ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

ROSELAND WOOD SITE
ROSELAND AVENUE
PRINCETON, MERCER COUNTY, WEST VIRGINIA 24740
EPA FACILITY ID: WVSFN0305525
FEBRUARY 25, 2009

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

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EPA FACILITY ID: WVSFN0305525

Prepared by:

West Virginia Department of Health and Human Resources
Under Cooperative Agreement with
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Atlanta, Georgia

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Foreword

West Virginia Department of Health and Human Resources (WVDHHR) and Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate, based on the information currently available, any known or potential adverse human hazards related to exposure to contaminants in surface soil, surface water and sediment associated with the Roseland Wood Site. This document is prepared in response to the public health's concerns about potentially unhealthy exposures to chemicals from the Roseland Wood site. These public health concerns (1999) were related to the environmental emissions and the potential exposure levels from the chromated copper arsenate (CCA) and creosote utilized by the adjacent Acme Wood Preserving, Inc., facility.

The U.S. Environmental Protection Agency (USEPA) and the West Virginia Department of Environmental Protection (WVDEP) separately conducted site assessments and investigations in October 1999 and October 2002, respectively. The investigations included on-site high volume air sampling, surface soil and surface water/sediment sampling. People who could come into contact with these chemicals included facility workers, nearby residents and other transient persons near the site.

The steps taken in completing a public health assessment are as follows:

Evaluating exposure: The WVDHHR and ATSDR Cooperative Partners Program starts by reviewing available information about environmental conditions at the site. The first task is to determine how much contamination is present, where it is located on the site, and who might be exposed to it. WVDHHR typically does not collect environmental samples. WVDHHR relies on information provided by the WVDEP, the USEPA, other governmental agencies, and other sources of accurate and reliable information.

Evaluating health effects: If evidence indicates that people are being exposed, or could be exposed to hazardous substances, WVDHHR will take steps to evaluate whether that exposure could be harmful to human health. The evaluation is based on existing scientific information, and is reported in the form of a written public health assessment. The public health assessment focuses on public health and its impact on the community.

Developing recommendations: In the Public Health Assessment, WVDHHR outlines its conclusions regarding any potential health threat posed by a site and offers recommendations for reducing or eliminating human exposure. The role of WVDHHR at a site is primarily advisory. The recommendations proposed in the public health assessment will typically be considered by other agencies, including WVDEP and USEPA.

Soliciting community input: The evaluation process is interactive. WVDHHR starts by soliciting and evaluating information from various governmental agencies, the organizations responsible for cleaning up sites, and the community surrounding the site. Any conclusions about the site are shared with those who provided the information, and the community.

If you have questions or comments about this report, we encourage you to:

write: Program Manager
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West Virginia Department of Health and Human Services
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Summary and Statement of Issues

At the request of West Virginia Department of Environmental Protection (WVDEP), the West Virginia Department of Health and Human Resources (WVDHHR) prepared this public health assessment to determine whether the residents on or near the Roseland Wood Site were exposed to the chemical components of chromated copper arsenate (CCA) and creosote at the levels harmful to their health. It is public knowledge that Acme Wood Preserving, Inc., has been using the CCA and creosote to treat wood products. The US Environmental Protection Agency (USEPA) and WVDEP have conducted investigations and assessments at the site in 1999 and 2002, respectively. For this public health assessment, WVDHHR reviewed the available environmental information, and evaluated the public health significance related to the contaminants.

The potential route of human exposure identified at the Roseland Wood Site is ingestion of contaminated surface soil, surface water and sediment. The inhalation pathway can only be considered as a potential exposure pathway due to limited environmental data and limited assessment of this exposure pathway at this time. Based on the available environmental information, site-specific exposure dose estimations and toxicological analyses, WVDHHR concluded that:

- The overall chronic and acute exposure to arsenic at the levels detected in both on-site residential surface soil and the unnamed tributary sediment *poses no apparent public health hazard* to residents, including children 1-6 years old and children with pica behavior. No adverse non-carcinogenic health effects are expected. Estimated excess theoretical lifetime cancer risk is well below 1 in 10,000, which is considered a very low risk by WVDHHR.
- The overall chronic and acute exposure to some of the carcinogenic polycyclic aromatic hydrocarbons (PAHs) such as Benzo(a)anthracene, Benzo(a)pyrene, Benzo(g,h,i)perylene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene at the levels found in both on-site residential surface soil and the unnamed tributary sediment *poses no apparent public health hazard* to residents, including children 1-6 years old. Estimated excess theoretical lifetime cancer risk is less than 1 in 10,000, which is considered a very low risk by WVDHHR.
- Consumption of fish from Brush Creek poses *an indeterminate public health hazard*. Environmental data characterizing contamination of Brush Creek are needed to complete the evaluation of this potential pathway.
- Inhalation of the air on site poses an *indeterminate public health hazard*. Air sampling data characterizing the air quality are needed to complete the evaluation of this potential pathway.

WVDHHR prepared this public health assessment under a cooperative agreement with the ATSDR.

Background

Site Description

The Roseland Wood Site is located in Princeton, Mercer County, West Virginia. Encompassing approximately 50 relatively flat acres, the site includes:

- the Acme Wood Preserving, Inc. property
- a commercial property (Jiffy Lube), and
- residential properties adjacent to Acme Wood Preserving, Inc., and located east of Roseland Avenue

There are four residences on the site along Roseland Avenue. An unnamed tributary of Brush Creek is located at the site between Acme Wood Preserving, Inc., and the residential properties along Roseland Avenue. This unnamed tributary appeared to be intermittent and this surface water drainage culvert was "dry" up gradient of the site [1]. The site has been used for manufacturing since 1974 and for agricultural purposes before 1974.

The site is bordered to the north by Roger Street, to the east by Roseland Avenue, to the south by a former asphalt manufacturing plant and State Route 460, and to the west by the Norfork Southern Corporation railroad tracks. Surrounding the site to the west, north and east is mixed residential, commercial and industrial land-uses. The south side of the site is bordered by State Route 460 and hilly terrain. The site is down gradient of the former asphalt manufacturing plant. See Figure 1 the Site Map in Appendix A.

Groundwater and Surface Water Use

There is no record of groundwater or surface water use available in WVDEP, Office of Environmental Remediation (OER) project files [1].

According to the USEPA Safe Drinking Water Information Services (SDWIS) website, http://oaspub.epa.gov/enviro/sdw_form_v2.create_page?state_abbr=WV, the West Virginia America Water Company –Bluefield District (WVAWC-BLUEFIELD DISTRICT) supplies potable water to 12,175 people in the area since July 1969, including the Roseland Wood Site. Since July 2002, WVAWC Bluestone Plant is the water supplier to the area. The primary water source of the Bluestone plant is Bluestone Lake, located downstream from the facility. There are no community water systems actively using groundwater within a four-mile radius of the site. In addition, there is no record of individuals using private groundwater wells within a four-mile radius of the site [1].

Brush Creek, located down gradient of the site, flows north and parallel to Roseland Avenue. Brush Creek is a perennial stream used for recreational purpose such as swimming, boating and fishing. It was reported that local residents fish there daily for both recreational and subsistence purposes. The species reportedly caught from the creek and consumed include catfish, bass, trout and groupie.

Public Health Concern

Later in 1999, USEPA Region III was contacted by a concerned resident who lived on Roseland Avenue adjacent to the Acme Wood Preserving, Inc. site. Residents in the surrounding community were concerned about the emissions and potential exposure levels from CCA and creosote utilized by Acme Wood Preserving, Inc. The concerned property owner stated that local residents have been complaining of symptoms similar to those associated with over exposure to the chemical components of CCA [1].

Demographics

Based on the 2000 Census Data [2], the total population in the zip code area of the Roseland Wood Site is 30,375. Among them, 47% are male and 53% are female, 5.8% are under 5 years-old, 79% are 18 years and over and 17.7 % are 65 years and over. In terms of race, the population consists of 95.6% White, 2.7% of Black or African American, and the rest of 1.7% are American Indian and Alaska Native, Asian and Hispanic or Latino.

