holding tanks for later discharge and treatment through the Waynesville wastewater treatment plant. In 2007, the groundwater extraction system was shut down because contaminant concentrations were below clean-up levels in all but one on-site well, the system was not effectively capturing the flow of the groundwater, and as a result, the system was not cost effective. In conjunction with the U.S. Army Corps of Engineers second 5-year review completed in 2008, EPA is evaluating using the natural microbial processes in the groundwater environment to provide an environmentally and economically effective means to control off-site movement of the contaminants remaining in the groundwater (EPA 2008b).

EPA's 2003 review of the site noted the site was vacant, was "moderately" vegetated, with more dense vegetation noted along Browning Branch. The site was surrounded by a 6-foot chain-link fence (EPA 2003).

As part of EPA's on-going oversight of the Benfield Industries NPL site, there is continued monitoring of the groundwater. Groundwater samples have been collected from various on-site and off-site wells to monitor contaminant migration and concentrations since prior to ATSDR's 1990 PHA. Groundwater from sixteen wells on-site and in the groundwater flow path beyond the site perimeter have been periodically sampled and monitored for volatile organic compounds (VOCs), semi- volatile organic compounds (SVOCs) and metals (EPA 2008b).

In February 2010, an EPA contractor collected additional shallow aquifer groundwater samples from 7 wells on site and 7 wells off the site to determine if the selected groundwater clean-up method would be effective in removing the contamination. The sample collected furthest from the site, in the direction of groundwater flow, was from a closed private well 1900 feet northwest of the site. This closed private well was drilled into the lower bedrock aquifer, 405 feet below ground surface (EPA 2010).

CURRENT SITE CONDITIONS

Current conditions at the site are dominated by the Hazelwood Vocational Opportunities, Inc. (HVO) complex completed in 2004. HVO re-developed approximately 4 acres of the 6 acre site for a manufacturing facility; with the 4 acres now either under the building or three paved parking areas. During site re-development, additional clean soil was placed on top of the clean fill covering the site after the 1982 fire and the clean fill replaced on the site after soil remediation was completed in 2000. Two feet of clean soil was placed in the area where the HVO building was constructed, and up to 4 feet of clean fill was placed in the north parking area. The additional soil was added to raise the site above the 100-year flood plain. The HVO manufacturing building occupies most of the east side of the property. Approximately two acres remain as "green space" on the south end of the site. This area did not receive additional fill material during HVO development. A storm water retention pond was constructed on the west side of the property to collect rain run-off from the building and parking areas.

The site is fenced and has limited access to the public. A 6-foot chain-link security fence topped by barbed wire surrounds most of the site, including the HVO building and two paved parking areas. The parking areas inside the fenced area include a paved bermed parking area on the west side of the building and a paved semi-truck loading dock on the north side of the building at the truck bays. Locked security gates control access to the fenced areas.

A grass covered area and a paved public parking lot dominates the southern area of the site. This area is not enclosed by the security fence. Access to the public parking lot is controlled by a security gate that remains open during business hours. The grass area is landscaped and connects with Browning Branch. Browning Branch runs adjacent to the west side of the site, flowing to the north-northwest. Browning Branch is a shallow flowing stream approximately 12-20 feet wide in the area of the site.

The site is surrounded by light industrial, commercial, and residential areas. A house and antique shop are located just beyond the north perimeter of the site. Single family dwellings dominate the east side of Riverbend Street, opposite the HVO facility, and the area immediately south of the site. To the west of the site is another HVO building and other industrial operations. Along Hazelwood Street north, northeast and northwest of the site are commercial operations. Light commercial operations are also located along Hazelwood Street west of the site. Single family dwellings and commercial operations dominate the area in the down gradient groundwater direction from the site (north-northwest of Hazelwood Street).

Appendix A includes historical and current satellite views of the site, as well as pictures of the residential, commercial and industrial areas adjacent to the site.

DEMOGRAPHICS

According to Census 2000 figures, 3,361 persons live within one mile of the site. Approximately 93% of the population is White, 6% African-American, 1% Hispanic and 1% American Indian. Approximately 5% of the population is children 5 years old or less, and 21% is 17 years old or younger. The poverty level is 12% which is similar to the state and nation. Ten percent (10%) of the population has less than 9th grade education. There are approximately 1,657 housing units in the area. The percentage of renter occupied housing units is 34% (EnviroMapper). Additional demographics detail for the community surrounding the site is provided in Appendix B.

SITE GEOLOGY AND HYDROGEOLOGY

During site clean-up activities 6 to 18 inches of clean fill soil were placed over much of the site. The fill soil type was identified as clayey-silt and silty soil. This material included native site soils that had gone through microbial remediation to reduce or eliminate the concentration of organic contaminants. During redevelopment of the site by Haywood Vocational Opportunities, Inc. (HVO), an additional 2 to 4 feet of clean fill was added to the area under the HVO building and the north parking area. This area includes approximately 4 acres of the 6 acre site.

Three native geologic layers existed on-site prior to the addition of fill material. The top layer is 10-15 feet thick “alluvial” soils. Alluvial soils are deposited by running water and are typically made-up of silts, clays, sand and gravel. Site information indicates this layer allows for relatively rapid movement of water. The next deeper layer is identified as “saprolite”, and runs from 25 to 30 feet thick. Saprolite is soft, typically clay-rich weathered rock. Water moves through saprolite more slowly than through alluvial soils. Beneath the saprolite layer is fractured coarse-grained metamorphic bedrock. The bedrock layer runs approximately 30 to 52 feet below the surface.

The groundwater table on-site ranges from 3.9 to 9.2 feet below ground surface (bgs). Groundwater flows under the site from the south to the north. Browning Branch, which runs from along the west side of the site, also flows from south to north (EPA 2008, EPA 2003).

SITE VISIT

HACE staff visited the site on September 28, 2009, and completed a walking tour of the former Benfield Industries NPL site. Haywood County Environmental Health Department staff and Haywood Vocational Opportunities (HVO) staff accompanied HACE on the site tour. The site appears to represent a model for remediation and re-development of NPL sites that benefit the local community. The only indication of the previous activities related to the Benfield Industries NPL site are the secured monitoring wells visible at several locations on the site. No odors or stressed vegetation were noted. There is no indication of stress to Browning Creek related to the former NPL site or remediation activities. Pictures of the HVO property and surrounding community taken during the site visit are provided in Appendix A.

DISCUSSION

The ATSDR Health Effects Evaluation Process

This section provides a summary of the ATSDR health effects evaluation process. A more detailed discussion is provided in Appendix C.

The ATSDR health effects evaluation process consists of two steps: a screening analysis of environmental monitoring data and evaluation of how the community may come into contact with the identified substances (the exposure pathway analysis). At some sites, based on the results of the screening analysis and community health concerns, a more in-depth analysis to determine possible public health implications of site-specific exposure estimates is undertaken.

The two step screening analysis process provides a consistent means to identify site contaminants that need to be evaluated more closely through the use of "comparison values" (CVs). The first step of the screening analysis is the "environmental guideline comparison" which involves comparing site contaminant concentrations to water, soil, air, or food chain comparison values derived by ATSDR from standard exposure default values. The highest concentration of a chemical found for each sample set is compared to CVs to provide a highly health protective "worst-case" exposure estimate. The average concentration for chemicals found in multiple samples is also compared to CVs to provide an average exposure estimate. The second step is the health guideline comparison and involves looking more closely at site-specific exposure conditions, estimating exposure doses, and comparing the dose estimate to dose-based health-effect comparison values.

ATSDR's comparison values are set at levels that are highly health protective and well below levels known or anticipated to result in adverse health effects. When chemicals are found on a site at concentrations greater than the screening values (CVs) it does not necessarily indicate that adverse health effects would be expected. Contaminant concentrations at or below the CV may reasonably be considered safe.

After completing a screening analysis, site contaminants are divided into two categories. Those not exceeding CVs do not require further analysis. Contaminants exceeding CVs are selected for a more in-depth site-specific analysis to evaluate the likelihood of possible harmful health effects. Contaminant concentrations exceeding the appropriate CVs are further evaluated against ATSDR health guidelines (HGs). Health guidelines represent daily human exposure levels to a substance that is likely to be without appreciable risk of adverse health effects during specific exposure duration. To determine exposure dose, N.C. DPH uses standard assumptions about typical body weights, ingestion or inhalation rates, and duration of exposure. Important factors in determining the potential for adverse health effects include the concentration of the chemical, the duration of exposure, the route of exposure, and the health status of those exposed. Site contaminant concentrations and site-specific exposure conditions are used to calculate highly health protective estimates of site-specific exposure doses for children and adults. These values are then compared to ATSDR health guideline values (HGs). An exposure dose is an estimate of the amount of a substance a person may come into contact with in the environment during a specific time period, expressed relative to their weight.

Exposure dose estimates are also compared to data collected in animal and human health effect studies for the chemicals of concern. The health study data is generally taken from ATSDR or EPA references that summarize data from studies that have undergone extensive validation review. Comparisons are made on the basis of the exposure route (ingestion/eating, inhalation/breathing, or dermal/skin contact) and the length of the exposure. Preference is given to human study data and chemical doses or concentrations where no adverse health effects were observed. If human data or adverse effect data is not available, animal data or the lowest chemical dose where adverse health effects were observed, may be used.

There are limitations inherent to the public health assessment process. These include the limitations of the analytical data available for a site, the health effect study information, and the risk estimation process. To overcome some of these limitations, highly health protective (i.e., "worst-case") exposure assumptions are used to evaluate site data and interpret the potential for adverse health effects. ATSDR screening values (CVs) and health guideline values (HGs) incorporate large margins-of-safety to protect groups of the exposed population that may be particularly sensitive, such as children, the elderly, or persons with impaired immune responses. Exposure concentrations are calculated using the highest concentration of a chemical found in the water, soil or air on the site. Large margins-of-safety are also employed when comparing exposure concentrations to health effect study data. The assumptions, interpretations, and recommendations made throughout this public health assessment err in the direction of protecting public health.

