ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

ALLEGANY BALLISTICS LABORATORY
ROCKET CENTER, MINERAL COUNTY, WEST VIRGINIA
EPA FACILITY ID: WV0170023691
MAY 21, 2007

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.

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

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PUBLIC HEALTH ASSESSMENT

ALLEGANY BALLISTICS LABORATORY

ROCKET CENTER, MINERAL COUNTY, WEST VIRGINIA

EPA FACILITY ID: WV0170023691

Prepared by:

U.S Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

FOREWORD

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

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

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

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

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

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

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

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

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

Letters should be addressed as follows:

Agency for Toxic Substances and Disease Registry
ATTN: Records Center
1600 Clifton Road, NE (Mail Stop E-60)
Atlanta, GA 30333

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List of Abbreviations

ABL	Allegany Ballistics Laboratory
ATK	ATK Tactical Systems Company LLC
ATSDR	Agency for Toxic Substances and Disease Registry
EPA	U.S. Environmental Protection Agency
^{o}F	degrees Fahrenheit
MD	Maryland
MDE	Maryland Department of the Environment
MGD	million gallons per day
NEI	National Emissions Inventory
NPL	National Priorities List
PHA	public health assessment
RAB	Restoration Advisory Board
RDX	1,3,5-trinitro-1,3,5-triazine
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SVOC	semi-volatile organic compound
TCE	trichloroethylene
TEQ	toxic equivalent
TNT	2,4,6-trinitrotoluene
µg/L	micrograms per liter
VOC	volatile organic compound
WV	West Virginia
WVDEP	West Virginia Department of Environmental Protection
WVDHHR	West Virginia Department of Health and Human Resources

Summary

Allegany Ballistics Laboratory (ABL) consists of 1,577 acres of Navy-owned property contiguously located with 57 acres of property owned by ATK Tactical Systems Company LLC (ATK). ATK, a Navy contractor, operates the Navy-owned property and the privately-owned property as one integrated facility. The facility is located in Mineral County, West Virginia, along the North Branch Potomac River. Immediately across this river is Allegany County, Maryland, where the nearest residents live. Operations at ABL generate various wastes that are either managed on site or transferred off site for treatment or disposal, but some past waste disposal practices at ABL have contaminated the local environment. While the Navy has removed or otherwise addressed contamination at many locations at ABL, some contamination remains.

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate environmental health issues related to contamination at ABL. The objectives of this PHA are (1) to determine whether residents have been exposed to harmful levels of contamination originating from ABL; and (2) to make recommendations to ensure that harmful exposures do not occur in the future.

Conclusions in this PHA are based largely on environmental sampling data, modeling studies, and other records generated by multiple parties, including the U.S. Environmental Protection Agency (EPA), the West Virginia Department of Environmental Protection (WVDEP), the West Virginia Department of Health and Human Resources (WVDHHR), the Navy, and ATK. ATSDR considered relevant information from them when preparing this PHA.

This PHA focuses on five different ways that local residents might be exposed to environmental contamination at ABL, whether in the past, present, or future. ATSDR's findings for these five exposure pathways are presented below and summarized in Table 1.

- **Local drinking water quality.** Past operations at ABL have contaminated the groundwater at several on-site locations. The groundwater contaminants include chemicals from solvents and residues from propellants and explosives. ABL has implemented several measures to prevent the contamination from moving off site and affecting local drinking water supplies. Sampling data have shown that ABL's water supply and local municipal water supplies are not affected by contamination from ABL, but few of the local private wells have been sampled. Recognizing the uncertainty associated with the local geology and movement of perchlorate in water bearing fractures, ATSDR recommends that the Navy sample private wells serving homes located along McKenzie Tower Road in Maryland for perchlorate to verify that water is not moving thru fractures to active drinking water or irrigation wells. Given multiple nearby potential sources of groundwater contamination *other* than ABL, ATSDR recommends that owners of private wells serving homes located in Pinto and along McKenzie Tower Road have their drinking water tested for contaminants other than perchlorate to ensure that the well water is safe to drink.
- **Air emissions from open burning, boilers, and other operations.** Nearly 8 years ago, ATSDR issued a health consultation for this site that found air emissions from open burning of waste material at ABL to not pose a health hazard to nearby residents. After reviewing

more recent data on this issue, ATSDR continues to support its previous conclusion. Provisions in operating permits issued by WVDEP should help ensure that air emissions from the boilers and all other sources at ABL do not pose a health hazard to local residents.

- **Contamination in the North Branch Potomac River.** Pollutants in the North Branch Potomac River originate from many industrial sources (including ABL), municipal sources, and agricultural sources. Releases from ABL are diluted considerably by the high river flow to the point that ABL's releases alone are not expected to adversely affect downstream drinking water supplies or downstream farms that use river water for irrigation. Fish in the North Branch Potomac River have elevated levels of contamination that originated primarily from sources upstream of ABL. Perchlorate has been found essentially at the same levels up and down stream of ABL. Insects near ABL have been found to have elevated levels of perchlorate. The level of uptake of perchlorate by fish from the water or from eating insects near ABL or other locations along the river has not been determined. Residents can avoid the hazards posed by this fish tissue contamination by heeding the applicable West Virginia fishing advisories, which are presented in Table 4 of this PHA.
- **Eating cuts of meat from locally harvested deer and game.** Deer and other terrestrial wildlife feed on grasses and shrubs at ABL, including in areas with environmental contamination. All herbivores including deer will deliberately eat mineral soil. Uptake also occurs accidentally from soil on roots, and soil that has washed or blown onto leaves (Beyer et al. 1994). Deer tissue samples from ABL have never been collected, nor have such sampling studies been required. However, sampling studies conducted at other facilities with similar environmental contamination issues suggest that environmental contamination at ABL likely is not entering deer muscle tissue (cuts of meat) at levels of health concern. Other wild game and birds have not been seen in contaminated areas on a routine basis.
- **Potential to encounter explosive gases.** Some inactive waste disposal sites at ABL contain methane gas. This gas could be of concern if it were to accumulate in confined spaces, which can lead to explosions and fires. Accumulation of methane gas at this site is not a health hazard to residents, due to the current site restrictions which prevent residents from coming into contact with harmful amounts of site-related substances. The former landfill at ABL (also known as Site 5) should not present an explosion hazard that impacts people in the future due to deed restrictions filed by the Navy and provided that buildings, structures or equipment that could collect and build up landfill gases are not constructed or operated immediately adjacent to the site. With deed restrictions in place to limit development at this site, the methane gas should present no hazard to residential communities outside of the boundaries of ABL in the future, provided the post-closure plan is followed.

The remainder of this PHA describes how ATSDR reached the summary statements listed above. Those interested in only a brief summary of the main conclusions and recommendations should refer to the Conclusions and Public Health Action Plan near the end of this report. Those interested in a detailed account of ATSDR's scientific analyses are encouraged to read the entire report. Appendix A of this PHA presents a glossary of terms commonly used in environmental health evaluations. Appendix B describes specific sources of environmental contamination at ABL that ATSDR evaluated before completing this PHA.

Table 1. Exposure Pathways Evaluated for ABL

Exposure Pathway	*Time Frame*	*Exposure?*	*Conclusion*	*Actions Taken to Limit Exposure*
Drinking or contacting contaminated groundwater (ABL water supply, local municipal water supplies, and most private wells)	Past Current Future	No No No	Pathway presents no health hazard because people have never and are not expected to ever come into contact with harmful amounts of site-related substances from currently identified sources of contamination	1) Groundwater contamination plumes at ABL are closely monitored. 2) Groundwater pump-and-treat operations prevent migration of contaminated plumes. 3) ABL's water supply and local municipal water supplies are routinely tested for potential contamination.
Drinking or contacting contaminated groundwater from individual private wells in McKenzie Tower Road areas	Past Current Future	Possible Possible Possible	A judgment about the level of hazard cannot be made because information critical to such a decision is lacking	1) Groundwater contamination plumes at ABL are closely monitored. 2) Groundwater pump-and-treat operations prevent migration of contaminated plumes.
Inhaling air pollutants from open burning of waste material, boiler exhaust, and various other ABL operations	Past	Possible	A judgment about the level of hazard cannot be made because information critical to such a decision is lacking	1) ATSDR's previous health consultation found no apparent public health hazard for air emissions of most pollutants. 2) Insufficient data were available to determine if air emissions of dioxin were a health hazard for years prior to 1995.
	Current Future	Possible Possible	Exposure to contaminated media occurs through this pathway, but not at levels expected to cause any harmful health effects	1) An air permit and waste management permit issued by the West Virginia Department of Environmental Protection limit the conditions under which open burning of waste material can occur. 2) ABL implemented improved open burning practices (e.g., using burn pans, restricting the material that is burned) to reduce emissions.

Exposure Pathway	*Time Frame*	*Exposure?*	*Conclusion*	*Actions Taken to Limit Exposure*
Coming into contact with contamination from ABL in the North Branch Potomac River	Past Current Future	Possible Possible Possible	Exposure to contaminated media occurs through this pathway, but not at levels expected to cause any harmful health effects	1) Downstream drinking water supplies treat the river water before distributing it and test the quality of the treated water. 2) Fishing advisories have been developed for the North Branch Potomac River.
Eating meat or locally harvested deer and game	Past Current Future	Possible Possible Possible	Exposure to contaminated media occurs through this pathway, but not at levels expected to cause any harmful health effects	1) The Navy is cleaning up contamination that remains in surface soils. This will further limit the amount of site-related contamination that animals might uptake.
Coming into contact with potentially explosive gases in residential areas outside of ABL	Past Current Future	No No No	Pathway presents no health hazard because people in residential areas never have and are not expected to ever come into contact with harmful amounts of site-related substances	1) The Navy installed a gas collection and venting system at the former landfill (Site 5). 2) Methane gas at the former landfill is periodically monitored at some locations. A judgment about the level of explosive and fire hazards at the landfill cannot be made because information critical to such a decision is lacking. 3) The Navy has a deed restriction to limit future development of the former landfill site.

Notes: Refer to Appendix A for definitions of the conclusion categories listed in this table.

ATSDR considered past exposures to the extent that sufficient information (whether based on sampling data or judgment) was available to support an evaluation. While ATSDR could not assess environmental health issues dating back to the 1940s, when operations first began at what is now ABL, the available information does allow ATSDR to draw reasonable inferences about past exposures over the time frame that ATSDR has been involved with this site. Thus, "past" exposures in this table refer to those that occurred over approximately the last 15 years.

Background

This document evaluates whether environmental contamination at Allegany Ballistics Laboratory (ABL) poses health hazards to local community members. After reviewing site documents, consulting with state environmental and health agencies, and identifying relevant community health concerns, ATSDR identified five scenarios through which people might be exposed to contamination originating from ABL, whether now or in the future. These exposure scenarios are:

- Drinking contaminated groundwater
- Inhaling air pollutants
- Contacting contaminants in the North Branch Potomac River, whether through drinking river water or eating fish caught from the river
- Eating cuts of meat from deer or other locally harvested game
- Encountering potentially explosive gases

This public health assessment (PHA) presents ATSDR's findings for each exposure scenario. Table 1 briefly summarizes ATSDR's main conclusions, along with actions that have been taken to limit potential exposures. The recommendations ATSDR made to ensure that unsafe exposures do not occur in the future are listed at the end of this document (see page 25). In addition, Appendix B of this PHA documents the known areas of environmental contamination at ABL and describes actions being taken to ensure that these contaminated areas do not harm human health or the environment.

When preparing this PHA, ATSDR first collected background information on topics such as ABL's operational history, local environmental setting, and demographics. The remainder of this section summarizes this background information by presenting facts and observations about ABL, without any analyses or interpretations. This background section is not intended to provide a comprehensive account of the ABL site; rather, the section focuses on topics that relate to the five main exposure scenarios considered in this PHA. Later sections in this report (see Discussion, page 9) describe how the background information fits into the overall environmental health analysis for this site.

Where can residents get more information on environmental contamination at ABL?

Dozens of relevant reports prepared for ABL by the Navy, its contractors, and other parties are on file at two local record repositories. The repositories are located at:

La Vale Public Library
815 National Highway
La Vale, Maryland 21502
Contact: 301-729-0855

Fort Ashby Public Library
Box 74, Lincoln Street
Fort Ashby, West Virginia 26719
Contact: 304-298-4493

Residents can learn more about ATSDR's past and current activities related to ABL by dialing the agency's toll free number, 1-888-42ATSDR (or 1-888-422-8737).

Site Description and Operational History

ABL is located along the North Branch Potomac River, which forms the border between West Virginia and Maryland (see Figure 1). The site lies entirely within Mineral County, West Virginia (WV). The nearest residents live across the North Branch Potomac River in Allegany County, Maryland (MD). A small mountain range separates the nearest residential communities in West Virginia from ABL. Developed land uses in the immediate vicinity of ABL are primarily agricultural and light residential, and the nearby undeveloped lands are mostly forest.