Further breakdown by miles-radius with Roseland Wood site as a center, the population distribution is as following:

- 21,639 within a four-mile radius,
- 17,028 within a three-mile radius,
- 12,089 within a two-mile radius,
- 4,508 within a one-mile radius,
- 786 within a ½-mile radius, and
- 65 within a ¼-mile radius.

Historical Investigation and Site Activities

Summary of Environmental Investigation History for Roseland Wood Site [1]

Time	Events / Investigations / Activities
July 17, 1986	A Compliance Evaluation Inspection (CEI) of Acme Wood Preserving, Inc., was performed by West Virginia Department of Natural Resources, Division of Waste Management (WVDNR / DWM). No violations were detected and no hazardous waste was generated.
May 5, 1987	An unannounced CEI was performed by WVDNR / DWM, No violations were detected and no hazardous waste was generated.
November 13, 1987	300-gallons of creosote were spilled onto the ground covering a 50-feet by 50-feet confined area. 550-gallons of contaminated soil were remediated and disposed as hazardous waste by Environmental Options, Inc.. in Michigan.
February 16, 1988	A CEI was performed by WVDNR / DWM at Acme Wood Preserving, Inc. as a follow up to the spill on November. 13, 1987. Four surface soil samples were taken from the spilled area. The levels of creosote in the soil of the spilled area were below the levels detected in the adjacent treated wood storage area.

Time	Events / Investigations / Activities
January 9, 1990 March 19, 1991	An unannounced CEIs was performed by WVDNR / DWM, No violations were noticed.
August 12-13, 1991	Four groundwater monitoring wells were installed at Acme Wood Preserving, Inc.
June 28, 1995	A record flood event occurred. Chromated copper arsenate (CCA) mix tank was dislodged from its platform causing the piping to rupture. 515-gallons of diluted CCA were released. Portion of the spill was recycled by facility personnel.
February 22, 1996	A CEI was conducted by West Virginia Department of Environmental Protection, Office of Waste Management, (WVDEP/OWM) as a follow up to the spill associated with the flood on June 28, 1995. A Notice of Violation (NOV) was issued on July 15, 1996, in response to the CEI.
November 4, 1996	A Consent Order was entered into with WVDEP/OWM and Acme Wood Preserving, Inc., Acme Wood Preserving, Inc., agreed to determine the levels of chromium and arsenic (from CCA) in the soil of the potentially affected area, and determine if remediation was necessary.
January 22, 1997	Data showed no impact to site soil from release on June 28, 1996, as based on comparison to Consent Order action level.
April 3, 1997	WVDEP/OWM notified the Acme Wood Preserving, Inc., that it had no further obligation under the Consent Order.
July 7, 1999	An on-site resident reported to WVDEP and USEPA Region III and ATSDR that her three children were experiencing adverse health effects. Children's pediatrician believes the symptoms could be caused by chemical exposure.
July 8, 1999	Windshield Site Assessment conducted by USEPA Region III and a Site Assessment Technical Assistance (SATA) representative concluded the facilities were not a significant emission source.
October 27, 1999	Surface soil and air samples were collected by Roy F Weston, Inc., SATA contractor for USEPA. Data showed contaminants levels in soil were below the USEPA Region III Soil Removal Action Values, and air contaminant levels were below the USEPA Region III Removal Action Values and USEPA Region III Risk-Based Concentrations for ambient air.
October 10, 2001	WVDEP/Office of Environmental Remediation (OER) and TRIAD Engineering, Inc., interviewed the on-site resident who complained previously. Her children were still experiencing the same symptoms as those suffered in 1999, according Mrs. Walls.
October 3-4, 2002	TRIAD Engineering, Inc., a contractor for WVDEP performed Preliminary Assessment / Site Investigation (PA/SI) field sampling activities at the residential portion of Roseland Wood CERCLA Site.

Polycyclic Aromatic Hydrocarbon (PAH), Benzo[a]Pyrene (BaP) TEF and Equivalent Concentration

Polycyclic aromatic hydrocarbons (PAH) are a group of more than 100 compounds that consist of fused aromatic rings. PAHs are an ubiquitous product of combustion from common sources such as motor vehicles and other gas-burning engines, wood-burning stoves and furnaces, cigarette smoke, industrial smoke or soot, and charcoal-broiled foods [3].

Several PAHs, especially those with four or more benzene rings, have been identified as carcinogens in laboratory animals. Among those carcinogenic PAHs, Benzo(a)pyrene (BaP) is the most potent and best studied. Because cancer potency factors for the carcinogenic PAHs other than BaP have not been developed, the potency factor for BaP is used as a basis for determining relative carcinogenic potential for the other carcinogenic PAHs. The Benzo(a)pyrene (BaP) equivalent concentration is a method used to estimate the carcinogenicity of a mixture of PAHs relative to that of BaP. USEPA has developed toxicity equivalence factors (TEFs) to rank the relative carcinogenic potential of other PAHs to BaP[4].

A significant amount of knowledge of toxicological actions of PAHs is based on extrapolation of studies with BaP to other carcinogenic members of the class. The USEPA has classified several PAHs such as BaP, indeno(1,2,3-cd)anthracene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)anthracene, and chrysene as Group B2 carcinogens, indicating sufficient evidence of carcinogenesis in animals, but inadequate evidence in humans [5].

The TEFs can be used for estimating the relative carcinogenicity of an environmental mixture with a known distribution of PAHs. Specifically, the concentration of each carcinogenic PAH is multiplied by the appropriate TEF and then summed to provide an estimate of the BaP Equivalent Concentration. The TEFs of some of the carcinogenic PAH compounds are listed below [3].

PAHs Compounds	TEF
Benzo(a)pyrene	1
Dibenzo(a,h)anthracene	5
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Indeno(1,2,3-cd)anthracene	0.1
Benzo[g,h,i]perylene	0.01

Discussion

WVDHHR Evaluation Process:

WVDHHR determines site-specific public health significance, provides recommendations based on levels of environmental contaminants detected at a site, evaluates potential exposure pathways, and determines the durations of exposure.

WVDHHR identifies contaminants for their potential to cause adverse health effects using chemical-specific, health-based comparison values (CV) established by various state and federal agencies. CVs are developed from available scientific literature concerning exposure and health effects. They are derived for each media (air, water, soil, food) and reflect an estimated chemical concentration that is not expected to cause harmful health effects. Contaminants levels at or below the relevant CVs could be considered safe. But contaminants levels above CVs will not necessarily cause harm. Rather, it represents a point at which further evaluation is necessary.

WVDHHR uses site-specific exposure scenarios and performs in-depth evaluations for contaminants at concentrations above CVs.

The following CVs were used in this public health assessment:

1. **ATSDR's Environmental Media Evaluation Guides (EMEG**), are estimated contaminants concentrations that are not expected to result in adverse non-cancer health effects based on ATSDR evaluation. EMEGs are based on ATSDR Minimal Risk Levels (MRL) and conservative assumptions about exposure, such as intake rate, exposure frequency, duration and body weight.
2. **ATSDR's Reference Dose Media Evaluation Guides (RMEG),** are derived from USEPA's oral reference doses, which are developed based on EPA evaluations. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects.
3. **ATSDR Cancer Risk Evaluation Guides (CREG),** are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (70 years). ATSDR's CREGs are calculated from USEPA's cancer slope factors (CSF) for oral exposures or unit risk values for inhalation exposures. These values are based on USEPA evaluations and assumptions about hypothetical cancer risks at low levels of exposure.
4. **USEPA Region III Risk Based Concentrations (RBC).** The primary use of RBCs is for chemical screening during baseline risk assessment (see USEPA Regional Guidance USEPA/903/R-93-001, "Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening").
5. **USEPA's reference dose (RfD),** which is an estimate of the amount of a contaminant that an individual can be exposed to daily without expected adverse health effects over a lifetime.
6. **Cancer slope factor (CSF),** is chemical specific, and is an upper bound estimate, approximating a 95% confidence limit, on the increased cancer risk from a lifetime exposure to a chemical. USEPA has set the acceptable risk range for cancer induction from exposure to a chemical at 10^{-4} (0.0001) to 10^{-6} (0.000001), or one additional cancer per 10,000 to 1,000,000 people exposed.