Review of Site Environmental Data

N.C. DPH reviewed all analytical data generated since the initial ATSDR Public Health Assessment published in 1990, through samples collected in 2008.

Surface Soils: N.C. DPH considers soils of concern for human exposure those from the ground surface to 6 inches below ground surface ("bgs"). Contaminated site soils were excavated and disposed of off-site or remediated and returned to the site as clean back-fill. Most of the site was covered by an additional layer of clean fill soil, paved, or covered by the HVO building. Remaining areas of the site are covered by grass or the storm water retention pond. The layers of clean fill material added ranged from 2 to 6 feet deep. No surface soil data has been collected since completion of the on-site soil remediation activities as contaminated soils are no longer present at the surface. The property deed restriction requires prior approval from N.C. DENR to dig more than 1 foot bgs and limits alteration of the surface soil, thus on-site activities that would expose people to soil contaminants are restricted. Access to the site is limited by a fence. As a result of these conditions, the site surface soil does not present an exposure hazard (EPA 2008, EPA 2003).

Groundwater: The groundwater was actively remediated from 2001 until 2007, and is currently being remediated through natural contaminant break-down processes in the sub-surface. In 1992, EPA identified there were no private wells in the vicinity of the site or in the flow path of the contaminated groundwater. EPA also stated there was no public water system intake well in the vicinity of the site (EPA 2008b). ATSDR's 1990 PHA identified the closest private wells were 1,900 feet beyond the northern perimeter of the site. The PHA noted these two wells were in the deeper bedrock aquifer (an aquifer is an underground layer of water that may serve as a source of drinking water) that EPA believed to not be contaminated (ATSDR 1990, EPA 2008). In 1992, contaminated shallow groundwater was found to have migrated approximately 550 feet down gradient (north) of the property boundary.

Groundwater in the two shallowest aquifers has been monitored from on-site wells and two down gradient wells since the early 1990s and will continue to be monitored as part of the natural remediation process. DPH reviewed this data to determine if there are concerns with using groundwater flowing away from the site as a potential future drinking water source. No VOC or SVOC contaminants were detected in a 2008 sample of groundwater collected from the monitoring well located the farthest down gradient and off site (MW09). Environmental sampling locations associated with the site are identified in Appendix A, Figure 5.

Groundwater data collected since 1990 from the monitoring wells located directly north (down gradient) of the site (MW08) were also evaluated. Metals data has not been collected since 2003. Maximum or average concentrations for three metals exceeded ATSDR screening values, including chromium, manganese, and barium. Chromium was reported as total chromium and exceeded screening values for the more toxic form of chromium, hexavalent chromium. One detected organic compound, carbazole, did not have an ATSDR screening value and was compared to a Florida and EPA drinking water guidance levels, both of which it exceeded. The single carbazole detection was in 1994. Carbazole is used in the manufacture of insecticides, dyes, lubricants, rubber antioxidants, and as an odor inhibitor in detergents (Micromedex 2009). No detected volatile or semi-volatile organic compounds exceeded comparison values (CVs) in the period from 2003 through 2008 in either MW08 or MW05, located on the northern edge of the site and in the direction of the groundwater flow. The groundwater data exceeding ATSDR screening values is summarized in Appendix C, Table 3.

The property deed restricts using on-site groundwater (or surface water) as a source of drinking water, or for purposes that would result in direct human contact, such as swimming. The State of N.C. has classified the groundwater aquifer that flows under the site as a potable water source (suitable for drinking water). There are no known private well users within the vicinity of the plume down gradient from the site (EPA 2008b), and this was confirmed in 2010 (LHC 2010).

In February 2010 shallow aquifer groundwaters and a water sample from a closed private well in the deeper bedrock aquifer were analyzed for VOCs, SVOCs and metals. These samples were collected after the publication of the draft PHA (PHA 2010) and the health evaluation was discussed in the Letter Health Consultation published in October 2010 (LHC 2010). The only site-associated contaminants found at concentrations exceeding health screening values were in groundwaters collected on the site and where people can not come into contact with these groundwaters.

Private Well Water*:* In 1992 EPA indicated no private wells were in use as drinking water sources in the vicinity or down gradient of groundwater flow from the site, and that any known wells were accessing the deeper bedrock aquifer. The Town of Hazelwood uses groundwater for its municipal water supply. The well is 1.5 miles west of the site, not down gradient from the Benfield Industries NPL site. Waynesville's drinking water source is the Allen Creek Reservoir, located 4 miles south and up gradient of the site. In ATSDR's 1990 PHA, it was identified that the 2 closest private wells were cased in bedrock and were approximately 1,900 feet north-northwest of the site. There is no indication that contaminated groundwater from the site is being used as a source of drinking water.

In 2010 EPA collected a groundwater sample from the deeper bedrock aquifer, which it considered the most likely source of private well drinking water in the area. The sample was collected from a closed private well 1900 feet northwest of the site, in the direction of groundwater flow. Detected compounds were at concentrations less than health screening values and were not associated with the Benfield Industries NPL site. There are no private wells in the area of the site and the property deed restricts using on-site groundwater as a source of drinking water or for purposes that would result in direct human contact, such as swimming.

Vapor Intrusion: The site was not occupied from 1982 through construction of the HVO building in 2004. The HVO building is a slab construction, sits atop at least 2 feet of clean fill soil, and uses the municipal water supply. Vapor intrusion is not a relevant exposure concern for the HVO building. The highest detected groundwater VOC concentration in the off-site monitoring wells (MW08) just north of the site was 2 micro-grams per liter (µg/L or parts per billion, "ppb"). Vapor intrusion is not an exposure concern for the Benfield Industries NPL site.

Ambient Air: No air monitoring has been performed at the site. There is no potential source of air contamination since the surface soils have been remediated and the site was covered with clean fill soils. Groundwater does not present an air contamination source since it is not being used for commercial or residential purposes. The deed restrictions prevent digging on the site or using the groundwater.

Surface Water and Sediment: The only surface water on site is the storm water collection basin. Browning Branch flows from south to north-northwest, off-site, along the west side of the property. Surface water and sediment samples were collected by EPA in their initial investigation after NPL-listing of the site (around 1990-92). Substances detected in sediments collected next to and down gradient of the site were also detected up gradient, and were not attributed to the site. There were no detections noted in the surface water.

Surface water and sediment samples were collected in Browning Branch in 2002. No VOCs or SVOCs were detected in the surface water, and concentrations of metals detected on-site were similar to those detected up gradient. One VOC (toluene) and 11 PAHs were detected in sediments collected to the west of the site. Toluene was not detected up-gradient of the site, but minimum reporting levels up gradient were higher than the concentration identified adjacent to the site. The concentration of toluene found in the sediment sample adjacent to the site (2 µg/L, estimated) was less than the ATSDR screening value. All PAH concentrations from the sample adjacent to the site were at concentrations similar to those observed in sediments up gradient of the site, and were not considered attributable to the site. A number of metals were detected in the 2002 sediment samples, as would be expected for any sediment. The average concentrations for all site sediment metals were less than twice the concentration of the up gradient sample collected for background comparison, indicating they are within expected background concentrations. Surface water and sediment data collected in 2002 for Browning Branch does not indicate that it has been impacted by the site.

Exposure Pathway Analysis

An exposure to a chemical requires persons come into contact with the chemical through:

- ingestion (eating the chemical),
- inhalation (breathing the chemical), or
- absorbing the chemical through the skin (dermal exposure)

Having contact with a chemical does not necessarily result in adverse (harmful) health effects. A chemical's ability to result in adverse health effects are influenced by a number of factors in the exposure situation, including:

- how much of the chemical a person is exposed to (the dose)
- how long a time period a person is exposed to the chemical (the duration)
- how often the person is exposed (the frequency)
- the amount and type of damage the chemical can cause in the body (the toxicity of the chemical)

To result in adverse health effects, the chemical must be present at concentrations high enough and for long enough to cause harm. Exposures at concentrations or time periods less than these levels do not cause adverse health effects. Knowing or estimating the frequency with which people have contact with hazardous substances is essential to assessing the public health importance of contaminants.

Responses of persons to potentially harmful substances may vary with the individual or particular groups of individuals, such as children, the elderly, or persons with weakened immune responses, or other chronic health issues. These susceptible populations may have different or enhanced responses as compared to most persons exposed at the same concentration to a particular chemical in the environment. Reasons for these differences may include:

- genetic makeup
- age
- health status
- nutritional status
- exposure to other toxic substances (like cigarette smoke or alcohol).

These factors may limit that persons' ability to detoxify or eliminate the harmful chemicals from their body, or may increase the effects of damage to their organs or physiological systems. Child-specific exposure situations and susceptibilities are also considered in DPH health evaluations.

The exposure pathway (how people may come into contact with substances contaminating their environment) is evaluated to determine if people have come into contact with site contaminants, or if they may in the future. A completed exposure pathway is one that contains the following elements:

- a **source** of chemical of concern (contamination), such as a hazardous waste site or contaminated industrial site,
- movement **(transport)** of the contaminant through **environmental media** such as air, water, or soil,
- an **point of exposure** where people come in contact with a contaminated medium, such as drinking water, soil in a garden, or in the air,
- a **route of exposure**, or how people come into contact with the chemical, such as drinking contaminated well water, eating contaminated soil on homegrown vegetables, or inhaling contaminated air, and
- an **exposed population (**persons that can come into contact with the contaminants)

The elements of an exposure pathway may change over time, so the time frame of potential exposure (contact) is also considered. Exposure may have happened in the past, may be taking place at the present time, or may occur in the future. A **completed pathway** is one in which all five pathway components exist in the selected time frame (the past, present, or future). If one of the five elements is not present, but could be at some point, the exposure is considered a **potential exposure pathway**. The length of the exposure period, the concentration of the contaminants at the time of exposure, and the route of exposure (skin contact, ingestion, and inhalation), are all critical elements considered in defining a particular exposure event. If one of the five elements is not present and will not occur in the future it is considered an **eliminated exposure pathway**.