Two operating plants are located at ABL (see Figure 1). Most of ABL is known as "Plant 1," which covers 1,577 acres. Plant 1 is currently owned by the U.S. Navy (Navy) and operated by a contractor named ATK Tactical Systems Company LLC (ATK). Nearly all operations at this facility occur in the Industrial Area, which covers approximately 400 acres. The rest of Plant 1 is typically referred to as the Undeveloped Area, which has extremely limited operations. "Plant 2" covers 57 acres, and ATK both owns and operates that facility. Of the two plants, only Plant 1 is on EPA's National Priorities List (NPL) for sites containing hazardous wastes; Plant 2 is not. Accordingly, this PHA focuses on environmental contamination at Plant 1.

Operations at ABL date back to 1942, when the U.S. Army acquired the property that is now the industrial portion of Plant 1. The primary research activities conducted at ABL during this time focused on solid propellants used for ballistic devices. The Navy took ownership of the land in 1946, when Hercules Powder Company began managing operations at Plant 1. The Navy acquired the Undeveloped Area of ABL in 1962, and Plant 2 was constructed in 1967. Although the specific activities conducted at the site varied from one year to the next, most of ABL's operations over the years involved research, development, production, and testing of ballistic devices, solid propellants, and motors that the military uses in ammunition, rockets, and armaments. Public access to ABL is restricted by fences and monitored by video surveillance and security patrols.

Historically, operations at ABL have generated a variety of wastes, including solvents, ash, and other residues from industrial processes. Before 1978, most of these wastes were disposed of at landfills, pits, and other areas at ABL (EPA 2005a). More recently, site wastes have been handled according to EPA's waste management regulations and specifications in ABL's environmental permits. Though contamination still remains on site from past waste disposal practices and some site-related contaminants have been detected in the North Branch Potomac River, ABL has made extensive efforts to clean up or otherwise address these issues. Waste materials found at ABL include propellants, explosives, solvents, metals, and other chemicals.

Remedial and Regulatory History

As Table 2 shows, key events in ABL's remedial and regulatory history date back to at least 1983, when the Navy completed its Initial Assessment Study of environmental contamination at ABL. Since that time, as part of the U.S. Department of Defense's Installation Restoration

Program, the Navy has funded numerous environmental investigations at ABL. These investigations helped identify, evaluate, and clean up areas of environmental contamination that remain from past operations. The majority of contamination identified at ABL is found in the Industrial Area in Plant 1, with limited contamination occurring in the Undeveloped Area.

In 1993, EPA proposed listing ABL on the NPL due to evidence of groundwater contamination. This listing was finalized in 1994. The NPL listing triggered many environmental investigations to characterize the nature and extent of contamination and to decide what actions should be taken to protect human health and the environment. Both EPA and the West Virginia Department of Environmental Protection (WVDEP) have provided regulatory oversight on these investigations, and community and stakeholder input has been provided through a Restoration Advisory Board (RAB).

ABL's ongoing investigations have focused largely on several sites with documented environmental contamination. To date, the Navy has signed four Records of Decision (RODs) that outline measures to be taken to address environmental contamination at specific sites (EPA 1997a; 1997b; 1998; 2001), and remedial investigations continue at the sites for which RODs have not been signed. Appendix B briefly summarizes the status of ongoing environmental investigations at ABL.

Table 2. Selected Milestones in ABL's Regulatory and Remedial History

Date	*Milestone*
January 1983	The Navy publishes its Initial Assessment Study for ABL.
June 1993	EPA proposes listing ABL on the NPL.
May 1994	EPA officially lists ABL on the NPL.
December 1994	A Restoration Advisory Board forms.
February 1997	ROD signed for soil contamination at Site 5.
May 1997	ROD signed for groundwater contamination at Site 1.
January 1998	The Navy, EPA, and the state sign the Federal Facility Agreement.
June 1998	Interim ROD signed for groundwater contamination at Site 10.
September 2001	No Further Action ROD signed for Site 7.
August 2005	ROD signed for groundwater contamination at Site 10.

Note: Appendix B includes further information on the regulatory status of the contaminated sites at ABL.

Environmental Setting

The environmental setting for a site largely determines how close residents can come to sources of contamination and how contaminants move through the environment. Accordingly, ATSDR reviewed ABL's environmental setting to provide background information on the main exposure scenarios considered in this PHA. Key observations on the environmental setting follow:

- **Hydrogeology.** Hydrogeology is the science of where groundwater occurs and how it moves through the environment. ATSDR reviewed the hydrogeology at ABL to address the exposure scenario of drinking water quality. Groundwater beneath most of the operations at ABL flows in two aquifers: an alluvial aquifer and a bedrock aquifer.

  The alluvial aquifer is nearest the surface. Groundwater in this aquifer flows through alluvial deposits of clay, silt, sand, and gravel. The composition of these materials varies with depth

and location; the total depth of the alluvial aquifer is approximately 25 to 40 feet below ground surface throughout most of the Industrial Area. The groundwater in the alluvial aquifer primarily flows toward, and is currently believed to eventually discharge into, the North Branch Potomac River. Some of the groundwater in the alluvial aquifer enters the deeper bedrock aquifer.

The bedrock beneath the alluvial deposits is predominantly folded and fractured shale. Groundwater in this aquifer flows largely in the fractures. Throughout most of the Industrial Area, groundwater in the shallow bedrock flows toward the North Branch Potomac River and discharges directly to the river, without flowing beneath the river. However, some early studies at ABL suggested that groundwater in the shallow bedrock in the easternmost portion of the Industrial Area could possibly flow beneath the river and continue moving towards locations in Maryland (EPA 1997a). Based on an analysis of well sampling data from Maryland, however, EPA eventually concluded that "…the river is most likely a discharge zone for shallow bedrock groundwater in the vicinity" of the Industrial Area (EPA 1997a). EPA reported no evidence of site-related contamination being found in any of the groundwater samples collected in Maryland. The evaluation of the drinking water exposure scenario reviews this issue further (see Local Drinking Water Quality, page 10).

- **Climate and meteorology.** ATSDR reviewed the climate and meteorology near ABL given that the weather and prevailing wind patterns affect how contaminants move through the air, which is one of the exposure scenarios that this PHA evaluates. Weather conditions at ABL vary considerably from season to season. For example, according to 30 recent years of weather observations made in Mineral County, the monthly average temperature in the area ranges from 30.5 degrees Fahrenheit (^{o}F) in January to 73.3 ^{o}F in July; the area receives roughly 40 inches of precipitation a year, primarily in the form of rain (NCDC 2002a,b). The local terrain features strongly influence prevailing wind patterns. Consistent with the orientation of the valley at ABL (see Figure 2), winds in the Industrial Area predominantly blow either from west to east or from east to west (ATSDR 1997a; CH2M Hill 2002b). These observations factored into ATSDR's evaluation of air emissions sources at ABL (see Air Emissions from Open Burning and Other Operations, page 12).
- **Surface water.** The North Branch Potomac River is the primary receiving stream for all storm water and treated wastewater discharges at ABL. While precipitation that falls at ABL flows into various small creeks and ditches, all of these eventually flow into the North Branch Potomac River. Therefore, when evaluating site-related contamination in off-site surface waters, this PHA considers only the North Branch Potomac River. Recreational uses of the North Branch Potomac River in the vicinity of ABL are currently limited and multiple fishing advisories have been posted for the river. Later sections of this PHA revisit these issues when addressing the river's water quality (see Contamination in the North Branch Potomac River, page 16).
- **Sediments.** ATSDR considered the possibility of contamination released from ABL in surface water mixing and being deposited with other up river sediments being carried by the North Branch Potomac River.
- **Wildlife.** Certain environmental contaminants, when found in soils and surface water, can accumulate in various wildlife species, including plants, birds, and mammals. Given that ABL and its surroundings are habitats for a variety of wildlife species, ATSDR considered

the possibility of contamination entering the local food chain. The focus of this evaluation is on deer, which were observed during the site visit to feed on grasses throughout ABL, including in areas with known environmental contamination. Though hunting is prohibited in the Industrial Area of ABL, this activity is permitted in the Undeveloped Area and nearby lands. Refer to the exposure pathway evaluations (see Eating Cuts of Meat from Locally Harvested Deer and Game, page 19) for further insights on whether cuts of meat from deer hunted in this area are safe to eat.

Demographics

Figure 1 displays demographic data (i.e., population information) for the ABL vicinity, based on statistics compiled from the 2000 U.S. Census. The estimated population within 1 mile of the ABL site boundary is 1,934 residents, who mostly live in Maryland. The Maryland residents who live closest to ABL reside in the community of Pinto, which is located directly across the North Branch Potomac River from the Industrial Area. The figure also presents the estimated proportion of the population who are children (9%), women of childbearing age (20%), and elderly (16%). No residents live within the ABL property boundary, though approximately 850 full-time employees work at the site.

Quality Assurance and Quality Control

In preparing this PHA, ATSDR reviewed and evaluated environmental sampling data provided in various reports prepared by the Navy, its contractors, state regulatory agencies, and other parties. Most environmental sampling data considered in this PHA were required to meet specific quality assurance and quality control measures for chain-of-custody procedures, laboratory procedures, and data reporting. Limitations associated with the sampling data are documented in this PHA, as appropriate. The validity of analyses and conclusions drawn in this PHA are based on the reliability of information referenced in reports prepared for the ABL site. ATSDR believes that the quality of environmental data available in these reports is sufficient to support this public health assessment.

Discussion

ATSDR reviewed environmental data documented in numerous reports (see References, page 28) to evaluate the five exposure scenarios of greatest concern for ABL. When addressing these issues, ATSDR evaluated the levels of contamination present, the extent to which people come into contact with (i.e., are exposed to) the contamination, and whether this contact would result in a past, current, or future public health hazard.

ATSDR's evaluation process emphasizes the importance of **exposure**, or the different ways that people can come into contact with environmental contaminants. Evaluating exposure is quite critical because, if residents are not exposed to a site's environmental contamination, then the contaminants cannot pose a public health hazard. If, on the other hand, residents are exposed to site-related contaminants, then further analysis is needed to characterize the exposure. However, the fact that exposure occurs does not mean that residents necessarily will have health effects or get sick. In fact, for many contaminants, environmental exposures are often far lower than the exposure people experience through their diets, use of exposure through household products, and perhaps through their occupations. In cases where exposure does occur, ATSDR must answer

several questions to understand the public health implications (e.g., To what contaminants are people exposed? How often are people exposed, and for how long? To what contamination levels are people exposed?). These are just some of the issues ATSDR considers when assessing whether harmful health effects might result from exposure.

An initial step in evaluating exposures is clearly defining the issues to be evaluated. As stated previously, this PHA focuses on five specific exposure scenarios of particular concern to residents and through which residents might come into contact with contamination from ABL. The remainder of this section addresses these five scenarios, and Appendix B presents ATSDR's review of environmental contamination detected at specific locations at ABL.

Local Drinking Water Quality

Workers at ABL and nearby residents get their drinking water from various water supplies, several of which draw from groundwater resources. ATSDR evaluated the safety of these drinking water supplies, considering whether groundwater contamination from ABL might affect the drinking water quality. (See Appendix B for further information on groundwater contamination at ABL.) ATSDR's evaluation considered the following three types of water supplies:

Past operations at ABL have contaminated the groundwater at several on-site locations. The groundwater contaminants include volatile organic compounds (VOCs) from chlorinated solvents and residues from propellants and explosives. All sampling studies reviewed to date suggest, but do not prove, that the groundwater contamination currently remains mostly within the site boundary. ABL has implemented several measures to prevent the contamination from moving off site and affecting drinking water supplies. ATSDR recognizes the uncertainty associated with the local geology and movement of perchlorate in water bearing fractures.

ATSDR recommends that the Navy sample private wells serving homes located along McKenzie Tower Road in Maryland for perchlorate to verify the effectiveness of current remediation measures. Further, given nearby potential sources of groundwater contamination other than ABL, ATSDR recommends that owners of private wells serving homes located in Pinto and along McKenzie Tower Road have their drinking water tested for contaminants other than perchlorate to ensure that the well water is safe to drink.

- **ABL water supply.** Drinking water in ABL's buildings comes from six groundwater wells located in the Undeveloped Area. These wells pump groundwater from the bedrock aquifer at depths ranging from 135 to 620 feet beneath the ground surface. The pumped water is then treated before being distributed throughout the facility (ABL 1994). These water supply wells were all drilled in locations that are not influenced by any known sources of groundwater contamination, nor has any groundwater contamination been found up-gradient from these wells. Additionally, ABL tests the quality of the raw and treated water to ensure that it meets health-based standards established under EPA's Safe Drinking Water Act (SDWA). Testing currently occurs for numerous chemicals, including pesticides, metals, volatile organic compounds (VOCs), perchlorate, and selected inorganic chemicals. According to sampling results that ABL has collected over the last 5 years, no chemicals have been found in the water at levels exceeding EPA's health-based standards. Based on these observations, ATSDR finds that the ABL supply provides safe drinking water. Required ongoing testing of water quality should verify that the supply remains safe in the future.
- **Local municipal water supplies.** Municipal water supplies that serve nearby communities obtain their drinking water from various sources. The local municipal water supplies that

draw from *surface waters* are not affected by contamination from ABL, given that none of these supplies obtain their drinking water from the North Branch Potomac River.[1] According to EPA, seven community water supplies in Allegany County (MD) and five community water supplies in Mineral County (WV) obtain their drinking water from *groundwater* resources (EPA 2005c). Because groundwater wells for these community water supplies are all more than 5 miles away from ABL, contamination at ABL likely does not affect any of these supplies. Ongoing sampling, as mandated by the SDWA, should verify that the municipal water supplies near ABL continue to provide safe drinking water.