Quality Assurance and Quality Control (QA/QC)

The data presented and discussed in the subsequent sections are collected from USEPA or WVDEP. WVDHHR's conclusions for this public health assessment are determined by quality of the data, including validity and representativeness of the sample analyses and results, and reliability of the referenced information. WVDHHR assumes that adequate quality assurance and control measures were followed with regard to chain-of-custody, laboratory procedures, and data reporting.

Environmental Sampling Data

WVDHHR reviewed the available environmental sampling results of the Roseland Wood Site, which includes 68 groundwater samples collected quarterly from 4 on-site monitoring wells from 1992–1997; 21 on-site residential, surface soil samples collected by a contractor for USEPA Region III on October 27, 1999, and a contractor for WVDEP on October 3 and 4, 2002; three surface water and three sediment samples collected from the unnamed tributary of Brush Creek and Brush Creek on October 3 and 4, 2002, and 3 air samples collected by a contractor for USEPA Region III on October, 27, 1999.

All samples were analyzed for (a) Target Analyte List (TAL) metals (a total of 23 TAL metals), which includes the components in chromated copper arsenate (CCA), (b) volatile organic compounds (VOCs), and (c) semi-volatile organic compounds (SVOCs), which includes Polycyclic Aromatic Hydrocarbons (PAHs). All contaminants detected were screened against health based environmental guidelines.

Groundwater

Four groundwater monitoring wells were installed on August 12 and 13, 1991, at Acme Wood Preserving, Inc., as a part of the National Pollutant Discharge Elimination System (NPDES) permit application to the WVDEP. Groundwater samples were collected quarterly from each of the four monitoring wells during the period of October 1992 to January 1997. A total of 68 groundwater samples were collected for total TAL metals analysis. WVDHHR reviewed all TAL metals detected in the 68 groundwater samples. As a result, with the exceptions of arsenic, copper and chromium, all other TAL metals analyzed were not-detected. Chromium was detected only twice between 1992 and 1997. Chromium was detected at 5 ppb in monitoring well #3 on October 28, 1992, and 11 ppb from well #4 on November 6, 1995. Both results were below the ATSDR drinking water Reference Dose Media Evaluation Guides (RMEG) of 30 ppb for children. The maximum arsenic concentration of 230 ppb was detected on September 2, 1994, from well #3, with an average arsenic concentration of 21.1 ppb, which exceeded the ATSDR drinking water chronic Environmental Media Evaluation Guides (chronic EMEG) of 3 ppb for children. The maximum concentration of copper, 760 ppb, was detected on August 10, 1996 from well # 4, with the average copper concentration of 106 ppb, which exceeded the ATSDR drinking water intermediate Environmental Media Evaluation Guides (Int. EMEG) of 100 ppb for children. Therefore, due to exceedances of their respective CVs, monitoring well #3 will be further evaluated for arsenic and well # 4 will be further evaluated for copper. Table 1 (Appendix B) presents the contaminants of concern (COCs) in on-site groundwater.

Surface Soil

WVDHHR reviewed analytical results of 21 on-site residential surface soil samples. Ten were collected by a contractor for USEPA in October 1999, and 11 were collected by TRIAD Engineering, Inc., a contractor for WVDEP in October 2002. As presented in Table 2 (Appendix B), the COCs from on-site residential surface soil are:

- Arsenic, which was detected consistently throughout all the samples. The maximum arsenic concentration of 17.2 ppm exceeded ATSDR cancer screening values of 0.5 ppm (the cancer risk evaluation guide, or CREG), but was below the chronic EMEG screening value of 20 ppm.

- Dibenzo(a,h)anthracene was detected in 2 of 21 samples with a maximum concentration of 0.12 ppm, which exceeded the USEPA Region III Risk Based Concentration (Reg. III RBC) of 0.022 ppm for residential soil.

- Benzo(b)fluoranthene was detected in 13 of 21 samples with a maximum concentration of 1.6 ppm, which exceeded the USEPA Reg III RBC of 0.22 ppm for residential soil.

- Benzo(a)anthracene was detected in 12 of 21 samples with a maximum concentration of 0.99 ppm, which exceeded the USEPA Reg III RBC of 0.22 ppm.

- Benzo(a)pyrene was detected in 11 of 21 samples with a maximum concentration of 1.1 ppm, which exceeded the ATSDR's CREG of 0.1 ppm for residential soil.

- Benzo(g,h,i)perylene was detected in 9 of 21 samples with a maximum concentration of 0.42 ppm, which exceeded the USEPA Reg III RBC of 0.022 ppm for residential soil.

- Indeno(1,2,3-cd)pyrene was detected in nine of 21 samples with a maximum concentration of 0.49 ppm, which exceeded the USEPA Reg III RBC of 0.022 ppm for residential soil.

Therefore, arsenic, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, benzo(a)anthracene and Indeno(1,2,3-cd)pyrene were identified as the COCs requiring further evaluation in groundwater. (See Table 2 in Appendix B)

Surface Water and Sediment

The nature of contamination in surface water and sediment samples can be indicative of the contaminant migration pathways flowing off-site via surface water run-off. Areas sampled included (a) the unnamed tributary of Brush Creek located between Acme Wood's wooden fence and the residential properties parallel to Roseland Avenue; and, (b) Brush Creek, down gradient of the discharge from the unnamed tributary located approximately 1,000 feet north of the Acme Wood property [6]. WVDHHR reviewed the analytical results of six on-site surface water and sediment samples. Two surface water and two sediment samples were collected from the unnamed tributary to Brush Creek at the site, a surface water and a sediment sample were collected from Brush Creek down gradient of the discharge from the unnamed tributary. All surface water and sediment samples were analyzed for TAL metals, VOCs and SVOCs.

No VOCs or SVOCs were detected from the three surface water samples. Twelve metals were detected in the two surface water samples from the unnamed tributary, but none exceeded the ATSDR health based drinking water CV. Nine metals were detected in the surface water samples from Brush Creek down gradient of the discharge from the unnamed tributary, and again none of the detected metals exceeded their corresponding health based environmental guidelines.

Sediment sample analyses showed that concentrations of arsenic, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene exceeded their respective health based CVs. Therefore, these COCs were

identified for further evaluation in surface water and sediment. Table 3 (Appendix B) presents COCs in surface water and sediment.

Air

Three high volume air samples were collected by Roy F. Weston, Inc., a contractor for USEPA in October 27, 1999. Two air sampling stations were located in the on-site residential area, and one was less than one quarter mile west of the Acme Wood Preserving property, and upwind of the area of concern. Data showed no impact to air as compared to USEPA Region III Removal Action Values, and their RBCs for ambient air [1]. No COCs were identified in air following an evaluation of this limited sampling data.

Exposure Assessment

Exposure Pathways Analysis

To determine whether nearby residents are exposed to contaminants migrating from the site, WVDHHR evaluates the environmental and human components that lead to human exposure. Exposure may occur by breathing, eating or drinking the contaminants, or by skin (dermal) contact with the substance. Exposure pathway is a term that is often used to analyze and characterize the human exposure scenario.

An exposure pathway is the route by which a contaminant travels from its source to the human body. It consists of five components:

- a source of contamination,
- an environmental media through which the contaminants transport through
- a point of exposure,
- a route of human exposure, and ultimately
- the exposed population.

WVDHHR identifies exposure pathways as completed, potential, or eliminated. Completed pathways are those that meet the five elements listed above. A potential pathway exists when one of the above listed five elements is missing, but could exist. Potential pathways indicate exposure to a contaminant may have occurred, may be occurring, or may occur in the future. An eliminated pathway occurs when at least one of the five elements is missing and will never be present.

On-Site Residential Soil – A Completed Exposure Pathway

Based on the contaminant levels identified in on-site residential surface soil, an exposure could happen to anyone who wandered onto or worked on these on-site properties, or to children who played in their yard in this on-site residential area. The routes of exposure could be ingestion of soil, dermal contact, or inhalation of soil particles. This pathway is considered complete because exposure to chemicals at levels above a Comparison Value (CV) had occurred through direct contact with contaminated soil. The chemicals for which people have been exposed in this on-site area include arsenic, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, benzo(a)anthracene, and indeno(1,2,3-cd)pyrene.