The population of concern for the Benfield Industries NPL site is people living near the site or persons visiting the site on a frequent basis, such as HVO facility staff. The environmental media and exposure routes investigated for the site and the resulting pathway analysis are summarized in the Table 1 below.

Summary of Environmental Exposure Potential at the Site

N.C. DPH reviewed site conditions and environmental media analytical data generated by U.S.EPA relevant to the Benfield Industries NPL site since the previous ATSDR Public Health Assessment was published in 1990. This information indicates that contaminants at one time present, or those remaining, on the site do not present a health hazard to persons visiting or living near the site. For a health hazard to exist there must be the potential for persons to come into contact with the hazardous substances present on the site. Through soil and groundwater remediation efforts, deed restrictions placed on the possible uses and activities at the site, and site re-development activities, the potential for persons to contact hazardous substances does not exist. As there has not been confirmation since 1992 that there are no private wells in the flow path of the groundwater coming off the site, N.C. DPH has identified the potential for persons to be exposed off-site to contaminated groundwater.

Table 1. Summary of Benfield Industries NPL site evaluated exposure pathways and pathway status.

Source	Environmental Transport and media	Exposure point	Exposure Route	Exposed population	Time Frame	Pathway status
Benfield Industries NPL site	Surface soil	Surface soil	Eating, Breathing, Touching	People visiting the site	1990 to Current Current Future	Eliminated Eliminated Eliminated
Benfield Industries NPL site	Groundwater	Private wells	Eating, Breathing, Touching	People living near or frequently visiting the site	1990 to Current Current Future	Potential Potential Potential
Benfield Industries NPL site	Surface water and Sediment	Browning Branch	Eating, Touching	People living near or frequently visiting the site	1990 to Current Current Future	Eliminated Eliminated Eliminated
Benfield Industries NPL site	Air	Ambient air	Breathing	People living near or frequently visiting the site	1990 to Current Current Future	Eliminated Eliminated Eliminated
Benfield Industries NPL site	Vapor intrusion from groundwater	Indoor air	Breathing	People living near or frequently visiting the site	1990 to Current Current Future	Eliminated Eliminated Eliminated

COMMUNITY HEALTH CONCERNS

The ATSDR Public Health Assessment published in 1990 identified community concerns expressed in 1980 (prior to the fire) related to “vapors” migrating from the Benfield Industries plant. In 1981, the state investigated this concern and did not find any indication of vapors migrating from the site. In 1982, concern was expressed about materials left on-site after the fire and before site clean-up. EPA noted there was considerable community interest in the site prior to site clean-up, but does not identify the specifics of those concerns. The 1990 PHA indicated there were no community health concerns expressed after 1982, the year of the fire.

EPA’s 5-Year Review published in 2008 noted there had been little community interest in the site since the clean-up activities, and there had been no complaints according to City Officials. Overall the community seemed to be pleased that the site had been re-developed and was being used by HVO to provide jobs for persons with disabilities. EPA did reference that some in the community felt there were some “unanswered questions”, but did not elaborate on this statement.

Contact with the Haywood County Health Department and Environmental Health Department in September 2009 indicated there had been no concerns voiced by the community about the site in recent years. No issues or complaints by Haywood Vocational Opportunities (HVO) occupants or staff were noted by the HVO Health and Safety Officer during the HACE team site visit.

CHILD HEALTH CONSIDERATIONS

The ATSDR recognizes there are unique exposure risks concerning children that do not apply to adults. Children are at a greater risk than are adults to certain kinds of exposures to hazardous substances. Because they play outdoors and because they often carry food into contaminated areas, children are more likely to be exposed to contaminants in the environment. Children are shorter than adults and as a result, they are more likely to breathe more dust, soil, and heavy vapors that accumulate near the ground. They are also smaller, resulting in higher doses of chemical exposure per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Probably most important, however, is that children depend on adults for risk identification and risk management, housing, and access to medical care. Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly. Child-specific exposure situations and health effects are taken into account in N.C. DPH health effect evaluations.

CONCLUSIONS

N.C. DPH reviewed site conditions and environmental data reported by U.S.EPA for the Benfield Industries NPL site since ATSDR's 1990 Public Health Assessment. N.C. DPH reached two important conclusions.

- **Chemicals in surface soil and groundwater within the boundaries of the former Benfield Industries NPL site are not at levels that will harm people's health.**
- **N.C. DPH can not currently conclude whether drinking groundwater contaminated by chemicals traveling away from the former Benfield Industries NPL site are at high enough levels to harm people's health.**

Update: EPA's February 2010 investigation confirms that there are no private wells in use in the path of the contamination. As a result, it can be concluded, with the additional information, that people's health can not be adversely affected by the groundwater because it is not being used as a drinking water source.

Site soil and groundwater clean-up activities, site re-development measures, and property deed restrictions that limit the use of groundwater and soil disturbances on the site, have effectively eliminated the potential for persons to be exposed to any remaining site contaminants. The potential to come into contact with contaminated surface soils or groundwater has been eliminated on the site. Concentrations of metals greater than health guidelines were detected in the shallow groundwater samples collected through 2003, but no metals analyses have been done since that time. The deeper bedrock aquifer that is thought to likely serve as the source of private well water in the area was evaluated analytically in 2010. EPA verified in 2010 that no private wells exist down gradient from the site.

RECOMMENDATIONS

The N.C. DPH makes the following recommendations:

- Evaluate the need to verify that the bedrock aquifer that has been identified as the most likely source of private drinking water wells in the area has not been impacted by site contaminants. Verify that no private wells immediately down gradient or in the vicinity of the site are being used as a source of drinking water. If any are located, test the wells for volatile and semi-volatile organic compounds, and metals using EPA-approved analytical methods. If concentrations of contaminants are found exceeding drinking water regulatory standards or health guideline values immediately provide an alternative drinking water source.

Update: EPA verified in 2010 there are no private wells in the vicinity of the site and that the bedrock aquifer down gradient of the site does not contain chemicals at concentrations grater that health screening values.

- Continue to monitor the effectiveness of the natural microbial process to reduce the concentration of groundwater contaminants under and down gradient of the site. Include volatile and semi-volatile organic compound analytical scans.
- Re-institute metals analysis of the groundwater. Several metals exceeding health screening values were detected in off-site ground waters prior to 2003 when metals analyses were stopped.

Update: EPA contractors monitored the groundwater in 2010 and will continue to monitor the groundwater annually. Metals analysis has been included in the analytical plan since 2010.

PUBLIC HEALTH ACTION PLAN

The purpose of the Public Health Action Plan (PHAP) is to ensure that this Public Health Assessment provides a plan of action designed to mitigate or prevent potential adverse health effects.

A. Public Health Actions Completed

- N.C. DPH has evaluated site information, environmental media analytical data, and health effects information to determine the potential for the health of the local community to be adversely impacted by substances identified on the Benfield Industries NPL site.
- A draft copy of N.C. DPH's Public Health Assessment (PHA) was made available to U.S. EPA, N.C. DENR, and Haywood County officials. DPH reviewed the comments and made the appropriate modifications to the document which were reflected in the PHA *Public Comment Release* draft version published February 18, 2010.
- The PHA *Public Comment Release* draft version published February 18, 2010 was made available on the ATSDR and N.C. DPH HACE program web sites. Print copies were also available from ATSDR. A print copy of the PHA was placed at Haywood County Community Library in Waynesville.

- On October 5, 2010 N.C. DPH’s Letter Health Consultation (LHC) evaluating the additional site groundwater data collected by U.S. EPA contractors was published. The report was titled “*Health evaluation of groundwater samples collected in February 2010 by U.S. EPA contractors at the former Benfield Industries NPL site (EPA ID: NCD981026479), Waynesville, Haywood County NC. October 5, 2010”*.
- The October 2010 LHC was made available on the ATSDR and HACE program web sites. An announcement of the availability of the document was provided to the local newspaper, local schools and churches, and Haywood County and Town of Waynesville officials.
- On December 2, 2010 an opportunity was provided for community members to meet with HACE staff to discuss site activities and the DPH health evaluations. The meeting was held at the Haywood Vocational Opportunities facility on the site. An announcement of the meeting was provided to the local newspaper, local schools and churches, and Haywood County and Town of Waynesville officials. The Haywood County Environmental Health Director was also present to meet with community members.
- A Benfield Industries PHA and LHC update summary factsheet was prepared by HACE and is available on the HACE web site. Availability of the document was provided to the local newspaper, local schools and churches, and Haywood County and Town of Waynesville officials.
- N.C. DPH has provided contact information to agencies, organizations, and the public desiring additional inquiries about the site, the PHAs or the LHC.

B. Public Health Actions Planned

- The final PHA will be available on the ATSDR and HACE web sites. Print copies can be requested through ATSDR. A copy will be available at the Haywood County Community Library.
- HACE staff will attend site status update meetings provided by U.S. EPA for the community. HACE will be available to provide an overview of the findings of the PHA and LHC and respond to the community’s questions and concerns..
- N.C. DPH will continue to monitor health-relevant data generated by Federal, State, or County agencies, or other groups, regarding this site.

CONTACT INFORMATION

Contact information for additional inquiries regarding the Benfield Industries NPL Site Public Health Assessment:

Web links:

N.C. DPH HACE: www.epi.state.nc.us/epi/oee/hace/reports.html

ATSDR access to the Benfield Industries NPL Site Public Health Assessment:
www.atsdr.cdc.gov/HAC/PHA/index.asp

HACE e-mail address: nchace@dhhs.nc.gov

HACE telephone number: (919) 707-5900
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CERTIFICATION

This Public Health Assessment for the Benfield Industries NPL Site (EPA ID: NCD981026479) was prepared by the North Carolina Division of Public Health (N.C. DHHS) under a cooperative agreement with the Federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consult and update was initiated. Editorial review was completed by the cooperative agreement partner.