- **Private wells.** Some residents in Mineral County (WV) and Allegany County (MD) obtain their drinking water from private groundwater wells. ATSDR evaluated private wells separately because the federal Safe Drinking Water Act's sampling requirements do not apply to private wells. ATSDR's evaluation of private wells located nearest ABL in West Virginia and Maryland follows:

  Mineral County, WV. The residential private wells in Mineral County are all located at least 1 mile from the known groundwater contamination plumes at ABL. Further, it is not believed that the wells in this county lie in the direction that the contaminated groundwater in the alluvial aquifer is moving. Therefore, groundwater contamination at ABL is not believed to pose a hazard to the residential private wells in Mineral County (WV).

  Allegany County, MD. According to previous EPA analyses, approximately 15 residents who live across the North Branch Potomac River from the Industrial Area obtain drinking water from groundwater wells, most likely drilled into the bedrock aquifer (EPA 2005a). Some of these private wells are located within 1,500 feet of the ABL site boundary. To evaluate whether the known groundwater contamination along the northern edge of the Industrial Area is flowing beneath the North Branch Potomac River toward these private wells, ATSDR considered several observations.

  - As discussed previously, EPA has concluded that contaminated groundwater from the Industrial Area at ABL likely discharges to the North Branch Potomac River, and does not flow beneath it.
  - ABL now operates a groundwater treatment program (see Appendix B) that removes contaminated groundwater from the bedrock at multiple locations to prevent the contamination from crossing beneath the river both now and in the future.
  - Sampling of two groundwater wells located across the river from ABL along McKenzie Tower Road in 1994 and 1996 has shown no evidence of VOC contamination (EPA 1997a). In both wells, samples were collected from two depth ranges and analyzed for 24 metals and 33 VOCs. Some metals, most likely of natural origin, were detected in all of the samples collected; but no VOCs were detected in any of the samples, suggesting that the groundwater contamination at ABL was not affecting these private wells. However, these wells were not sampled for perchlorate.

[1] No drinking water supplies downstream of ABL draw from the North Branch Potomac River. About 30 miles downstream from ABL, the municipal water supply for Paw Paw, West Virginia, obtains drinking water from the Potomac River. The section of this PHA that addresses surface water contamination considers the safety of the Paw Paw water supply (see Contamination in the North Branch Potomac River, page 16).

- Water recharge of the groundwater aquifers in Maryland would likely reduce the potential for groundwater migration from West Virginia beneath the North Branch Potomac River.

Based on these observations, ATSDR generally agrees with EPA's finding of contaminated groundwater migration at ABL currently being "under control" (EPA 2005b). However ATSDR also recognizes the uncertainty associated with the local geology and movement of perchlorate in water bearing fractures. For example, the directions, angles, and sizes of fractures may vary with depth, thus causing changes in groundwater flow and direction. Consequently, contaminated groundwater might move through water bearing fractures other than those that the monitoring wells sample. It is due to this uncertainty that ATSDR recommends that the Navy sample the nearest private wells in Maryland (i.e., those serving residences along McKenzie Tower Road [see Figure 3]) for perchlorate to verify the effectiveness of ABL's ongoing groundwater remediation measures. If perchlorate is indeed present in the private wells above background levels, then other contaminants might be investigated.

When reviewing site records, ATSDR learned that several past and ongoing sources of groundwater contamination *other* than ABL might affect the residential private wells located immediately across the North Branch Potomac River from ABL. Specifically, releases from the following sources could potentially impact these wells: an aeration basin used to treat wastewater from local unincorporated Maryland communities (EPA 1997a), a former "limestone quarry and treatment works" that ceased operating more than 50 years ago (EPA 1997a), an unspecified industrial operation that previously was located atop a bedrock terrace (EPA 1997a), and pesticides and agricultural chemicals from agricultural sources. Given the presence of these and other potential sources, ATSDR recommends that residents of the Pinto area and residents who live along McKenzie Tower Road and its side streets who obtain drinking water from groundwater wells have the water quality tested to ensure that it is not impacted by any past or ongoing releases from local sources other than ABL. Stated slightly differently, sampling of private wells by well owners in this area is recommended as a prudent public health measure to verify that the drinking water has not been affected by contamination from their local sources. This recommendation is consistent with EPA guidance suggesting that individual home owners test water from their private wells annually (EPA 2002). EPA's general recommendations to owners of private wells can be found online at http://www.epa.gov/safewater/privatewells.

Air Emissions from Open Burning and Other Operations

Like most industrial facilities, ABL has operations that release pollutants into the air. Examples of some fairly typical air pollution sources at this facility include boilers, storage tanks, motor vehicle traffic, and wastewater treatment operations. A somewhat unique source, and one that has been the focus of previous community health concerns (ATSDR 1994), is ABL's open burning of waste material containing

In a 1997 health consultation on ABL, ATSDR found air emissions from open burning of waste material at ABL to not pose a health hazard to nearby residents. ATSDR reviewed more recent data on this issue, and continues to believe that the open burning operations do not expose residents to unhealthy levels of air pollution. Provisions in ABL's facility-wide air permit (issued by WVDEP) should help ensure that air emissions from the site's boilers and all other sources at ABL do not pose a health hazard to local residents.

propellants and explosives. ATSDR evaluated the public health implications of exposure to air emissions by considering two general categories of emissions sources: open burning of waste material and all other emissions sources (including boilers).

- **Open burning of waste material.** When ATSDR first visited ABL in 1994, community members expressed concern about the health implications of inhaling smoke that blows from ABL's open burning of waste material across the North Branch Potomac River into residential neighborhoods. During open burning events, waste materials are piled in a fixed location, ignited, and allowed to burn until only incombustible material (i.e., ash) remains. Open burning has been widely used at Department of Defense facilities to manage wastes containing propellants and explosives, in part to avoid the hazards associated with transporting such wastes. In an open burning event, the waste material is broken down primarily into simple molecules (e.g., water, carbon dioxide) that are relatively benign. Therefore, perchlorate and explosive material in the waste is almost entirely destroyed during open burning events. However, open burning can release toxic chemicals that form as combustion by-products. The amount of toxic chemicals formed depends on the type and amount of waste being burned and the conditions under which open burning occurs.

  Open burning practices at ABL have changed throughout the site's history. Prior to 1995, ABL used open burning to treat a variety of wastes. These wastes included propellants and explosives, materials contaminated with propellants and explosives, plastic gloves, swabs, tape, and plastic sheeting (ATSDR 1997a). Much of the burning historically occurred directly on the ground surface and there were no restrictions as to when open burning events could occur. In response to community concerns regarding air quality impacts from open burning, ABL entered into a Consent Order with WVDEP in 1995. This agreement included several requirements to reduce potential air quality impacts, such as limiting the types of wastes that can be treated and prohibiting open burning events during times when winds blow from ABL toward the residential areas directly across the North Branch Potomac River (WVDEP 1995). In July, 2005, WVDEP issued ABL an operating permit (Permit Number HW-X-1) that replaces the Consent Order but still specifies conditions under which open burning can occur in a manner that is protective of human health and the environment.

  In a health consultation released in 1997, ATSDR thoroughly evaluated the public health implications of air emissions from open burning events at ABL. By this time, all open burning was conducted in metal burn pans, and no longer on soil surfaces. This updated procedure helped reduce the amount of particulate emissions from the open burning operations. ATSDR's main conclusion in the 1997 health consultation was that nearby residents "should experience no impact" from future open burning operations, provided that ABL follows the constraints established in the Consent Order (ATSDR 1997a). The health consultation recommended, among other actions, that surface soil sampling occur at the open burning grounds and in the nearest residential neighborhoods and that ABL investigate source reduction activities that would reduce the amount of waste material treated by open burning.

  When preparing this PHA, ATSDR reevaluated its previous findings, focusing on information that has become available since the 1997 health consultation. First, ATSDR reviewed data on the amount of waste material treated by open burning in recent years. This

information is displayed in Figure 4, which indicates that the amount of waste material that has been burned in the years since the 1997 health consultation is fairly constant, and certainly has not increased. Further, the figure indicates that the waste treatment quantities are considerably lower than those that occurred at ABL in the early 1990s. Second, ATSDR considered findings published in a more recent air dispersion modeling study (CH2M Hill 2002b). The study, conducted by Navy contractors, predicted air quality impacts for several pollutants that are associated with current open burning practices. The modeling was based on reasonable assumptions, including waste treatment quantities approximately 5 times greater than the current open burning rates. The estimated air quality impacts in nearby residential areas were all safely below applicable EPA health-based standards. Third, ATSDR evaluated results of surface soil samples that ABL collected during 2001 (CH2M Hill 2004). These samples measured dioxin concentrations in the top ½ to 1 inch of soils from 32 locations throughout the open burn area. Of these 32 samples, the average concentration of dioxin and dioxin-like compounds was 0.006 ppb, expressed as toxic equivalents (TEQs).[2] This average is considerably lower than the screening value (0.05 ppb TEQ) that ATSDR uses to evaluate surface soil contamination for these compounds (ATSDR 1997b). A single sample had a dioxin and dioxin-like concentration (0.061 ppb TEQ) greater than ATSDR's screening value, but this value appears to be an outlier, not representative of area-wide contamination. Based on these sampling results, there is no evidence of widespread dioxin contamination at ABL due to deposition of particles from open burning of waste material.

Overall, the three previous observations are consistent with, and provide further support for, the conclusions that ATSDR reached in 1997: air emissions from open burning are not a health hazard to local residents, and ongoing emissions should continue to be safe provided that ABL continues to abide by restrictions listed in the most recently issued operating permits. Having reviewed fairly extensive soil sampling results for this PHA, ATSDR no longer recommends that additional soil sampling occur at off-site locations to address concerns about the open burning operations causing deposition of potentially toxic chemicals onto soils.

- **All other air emissions sources.** ABL's research, development, testing, and production activities generate air emissions throughout the facility, not only where wastes are burned. Examples of these other air emissions sources were listed earlier, and include boilers, spray booths, drying ovens, and parts washers. Residents reportedly were previously concerned about exposures to soot from the boilers, though ATSDR has learned that this soot might have also originated from various coal burning operations in the area. Regardless, many of the air pollution sources at ABL have emissions controls that greatly reduce the amount of contaminants that would otherwise be released directly to the air. Air emissions throughout ABL are closely regulated by a facility-wide air permit, known as a "Title V" permit (WVDEP 2003a).

[2] Dioxin and dioxin-like compounds are a large group of chemicals that are formed in some combustion processes. Rather than evaluating the toxicity of every single compound in this group, scientists often use a weighting scheme to express the toxicity of the entire group of compounds using a single value, or TEQ. More information on this approach is documented in numerous reports (e.g., ATSDR 1997b; EPA 1989). Only detected concentrations were considered in the TEQ calculations for this evaluation.

To assess the significance of these various other emissions sources at ABL, ATSDR ran queries on EPA's National Emissions Inventory (NEI) — a database that includes emissions estimates for multiple pollutants from a broad array of industrial sources nationwide. The data in NEI have some inherent limitations. For instance, most data in the inventory are based on estimates, rather than measurements, of air emissions. Nonetheless, NEI data are compiled in a systematic fashion using well-established protocols. Table 3 summarizes the NEI data for 1999 (the most recent year available), both for ABL and for the entire state of West Virginia. Specifically, the table notes the estimated emissions for ABL, specifies how ABL's emissions rank among those from other industrial facilities in the state, and lists the range of estimated air emissions from facilities statewide.

ATSDR acknowledges that simply comparing emission rates from one facility to the next does not characterize how a particular facility affects air quality. However, the table does provide insight on the significance of ABL's air emissions. Specifically, Table 3 shows that although operations at ABL clearly release contaminants into the air, the amounts released are relatively small when compared to other facilities in the state. This finding is not particularly surprising, given that ABL conducts research, development, and limited production activities, rather than large-scale manufacturing.

Table 3. Summary of 1999 Air Emissions Estimates for Industrial Sources in West Virginia

Contaminant	*Estimated Emissions from ABL (tons/year)*	*Rank of ABL's Emissions Among Industrial Facilities in West Virginia*	*Range of Estimated Emissions Among Industrial Facilities in West Virginia (tons/year)*
Carbon monoxide	18.5	127 out of 268	0.001 – 61,265
Hazardous air pollutants	15.3	75 out of 355	0.038 – 8,530
Nitrogen oxides	55.7	117 out of 269	0.001 – 55,611
Particulate matter (<2.5 microns)	9.46	125 out of 384	0.005 – 6,800
Particulate matter (<10 microns)	13.4	150 out of 384	0.005 – 7,804
Sulfur dioxide	155	38 out of 259	0.001 – 108,729
VOCs	11.0	165 out of 302	0.001 – 1,384

Source: EPA 2005d.
Notes: Data are presented for the main pollutants tracked in the NEI. The total number of facilities for which emissions data are available varies from pollutant to pollutant.