On –Site Surface Water and Sediment – A Completed Exposure Pathway

Exposure to contaminated surface water and sediment could result from recreational activities in Brush Creek, including swimming, boating and fishing. The routes of exposure would be accidental ingestion and dermal absorption.

The nearest waterway is Brush Creek, located approximately 1,000 feet north of the site. Surface water runoff from Roseland Wood Site drains to the unnamed tributary of Brush Creek flowing north and parallel to the Roseland Avenue. The unnamed tributary discharges into Brush Creek down gradient of the site. Brush Creek is a perennial stream. Some of the local residents use it for recreational purpose such as swimming, boating and fishing [1].

Based on the contaminant levels identified in on-site surface water and sediment, individuals could be exposed to the contaminants through the ingestion and dermal contact with on-site sediment when they play in the unnamed tributary of Brush Creek and Brush Creek. However, the exposure via this pathway is considered relatively minor compared to the soil pathway, because regular year round contact is less likely.

Food Chain – A Potential Exposure Pathway

Individuals could be exposed to contaminants through consumption of fish caught from Brush Creek. Consumption of fish from Brush Creek was identified as a potential exposure pathway because contamination levels in fish are unknown. The contaminants of concern include arsenic and PAHs. Although some fish and shellfish take in arsenic, which may build up in tissues, most of this arsenic is in an organic form called arsenobetaine (commonly called “fish arsenic”) that is much less harmful [7]. There is no evidence of apparent bioaccumulation of PAHs in various fish and shellfish species according to a study, however, there was a suggestion that contamination may be increasing with time [3]. It appears that the contaminant levels in onsite surface water and sediment must be high enough to result in significant contamination of the food chain. WVDHHR cannot fully evaluate this exposure pathway without Brush Creek fish tissue data.

Based on the contaminant levels identified (between 1992 and 1997) in on-site groundwater monitoring wells, arsenic and copper are the contaminants of the concern. Since the contaminants levels in the residential groundwater were not known, the exposure pathways via groundwater ingestion are considered potential exposure pathways.

Inhaling of Air – A Potential Exposure Pathway

People in the area could be exposed to the contaminants by breathing the potentially contaminated air based on the nature of chemicals used in the wood preserving facility. However, due to lack of air monitoring data, this pathway cannot be further evaluated at this time and ATSDR has identified this as a potential exposure pathway.

Groundwater – An Eliminated Exposure Pathway

There is no record of groundwater or surface water use available in WVDEP. According to the USEPA SDWIS website, there are no community water systems using groundwater within a four-mile radius of the site [1]. Public water was available and supplied to every residence on and near the site. However, according to local health officials, local residents may use well water for economic purposes, even though there is no record.

Table 4 in Appendix B summarized all the exposure pathways described above.

Estimated Exposure Doses

An exposure dose is an estimate of how much of a contaminant gets into a person's body. Estimating an exposure dose requires identifying how much, how often and how long a person may come in contact with certain levels of contaminants in a specific media (i.e. air, water, soil), which in turn, depends on the concentrations of contaminants in various media, and the type of activities and personal habits conducted, including:

- Children playing outside;
- Children exhibiting pica behavior (pica behavior, refers to intentional ingestion of soil items); specifically, the sensitive population associated with pica behavior is children 1-3 years old;
- Adults working or playing outside;
- Teens and adults diving or swimming in Brush Creek and its unnamed tributary; and
- Fishing in Brush Creek.

Depending on the exposure scenarios, assumptions were made in order to determine exposure doses. Generally, those assumptions include exposure duration, exposure frequency, intake rates, and body weights. The assumed exposure durations and frequency are based on communication with local health officials. Intake rates and body weights are based on recommendations from the USEPA Exposure Handbook [8] and the ATSDR Public Health Assessment Guidance Manual [9]. Table 5 in Appendix B summarizes the assumptions used in exposure doses estimation.

These assumptions and the respective exposure scenarios are used to determine the estimated doses for each chemical. The estimated doses will then be compared to health guidelines and the available scientific literature to determine if health effects are likely to occur.

The equation and assumptions used to estimate exposure doses from ingesting contaminants in surface soil is as following:

Equation 1: Exposure Dose Equation for Ingestion

$$\textbf{Dose} = \frac{\textbf{C x IR x EF x CF x BF}}{\textbf{BW}}$$

Where:

D	=	exposure dose in milligrams per kilogram per day (mg/kg/day)
C	=	chemical concentration in milligrams per kilogram (mg/kg)
IR	=	intake rate in milligrams per day (mg/day)

EF = exposure factor (unitless = 1)
CF = conversion factor, 1×10^{-6} kilograms/milligram (kg/mg)
BF = bioavailability factor (unitless)
BW = body weight in kilograms (kg)

The theoretical lifetime cancer risk will be estimated for all the carcinogenic contaminants. The excess cancer risk is the number of cases of cancer in a population that may result from exposure to a particular contaminant at the site under the assumed exposure conditions. A cancer slope factor (CSF) expressed in $(mg/kg/day)^{-1}$, is an estimate of the possible increases in cancer cases in a population in responding to the exposure doses. It is chemical-specific. The USEPA's current CSF for arsenic is 1.5 $(mg/kg/day)^{-1}$, and 7.3 $(mg/kg/day)^{-1}$ for carcinogenic PAHs. Many uncertainties and conservative assumptions were applied to determine these CSFs, such as:

- Past exposures to carcinogenic chemicals were the same as those at currently measured levels.
- Effects from short exposures are averaged over a 70-year lifetime.
- No safe level of exposure for cancer causing chemicals.
- The cancer slope factor is based on the most sensitive range of responses, the 95% upper bound risk. The excess cancer risk would be lower if the average response was used to calculate the cancer slope factor.

This means the actual risk of cancer is probably lower than the calculated number, perhaps by several orders of magnitude. The true excess cancer risk is unknown and could be as low as zero.

Considering many uncertainties, WVDHHR believed that estimated theoretical cancer risks lower than 1 in 10,000 are considered very low which needs no further review, between 1 and 9.9 in 10,000 are classified as low, between 10 and 99 in 10,000 are classified moderate, and greater than 99 in 10,000 are considered significant.

The equation and assumptions used to estimate theoretical cancer risk from ingesting contaminants in surface soil is as following [9]:

Equation 2: Estimated Excess Lifetime Cancer Risk

ER = CSF x Dose

Where:

ER = estimated theoretical risk (unitless)

Dose = estimated life time (70 years) exposure dose (mg/kg/day)

CSF = Cancer Slope Factor $(mg/kg/day)^{-1}$

Arsenic

Non-Cancer Assessment

For arsenic in soil, the primary exposure route of concern is ingestion (oral exposure). Ingestion of soil could occur by the inadvertent consumption of soil on hands or food items, inhalation and

subsequent ingestion of soil particles in the air, mouthing of objects, or intentional ingestion (pica behavior).

Exposure to sediment may occur to older children and adults via seasonal recreation activities in the Brush Creek and its unnamed tributary. Given the nature, size, and purported use of Brush Creek and its unnamed tributary, contact with sediment near Acme Wood should be minimal. However, to maximally protect public health, the estimated exposure dose to sediment is also calculated using the conservative assumption of seasonal access to the sediment.

The estimated overall dose for non-cancer health effects from exposure to surface soil and surface water sediment are calculated for four representative exposure populations: adults, teenage, pre-school children and pica children. According to the estimated exposure doses, the acute exposure (i.e. less than two weeks of exposure) of adults, teenagers and children to even the maximum concentration of arsenic detected in soil and sediment would not be expected to result in non-cancer health effects, as their exposure doses are lower than the ATSDR acute Minimal Risk Level (MRL) for arsenic. Similarly, chronic (i.e. over one year) exposure of adults, teenagers and children to the average arsenic concentration detected in soil would not be expected to result in non-cancer health effects, as their exposure doses are below the chronic arsenic MRL. Acute exposure for children exhibiting pica behavior exceeds the acute MRL, but is still below the dose level where the adverse health effects in human were seen [7]. Table 6 in Appendix B presents the estimated exposure doses.