Jennifer A Freed

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

Alan Yarbrough
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Appendix A

Figures

Figure 1. Location of Benfield Industries NPL site, Waynesville, NC (EPA 2008b).

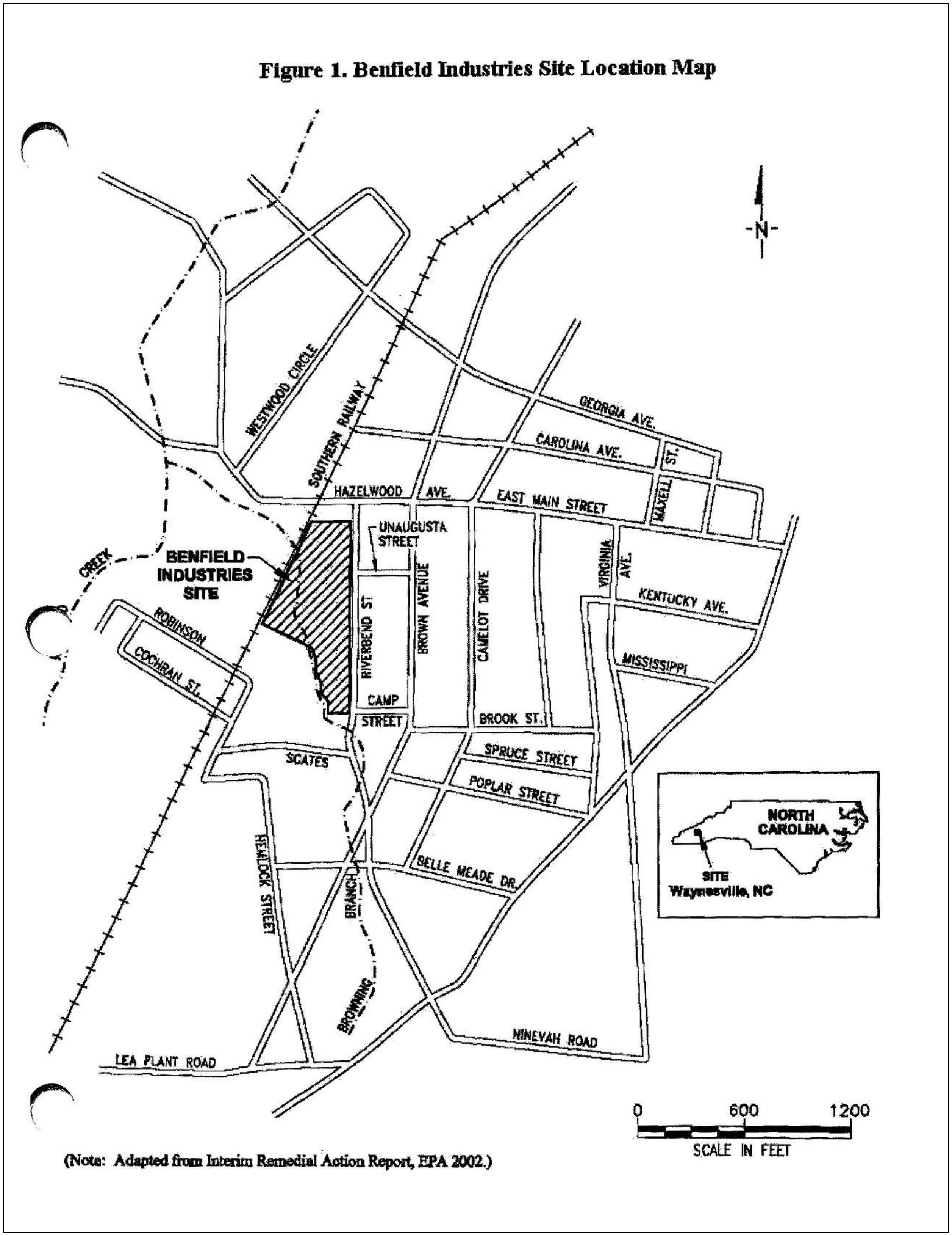


Figure 2. Satellite view of the Benfield Industries NPL site in 1995 prior to soil remediation activities (Google Earth).

Figure 3. Satellite view of the Benfield Industries NPL site in 1998 during soil remediation activities (Google Earth).

Figure 4. 2009 satellite view of the Benfield Industries NPL site showing the Hazelwood Vocational Opportunities facility re-development of the site (Google Earth).

Figure 5. Benfield Industries NPL site map indicating original sample locations (EPA 2008b).

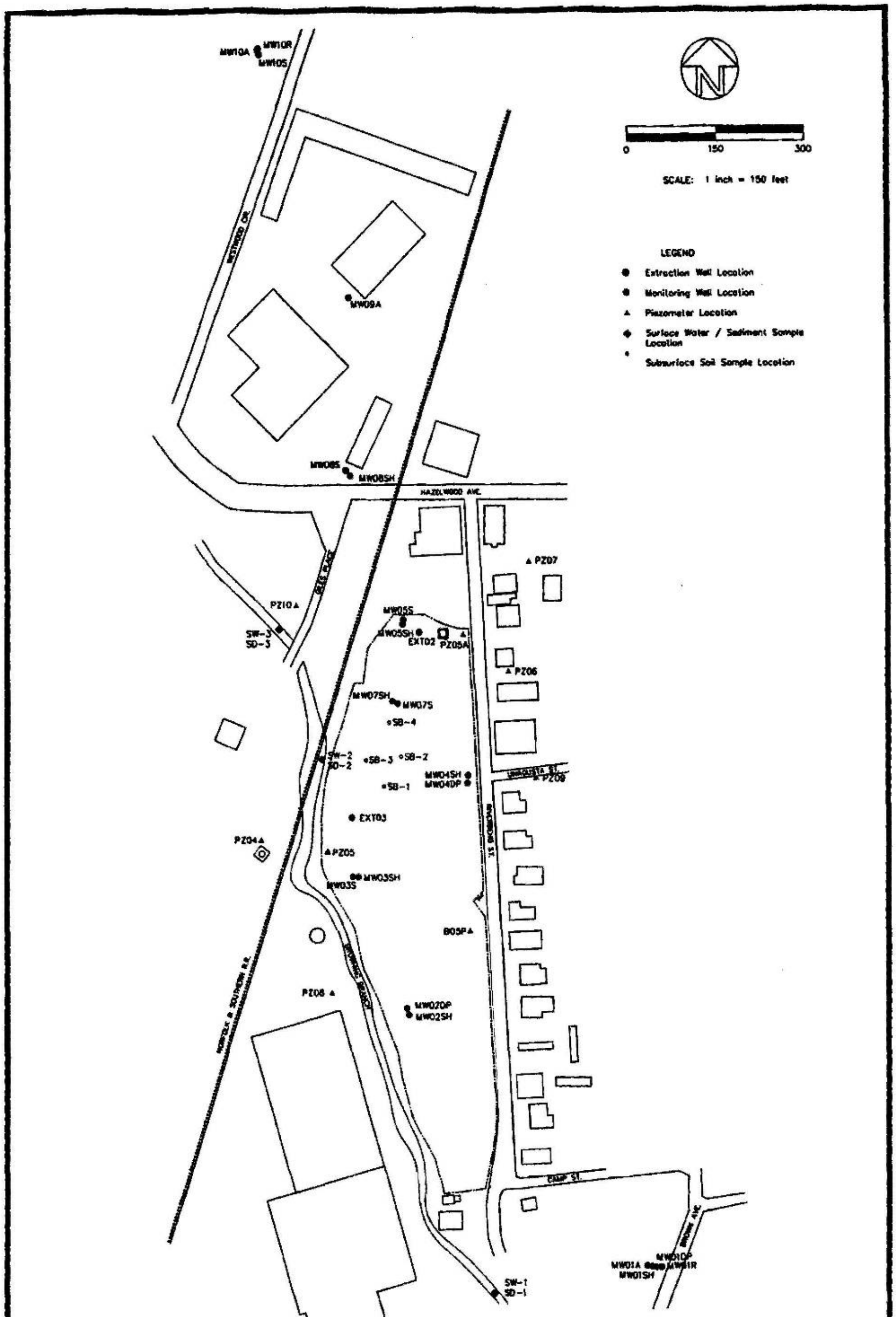


Figure 9
Surface Water, Sediment and Subsurface Soil Sample Locations
Benfield Industries Site - Waynesville, NC

(adapted from the 1st. Five Year Review Report Benfield Industries Site, June 2003)

Figure 6. Benfield Industries NPL site, September 2009. From south end of site facing north toward Haywood Vocational Opportunities (HVO) building. View of grass covered area and public access parking area south of HVO building, outside of security fence.

Figure 7. Benfield Industries NPL site, September 2009. South limit of Benfield Industries NPL site. View of Browning Branch flowing north-northwest along west side of site.

Figure 8. Benfield Industries NPL site, September 2009. View of security fence surrounding north and west portions of HVO facility. View of secured gate on southwest corner of HVO building, facing northwest.

Figure 9. Benfield Industries NPL site, September 2009. View facing north-northwest inside HVO secured area. View of storm water collection pond, security fence and 2 monitoring wells.

Figure 10. Benfield Industries NPL site, September 2009. Looking northwest across Norfolk and Southern Railroad tracks from near the northwest corner of the storm water retention pond inside the HVO security fence.

Figure 11. Benfield Industries NPL site, September 2009. North perimeter of Benfield Industries NPL site. View of security fence and commercial building beyond north side of site. Monitoring wells are visible in the foreground.

Figure 12. Benfield Industries NPL site, September 2009. Security fence along Riverbend Street, facing west toward truck bays and paved areas on north end of HVO building.