Overall, ATSDR concludes that air emissions from the various other emissions sources at ABL do not cause unhealthy air quality impacts at off-site locations. This conclusion is based on several observations, including the relatively low emission rates (when compared to other industrial sources), the large distance separating most operations at ABL from nearby residents, and the extensive monitoring, testing, record keeping, and reporting requirements outlined in ABL's facility-wide air permit. Figure 7 shows the main areas of Allegany Ballistics Laboratory (ABL).

Contamination in the North Branch Potomac River

Pollutants enter the North Branch Potomac River from numerous industrial sources (including ABL), municipal sources, and agricultural sources. Due to the considerable dilution from the high river flow, releases from ABL alone are not expected to adversely affect downstream drinking water supplies or downstream farms that use river water for irrigation. Fish in the North Branch Potomac River have elevated levels of contamination that originated primarily from sources upstream of ABL; residents can avoid the hazards posed by this contamination by heeding the applicable West Virginia fishing advisories, which are listed in this section.

The North Branch Potomac River flows approximately 45 miles from its headwaters before it reaches ABL. Upstream of ABL, pollutants enter the river and its tributaries from various sources, including abandoned and active mines, railroads, a large paper mill, agricultural operations, and several additional industrial and municipal dischargers. At ABL, pollutants enter the North Branch Potomac River from multiple outfalls that primarily discharge treated wastewater and untreated storm water. ABL's water pollution control permit regulates the amounts of chemicals that can be released; further, the permit requires the facility to sample several outfalls periodically to demonstrate compliance with these discharge limits (WVDEP 2003b). ATSDR's evaluation considered three pathways by which people might come into contact with chemicals that ABL (and other facilities) discharge to the North Branch Potomac River:

- **Using the river as a source of drinking water.** Downstream of ABL, none of the nearby residential communities use the North Branch Potomac River as a source of drinking water. The nearest downstream drinking water supply potentially affected by ABL's releases is in Paw Paw, West Virginia — approximately 30 miles downstream from ABL on the Potomac River (see Figure 2). ATSDR considered the possibility that surface water discharges from ABL might adversely impact not only the Paw Paw water supply but also any undocumented uses of North Branch Potomac River for drinking water.

  To assess this issue, ATSDR considered two lines of evidence:

  - First, ATSDR considered the extensive dilution that occurs once ABL's discharges enter the North Branch Potomac River. According to ABL's water pollution control permit, the maximum water flow rate allowed out of the main outfall (i.e., Outfall 280) is 0.207 million gallons per day (MGD) (WVDEP 2003b).[3] In contrast, the average flow rate of the North Branch Potomac River in the vicinity of ABL is 1,440 MGD (USGS 2005). Consequently, surface water discharges from ABL are greatly diluted — by a factor of approximately 7,000 — shortly after they flow into the North Branch Potomac River. Given this dilution factor and the permitted discharge limits for toxic chemicals, ABL's discharges alone simply cannot cause the North Branch Potomac River water to exceed safe drinking water guidelines, unless the facility were to be in gross violation of its permits; but there is no evidence of such non-compliance from the records ATSDR reviewed (ABL 2004a). Readers should note

[3] This dilution calculation has some limitations. For instance, the calculation does not account for groundwater seeps that might flow from ABL into the North Branch Potomac River. However, ABL's groundwater extraction wells in the Industrial Area help ensure that little, if any, contaminated groundwater flows directly into the river. The discussion for "Site 1" in Appendix B describes this groundwater extraction system further. Nonetheless, the calculation demonstrates that contamination from ABL is considerably diluted once it enters the river.

that ATSDR used this dilution calculation only to assess the largest possible incremental impact that ABL's discharges might have on water quality in the North Branch Potomac River. This calculation does not imply that elevated pollutant discharges into higher-flow surface waters are acceptable due to the dilution that occurs. Rather, the calculation merely supports the fact that ongoing compliance with ABL's water pollution control permit should be sufficient for demonstrating that discharges do not cause the nearby river water to have unhealthy levels of contamination.

- Second, ATSDR considered available surface water sampling data. Pursuant to an Administrative Order that WVDEP issued in October 2005 (WVDEP 2005), ATK recently began monthly monitoring for perchlorate in the North Branch Potomac River. Monitoring results from November 2005 through June 2006 were available at the time this report was released. According to this sampling, perchlorate was consistently detected in the monthly samples, but at similar concentrations both upstream and downstream from ABL's primary wastewater discharge (CH2M Hill 2006a). The concentrations ranged from 7.2 to 74 ppb, with average concentrations less than 24.5 ppb, which is EPA's Drinking Water Equivalent Level (i.e., the concentration of a contaminant in drinking water that is believed to have no adverse effects on humans, assuming exposure occur only through drinking water ingestion) (EPA 2006). Therefore, surface water sampling data collected in the vicinity of ABL, though somewhat limited, generally support the conclusion that the facility's releases alone do not dramatically increase concentrations of toxic chemicals in the river water (ABL 2004a).

- **Eating fish from the river.** In the 1940s, no fish were observed in long stretches of the North Branch Potomac River due to effects that acid mine drainage releases throughout the watershed had on the ecosystem (Mills and Davis, 2000). In the past few decades, regulatory agencies began addressing the various pollutant loadings to the North Branch Potomac River. As a result, the river has been gradually recovering and continues to do so today. As evidence of this recovery, fish populations have been successfully reintroduced to several stretches of the North Branch Potomac River.

  Fishing activity varies greatly with location in the North Branch Potomac River watershed. Some residents occasionally fish in the North Branch Potomac River near ABL. However, extensive sport fishing or subsistence fishing does not occur in this stretch of the river largely because upstream locations and tributaries have much better fishing conditions (e.g., greater fish populations, more areas where recreational watercraft can easily enter waters, and less environmental contamination).

  The West Virginia Department of Health and Human Resources (WVDHHR) has evaluated environmental contamination levels in fish tissue caught from several rivers throughout the state, including the North Branch Potomac River. Based on these sampling results, WVDHHR has issued fish consumption advisories to encourage residents to restrict their consumption of fish caught from this stretch of the river (WVDHHR 2005).

Table 4 summarizes the fish consumption advisories, which vary by fish species. The table also specifies the reason that WVDHHR issued the specific advisory. Some of the consumption advisories apply to the entire state of West Virginia, while others address contamination in the North Branch Potomac River. None of these advisories were issued to address releases from ABL. Currently fish in the North Branch Potomac River Near ABL have elevated levels of contamination that originated primarily from sources upstream of ABL. Perchlorate has been found in the river water essentially at the same levels up and down stream of ABL. Insects near ABL have been found to have elevated levels of perchlorate. The level of uptake of perchlorate by fish from the water or from eating insects near ABL or other locations along the river has not been determined. Provided residents heed the WVDHHR advisory, the contamination found in the North Branch Potomac River fish does not pose a health hazard.

- **Using river water to irrigate farms.** Some farms may draw river water from the Potomac River watershed for irrigation purposes or to renew soils with nutrient-rich river sediments. Consequently, contamination in the river water might end up being found in the crops. As stated previously, ABL releases pollutants into this watershed, but these discharges are diluted tremendously by the flow of the North Branch Potomac River, with the magnitude of this dilution increasing as additional tributaries flow into the river. Thus, it is extremely unlikely that ABL's surface water discharges alone would adversely impact crops at farms that use river water for irrigation purposes. Farmers interested in learning more about the quality of their irrigation water and its affect on crops should consult their state agriculture office (i.e., Maryland Department of Agriculture, West Virginia Department of Agriculture).

Table 4. Fish Consumption Advisory Applicable to the North Branch Potomac River

Fish Species	*Advisory*	*Reason for Advisory*
Rainbow trout	No suggested limit on consumption	Not applicable
Brook trout, brown trout, pickerel, muskellunge, northern pike, tiger musky, rock bass, crappie, blue gill, and channel catfish less than 17 inches long	Limit consumption to 4 meals per month	Statewide fish consumption advisory (WVDHHR 2005) due to elevated mercury levels which originate from a wide range of sources (Charleston Gazette 2005).
Black bass less than 12 inches long (includes largemouth bass, smallmouth bass, spotted bass), channel catfish greater than 17 inches long, sauger, all suckers	Limit consumption to 2 meals per month	
Black bass greater than 12 inches long (includes largemouth bass, smallmouth bass, spotted bass), walleye, saugeye, white bass, and hybrid striped bass	Limit consumption to 1 meal per month	
All other species	Do not eat	Supplemental advisory specific to the North Branch Potomac River to address dioxin contamination that originates primarily at sources upstream from ABL.

Source: WVDHHR 2005

Notes: The average meal size used to develop the fish advisories depends on the weight of the individual. For people who weigh more than 150 pounds, the meal size was assumed to be 8.0 ounces (or ½ pound) of fish before cooking. For children who weigh between 35 and 50 pounds, the meal size was assumed to be just 2.0 ounces of fish before cooking.

Eating Cuts of Meat from Locally Harvested Deer and Game

Deer and other terrestrial wildlife have been observed feeding on grasses and shrubs in areas at ABL contaminated with explosive chemicals, perchlorate, and other pollutants. Although deer tissue samples from ABL have not been analyzed for the presence of chemical contamination, studies conducted at other facilities with similar contamination patterns suggest that the environmental contamination at ABL has not affected the edible deer tissues. If any perchlorate is found in deer, the highest levels would likely occur in milk, which humans do not consume.

Certain contaminants, when found in soils, can enter the food chain by accumulating in tissues of plants and animals. People, in turn, can be exposed to these contaminants when they eat affected food items. The significance of the food ingestion exposure pathway depends primarily on how much contamination enters the food chain and how frequently residents consume locally harvested food items. ATSDR assessed food chain exposures by focusing on deer (rather than other species) for three reasons: deer forage in contaminated areas within the Industrial Area of ABL, deer hunting is permitted in nearby areas, and deer have relatively small home ranges when compared to other wildlife species (e.g., birds, bear) that are hunted in the area.

Deer are frequently observed foraging in the Industrial Area at ABL. In fact, during ATSDR's site visit, deer were seen foraging in some areas of known environmental contamination. Given that the typical home range for deer in West Virginia is roughly 640 to 1,920 acres (WVU 1985), deer likely do not forage exclusively in contaminated areas at ABL, which span much smaller areas. Nonetheless, it is possible for deer that forage in the Industrial Area to be found in the Undeveloped Area and beyond. This observation is significant because deer hunting is permitted outside the Industrial Area. West Virginia's hunting regulations establish the deer hunting season and the maximum seasonal bag limit for deer (WVDNR 2004a). Throughout West Virginia, deer hunting is restricted primarily to autumn months. In Mineral County, each hunter is allowed to bag up to nine deer per year, and each deer killed must be registered at a local tagging office. State records indicate that the total harvest for Mineral County in 2003 was 3,788 deer (WVDNR 2004a). Most of these deer were harvested from private lands (WVDNR 2004b).

Sampling of contamination in deer tissue (i.e., venison) from ABL would be the most relevant metric for assessing this exposure pathway. However, no such data are available for ABL, nor has the facility been required to collect such data. In the absence of sampling data, ATSDR consulted other sources of information to evaluate potential exposures to site-related contaminants in deer:

- **Explosive chemicals.** Surface soils in a small part of the Industrial Area are contaminated with various explosives, including trinitrotoluene (TNT) and 1,3,5-trinitro-1,3,5-triazine (RDX). For perspective on this matter, ATSDR referred to a health consultation for another military installation that addressed the potential for deer to uptake such chemicals (ATSDR 1996). That health consultation reviewed multiple studies from four different military installations at which TNT and RDX were measured in deer that foraged in contaminated areas. Based on the data collected from those other installations, ATSDR concluded: "uptake of explosives in animal tissue, particularly deer, does not occur" (ATSDR 1996). In addition, the U.S. Army conducted a similar literature review, but considering more recent sampling studies and similarly found that "TNT exposure in humans via the food chain is exceedingly

unlikely" (CHPPM 2002). While this study acknowledged that RDX accumulates in trace levels in rodents provided with contaminated feed, a much larger study has found no evidence of RDX in the tissues of 150 white-tailed deer tissue samples from a highly contaminated ordnance proving ground (CHPPM 1995). These observations, combined with the relatively low levels of surface soil contamination at ABL,[4] suggest that deer hunted near the facility likely do not contain harmful levels of RDX, TNT, and other chemicals used in explosives.