Estimated Excess Lifetime Cancer Risk

The estimated excess theoretical lifetime cancer risk is calculated using the lifetime exposure to the average arsenic concentration. The cancer risk from exposure to arsenic in surface soil, and surface water and sediment for three exposure populations (i.e. adults, teenage, pre-school children) was estimated. As indicated in Table 8 (Appendix B), lifetime exposure to the maximum detected arsenic concentration results in an excess cancer risk of lower than 1 in 10,000, which is considered by WVDHHR to be a very low risk.

Polycyclic Aromatic Hydrocarbons (PAH)

Based on the contaminant levels identified in on-site surface soil and surface water sediment, six PAHs exceed their CVs, and therefore were identified as COCs requiring further evaluation: Benzo(a)pyrene, Benzo(g,h,i)perylene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Benzo(a)anthracene, Indeno(1,2,3-cd)pyrene. Since their observed health effect level for carcinogenic endpoints is much lower than for non-cancer endpoints [3], WVDHHR will focus this evaluation on cancer effects. The lifetime exposure dose of those PAHs is calculated using the assumptions presented in Table 5 (Appendix B), and the equivalency concentration of Benzo(a)pyrene calculated using their respective TEF and maximum detected concentration. The estimated theoretical cancer risk via exposure to those PAHs from soil and sediment is calculated using equation 2. As presented in Table 9 (Appendix B), lifetime exposure to the maximum detected concentrations of the six carcinogenic PAHs in surface soil and sediment results in an excess cancer risk of less than 1 in 10,000, which is considered by WVDHHR to be a very low risk.

Public Health Implications

Arsenic

Arsenic occurs naturally in soil and minerals. People normally take in small amounts of arsenic in air, water, soil, and food. Of these, food is usually the most common source of arsenic for people [7]. The health-based guidelines for arsenic developed by the USEPA and the ATSDR are defined as estimates of a daily oral exposure of humans, including sensitive sub-populations that are likely to be without an appreciable risk of deleterious, non-cancer effects. Such guidelines are not thresholds for toxicity, but are useful for screening to determine if further evaluations are necessary. The USEPA guideline is referred to as a Reference Dose (RfD), and the ATSDR guideline value is the Minimal Risk Levels (MRL).

In order to determine whether the exposures to arsenic-contaminated soil, surface water, or sediment presents a public health hazard at this site, WVDHHR compared the estimated site-related exposure doses with health-based guidelines that are derived from dose levels known to produce adverse health effects. ATSDR's MRLs for brief exposures (acute, or less than 14 days) and longer term exposures (chronic, or more than a year) are derived from levels known to produce adverse effects, with uncertainties (or safety factors) incorporated into the value. Estimated exposure dose levels below an MRL are not likely to produce adverse, non-cancer effects. For cases of estimated doses above the MRL, WVDHHR evaluates the potential for adverse health effects in an exposed community by comparing levels known to produce adverse effects to the estimated site-specific doses. This margin of exposure (MOE) approach, along with an evaluation of available epidemiologic, toxicological, and medical data, is used by health assessors as part of the public health determination to reach qualitative (rather than quantitative) decisions about hazards posed by site-specific conditions of exposure.

Considering a worst case scenario, a 1 to 3 year old child (weight of 10 kg) briefly exposed to contaminated residential surface soil by ingesting 5000 mg (pica behavior) of soil per day while playing on the residential property, would receive a dose of 0.0086 mg/kg/day. This estimated exposure dose slightly exceeds the ATSDR acute MRL of 0.005 mg/kg/day, but is still six times lower than the Lowest-Observed-Adverse-Effect-Level (LOAEL) where several temporary effects such as nausea, vomiting, diarrhea, occult blood in feces and gastric and duodenal juice were observed [7]. Acute exposure to arsenic can be toxic to the stomach and intestines, with symptoms such as pain, nausea, vomiting, and diarrhea. The acute MRL for arsenic is derived by dividing the LOAEL by an uncertainty factor of 10, meaning the acute MRL is 10 times lower than the dose level (LOAEL) where stomach symptoms were observed.

At low-level exposures, the human body has the ability to change the more toxic form of arsenic (inorganic arsenic) to the less toxic form (organic arsenic), followed by excretion in the urine [7]. At higher-level exposures, however, the body may not be able to transform the increased amount of arsenic effectively. When this overload happens, blood levels of arsenic increase and adverse health effects may occur. Arsenic, like some other chemicals, does not seem to cause adverse health effects until a certain amount, or threshold, of the chemical has entered the body. Once the threshold, also known as the minimal effective dose, is reached, adverse health effects may result [7].

In addition to the acute MRL, ATSDR developed a chronic oral MRL for arsenic of 0.0003 mg/kg/day. As indicated in Table 5, the estimated chronic exposure doses for three exposure sub-populations: preschool children (non-pica), teenagers and adults, do not exceed the chronic oral MRL. The ATSDR chronic oral MRL is based on common and characteristic effects of arsenic ingestion; a pattern of skin changes that include hyperpigmentation (dark spots on the skin) and hyperkeratosis (a skin condition marked by thickening of the outer layer of the skin, which is made of keratin, a tough, protective protein). These dermal effects have been noted in some human studies that involved daily, long-term ingestion (more than 45 years) of elevated arsenic levels in drinking water. Collectively, these studies indicate that the lowest dose for hyperpigmentation and hyperkeratosis is 0.014 mg of arsenic/kg/day [7]. The highest No-Observed-Adverse-Effect-Level (NOAEL) has been observed at arsenic doses of 0.008 mg/kg/day [7].

Therefore, based on a review of this information, WVDHHR concludes that both acute and chronic non-cancer health effects are not expected to occur in children, adults and even pica children based on the results of 1999 and 2002 residential surface soil sampling and the 2002 on-site unnamed tributary sediment sample.

Excess lifetime cancer risks for exposure to on-site residential surface soils and sediment are presented in Table 7 in Appendix B. These theoretical cancer risks assume that adults, teenagers, and preschool children have been regularly exposed to the residential soils year round and seasonally exposed to the sediment in the unnamed tributary for 30, 15 and 6 years, respectively. The resulting excess lifetime cancer risks from exposure to arsenic in the on-site residential surface soil and sediment are all less than 3 in 100,000 (Table 7), which is considered a very low risk by WVDHHR.

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are a complex group of chemicals occurring in the environment as mixtures of many components with widely varying toxic properties. PAHs do not readily dissolve in water, they attach to particles and settle to the bottom of a surface water body. For this reason, PAH concentrations in sediments can be an order of magnitude greater than the surface water concentrations. Although mammals metabolize and excrete PAHs rapidly, they can accumulate in fat tissue, the kidney and liver and in breast milk. Evidence exists to indicate that certain PAHs are carcinogenic in human and animals [3]. Animal studies indicate that several PAHs including Benzo(a)pyrene, Benzo(g,h,i)perylene, Benzo(b)fluoranthene, Benzo(a)anthracene, chrysene, Dibenzo(a,h)anthraxene, Indeno(1,2,3-cd)pyrene are carcinogenic when they are inhaled, ingested or come into contact with the skin. Human studies show that long term exposure to mixtures that contain PAHs and other compounds would cause cancer.

USEPA and others have developed a relative potency estimate approach for the PAHs. By using this approach, the cancer potency of the other carcinogenic PAHs can be estimated based upon their relative potency to benzo(a)pyrene (BaP). In order to evaluate their possible carcinogenic health effects, WVDHHR computed the BaP concentration equivalent from the maximum detected concentration of each PAH COC. As a result, the maximum BaP equivalent concentration of 2.01 mg/kg (ppm) was found in on-site residential surface soils, and 7.55 mg/kg (ppm) was found in the on-site unnamed tributary sediment. (see Table 9 in Appendix B).