Figure 13. Benfield Industries NPL site, September 2009. Facing south down Riverbend Street from north end of HVO building on the right (west). Residential areas are on the left (east)

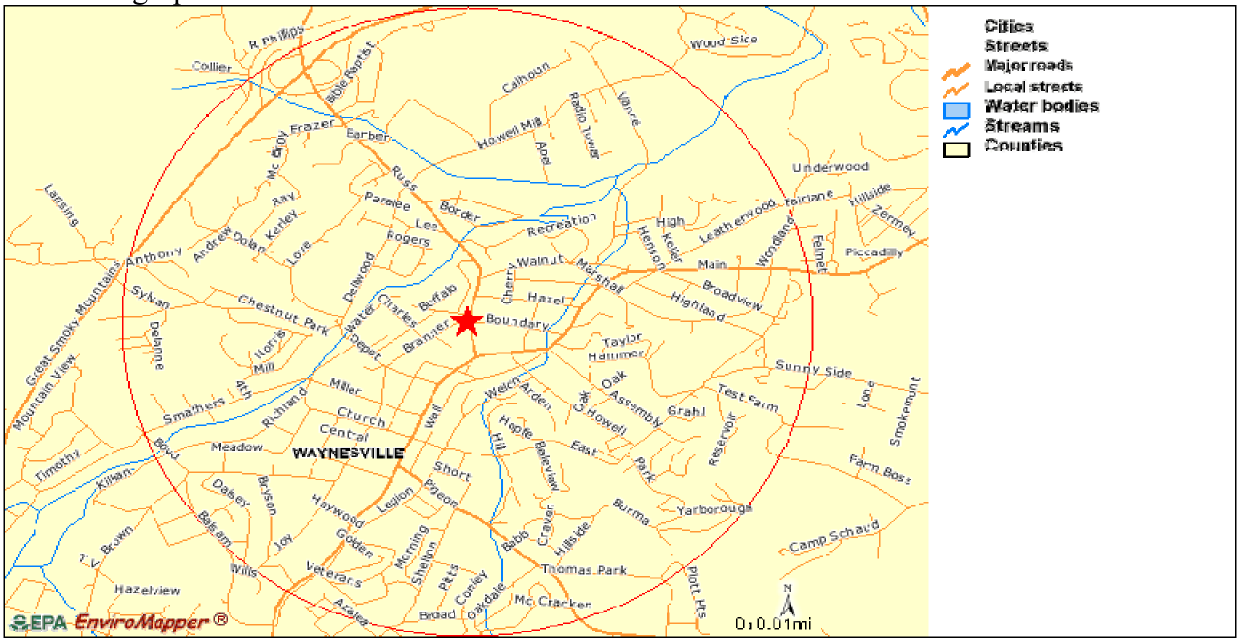
Figure 14. Benfield Industries NPL site, September 2009. View of homes on east side of Riverbend Street across from HVO (facing north).

Figure 15. Benfield Industries NPL site, September 2009. View of homes on east side of Riverbend Street across from HVO (facing south).

Appendix B

Demographics Data

Site demographics for the 1-mile radius around the Benfield Industries NPL site.



Demographics figures for the 1-mile radius around the
Benfield Industries NPL site.

	Benfield Site	North Carolina	U.S.
Total population	3361	20,6330	281,421,906
Percent Minority	8		
Ethnicity			
White	93%	72%	75%
African-American	6%	22%	12%
Hispanics	1%	5%	13%
Asians	0%	1%	4%
American Indians	1%	1%	1%
Poverty Level	12%	12%	12%
High school diploma or higher	74%	77%	80%
Less than 9th grade	10%		

Reference:

EnviroMapper. U.S.EPA. http://www.epa.gov/emefdata/em4ef.home

Appendix C

Tables

Table 2. Summary of contaminants exceeding ATSDR comparison values identified in off-site groundwater monitoring well MW08 since 1990 for the Benfield Industries NPL site (EPA 2008b).

Contaminant	Frequency of Detection	Range of Detections (µg/L)	No. of Detections Greater than CV	Comparison Values (CV), (µg/L)	Type of CV
Manganese	5/5	310 to 2,200	4	Child 500 Adult 2,000 300	RMEG RMEG LTHA
Total Chromium	3/6	5.3 to 250	0, as Trivalent Chromium[a] 2, As Hexavalent Chromium[b]	as Trivalent Chromium: Child 20,000 Adult 50,000 as Hexavalent Chromium: Child 10 Adult 40	RMEG RMEG Chronic EMEG Chronic EMEG
Barium	6/6	82 to 2,500	1	Child 2,000 Adult 7,000 2,000	Chronic EMEG Chronic EMEG MCL
Carbazole	1/15	27	1	No ATSDR CVs 7.5 3.4	FLA DW EPA tap water CA SL

Notes: µg/L = micro-grams per liter
CV = ATSDR comparison value
RMEG = Reference Dose Media Evaluation Guide, ATSDR (see Appendix D)
LTHA = Lifetime Health Advisory for drinking water, EPA (see Appendix D)
EMEG = Environmental Media Evaluation Guide, ATSDR (see Appendix D)
MCL = Maximum Contaminant Level for drinking water, EPA (see Appendix D)
FLA DW = Florida drinking water level
EPA tap water CA SL = EPA tap water cancer screening level
[a] Trivalent Chromium is the less hazardous form of Total Chromium
[b] Hexavalent Chromium is the more hazardous form of Total Chromium

Appendix D

The ATSDR Health Effects Evaluation Process

The ATSDR Health Effects Evaluation Process

The ATSDR health effects evaluation process consists of two steps: a screening analysis, and at some sites, based on the results of the screening analysis and community health concerns, a more in-depth analysis to determine possible public health implications of site-specific exposure estimates.

In evaluating data, ATSDR uses comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific medium (soil, water, or air) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, water and soil that someone may inhale or ingest each day.

The two step screening analysis process provides a consistent means to identify site contaminants that need to be evaluated more closely through the use of "comparison values" (CVs). The first step of the screening analysis is the "environmental guideline comparison" which involves comparing site contaminant concentrations to medium-specific comparison values derived by ATSDR from standard exposure default values. The second step is the "health guideline comparison" and involves looking more closely at site-specific exposure conditions, estimating exposure doses, and comparing them to dose-based health-effect comparison values.

As health-based thresholds, CVs are set at a concentration below which no known or anticipated adverse human health effects are expected to occur. CVs are not thresholds of toxicity and do not predict adverse health effects. CVs serve only as guidelines to provide an initial screen of human exposure to substances. Contaminant concentrations at or below the relevant CV may reasonably be considered safe, but it does not automatically follow that any environmental concentration that exceeds a CV would be expected to produce adverse health effects. Different CVs are developed for cancer and non-cancer health effects. Non-cancer levels are based on validated toxicological studies for a chemical, with appropriate safety factors included, and the assumption that small children (22 pounds) and adults are exposed every day. Cancer levels are the media concentrations at which there could be a one additional cancer in a one million person population (one in a million excess cancer risk for an adult) eating contaminated soil or drinking contaminated water every day for 70 years. For chemicals for which both cancer and non-cancer CVs exist, the lower level is used to be protective. Exceeding a CV does not mean that health effects will occur, just that more evaluation is needed.

After completing a screening analysis, site contaminants are divided into two categories. Those not exceeding CVs usually require no further analysis, and those exceeding CVs are selected for a more in-depth analysis to evaluate the likelihood of possible harmful effects.

The North Carolina Department of Public Health (N.C. DPH) uses the following screening values for public health assessments:

1. **Environmental Media Evaluation Guide (EMEG):** EMEGs are estimated contaminant concentrations in water, soil or air to which humans may be exposed over specified time periods and are not expected to result in adverse non-cancer health effects. EMEGs are based on ATSDR "minimum risk levels" (MRLs) and conservative (highly health protective)

assumptions about exposure, such as intake rate, exposure frequency and duration, and body weight.

2. **Reference Dose Media Evaluation Guides (RMEGs):** RMEGs represent concentrations of substances in water and soil to which humans may be exposed over specified time periods without experiencing non-cancer adverse health effects. The RMEG is derived from the U.S. Environmental Protection Agency's (EPA's) oral reference dose (RfD).

3. **Cancer Risk Evaluation Guide (CREG**): CREGs are estimated media-specific contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million persons exposed over a 70-year lifetime. CREGs are calculated from EPA's cancer slope factors (CSFs) or inhalation unit risk (IUR) values.

4. **Maximum Contaminant Levels (MCL):** A Federal Maximum Contaminant Level (MCL) is the regulatory limit set by EPA that establishes the maximum permissible level of a contaminant in water that is deliverable to the user of a public water system. MCLs are based on health data, also taking into account economic and technical feasibility to achieve that level. (ATSDR 2005a)

5. **EPA Regional Screening Levels (RSL):** "Regional Screening Levels for Chemical Contaminants at Superfund Sites" are tables of risk-based screening levels, calculated using the latest toxicity values, default exposure assumptions and physical and chemical properties. The Regional Screening table was developed with input from EPA Regions III, VI, and IX in an effort to improve consistency and incorporate updated guidance. (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)

Contaminant concentrations exceeding the appropriate CVs are further evaluated against ATSDR health guidelines. N.C. DPH also retains for further assessment contaminants that are known or suspected to be cancer-causing agents. To determine exposure dose, N.C. DHHS uses standard assumptions about body weight, ingestion or inhalation rates, and duration of exposure. Important factors in determining the potential for adverse health effects also include the concentration of the chemical, the duration of exposure, the route of exposure, and the health status of those exposed. Site contaminant concentrations and site-specific exposure conditions are used to make conservative estimates of site-specific exposure doses for children and adults that are compared to ATSDR health guidelines (HGs), generally expressed as Minimal Risk Levels (MRLs). An exposure dose (generally expressed as milligrams of chemical per kilogram of body weight per day or "mg/kg/day") is an estimate of how much of a substance a person may come into contact based on their actions and habits. Exposure dose calculations are based on the following assumptions as outlined by the ATSDR (ATSDR 2005a):

- Children between the ages of 1 and 6 ingest an average of 1 liter of water per day
- Children weigh an average of 15 kilograms
- Infants weigh an average of 10 kilograms
- Adults ingest an average of 2 liters of water per day
- Adults weigh an average of 70 kilograms

Health guidelines represent daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during the specified exposure duration. The potential for adverse health effects exists under the representative exposure conditions if the estimated site-specific exposure doses exceed the health guidelines and they are retained for further evaluation. A MRL is an estimate of daily human exposure to a substance (in milligrams per kilogram per day [mg/kg/day] for oral exposures) that is likely to be without non-cancer health effects during a specified duration of exposure. Exposures are based on the assumption a person is exposed to the maximum concentration of the contaminant with a daily occurrence.