- **Perchlorate.** No deer tissue samples from ABL have been analyzed for perchlorate. However, a recent study measured perchlorate levels in five rodents that were trapped at locations in the Industrial Area with the highest documented contamination levels (Parsons 2001). In all five whole-body samples, perchlorate was not detected. These findings, though based on a limited sample size, suggest that rodents at ABL are not accumulating considerable amounts of perchlorate in their tissues. Further supporting this conclusion are findings from a more recent study in the peer-reviewed literature that documents rodent tissue samples in a Nevada watershed heavily contaminated with perchlorate (Smith et al. 2004). The study routinely found perchlorate at elevated levels in water, soil, and vegetation, but infrequently detected perchlorate in rodent tissues. This information suggests that only limited amounts of perchlorate might accumulate from soils and plants into mammalian tissues that people tend to consume. While some recent studies have detected perchlorate in milk from mammals (e.g., Kirk et al. 2003), the presence of perchlorate (if any) in deer milk is of limited human health consequence, given that people do not tend to drink this milk. ATSDR is unaware of consumption surveys that show what parts of deer are consumed by individuals and families near ABL.

  ATSDR also considered the possibility of subsistence hunters and their family members consuming blood and bone marrow, which might be mixed with other ingredients in home made sausage or in the long bones used to make soup. However, several observations suggest this likely is not an exposure of concern. First, it is highly unlikely that hunters would be consistently harvesting deer from the ABL herd. Second, most hunters would be expected to bleed the deer in the field without saving the blood. While some hunters in some parts of the United States do consume fresh blood or a portion of the liver when they eat meat in the field in the belief that this will reduce gastrointestinal problems, ATSDR is unaware of consumption of the thyroid (which may accumulate perchlorate), even in sausages. It is important to note that for livestock under USDA 9 CFR 310.15 (Disposition of thyroid glands and laryngeal muscle tissue), the thyroid may not be used or processed or used as human food or in a food product. Consequently, the perchlorate contamination at ABL likely is not accumulating in cuts of meat from local deer in quantities of health concern to hunters and their families.

- **Other contaminants.** As Appendix B describes further, ABL has several former solid waste management units that contain environmental contaminants other than explosive chemicals and perchlorate. The primary contaminants of concern at these sites are VOCs, most of which are not typically classified as being persistent or bioaccumulative. While metals have been detected at some waste sites and metals can accumulate in deer tissue, metals contamination

[4] Recent sampling data collected at ABL detected RDX in just 12 out of 73 surface soil samples and the measured concentrations ranged from 0.73 to 7.3 ppm. Similarly, TNT was detected in just 21 out of 132 surface soil samples, with all concentrations less than 14 ppm.

at ABL is either highly localized or at concentrations not dramatically higher than background levels. Therefore, the metals contamination at ABL does not present a health concern for deer tissue. Refer to Appendix E for the information ATSDR considered when evaluating potential exposures to dioxin through food items.

When reviewing the issue of potential contamination in deer meat, ATSDR also considered the likelihood of site-related contaminants being found in vegetation that people might consume. ATSDR believes the weight of evidence would indicate that perchlorate air emissions would not have affected farms, given that perchlorate is largely destroyed in open burning events. The greatest potential for exposure to perchlorate in vegetation might be people consuming berries from plants that grow within and along the lower part of banks of the North Branch Potomac River near ABL where perchlorate may have precipitated (near locations with fluctuating water levels, such as seeps) out into sediments before surface water mixing would allow for efficient perchlorate dilution in the river water. ATSDR believes it is unlikely that berries or other wild vegetation within 1 mile down stream of ABL form a significant portion of residents' diets. ATSDR has no reason to believe that this vegetation in and along the banks of the North Branch Potomac River would be consumed at a level that would cause health effects, given the infrequent consumption of these berries (even if they have concentrated perchlorate).

Potential to Encounter Explosive Gases

Waste disposal sites at ABL currently do not pose explosion hazards, due to site access restrictions and the limited land uses. The former landfill (also known as Site 5) at ABL should not present an explosion hazard in the future, due to deed restrictions filed by the Navy and provided that buildings are not constructed immediately adjacent to the site.

Landfills are large sources of methane gas, which forms when certain wastes decompose. Though relatively benign from a toxicity perspective, methane gas can present serious explosion hazards under certain landfill conditions. Of particular concern, is methane gas migrating beneath the soil surface and collecting in pockets in the landfill, in engineering fill along utility lines, under roads, in cracks and crevasses and may move toward or enter enclosed spaces of nearby structures. Even though it is considered to be a low risk event, in all of these situations methane levels can gradually accumulate to potentially explosive levels that may be initiated by sparks from brush fires or recreational and maintenance activities. Frozen ground or snow cover may result in greater build up of methane or movement of methane to greater distances under some circumstances. Warmer temperatures may also increase methane production and allow buildup of methane in nearby pockets

Landfill Gas Investigation: A Case Study

The British Geologic Survey (BGS) reported a case where landfill methane and carbon dioxide concentrations increase considerably with depth and distance from the landfill, such that measurements made near the surface might not reflect the highest sub-surface methane concentrations. In this specific case, methane concentrations were approximately 10% and were observed within a few meters of the surface, and much higher methane concentrations (up to 70% methane) were observed about 5 meters below the surface, thus highlighting a potential need for supplementing shallow soil gas surveying with deeper investigations when assessing potentially contaminated land. (For more information on this particular case study and visualization of lateral and vertical concentrations, see Figure 6.)

Recognizing this, ATSDR evaluated an exposure scenario of residents possibly encountering explosive gases generated within ABL property. Of all the contaminated sites at ABL, a closed landfill along the bank of the North Branch Potomac River in the Undeveloped Area appears to be the largest source of methane gas. Between the 1960s and 1985, ABL disposed of various wastes in this small landfill, which spans approximately 4 acres. ABL has recently implemented several closure activities at this landfill to reduce any potential risks to human health and the environment. Such activities include installing an impermeable cap (to prevent chemicals in the landfill from migrating into groundwater) and constructing a landfill gas collection trench and passive vents (to prevent unsafe accumulation of methane gas in the landfill) (CH2M Hill 2002a).

ABL also agreed to implement a post-closure monitoring plan for the landfill, which requires periodic measurement of methane gas concentrations at six locations around the landfill's perimeter. While methane gas levels at five of these six sampling points have never reached unsafe levels, quarterly monitoring data reveal that concentrations at a single gas collection well near the dead tree line reached potentially explosive levels between July 2001 and March 2002 (CH2M Hill 2002a). The elevated methane levels were localized to a single gas collection well and not considered to be representative of the landfill as a whole. ABL addressed this situation by, among other things, evacuating excess methane gas that had previously accumulated within the landfill — an action that has apparently proven effective at reducing methane gas levels at this depth and location (CH2M Hill 2002a).

ATSDR considered several factors to evaluate the methane gas levels measured. First, the extent of methane gas migration beneath the ground surface, though not known precisely, likely does not extend far from the landfill and almost certainly does not cross beneath the North Branch Potomac River. This judgment is based on the fact that at any depth that methane gas is lighter than air and tends to migrate upward and laterally (rather than downward) with distance from the source area where methane is being formed. This also helps explain how at any location the lateral movement of methane may result in a higher level of methane being found at a specific deeper depth but still decreasing at the specific depth with distance from the primary or secondary (e.g., leach moving into fractures) source. Second, methane gas movement is usually in the opposite direction of the movement of groundwater in unconfined aquifers and the location of the highest level of methane was in a gas collection well between the landfill and the river.

Third, elevated methane gas levels appear to be highly localized at a single gas collection well, which residents cannot approach given site access restrictions. However, ATSDR noted that the elevated methane gas levels were observed in an area near the visible dead tree line. ATSDR considered as one possibility that the dead tree line may mark a zone of methane-distressed trees. ATSDR believes that combined, these observations and considerations suggest that no residents under current land use could have come into contact with a potential explosive hazard even if the nature and extent of methane and carbon dioxide near the landfill are not yet fully characterized or if they increase or decrease over time. Further, ABL's efforts to address the elevated methane gas levels in the lone extraction well have addressed and identified methane and associated hazards that might have existed for workers and will be continued to be considered in site safety and health plans. Thus, the methane gas at this site poses no hazard under current land use for residents.

Whether methane gas at the former landfill presents a hazard in the future depends largely on any changes to land use and possible buildup of gas in areas and depths not sampled. Future development of the landfill site is not expected, due to a deed notation that the Navy recently filed with Mineral County. The notation delineates the area of the landfill and prohibits any future development that would disturb the landfill cover (CH2M Hill 2002a). ATSDR supports this action and recommends that ABL and local agencies carefully consider any future decisions to ease site access or build structures adjacent to the landfill, or use of the area for storage or recreational activities though no such actions are currently planned.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

Due to these factors, ATSDR specifically considered child heath issues when evaluating the potential exposures to environmental contamination at ABL. For instance, when addressing air pollution levels, ATSDR used air quality standards that are protective of children's exposures and of health conditions more common in children (e.g., asthma), to the extent that this information is available. Specifically, ATSDR used EPA's air quality standards for particulate matter and lead when evaluating air quality impacts from ABL's open burning activities. These standards were developed to protect the health of sensitive populations, including children.

Although ATSDR found that children near ABL might be exposed to trace amounts of environmental contamination from many different sources, the exposure levels associated with ABL's releases appear to be far too low to cause adverse health effects. In other words, ATSDR

found no evidence that chemicals released from ABL pose any unique health hazards for children.

Conclusions

ATSDR has reached the following conclusions regarding environmental contamination at ABL:

- Past releases of chemicals at ABL have contaminated the groundwater in certain areas within the site boundary. ABL has implemented several measures to prevent the contamination from moving off site and affecting drinking water supplies. ATSDR recognizes the uncertainty associated with the local geology and movement of perchlorate in water bearing fractures. Accordingly, ATSDR recommends that the Navy sample private wells serving homes located along McKenzie Tower Road in Maryland for perchlorate to verify the effectiveness of current remediation measures. Given nearby sources of potential groundwater contamination *other* than ABL, ATSDR recommends that owners of private wells serving homes located in Pinto and along McKenzie Tower Road have their drinking water tested for contaminants other than perchlorate to ensure that the well water is safe to drink. This recommendation to residents is consistent with EPA general recommendations that owners of private wells throughout the country have their water tested for potential contamination. *Since critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard ATSDR considers this an "Indeterminate Public Health Hazard".*
- ABL has numerous air emissions sources that release pollutants into the air, including open burning of waste material and boilers. Some pollutants likely reach off-site locations, where people might be exposed to them, but the estimated exposure levels are well below those associated with adverse health effects. *Since exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects, ATSDR considers this as a "No Apparent Public Health Hazard".*
- ABL is permitted to discharge storm water and treated wastewater into the North Branch Potomac River. The facility's water pollution control permit sets strict limits on the amount of contaminants that can be released and includes periodic monitoring requirements. Engineering calculations and limited sampling data strongly suggest that ABL's releases have negligible impacts on both downstream drinking water supplies and fish tissue contamination. Also, ATSDR currently does not believe that fish from the area in the mixing zone would be a significant portion of the fish caught during float trips nor a significant portion of the fish consumed by local anglers. Therefore, people might be exposed to some chemicals found in ABL's releases to the river, but not at levels expected to cause any harmful health effects provided that residents abide by fish consumptions advisories. These advisories have been issued for the North Branch Potomac River (see Table 4) to address fish tissue contamination that is attributed to sources other than ABL. *Since exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects, ATSDR considers this as a "No Apparent Public Health Hazard".*
- Deer and other game forage at ABL in areas with known environmental contamination. Limited data from ABL and more extensive data from other facilities with similar environmental issues suggest that this contamination may enter the edible cuts of meats of mammals, but only in trace levels below levels of health concern. Therefore, people might be

exposed to trace amounts of chemical contamination at ABL by eating cuts of meat from deer harvested in the area, but any such exposures are expected to be at levels below those that would cause harmful health effects. *Since exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects, ATSDR considers this as a "No Apparent Public Health Hazard".*

- Methane gas was previously found at elevated levels in a localized area of a former landfill, but the levels have since greatly reduced. Accumulation of methane gas at this site is not a health hazard to residents, due to the current site restrictions which prevent residents from coming into contact with harmful amounts of site-related substances. With Current ABL response capabilities to deal with fires and explosions, deed restrictions in place to limit development at this site, the methane gas and possible fires and explosions should present no hazard to surrounding communities in the future, provided the post-closure plan is followed and no structures are built immediately adjacent to the landfill. ATSDR supports this action and recommends that ABL and local agencies carefully consider any future decisions to ease site access or build structures adjacent to the landfill, or use the area for storage or recreational activities although no such actions are currently planned. *Since residential exposure to site-related chemicals might have occurred in the past, but the exposures were and are not at levels likely to cause adverse health effects, ATSDR considers this as a "No Apparent Public Health Hazard".*
- Contamination that remains in soils, sediment, and other media at specific locations at ABL also are not health hazards to residents, because site access restrictions prevent residents from accessing on-site areas with environmental contamination. Therefore, residents cannot come into contact with harmful substances found in these on-site areas. Ongoing environmental clean-up programs at ABL, conducted with EPA and WVDEP oversight, will help ensure that residual contamination does not pose a hazard in the future. *Since exposure to site-related chemicals might have occurred in the past occurring, but the exposures are not at levels likely to cause adverse health effects, ATSDR considers this as a "No Apparent Public Health Hazard".*

Public Health Action Plan

The public health action plan for ABL describes actions taken at the facility and those recommended to be taken following this PHA. The purpose of the public health action plan is to ensure that this PHA not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse health effects from occurring in the future. The following public health actions at ABL are completed, ongoing, planned, or recommended:

Completed Actions

The Navy, under oversight from EPA and WVDEP, has identified areas of environmental contamination, characterized the nature and extent of this contamination at numerous sites, and implemented multiple remedies to reduce or remove this contamination in a manner that is protective of human health and the environment.