A quantitative cancer risk estimate has been developed for BaP by the USEPA. The cancer slope factor for BaP is 7.3 $(mg/kg/day)^{-1}$. According to animal studies, the lowest cancer effect level (CEL) for acute exposure to BaP is 33.3 mg/kg/day, and for chronic exposure is 2.6 mg/kg/day. The estimated exposure doses for both acute (the worst case scenario of acute exposure: pica children) and chronic exposure are several orders of magnitude lower than the CEL. Additionally, the estimated theoretical cancer risks for three exposure populations: preschool children, teenagers and adults are at 1 in 100,000 levels, which is an order of magnitude lower than the acceptable very low risk level of 1 in 10,000, as defined by the WVDHHR.

Data suggests [3] that specific subsections of the population may be susceptible to the toxic effects produced by exposure to PAHs. People with the genetic ability to induce aryl hydrocarbon hydrolase (AHH), a mixed function oxidase believed to be responsible for the metabolism of BaP, are more susceptible to the carcinogenic effects of exposure to PAHs. People who undergo rapid reduction of body fat may be at risk from increased toxicity because of the systemic release and activation of PAHs stored in fat. Other subsections of the population that may be susceptible to the toxic effects of PAHs are people who smoke; people with a history of excessive sun exposure; people with liver and skin diseases; and, women, especially those of child-bearing age.

Note that the above estimates of excess lifetime cancer risk for arsenic and PAHs are based on doses estimated from the maximum concentration detected in the 1999 and 2002 soil samples, and the 2002 on-site sediment samples. In the absence of air monitoring data from plant emissions, residential groundwater data, and fish tissues data from Brush Creek and its unnamed tributary, WVDHHR cannot speculate on potential cumulative arsenic and PAH doses and cancer risks at Roseland Wood Site when the plant is operating.

Evaluation of Health Outcome Data

According to available information, a total of 1,113 children in the zip code area of 24740 had blood lead screening between January 1, 2003 and May 23, 2008. Initial screening showed that ten children had the blood levels above 10 µg/dL. However, confirmatory tests indicated that actual only seven children had a blood level above 10 µg/dL**.** No adequate information was available to determine the causes of the seven children's elevated blood lead level. However, the elevated blood lead levels were apparently not wide-spread and not site related because lead was not found at the site at levels of health concern.

Community Health Concerns

No community health concerns have been brought to WVDHHR's attention by the Mercer County Health Department. In 1999, USEPA and ATSDR received complaints from residents on Roseland Avenue, adjacent to Acme Wood Preserving, Inc., regarding health effects of children and adults. As a result of this community health concern, the USEPA conducted a site investigation by collecting three high volume on-site air samples, and multiple on-site residential surface soil samples. In 2002, WVDEP conducted an additional site investigation by collecting on-site residential surface soil and surface water/sediment samples. This public health assessment is prepared to respond to this community concern based on the data collected from

both environmental investigations performed by USEPA and WVDEP in 1999 and 2002. WVDHHR will continue to monitor community concerns (e.g., communicate with the Mercer County Health Department) as a part of the public health assessment process.

On September 30, 2008, the ATSDR issued the Roseland Wood Site public health assessment (PHA) for public comments. The Public Comment Release version was distributed to numerous individuals and local organizations. In addition, WVDHHR/ATSDR issued a press release on November 12, 2008 announcing the availability of the Public Health Assessment at the Princeton Library, and the scheduling of a public meeting on November 18, 2008.

On November, 18, 2008, WVDHHR/ATSDR representatives hosted a public meeting at Princeton to discuss their findings at the Roseland Wood Site, and to solicit comments. The meeting was conducted in the Council Chamber of Princeton City Hall from 6:30 P.M. to 9:00 P.M. In attendance were seven representatives from Acme Wood Preserving, Inc., and seven local, state and federal officials. No public health concerns were presented by anyone attending this meeting. The three month public comment period ended on December 31, 2008. No concerns were received.

Child Health Considerations

ATSDR/WVDHHR considers children in the evaluation of all exposures, and uses health guidelines that are protective for children. In general, children are assumed more susceptible to chemical exposures. In evaluating health effects from the site-specific environmental exposures, children were considered as a special population because:

- Children weigh less than adults, resulting in higher doses of chemical exposures;
- Children have higher rates of respiration;
- Metabolism and detoxification mechanisms differ in both the very young and very old and may increase or decrease susceptibility;
- A child's developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages; and,
- Outdoor playing and hand-to-mouth habits increase children's exposure potential. The fact that children are smaller than adults makes them more susceptible to the dust, soil, and vapors that are close to the ground.

This public health assessment considered these factors in the evaluation of potential health effects to children, development of conclusions and recommendation for this site.

Conclusion

The five public health hazard categories used by ATSDR are: (1) no public health hazard, (2) no apparent public health hazard, (3) indeterminate public health hazard, (4) public health hazard, and (5) urgent public health hazard.

The WVDHHR assessed the public health implications of chemical contaminants in the environmental media solely based on the available environmental information. Of the exposures evaluated, assumptions by WVDHHR regarding contact with observed contamination are generally very conservative (protective). Therefore, actual or potential risks are likely to be much less. However, other sources of exposure, such as inhalation of the compounds in tobacco and wood smoke, and consumption of PAHs in foods could contribute to an individual's overall risk. Those potential contributions are not reflected in the risk estimates provided in this report. As with all projections of potential risk, uncertainties exist that could impact conclusions to varying degrees.

Based on the evaluation of available environmental information and data associated with the site, WVDHHR concluded:

- The overall chronic and acute exposure to arsenic at the level detected in both on-site residential surface soil and unnamed tributary sediment *poses no apparent public health hazard*, including no apparent public health hazards to children 1 to 6 years old, and children with pica behavior. No adverse non-carcinogenic health effects are expected, and the estimated excess theoretical lifetime cancer risk is well below 1 in 10,000, which is considered very low by WVDHHR.
- The overall chronic and acute exposures to those carcinogenic polycyclic aromatic hydrocarbons (PAHs) such as Benzo(a)anthracene, Benzo(a)pyrene, Benzo(g,h,i)perylene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene at the levels found in both on-site residential surface soil and unnamed tributary sediment *poses no apparent public health hazard*, including no apparent public health hazards to children 1 to 6 years old. Estimated theoretical lifetime cancer risk is less than 1 in 10,000, which is considered very low by WVDHHR.
- Consumption of fish from Brush Creek poses *an indeterminate public health hazard*. Environmental data characterizing contamination of Brush Creek are needed to complete the evaluation of this potential pathway.
- Inhalation of the air on site poses *an indeterminate public health hazard*. Air monitoring data characterizing the air contamination are needed to complete the evaluation of this potential pathway.

Recommendations

In order to fully characterize the nature of the contamination, and assess the public health significance at the Roseland Wood Site, WVDHHR recommends the following:

- Conduct surface water and fish tissue sampling in Brush Creek, especially downstream of the site to determine the extent of contamination in Brush Creek and whether fish, commonly harvested for human consumption, are accumulating site-related contaminants to levels that might pose health hazards to individuals consuming the fish.
- Conduct air quality monitoring at exposure points in the downwind, residential community.

- Conduct a survey to determine whether any private wells are in use in the area. If wells are discovered to be in use, then groundwater sampling should be conducted to characterize the groundwater in the area.
- Conduct education activities (i.e. informational brochures) which provide basic guidelines (i.e. hygiene, grass-cover, etc.) for residents living in areas with increased concentrations of contaminants, including arsenic and PAHs.

WVDHHR will review any additional data which becomes available and revise the public health assessment accordingly.

Public Health Action Plan

WVDHHR will develop a fact sheet outlining the keys points of this report for the local health official, and the community members, and educational fact sheets for arsenic, and PAHs. In addition, WVDHHR will be planning a public meeting in the town of Princeton to present this report, and to provide education to community members in the future when concerns are expressed.

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Certification

This Roseland Wood Site public health assessment was prepared by West Virginia Department of Health and Human Resources (WVDHHR) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the public health assessment was initiated. Editorial review was completed by the Cooperative Agreement partner.