Generally, site-specific exposure doses that do not exceed screening values are dropped from further assessment. Exposure doses that exceed MRLs, or are known or suspected cancer-causing agents, are carried through to the health-effects evaluation. The health-effects evaluation includes an in-depth analysis examining and interpreting reliable substance-specific health effects data (toxicological, epidemiologic, medical, and health outcome data) related to dose-response relationships for the substance and pathways of interest. The magnitude of the public health issue may be estimated by comparing the estimated exposures to "no observed" (NOAELs) and "lowest observed" (LOAELs) adverse effect levels in animals and in humans, when available.

ATSDR's toxicological profiles serve as the primary source of the health-effects data. Other sources of toxicological data include EPA's Integrated Risk Information System (IRIS) database, International Agency for Research on Cancer (IARC) Monographs, and the National Toxicology Program (NTP). Standard toxicology textbooks and peer-reviewed scientific journals of environmental toxicology or environmental health can also be consulted.

Ingestion of contaminants present in drinking water
Exposure doses for ingestion of contaminants present in groundwater are calculated using the maximum and average detected concentrations of contaminants in milligrams per liter (mg/kg [mg/kg = ppm]). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated groundwater:

$$ED_w = \frac{C \times IR \times AF \times EF}{BW}$$

Where:

ED_w	=	exposure dose water (mg/kg/day)
C	=	contaminant concentration (mg/kg)
IR	=	intake rate of contaminated medium (liters/day)
AF	=	bioavailability factor (unitless)
EF	=	exposure factor
BW	=	body weight (kilograms)

Ingestion of contaminants present in soil
Exposure doses for ingestion of contaminants present in soil are calculated using the maximum and average detected concentrations of contaminants in milligrams per kilogram (mg/kg [mg/kg = ppm]). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated soil:

$$ED_s = \frac{C \times IR \times AF \times EF}{BW}$$

Where:

ED_s = exposure dose soil (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated medium (kilograms/day)
EF = exposure factor (unitless)
BW = body weight (kilograms)

The exposure factor is an expression of how often and how long a person may contact a substance in the environment. The exposure factor is calculated with the following general equation:

$$EF = \frac{F \times ED}{AT}$$

Where:

F = frequency of exposure (days/year)
ED = exposure duration (years)
AT = averaging time (ED x 365 days/year)

Inhalation (breathing) of contaminants present in air
Inhalation is an important pathway for human exposure to contaminants that exist as atmospheric gases or are adsorbed to airborne particles or fibers. Exposure doses for breathing contaminants in air were calculated using the maximum or average detected concentrations in milligrams per cubic meter (mg/m^3) or parts per billion by volume (ppbv). The following equation is used to estimate the exposure doses resulting from inhalation of contaminated air.

$$D = (C \times IR \times EF) / BW$$

Where:

D = exposure dose (mg/kg/day)
C = contaminant concentration (mg/m^3)
IR = intake rate (m^3/day)
EF = exposure factor (unitless)
BW = body weight (kg)

Calculations of Contaminant Exposures During Showering
When showering in contaminated water a person may be exposed to the chemicals in the water by breathing a portion of the chemical that comes out of the water into the air (inhalation exposure), or by absorbing the chemical from the water through their skin (dermal exposure). Inhalation and dermal exposures to volatile organic compounds (VOCs) in the shower or bath may be equal to or greater than exposures from drinking the contaminated water. ATSDR uses conservative assumptions to estimate "worst case" exposures to VOCs during showering with

contaminated water. The maximum concentration of VOC in the bathroom air is estimated with the following equation (Andelman 1990).

$$C_a = (C_w \text{ x } f \text{ x } F_w \text{ x } t)/V_a$$

Where:

C_a	=	bathroom air concentration (mg/m^3)
C_w	=	tap water concentration (mg/L)
f	=	fractional volatilization rate (unitless)
F_w	=	shower water flow rate (L/min)
t	=	exposure time (min)
V_a	=	bathroom volume (m^3)

Conservative calculation parameters are assumed, including a fractional volatilization of 0.9 for chlorinated VOCs, a flow rate of 8 L/min, and a small bathroom volume of 10 m^3. Conservative calculations are also made by using the maximum concentration found for each VOC in the tap water. Calculated bathroom air concentrations of VOCs can then be compared to ATSDR inhalation comparison values. Inhalation exposure dose estimates can be made using ATSDR's inhalation dose calculations.

Cancer Health Effect Evaluations

Theoretical increased numbers of cancers are calculated for known or suspected cancer-causing contaminants using the estimated site-specific exposure dose and cancer slope factor (CSF) provided in ATSDR health guideline documents. This theoretical calculation is based on the assumption that there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. This theoretical increased cancer risk estimate does not equal the increased number of cancer cases that will actually occur in the exposed population, but estimates a theoretical excess cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a lifetime or other selected period of exposure. For example, an estimated cancer risk of 1×10^{-4} predicts the probability of one additional cancer over the background number of cancers in a population of 10,000. Qualitative assessment of the predicted increased numbers of cancers is also used and represents terminology suggested by ATSDR and N.C. DPH.

The theoretical cancer risk calculation is:

$$\text{Theoretical Cancer Risk} = \text{Dose x CSF}$$

or

$$\text{Theoretical Cancer Risk} = \text{Air Concentration x IUR}$$

Where:

Theoretical Cancer Risk	=	Expression of the cancer risk (unitless)
Dose	=	Site-specific cancer dose (mg/kg/d)
Air Concentration	=	Site-specific air concentration ($\mu g/m^3$)

CSF = Cancer Slope Factor ($[mg/kg/d]^{-1}$)
IUR = Inhalation Unit Risk ($[\mu g/m^3]^{-1}$)

The N.C. Central Cancer Registry states:

"*Although much has been learned about cancer over the past couple of decades, there is still much that is not known about the causes of cancer. What we do know is that cancer is not one disease, but a group of diseases that behave similarly. We know that different types of cancers are caused by different things. For example, cigarette smoking has been implicated in causing lung cancer, some chemical exposures are associated with leukemia, and prolonged exposure to sunlight causes some types of skin cancer. Genetic research has shown that defects in certain genes result in a much higher likelihood that a person will get cancer. What is not known is how genetic factors and exposures to cancer causing agents interact.*

Many people do not realize how common cancers are. It is estimated that <u>one</u> out of every <u>two</u> men and <u>one</u> out of every <u>three</u> women will develop a cancer of some type during his or her lifetime. As a result, it is common to find what appear to be cancer cases clustering in neighborhoods over a period of years. This will occur in any neighborhood. As people age, their chance of getting cancer increases, and so as we look at a community, it is common to see increasing numbers of cancer cases as the people in the community age.

Cancers are diseases that develop over many years. As a result, it is difficult to know when any specific cancer began to develop, and consequently, what the specific factor was which caused the cancer. Because people in our society move several times during their lives, the evaluation of clusters of cancer cases is quite challenging. One can never be certain that a specific cancer was caused by something in the community in which the person currently resides. When we investigate clusters of cancer cases, we look for several things that are clues to likely associations with exposures in the community. These are:

1. *Groups of cases of all the same type of cancer (such as brain cancer or leukemia). Because different types of cancer are caused by different things, cases of many different types of cancer do not constitute a cluster of cases.*
2. *Groups of cases among children, or ones with an unusual age distribution.*
3. *Cases diagnosed during a relatively short time interval. Cases diagnosed over a span of years do not constitute a cluster of cases unless there is consistency in the type of cancer.*
4. *Clusters of rare cancers. Because lung, breast, colon, and prostate cancers are so common, it is very difficult to find any association between them and exposures in a community."*

N.C. DPH evaluates cancer health effects in terms of possible increased cancer risk. In North Carolina, approximately 30% of women and 50% of men (about 40% combined), will be diagnosed with cancer in their life-time from a variety of causes. This is referred to as the "background cancer risk". The term "excess cancer risk" represents the risk on top of the background cancer risk. A "one-in-a-million" excess cancer risk (1/1,000,000 or 10^{-6} cancer risk) means that if 1,000,000 people are exposed to the cancer-causing substance at a certain level every day of their life-time (considered 70 years), there would be up to one cancer in addition to those cancer cases that would normally occur in an unexposed population of one million people. In numerical terms, the background number of cancers expected in 1 million people over their life-time in 400,000. If they are all exposed to the cancer-causing substance daily throughout their life-time, then 400,001 people may get cancer, instead of the expected 400,000. The expression of the estimated cancer risk is not a prediction that cancer will occur, it represents the upper bound estimate of the probability of additional cancers, and merely suggests that there is a possibility. The actual risk may be much lower, or even no risk. For specific exposure situations N.C. DPH may use exposure periods of less than a life-time to provide a more realistic estimation of the risks that are known or predicted to have occurred for a particular area. If information on the specifics of the exposure situations at a particular site is not known, then N.C. DPH will always use health protective values to estimate the maximum level of risk that we believe to be realistic.