Ongoing Actions

ABL continues to monitor all known groundwater contamination plumes. For the groundwater plume nearest the site boundary in the Industrial Area, ABL continues to operate its pump-and-treat system that prevents contaminated groundwater from flowing off site.

All local public water supplies continue to routinely test the drinking water for contamination according to specifications in EPA's Safe Drinking Water Act.

The Navy continues to assess potential human health risks associated with environmental contamination at certain sites.

Consideration of explosive gases associated with monitoring of landfills, soils and groundwater will continue to the extent required by WVDEP.

Planned Actions

The Navy will propose remedial actions for the areas of environmental contamination for which RODs have not yet been signed. EPA and WVDEP will review all proposed remedies.

Recommended Actions

- **Local drinking water quality.** Recognizing the uncertainty associated with the local geology and movement of perchlorate in water bearing fractures, the Navy should sample private wells serving homes located along McKenzie Tower Road in Maryland for perchlorate to verify the effectiveness of current remediation measures. Given nearby sources of potential groundwater contamination other than ABL, owners of private wells serving homes located in Pinto and along McKenzie Tower Road should have their drinking water tested for contaminants other than perchlorate to ensure that the well water is safe to drink.
- **Residents should adhere to the fish consumption advisories** issued by WVDHHR (see Table 4).
- **Site 5: Inert Landfill.** ATSDR supports Navy deed restrictions for the landfill filed with Mineral County and recommends careful review and multi depth gas sampling if land uses change.

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Allegany Ballistics Laboratory (US Navy)

Mineral County, WV

EPA Facility ID: WV0170023691

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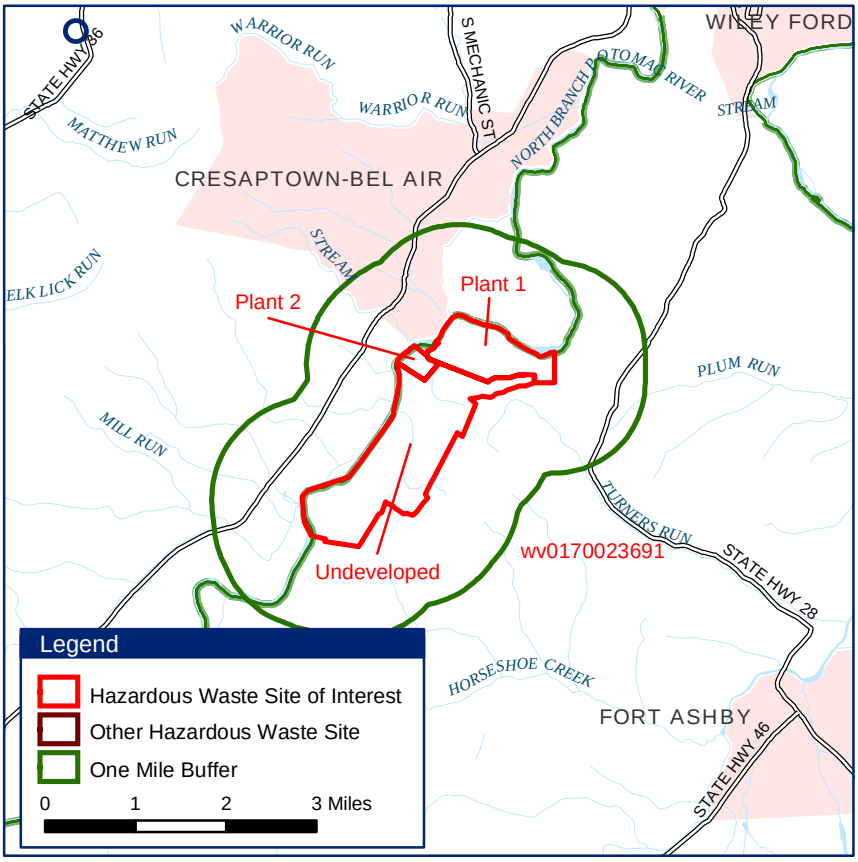

Base Map Source: Geographic Data Technology (DYNAMAP 2000), August 2002
Site Boundary Data Source: ATSDR Public Health GIS Program, August 2002
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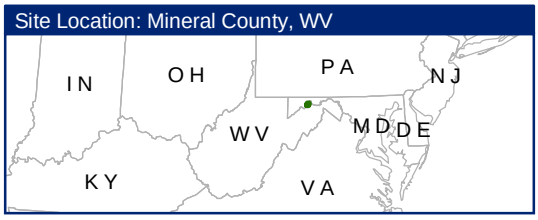
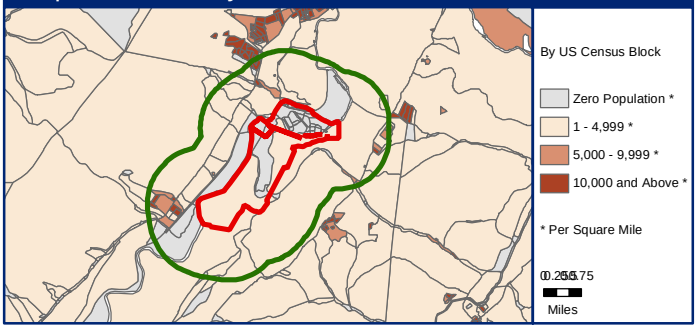


Demographic Statistics
Within One Mile of Site*

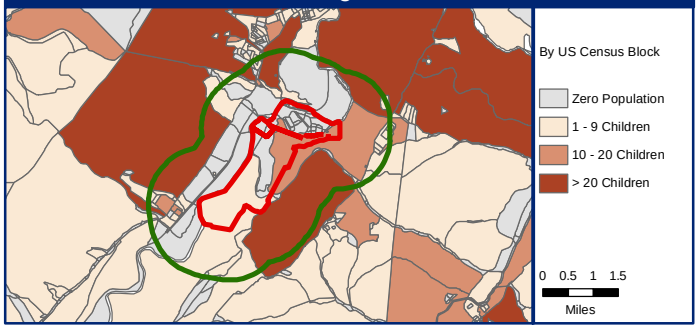
Total Population	1,934
White Alone	1,900
Black Alone	11
Am. Indian & Alaska Native Alone	2
Asian Alone	8
Native Hawaiian & Other Pacific Islander Alone	0
Some Other Race Alone	3
Two or More Races	10
Hispanic or Latino**	14
Children Aged 6 and Younger	168
Adults Aged 65 and Older	309
Females Aged 15 to 44	381
Total Housing Units	836

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

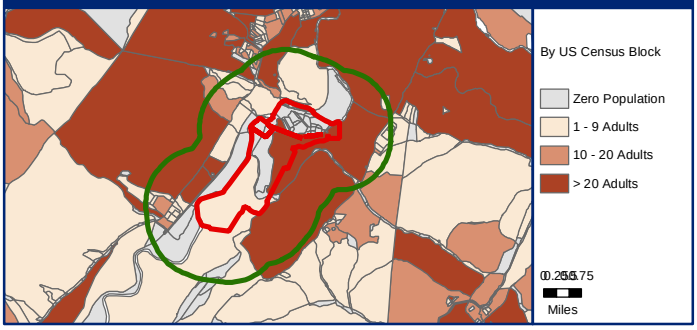
Population Density
Source: 2000 U.S. Census



Children 6 Years and Younger
Source: 2000 U.S. Census



Adults 65 Years and Older
Source: 2000 U.S. Census



Females Aged 15 to 44
Source: 2000 U.S. Census

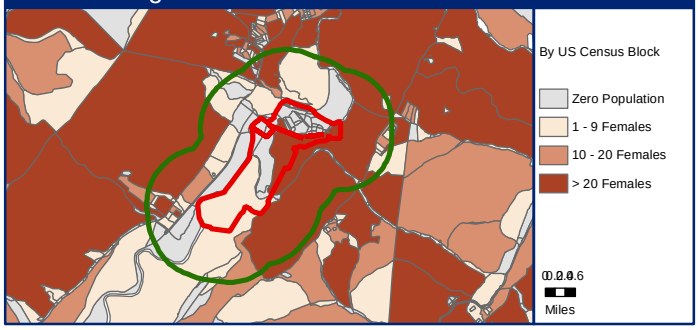


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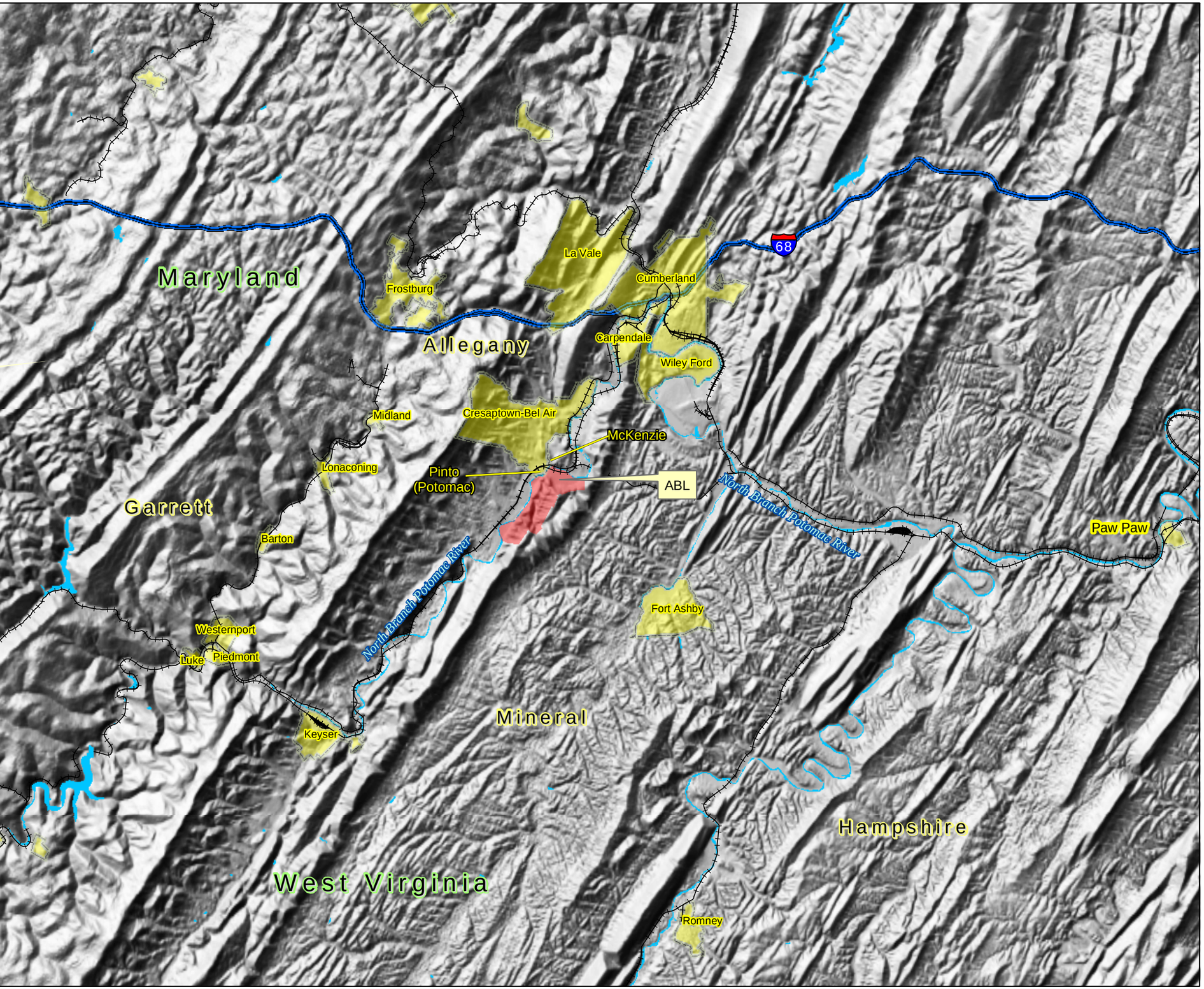
Figure 2