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

Alan Yarbrough
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Appendix A Figure


Figure 1 Roseland Wood Site
N
Daves Fork
Brush Creek
Brush Creek
Brush Creek
Roger St.
104
Northfolk Southern RR
Roseland Wood Site
Roseland Ave.
Appalachian Log Structures
Shufflebarger St.
Acme Wood Preserving INC.
460
460
Former Asphalt Manufacturing Area
Feet
0
250
500

Appendix B Tables

Table 1. Contaminants of Concern – Concentration in Groundwater On-Site

Well #	Contaminant	Detection Frequency (hits/total)	Min - Max Concentration (ppb)	Average Concentration (ppb)	Comparison Values	
					Values (ppb)	Source
1	Arsenic	2 / 17	ND - 14	5.88	3 *	ATSDR drinking water Comparison Values
	Copper	0 / 17	ND - ND	ND	100 **	
2	Arsenic	12 / 17	ND - 73	17.6	3	
	Copper	4 / 17	ND - 220	43.2	100	
3	Arsenic	4 / 17	ND - 230	21.1	3	
	Copper	2 / 17	ND - 350	32.05	100	
4	Arsenic	6 / 17	ND - 76	14.2	3	
	Copper	6 / 17	ND - 760	106	100	

Notes:

***** - *Arsenic benchmark of 3 ppb is ATSDR's comparison values* **, *Child Chronic*** EMEG**,** *Environmental Media Evaluation Guides for children's exposure longer than 365 days.*

** - ***C****opper benchmark of 100 ppb is* ***Child intermediate EMEG*** *- Environmental Media Evaluation Guides for children's exposure within a period of 14 to 365 days.*

ATSDR – ***Agency for Toxic Substances and Disease Registry***
Average - *Arithmetic mean of all measurements, half of detection limit 5 ppb was used in place of ND*
Max – ***Maximum***
Min - ***Minimum***
ppb - *parts per billion****, or µg/liter****, micrograms per liter*

ND - *not detected*

Table 2. Contaminants of Concern – Surface Soil On-Site Residential (1999 and 2002)

Contaminant	Detection Frequency (hits/total)	Maximum Detected Concentration (ppm)	Health-Based Comparison Values (CVs)	
			Value (ppm)	Sources
Arsenic	21 / 21	17.2	0.50	CREG
			20	EMEG
Dibenzo(a,h)anthracene	2 / 21	0.12	0.022	Reg III RBC
Benzo(b)fluoranthene	13 / 21	1.6	0.22	Reg III RBC
Benzo(a)anthracene	12 / 21	0.99	0.22	Reg III RBC
Benzo(a)pyrene	11 / 21	1.1	0.1	CREG
Benzo(g,h,i)perylene	9 / 21	0.42	0.1	CREG
Indeno(1,2,3-cd)pyrene	9 / 21	0.49	0.22	Reg III RBC

Notes:

CREG - *Cancer Risk Evaluation Guide (CREG) are estimated contaminant concentrations based on a probability of one excess cancer in a million persons exposed to a chemical over a lifetime. These values are established by the Agency for Toxic Substances and Disease Registry (ATSDR).*
EMEG - *Child chronic (over one year exposure) Environmental Media Evaluation Guide*

Reg III RBC - *USEPA Region III Risk-Based Concentration*
ppm - *Parts per million (equivalent to milligrams per kilogram)*

Table 3. Contaminants of Concern - Sediment On-Site

Chemical	Frequency of Detection	Concentration (ppm)		Comparison Values (CVs) (ppm)	
		Min - Max	Average	Value	Basis for screening
Unamed Tributary to Brush Creek Surface Water Sediment					
Arsenic	2 / 2	25.5 - 58.4	41.95	0.5	Soil CREG
Benzo(a)anthracene	2 / 2	1.4 - 4.5	2.95	0.22	Reg III RBC
Benzo(b)fluoranthene	2 / 2	3.2 - 7.9	5.55	0.22	Reg III RBC
Benzo(a)pyrene	2 / 2	1.8 - 2.9	2.35	0.1	Soil CREG
Indeno(1,2,3-cd)pyrene	2 / 2	1.8 - 2.4	2.1	0.22	Reg III RBC
Benzo(g,h,i)perylene	2 / 2	1.9 - 2.1	2	0.1	Soil CREG
Dibenzo(a,h)anthracene	1 / 2	0.63 - 0.63	0.63	0.022	Reg III RBC
Brush Creek Surface Water Sediment					
Arsenic	1 / 1	4.9 - 4.9	4.9	0.5	Soil CREG
Benzo(a)anthracene	1 / 1	0.25 - 0.25	0.25	0.22	Reg III RBC
Benzo(b)fluoranthene	1 / 1	0.48 - 0.48	0.48	0.22	Reg III RBC
Benzo(g,h,i)perylene	1 / 1	0.15 - 0.15	0.15	0.1	Soil CREG
Benzo(a)pyrene	1 / 1	0.26 - 0.26	0.26	0.1	Soil CREG

Notes:

Reg III RBC - *USEPA Region III Risk Based Concentration for residential soil*

CREG - *Cancer Risk Evaluation Guide (CREG) are estimated contaminant concentrations based on a probability of one excess cancer in a million persons exposed to a chemical over a lifetime. These values are established by the Agency for Toxic Substances and Disease Registry (ATSDR).*

ppm - *Parts per million, mg/kilogram or milligrams per kilogram*

Table 4. Exposure Pathways

Pathway Name	*Exposure Pathway Elements*					*Time Frame for Exposure*
	Sources of Contamination	*Environmental Medium*	*Point of Exposure*	*Routes of Exposure*	*Potentially Exposed Population*	
Completed Pathways						
Onsite Residential Surface Soil	Acme Wood Preserving, Inc., and other sources	Soil	Residential lawn east of the site	Ingestion Skin contact	Residents who live adjacent to the site	Past Current Future
Onsite Surface Water	Acme Wood Preserving, Inc., and other sources	Surface Water	Between Acme Wood Company and residence property	Ingestion Skin contact	Residents who live nearby the site	Past Current Future
Onsite Surface Water Sediment	Acme Wood Preserving, Inc., and other sources	Sediment	Between Acme Wood Company and residence property	Ingestion Skin contact	Residents who live nearby the site	Past Current Future
Potential Pathways						
Food chain	Unknown	Fish	In the Brush Creek and its tributary in the vicinity of the site	Ingestion	Residents who live nearby the site	Past Current Future
Inhaling Air When Facility in Operation	Emission from wood preserving operation and other sources	Air	Location in the immediate vicinity of the facility	Inhalation	Residents who live in the immediate vicinity of the facility	Past Current Future
Eliminated Pathway						
Groundwater	Some natural occur and some from the Acme Wood property	Groundwater	None. There is no record of people use onsite or offsite groundwater for potable water	None	None	None

Table 5. Exposure Scenarios and Assumptions

Exposure Population	Duration of Exposure to soil	Duration of Exposure to Sediment	Soil Intake Rate	Body Weight	Time Frame for Cancer Evaluation
Toddler (pica children)	A few hours to a day	NA	5, 000 mg/day 0.7 tsp/event	10 kg (22 lbs.)	NA: Single event; Acute Exposure
Preschool child (non-pica)	365 days/yr	15 hrs / year*	200 mg/day 0.02 tsp/day	16 kg (35 lbs.)	6 years
Teenage	365 days/yr	45 hrs / years**	150 mg/day 0.015 tsp/day	55 kg (122 Ibs.)	15 years
Adult	365 days/yr	90 hrs/ year***	100 mg/day 0.01 tsp/day	70 kg (154 lbs.)	30 years

Notes:

Soil intake rates*: Pica children, non-Pica children and adult soil ingestion rates are based on USEPA Exposure Factors Handbook, others are ATSDR or USEPA recommended rates (central tendency) for children and adults (USEPA Exposure Factors Handbook).*

The soil intake rates, as converted to teaspoons, are based on a soil bulk density of 1.5 g/cm^3 (grams per cubic centimeter) and a volumetric conversion of 1 tsp = 4.93 cm^3.