Estimates of Increased Number of Cancers Qualitative Assessment Categories Utilized by N.C. DPH

Estimated Number of Increased Cancers [a]	Qualitative Increased Risk Term
< 1/1,000,000	**No Increase**
< 1/100,000	**Very Low**
< 1/10,000	**Low**
< 1/1,000	**Moderate**
< 1/100	**High**
> 1/100	**Very High**

[a] As number of increased cancers above typical background numbers of cancers in the stated population size. "<1/1,000,000" = less than one additional cancer in a population of 1 million persons.

Polynuclear Aromatic Hydrocarbons (PAHs)

ATSDR does not provide individual comparison values (CVs) for the group of structurally related multi-carbon ring compounds known as polynuclear aromatic hydrocarbons or PAHs (PAHs my also be called "polycyclic aromatic hydrocarbons"). ATSDR does provide a CREG the PAH compound benzo(a)pyrene (BaP). BaP is the most studied of the individual chemicals of the PAH group, and is thought to be the most toxic. To evaluate potential adverse health effects associated with incidental ingestion of soil PAH concentrations, the concentrations of individual detected PAH compounds are converted to an equivalent BaP concentration and summed to provide a "BaP-equivalent" concentration for all detected PAHs. BaP-equivalent exposure dose are calculated by multiplying the concentration of individual detected PAH compounds by their "toxicity equivalency factor" (TEF), a value that relates the relative toxicity of the individual PAH compounds to the toxicity of BaP. Below is a table of TEF values used by N.C. DPH to calculated BaP-equivalent concentrations. An estimated soil ingestion BaP-equivalent exposure dose is calculated using soil exposure rates. Estimated numbers of increased cancers for the combined PAH exposure is calculated by multiplying the CREG value by the BaP-equivalent exposure dose.

$$PAH_{BaP\text{-}eq} = PAH_{conc} \times TEF$$

$$\text{Combined Cancer Risk}_{PAHs} = \sum PAH_{adj} \times CSF$$

Where:

$PAH_{BaP\text{-}eq}$	=	Benzo(a)pyrene equivalent TEF adjusted PAH compound concentration, mg/kg
PAH_{conc}	=	concentration of PAH compound, mg/kg
TEF =	=	Toxicity Equivalency Factor for PAH compound, unitless
Combined Cancer Risk_{PAHs}	=	Summed cancer risk of all detected PAH compounds
$\sum PAH_{adj}$	=	summed TEF-adjusted concentrations of all detected PAH compounds, mg/kg
CSF	=	Cancer Slope Factor, mg/kg-d

PAH Toxicity Equivalency Factors ("TEFs")

PAH compounds	TEF value
acenaphthene	0.001
acenaphthylene	0.001
anthracene	0.01
benzo(a)anthracene	0.1
benzo(a)pyrene	1.00
benzo(b,k)fluoranthene	na
benzo(g,h,i)perylene	0.01
benzo(b)fluoranthene	0.1
benzo(k)fluoranthene	0.01
chrysene	0.001
dibenzo(a,h)anthracene	1.00
fluoranthene	0.001
fluorene	0.001
indeno(1,2,3-cd)pyrene	0.1
2-methylnaphthalene	0.001
naphthalene	0.001
phenanthrene	0.001
pyrene	0.001

Source: *Toxicity equivalency factors for PAH and their applicability in shellfish pollution monitoring studies*. J Environ Monit, 2002, **4**, 383-388
na = not available

Limitations of the Health Evaluation Process

Uncertainties are inherent in the public health assessment process. These uncertainties fall into the following categories: 1) the imprecision of the risk assessment process, 2) the incompleteness of the information collected and used in the assessment, and 3) the differences in opinion as to the implications of the information. These uncertainties are addressed in public health assessments by using worst-case assumptions when estimating or interpreting health risks. The health assessment calculations and screening values also incorporate safety margins. The assumptions, interpretations, and recommendations made throughout this public health assessment err in the direction of protecting public health.

Assessment of Chemical Interactions

To evaluate the risk for noncancerous effects in a mixture, ATSDR's guidance manual (*Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures*, 2004) prescribes the calculation of a hazard quotient (HQ) for each chemical. The HQ is calculated using the following formula:

$$HQ = \text{estimated dose} \div \text{applicable health guideline}$$

Generally, whenever the HQ for a chemical exceeds 1, concern for the potential hazard of the chemical increases. Individual chemicals that have HQs less than 0.1 are considered unlikely to pose a health hazard from interactions and are eliminated from further evaluation. If all of the chemicals have HQs less than 0.1, harmful health effects are unlikely, and no further assessment of the mixture is necessary. If two or more chemicals have HQs greater than 0.1, then these chemicals are to be evaluated further as outlined below.

Since the HQ is greater than 1 for both adults and children the hazard index (HI) will be calculated. The HQ for each chemical then is used to determine the (HI) for the mixture of chemicals. An HI is the sum of the HQs and is calculated as follows:

$$HI = HQ_1 + HQ_2 + HQ_3 + \ldots HQ_n$$

The HI is used as a screening tool to indicate whether further evaluation is needed. If the HI is less than 1.0, significant additive or toxic interactions are highly unlikely, so no further evaluation is necessary. If the HI is greater than 1.0, then further evaluation is necessary, as described below.

For chemical mixtures with an HI greater than 1.0, the estimated doses of the individual chemicals are compared with their NOAELs or comparable values. IF the dose of one or more of the individual chemicals is within one order of magnitude of its respective NOAEL (0.1 x NOAEL), then potential exists for additive or interactive effects. Under such circumstances, an in-depth mixtures evaluation should proceed as described in ATSDR's *Guidance Manual for the Assessment of Joint Action of Chemical Mixtures*.

If the estimated doses of the individual chemicals are less than 1/10 of their respective NOAELs, then significant additive or interactive effects are unlikely, and no further evaluation is necessary.

Reference:

(Andelman 1990). *Total Exposure of Volatile Organic Compounds in Potable Water*. In: Significance and Treatment of Volatile Organic Compounds in Water Supplies, Chapter 20. Lewis Publishers, Chelsea, MI.

Appendix E

ATSDR Glossary

ATSDR Glossary

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

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

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

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

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

Aerobic
Requiring oxygen [compare with anaerobic].

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Carcinogen
A substance that causes cancer.

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

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

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

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

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

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

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

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

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

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

Completed exposure pathway [see exposure pathway].

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

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

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

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

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

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

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

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

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

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

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

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

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

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur.

EPA
United States Environmental Protection Agency.

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

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

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

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

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

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

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

Exposure registry
A system of ongoing follow-up of people who have had documented environmental exposures.

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

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

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

Half-life (t½)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Maximum Contaminant Level (MCL)
The highest level of a contaminant that EPA allows in drinking water. MCLs ensure that drinking water does not pose either a short-term or long-term health risk. EPA sets MCLs at levels that are economically and technologically feasible. Some states set MCLs which are more strict than EPA's.

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

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

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

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

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period

(acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

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

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

Mutagen
A substance that causes mutations (genetic damage).

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

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

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

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

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

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

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

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

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move.

For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

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

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

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

ppb
Parts per billion.

ppm
Parts per million.

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

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

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

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

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

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

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

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

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

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

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

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

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

Radionuclide
Any radioactive isotope (form) of any element.

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

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

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

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

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

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

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

RfD See reference dose

Risk
The probability that something will cause injury or harm.

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

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

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

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

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

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

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

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

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

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

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

Substance
A chemical.

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

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

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

Surveillance [see epidemiologic surveillance]

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

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

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

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

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

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

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

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

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

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

Appendix F

Response to Public Comments

Response to Public Comments

The *Benfield Industries NPL Site Public Health Assessment Public Comment Release Draft* was released February 18, 2010. Copies were provided to the U.S. EPA, N.C. DENR, Haywood County officials, and the public. A public comment period was provided from March 18, 2010 through April 18, 2010.

Comments were received from Haywood County Health Department and the N.C. DENR. No comments were received from the community or the U.S. EPA. The comments and N.C. DPH's responses to those comments follow.

Additional groundwater investigations were undertaken at the site by U.S. EPA in February 2010. These activities were to continue to monitor past and on-going remediation efforts at the site. N.C. DPH performed a health evaluation on the groundwater and private well water collected in February 2010. The results of that evaluation are provided in a separate document published on October 5, 2010: *Letter Health Consultation – Health Evaluation of Groundwater Samples Collected in February 2010 by U.S. EPA Contractors at the Former Benfield Industries NPL Site*. That document is available at:
www.epi.state.nc.us/epi/oee/hace/ncmap/CountyInfo.html#Haywood

Comments and N.C. DPH Response -

N.C. DENR comments –

1. N.C. DENR comment - *DENR requests the opportunity to review future DPH health evaluations prior to release of the draft to the public.*

N.C. DPH response – We welcome U.S. EPA's and N.C. DENR's input to N.C. DPH's public health assessments for sites on which your agencies may also be involved. The mission of the HACE program of the N.C DPH is to act as public health advocates for communities where there is the potential for site-specific environmental exposures to hazardous substances. A critical component of our program is that it operates independently from agencies such as U.S. EPA and N.C. DENR, which have regulatory oversight of these hazardous waste sites. We evaluate the data provided by your agencies, note any public health concerns, and provide the agencies the opportunity to review data and reports which are used as the basis of our public health evaluations. It is essential that our program's assessment of public health issues and recommendations remain independent.

2. N.C. DENR comment – "*Conclusion 2…Our office questions the need for this important conclusion that N.C DPH cannot say that chemicals in the groundwater have the potential to harm people's health. The groundwater monitoring data indicate that there is no off-site gw contamination. There is only one well on site that has contamination. There are MWs downgradient that do not have gw contamination. Some of these downgradient wells are off-site. In addition, homes in the vicinity of the site have access to public water and the need for a well survey is not indicated. The absence of bedrock aquifer data is the data does not indicate that the the bedrock aquifer is contaminated. Only one well is contaminated with*

polycyclic aromatic hydrocarbons—which are not very soluble or mobile. As for the absence of metal analysis, low-flow sampling was started and metals were no longer an issue in the gw. The change in the sampling and the new data indicating that metals were no longer an issue were not well documented and EPA and the state are now in the process of documenting low-flow sampling data and metal concentrations."