Local Area Topography

Allegany Ballistics Laboratory
Mineral County, West Virginia

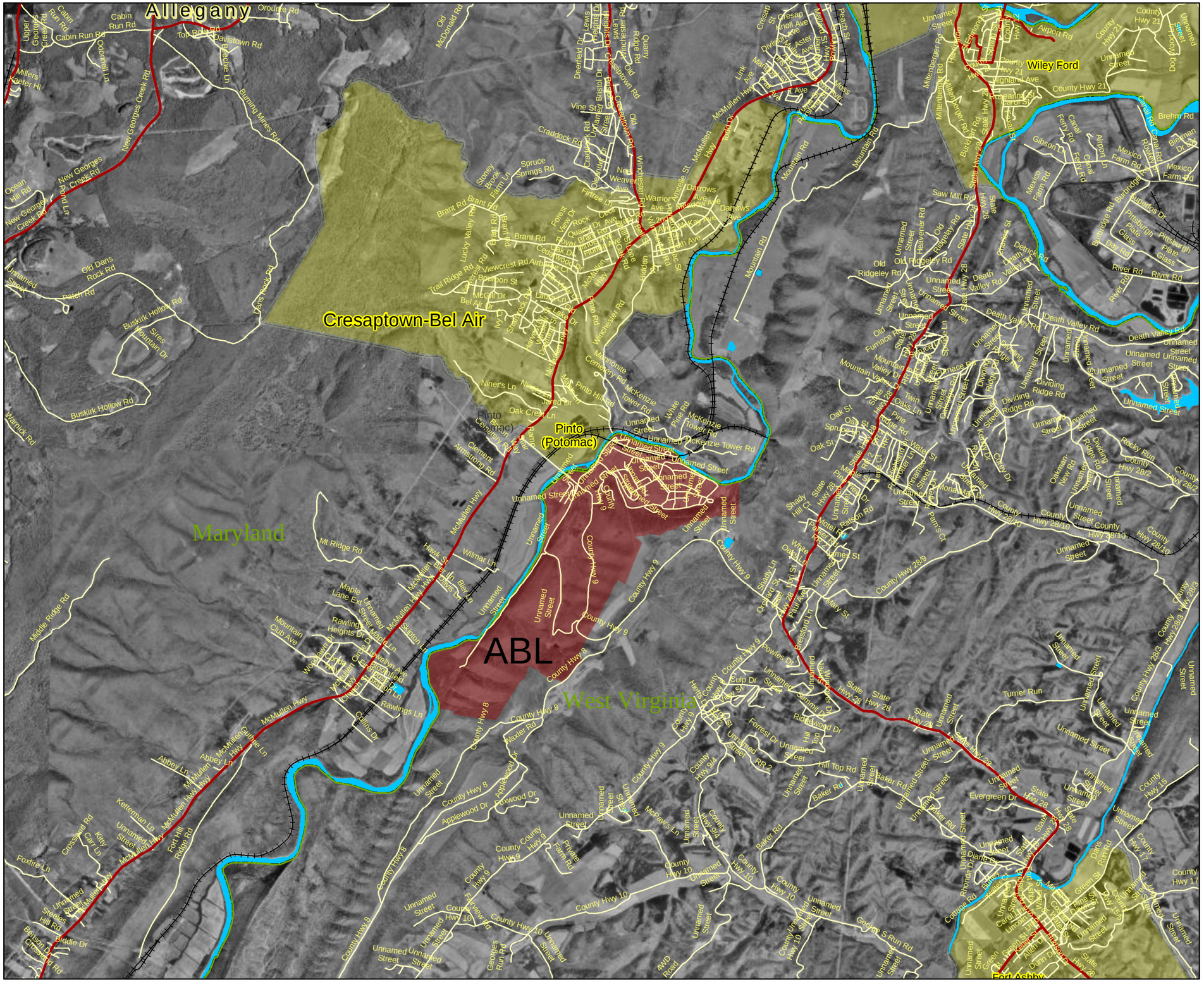


GRASP
GEOSPATIAL RESEARCH, ANALYSIS & SERVICES PROGRAM

Figure 3

Area Roads

Allegany Ballistics Laboratory
Mineral County, West Virginia
Area Roads nearest ABL
with Terrain Features



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Printing Date: Thursday, May 31, 2007
Prepared By: kbl3
ATSDR Public Health Geospatial Research, Analysis, & Services Program
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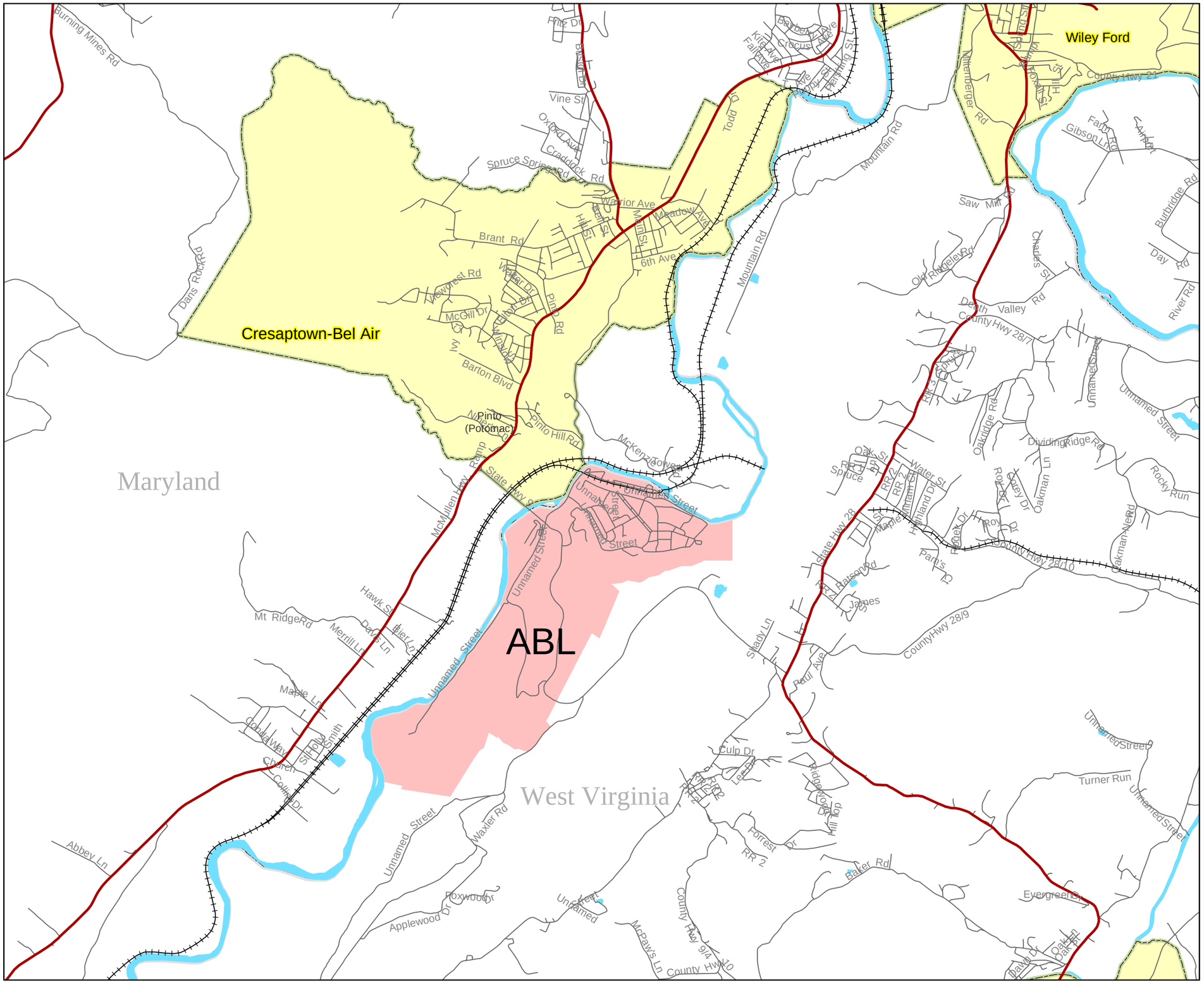
Project: prj_02167_Allegany_Ballistic_Lab

Figure 4

Area Roads

Allegany Ballistics Laboratory
Mineral County, West Virginia
Area Roads Nearest ABL
without Terrain Features



0 0.5 1 1.5 2 Miles

N

GEOSPATIAL RESEARCH, ANALYSIS & SERVICES PROGRAM

Printing Date: Thursday, May 31, 2007
Prepared By: kbl3
ATSDR Public Health Geospatial Research, Analysis, & Services Program
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Project: prj_02167_Allegany_Ballistics_Lab

Figure 5

Areas

Allegany Ballistics Laboratory
Mineral County, West Virginia
Maryland Area Roads
Nearest ABL

N

Census 2000 Block Groups

- 240010020001
- 240010020002
- 240010020003
- 540570102001
- 540570102003

0 1,250 2,500 3,750 5,000 Feet

GRASP
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ATSDR Public Health Geospatial Research, Analysis, & Services Program
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Project: prj02167_Allegany_Ballistic_Lab