***** *- Assumes that preschool kids play in Brush Creek and its unnamed tributary once a week, 1 hr/event, for 15 summer weeks (June, July and August)*

****** *- Assumes that a teenager play in Brush Creek and its unnamed tributary three times a week, 1 hr/event for 15 summer weeks (June, July and August)*

******* *- Assumes that an adult swims in Brush Creek and its unnamed tributary 5 times a week, 1 hr/event for 18 summer weeks (June, July, August and September)*

Hrs *- hours*
Kg *- kilograms*
Lbs *- pounds*
Mg/day *- milligrams per day*
NA *- Not applicable*
Yr *- year*
Tsp *- teaspoon*

Table 6. Estimated Exposure Dose – Arsenic (Surface Soil and Sediment)

Exposure Duration	Exposure Concentration (ppm)	Estimated exposure Dose (mg/kg/day)				MRL (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)
		Adult	Teenage	Pre-School Child	Child (pica)			
Arsenic in Surface Soil								
Acute	17.2	2.46E-05	4.69E-05	2.15E-04	8.6E-03	5.0E-03	NA	5.0E-02
Chronic	6.9	9.86E-06	1.88E-05	8.63E-05	NA	3.0E-04	8.0E-03	1.4E-02
Arsenic in Sediment								
Acute	58.4	8.57E-07	1.09E-06	3.75E-06	NA	5.0E-03	NA	5.0E-02
Chronic	41.95	6.16E-07	7.84E-07	2.69E-06		3.0E-04	8.0E-03	1.4E-02
Overall Dose From Exposure to Surface Soil and Sediment								
Acute	overall	2.54E-05	4.80E-05	2.19E-04	8.6E-03	5.0E-03	NA	5.0E-02
Chronic	overall	1.05E-05	1.96E-05	8.89E-05	NA	3.0E-04	8.0E-03	1.4E-02

Notes:

MRL - *An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure.*

NOAEL - *No-Observed-Adverse-Effect-Level. It is a dose at which no harmful effects were seen. The NOAEL for arsenic of 0.008 mg/kg/day is based on a human study of 45 yrs of arsenic exposure from ingestion of groundwater. Chronic MRL is derived by dividing the NOAEL by an uncertainty factor of 3.*

LOAEL - *Lowest-Observed-Adverse-Effect-Level. The lowest dose that is most likely to result in harmful effects. The LOAEL for arsenic of 0.05mg/kg/day is based on a human study of non-cancer health effects such as nausea, vomiting, diarrhea, occult blood in feces and gastric and duodenal juice. The acute MRL is obtained by dividing the LOAEL by an uncertainty factor of 10.*

Exposure frequency to surface water sediment is assumed as:

Child: *1hr/event, 1event/week for 15 weeks of summer months (June, July and August): 15 / 365x24*

Teenage: *1hrs/event, 3 events/week for 15 weeks of summer months (June, July and August): 3x15 / 365x24*

Adult: *1hr/event, 5 events/week for 18 summer weeks(June, July, August and September): 5x18 / 365x24*

Table 7. Estimated Cancer Risk – Arsenic (Surface Soil and Surface Water Sediment)

Exposure Situation	Exposure Concentration (ppm)	Estimated Excess Lifetime Cancer Risk			Is the overall Cancer Risk over 1 in 10,000?
		Adult	Teenage	Pre-School Child	
From Exposure to Surface Soil					
70 years	17.2	1.58E-05	1.51E-05	2.76E-05	No
From Exposure to Surface Water Sediment					
70 years	58.4	5.51E-07	2.63E-07	1.61E-07	No
Overall Lifetime Cancer Risk					
70 years	Overall	1.63E-05	1.53E-05	2.78E-05	No

Notes:

Cancer Slope Factor - *The cancer risk for each exposure population is calculated using As cancer Slope factor of 1.5 (mg/kg/day)$^{-1}$*

Exposure Concentration - *The cancer risk is estimated using maximum detected concentration.*

Exposure frequency to surface water sediment is assumed as:

Child - *1hr/event, 1event/week for 15 weeks of summer months (June, July and August): 15 / 365x24*

Teenage - *1hrs/event, 3 events/week for 15 weeks of summer months (June, July and August): 3x15 / 365x24*

Adult - *1hr/event, 5 events/week for 18 summer weeks(June, July, August and September): 5x18 / 365x24*

Table 8. Estimated Cancer Risk - PAHs (Surface Soil and Sediment)

Contaminants	Toxicity Equivalency Factor	Maximum Detected Concentration (ppm)	Equivalent Conc. of B[a]P (ppm)	Estimated Excess Theoretical Cancer Risk			Is the overall Cancer Risk over 1 in 10,000?
				Preschool Age (1-6)	Teenagers	Adult	
From Exposure to Surface Soil							
Benzo(b)fluoranthene	0.1	1.6	0.16				
Dibenzo(a,h)anthracene	5	0.12	0.6				
Benzo(a)pyrene (B[a]P)	1	1.1	1.1				
Benzo(g,h,i)perylene	0.01	0.42	0.0042				
Benzo(a)anthracene	0.1	0.99	0.099				
Indeno(1,2,3-cd)pyrene	0.1	0.49	0.049				
Total B[a]P Equivalent Concentration			2.01	1.57E-05	1.14E-05	8.99E-06	
From Exposure to Surface Water Sediment							
Benzo(a)anthracene	0.1	4.5	0.45				
Benzo(b)fluoranthene	0.1	7.9	0.79				
Benzo(a)pyrene	1	2.9	2.9				
Indeno(1,2,3-cd)pyrene	0.1	2.4	0.24				
Benzo(g,h,i)perylene	0.01	2.1	0.021				
Dibenzo(a,h)anthracene	5	0.63	3.15				
Total B[a]P Equivalent Concentration			7.55	1.01E-07	2.21E-07	5.20E-07	
Overall Cancer Risk from Exposure to Surface Soil and Sediment							
				1.58E-05	1.17E-05	9.51E-06	No

Notes:

Exposure frequency to surface water sediment is assumed as:

Child - *1hr/event, 1event/week for 15 weeks of summer months (June, July and August): 15 / 365x24*

Teenage - *1hrs/event, 3 events/week for 15 weeks of summer months (June, July and August): 3x15 / 365x24*

Adult - *1hr/event, 5 events/week for 18 summer weeks(June, July, August and September): 5x18 / 365x24*

Cancer Slope Factor - *7.3 $(mg/kg/day)^{-1}$ is used as cancer slope factor in estimation of cancer risk for PAHS*

Appendix C Glossary of Term

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)
ATSDR	Agency for Toxic Substances and Disease Registry
BaP	Benzo(a)pyrene
Cancer risk	A theoretical risk for getting cancer if exposed to a substances every day for 70 years (a lifetime exposure).
CCA	Chromated Copper arsenic
CEI	Compliance Evaluation Inspection
CELs	Cancer Effects Levels
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
Chronic	Occurring over a long time
Chronic Exposure	Contact with a substance that occurs over a long time (more than 1 year)
COCs	Contaminants of concern
CSF	Cancer slope factor
CVs	Comparison Values
CREG	Cancer Risk Evaluation Guides
EMEG	Environmental media evaluation guide
EPA	U.S. Environmental Protection Agency
HAZCAT	Hazard Categorization
Intermediate Exposure	Exposure duration of 14 – 365 days
LOAEL	Lowest Observed Adverse Effect Level
MCL	maximum contaminant level
MOE	Margin of exposure
MRL	Minimal Risk Level
NOAEL	No Observed Adverse Effect level
NOV	Notice of Violation
NPDES	National Discharge Elimination System
OER	Office of Environmental Remediation (OER)
OSC	On-Scene-Coordinator
OWM	Office of Waste Management
PAHs	Polycyclic Aromatic Hydrocarbons
PA/SI	Preliminary assessment/Site Investigation
PHA	Public health assessment
Pica	A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior
ppb	Parts per billion, microgram/liter (µg/L) or microgram/kilogram (µg/kg)
ppm	Parts per million, milligram/liter (mg/L) or milligram/kilogram (mg/kg)
QA/QC	Quality assurance and quality control
RBCs	Risk based concentrations

RfD	Reference Doses
RMEG	Reference Dose Media Evaluation Guides
SATA	Site Assessment and Technical Assistance
SDWIS	Safe Drinking Water Information Service
SVOC	Semi-volatile organic compounds
TAL	Target Analyte List
TEF	Toxicity Equivalent Factor
VOC	Volatile organic compound
WVDEP	West Virginia Department of Environmental Protection