N.C. DPH response – N.C. DPH recommendations are based on site information and data provided by the U.S. EPA and N.C. DENR. N.C. DPH will take a health protective approach in the evaluation of potential public health issues, requiring documentation of no likelihood of potentially harmful environmental exposures. We rely on available documented data and justifiable scientific reasoning. N.C. DPH believes that subsequent groundwater investigations provided by U.S. EPA in February 2010 further supports our recommendations (see reference [Benfield LHC]).

3. N.C. DENR comment – "*Page 2, Next Steps; page 15, Conclusions; page 16, Recommendations: Our office does not see the need for the first recommendation "to verify that no private wells in the vicinity of the site or downgradient are being used for drinking water sources". Groundwater sampling data indicate that only one well shallow well (MW03SH) has site related contamination in the groundwater. The chemicals are all PAHs that are not very soluble in water and have little mobility. The homes in the area have access to public water supply which is referenced on page 11 of the PHA. The need for a public well survey issue was discussed by EPA's Remedial Site Evaluation team. The team consists of EPA Region IV and HQ's, RSE contactor-Geotrans, and the state. In a memo summarizing a March 3, 2009 conference call about the RSE-Lite Report, the team recommended that as long as sampling continues to demonstrate no off-site migration above standards that a survey for potential downgradient receptor locations is not recommended. Sampling has not indicated any off-site migration.*"

N.C. DPH response – Neither the U.S. EPA nor N.C. DENR could provide documentation that a private well survey had been undertaken. N.C. DPH will take a health protective approach in the evaluation of potential public health issues, requiring documentation of no likelihood of potentially harmful environmental exposures. Site information and data provided by the U.S. EPA and N.C. DENR at the time did not rule out potentially harmful exposures.

4. N.C. DENR comment – "*Page 2, Next Steps; page 15, Conclusions; page 16, Recommendations: Our office does not agree with the second recommendation to test "the bedrock aquifer to confirm that site contaminants have not affected the bedrock aquifer". As above the only well that has contamination is well MW03SH and the contaminants are PAHs. In the same memo as referenced above, the team questions the need for any bedrock investigation as outlined in the Five-Year Review Report. This was a recommendation in the Five-Year Review Report was the team could not determine why it was in the report.*"

N.C. DPH response –N.C. DPH is charged with taking a health protective approach. The bedrock aquifer was tested in the subsequent February 2010 groundwater investigations conducted by U.S. EPA [Benfield 2010]. Samples were collected from the nearest identified down gradient former private well located in the deeper bedrock aquifer.

5. N.C. DENR comment – "*Page 2, Next Steps; page 15, Conclusions; page 16, Recommendations: Our office does not understand the need for this recommendation that MNA be evaluated as it is already being evaluated. On page 6 of the PHA, it states that EPA is evaluating MNA.*"

N.C. DPH response – N.C. DPH is supporting the continued monitoring of the MNA (monitored natural attenuation) approach only as it relates to the determination that there is no potential for adverse human exposures. If it is confirmed there are no down gradient human groundwater receptors, then N.C. DPH has no concern with the groundwater monitoring specifications.

6. N.C. DENR comment – "*Page 2, Next Steps; page 15, Conclusions; page 16, Recommendations: Our office does not feel that the recommendation to re-implement metals analysis is necessary. As stated above, after a change in sampling to low-flow sampling, the concentration of metals in the gw were below cleanup standards. This was not well documented and EPA and the state are in the process of checking the data. Metals analysis will be re-implemented if the metals data cannot be verified.*"

N.C. DPH response – See N.C. DPH's response provided for N.C. DENR comment #2. In addition, the U.S. EPA contractor's draft report for the February 2010 groundwater collections [Waller 2010] documents this trend in the metals concentrations. The February 2010 sampling event re-instituted metals analyses for the groundwater samples [Benfield 2010].

Haywood Co. Health Department comments –

7. HCHD comment - How many private wells are in the area of the site? If there is a well that needs to be tested who will do the testing?

N.C. DPH response - N.C. DPH's recommendations include verifying whether private wells exist in the direction of groundwater flow away from the site. At the time of publication of the public comment draft version of the PHA this information was not available. In February 2010 U.S. EPA conducted additional groundwater monitoring that included sampling the nearest identified down gradient former private well. N.C. DPH's health evaluation of the February 2010 analytical data is included in [Benfield LHC] reference.

U.S. EPA Region 4 –

U.S. EPA Region 4 did not provide comments.

Public/Community Comments –

There were no comments received from the community.

References:

[Benfield LHC]. Letter Health Consultation – *Health Evaluation of Groundwater Samples Collected in February 2010 by U.S. EPA Contractors at the Former Benfield Industries NPL Site Waynesville, Haywood County, North Carolina*. EPA Facility ID: NCD981026479. Prepared by the North Carolina Department of Health and Human Services. October 5, 2010. Available at: www.epi.state.nc.us/epi/oee/hace/pdf/BenfieldIndNPLSiteLHC.pdf

[Waller 2010]. *Draft Monitored Natural Attenuation Evaluation Report, Remedial Action Oversight, Benfield Industries Site, Waynesville, North Carolina*. Prepared for: U.S. Environmental Protection Agency, Remedial Action Contract II Lite, EPA Contract No. EP-S4-08-03 Task Order 009. Prepared by J.M. Waller Associates, Inc. May 2010.

Appendix G

Site Fact Sheet, November 23, 2010

Health Assessment, Consultation and Education Program (HACE)

Benfield Industries NPL Site

Public Health Assessment and Letter Health Consultation

November 23, 2010

Haywood Vocational Opportunities, Inc. on the re-developed Benfield Industries NPL Site

Background

The former Benfield Industries Site is located at 112 through 124 Riverbend Street in Waynesville, Haywood County, North Carolina. A bulk chemical mixing and repackaging facility, Benfield Industries, Inc., operated on the site from 1976 until 1982 when a fire destroyed the plant. Products handled by Benfield Industries included paint thinners, solvents, sealants, cleaners, de-icing solutions and wood preservatives. The original site covered six acres.

After the 1982 fire, Benfield Industries removed all chemicals and debris, and covered the site with clean fill material. The site was added to the Environmental Protection Agency's (EPA) "National Priorities List" or "Superfund" program in 1989.

During the Superfund process, soil and groundwater contamination with a variety of organic substances was identified on the site. Active soil and groundwater cleanup activities began in 1997 and ended in 2007.

In 2002, Haywood Vocational Opportunities, Inc. (HVO) bought the property. They completed the re-development of the site in 2004. HVO currently operates a manufacturing facility on the site.

The current property deed includes perpetual land-use restrictions to protect public health and the environment. The deed restrictions prevent use of the property for residential purposes, and prevent alteration or removal of existing soil. The deed also restricts the use of any surface or groundwater on the site as drinking water or for swimming.

As part of EPA's ongoing oversight of the Benfield Industries NPL site, there is continued monitoring of the groundwater beneath the site, as well as that flowing away from the site.

Purpose of the Public Health Assessment and Letter Health Consultation

EPA requested the Agency for Toxic Substances and Disease Registry (ATSDR) to conduct a Public Health Assessment as a follow-up to the one completed in 1990. This document presents the findings of the follow-up Public Health Assessment and a Letter Health Consultation. This work was conducted through a cooperative agreement between ATSDR and the N.C. Division of Public Health's Health Assessment, Consultation, and Education Program (HACE).

How was the Health Consultation conducted?

We evaluated data collected by EPA and by the N.C. Department of Environment and Natural Resources (DENR) from 1990 through 2008 in a

Public Health Assessment, and groundwater data collected in February 2010 in a Letter Health Consultation.

Conclusion

The following conclusions and recommendations are based on data evaluated in both the Public Health Assessment (February, 2010) and the Letter Health Consultation (October, 2010).

- There is no indication that individuals on or near this site are in contact with toxic chemicals in the soil or groundwater from the former Benfield Industries NPL site.

Basis for the Conclusion

- The contaminated soil has been removed and covered with several layers of clean soil. The area has been re-developed with a new building and the property deed includes perpetual land use restrictions to protect public health and the environment.
- There is no potential for people to come in contact with contaminated groundwater since there are no private wells in use in the path of the contamination.

Recommendations by the N.C. Division of Public Health

- Verify that no private wells near the site or in the likely path of the contamination are being used for drinking.

  UPDATE: EPA's February 2010 data confirms that there are no private wells in use in the path of the contamination. Residents were connected to the municipal supply in 1996 when the area was annexed to the Town of Waynesville.

- Any well near the site that is still used for drinking should be tested for volatile and semi-volatile organic compounds, and for metals. If levels found are above regulatory or health guideline levels, people should be immediately supplied with alternative water and then connected to municipal water.

  UPDATE: EPA verified that no private wells exist in the path of the contamination.

- To protect current or future users of the contaminated groundwater, EPA should consider testing the bedrock aquifer in the likely path of the contamination.

  UPDATE: EPA tested a closed private well that was drilled into the bedrock aquifer in the direction of flow away from the site. Very low levels of chemicals not associated with the site were found. However, there are no private wells in the area that could expose people to the chemicals.

- EPA or DENR should continue to monitor the concentration of organic chemicals and metals in the groundwater under and flowing away from the site.
- Drinking water wells should not be allowed to be drilled in the area affected by the site until all contaminants associated with the site have been reduced to levels that would not be harmful to health with long-term use.

Contact:
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Telephone: (919) 707-5900
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Additional Information

Full reports are available under Haywood County at www.epi.state.nc.us/epi/oee/hace.html