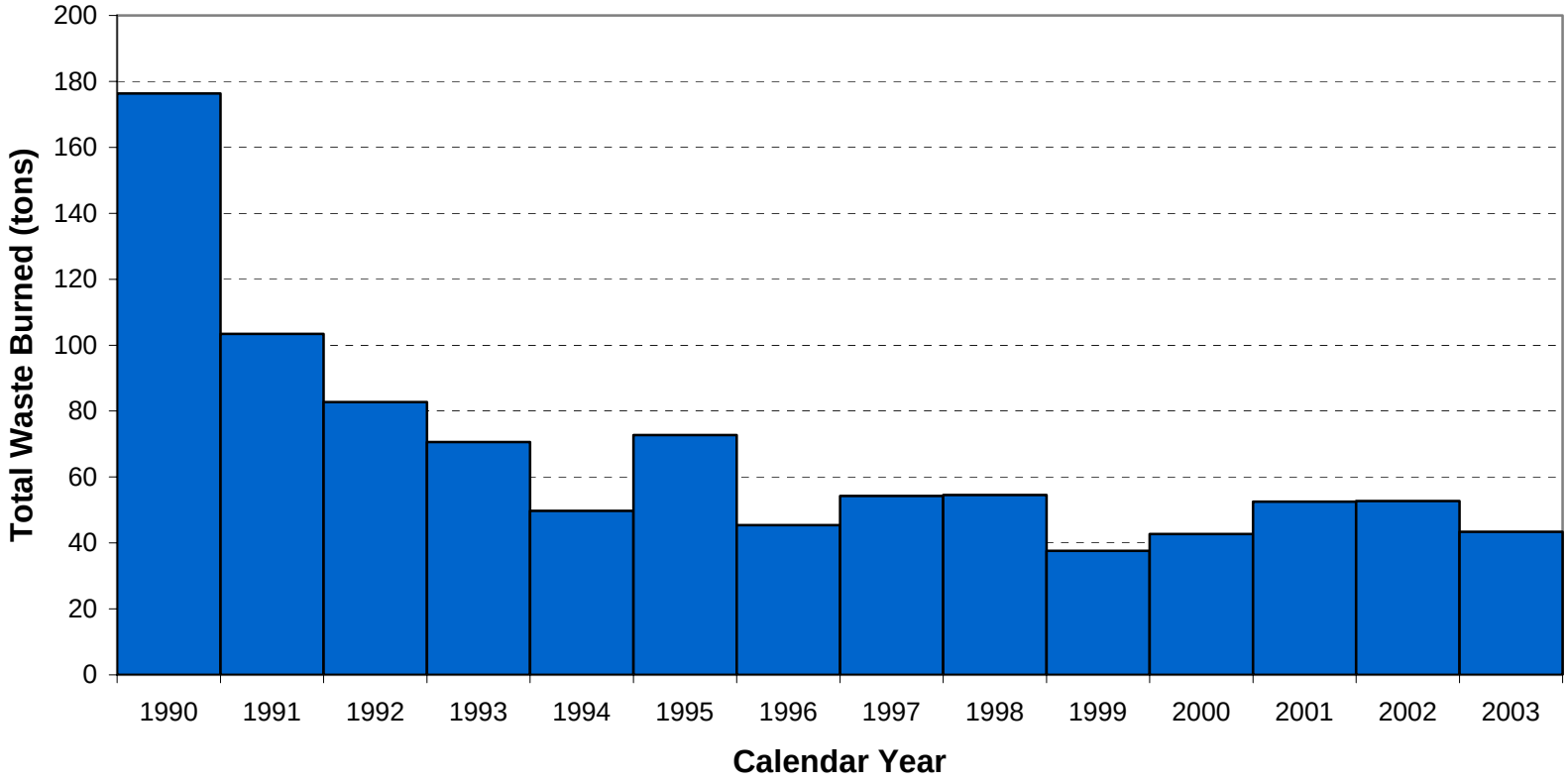


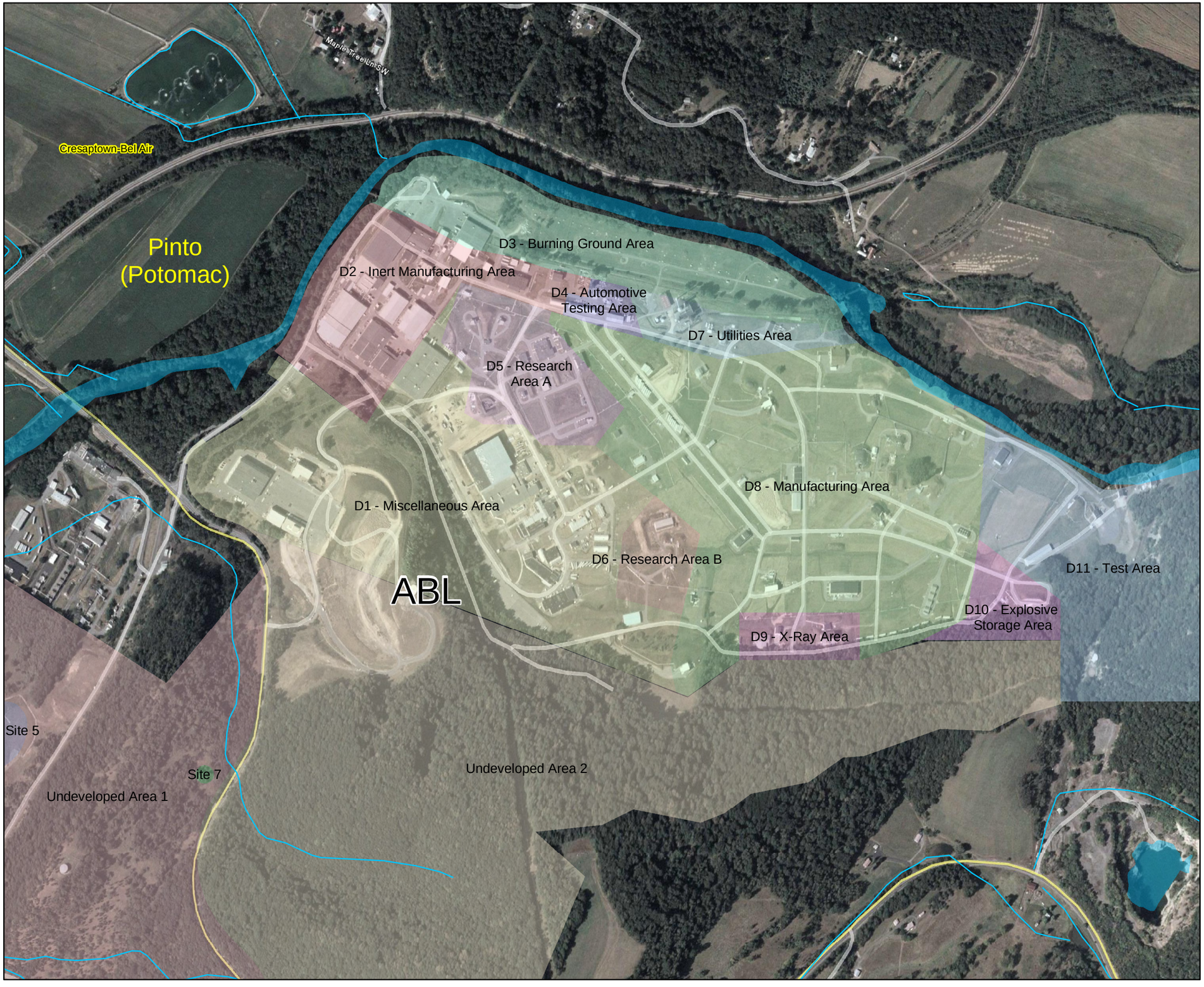
Figure 6. Total Waste Burned in Open Burning Operations, by Calendar Year

Data Source: ABL 2004b.

Figure 7

Areas

Allegany Ballistics Laboratory
Mineral County, West Virginia



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GRASP
GEOSPATIAL RESEARCH, ANALYSIS & SERVICES PROGRAM

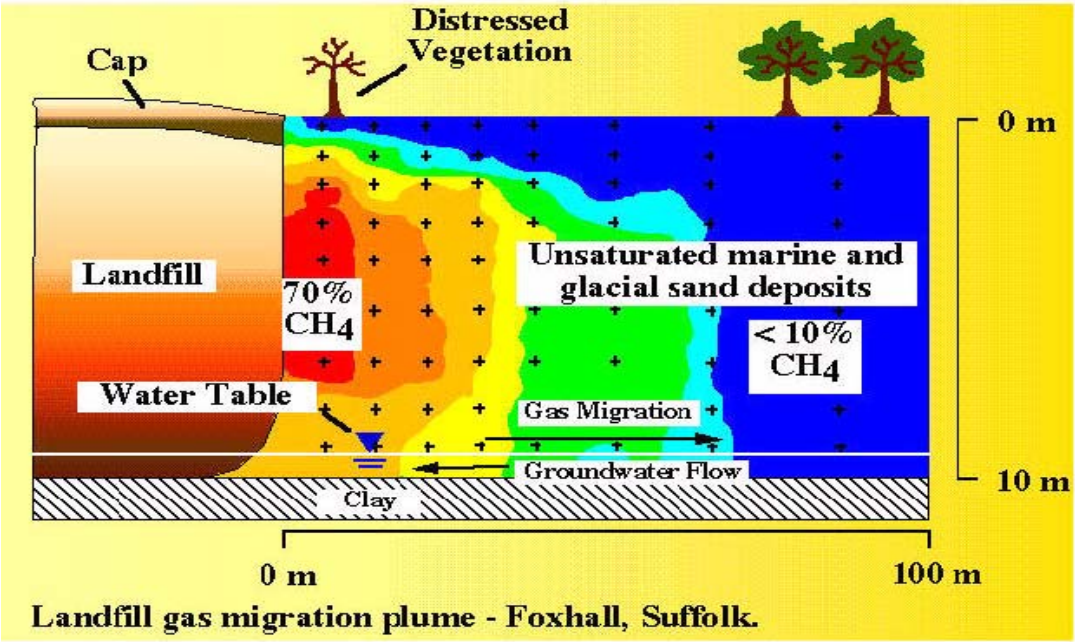
Printing Date: Thursday, May 31, 2007
Prepared By: kbl3
ATSDR Public Health Geospatial Research, Analysis, & Services Program
File: Figure-7_lab-areas.mxd
Project: prj02167_Allegany_Ballistic_Lab

Figure 8. British Geological Survey Landfill Case Study: Foxhall, Suffolk, England

Project Profile Migration and Alteration of Landfill Gases.

The presence of methane in the subsurface continues to be a problem faced by the construction industry, and particularly by developers of contaminated land and landfill operators. Many natural or anthropogenic sources of methane exist in the environment, which can make it difficult to identify the origin easily. Without knowledge of the source, the migration pathway and mode of transmission of the gas, remedial measures cannot be defined on a rational basis and inappropriate action may exacerbate the spread of gas.

In order to assess potential changes in landfill gas and potential source identifiers during migration, a study has been made at a landfill in Suffolk. Evidence of crop distress pointed to the existence of landfill gas migrating from the site. This was confirmed by site investigation and 39 probes have been installed within the gas plume for long-term gas monitoring and 3-dimensional delineation of the plume.



Landfill gas migration plume - Foxhall, Suffolk.

Results indicate that methane and carbon dioxide concentrations within 2 m of the surface are much lower than those at greater depths highlighting the need for supplementing shallow soil gas surveying with deeper investigation when assessing potentially contaminated land. Concentrations of methane and carbon dioxide both decrease with increasing distance from the landfill, although not to the same extent. greater extent than those of carbon dioxide. The stable isotope ratios of carbon (12C/13C) in methane and carbon dioxide vary antithetically with methane becoming isotopically heavier and carbon dioxide lighter with distance. This is consistent with microbial oxidation of methane in which bacteria preferentially metabolise 12C. Residual gases can then be confused with gases of thermogenic origin, e.g. coal gas. Methane concentration distribution along plume axis Over 77 volatile trace organic compounds have been identified in the soil gas. The more volatile compounds, especially the stable ones; vinyl chloride and dichlorofluoromethane, were found to have migrated the greatest distances. This indicates that they may be of potential use for source identification purposes.

Models have been used to simulate the observed concentration distributions of methane and carbon dioxide. It appears that diffusion coupled with a small element of advection (4.5m/year) is the most likely explanation for the observed concentration distributions.

Appendix A. Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption
The process of taking in. For a person or an 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].

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

Ambient
Surrounding (for example, ambient air).

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.

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.

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

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 occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk 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.
CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]
Chronic
Occurring over a long time [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]
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. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).
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.
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.
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.

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

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

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 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.

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

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

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

Hazardous 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].

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.

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].

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].

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 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]

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].

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 health action
A list of steps to protect public 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 meeting
A public forum with community members for communication about a site.

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

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.

Risk
The probability that something will cause injury or harm.

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].

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.

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.

Substance
A chemical.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (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].

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.

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

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

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)
National Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)
National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

For more information on the work of ATSDR, please contact:
Office of Policy and External Affairs
Agency for Toxic Substances and Disease Registry
1600 Clifton Road, N.E. (MS E-60)
Atlanta, GA 30333
Telephone: (404) 498-0080

Appendix B. Review of Selected Environmental Contamination Sites

This section addresses additional environmental and health concerns, beyond the five main issues of interest addressed in the main body of the report. These concerns were identified by reviewing the RAB minutes from 1989 to the present and from consulting with individuals familiar with the site. ATSDR organized these additional concerns into two categories, which are addressed separately.

I. Is anyone exposed to harmful levels of contamination at the existing waste sites? EPA and WVDEP oversee the Navy's site clean-up activities. Through a process outlined in the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the party responsible for environmental contamination (in this case, the Navy) conducts remedial investigations and feasibility studies before entering into records of decision (RODs) that describe what activities must take place to protect human health and the environment. Since 1994, when EPA listed ABL on the NPL, the Navy has evaluated over 100 areas of potential environmental contamination at ABL. In recent years, remediation efforts have been targeted at nine "sites" on ABL property, and each site is briefly reviewed below. Note that the site numbering scheme is not sequential; this is not an error, but rather results from the fact that the contaminated sites have been re-grouped and re-numbered over the years.

Overall, the information ATSDR reviewed for the multiple sites reveals several common themes. In general, past operations at ABL have caused environmental contamination at several locations. However, the ongoing remedial investigations and clean-up activities, conducted with EPA and WVDEP oversight, are ensuring that the contamination does not cause unacceptable harm to human health or the environment. These ongoing activities, combined with the fact that site access restrictions prevent residents from coming into contact with contamination, suggest that the environmental contamination at ABL's existing waste sites do not pose a public health hazard.

Site 1: Riverside Disposal Area

Site 1 spans 11 acres and includes several waste disposal units whose operations date back to the 1950s. The former units include two small landfills, three unlined solvent disposal pits, potential spill sites, and a drum storage area. Current operations at Site 1 are conducted at an active burning ground for disposing of waste material through open burning. Sampling investigations over the past 20 years have characterized how past disposal practices at Site 1 have contaminated the groundwater, soils, surface water, and sediments. The primary contaminants of concern are chlorinated solvents, especially in the vicinity of the former solvent disposal pits. For instance, groundwater concentrations of trichloroethylene (TCE) were at one time extremely elevated (240,000 µg/L) near where one pit was formerly located; other chlorinated VOCs, perchlorate, and other compounds were also measured in the groundwater at this location, but in much smaller amounts. TCE, presumably originating from Site 1, has previously been detected in the surface water flowing in the North Branch Potomac River.

In 1997, a ROD was signed that, among other actions, required the Navy to begin pumping contaminated groundwater, treating the water on site, and then discharging the treated water to the river or using that water to generate steam. The pump-and-treat system became fully operational in September 1998. Before the end of 1998, the groundwater flow direction beneath Site 1 was reversed such that contaminated groundwater was primarily being captured and treated, rather than discharging into the North Branch Potomac River (CH2M Hill 2002a). This system continues to pump and treat approximately 150 gallons of contaminated groundwater per minute, which translates into approximately 40 million gallons per year. Other environmental remediation activities at Site 1 continue to occur, such as long-term monitoring of the groundwater and continuing discussion on the most appropriate remedy for the contaminated soils.

While no one is exposed to the contaminants detected directly beneath Site 1, some of this contamination does migrate off site, whether into the North Branch Potomac River or in bedrock aquifers beneath the river. The public health implications of these releases are considered in the main body of this report (see Discussion, page 9).

Site 2: Previous Burning Ground (1942 to 1949)

Between 1942 and 1949, the area now known as Site 2 was used to burn various wastes and to store solvents. Site 2 is located in the Industrial Area of Plant 1, approximately 500 feet from the North Branch Potomac River. Sampling investigations conducted during the 1980s and 1990s focused on soils, but found very limited contamination of a few VOCs, SVOCs, and metals (CH2M Hill 2002a). Ongoing sampling has focused on the same groups of chemicals and this site is still undergoing remedial investigation. The levels of chemical contamination detected in the samples from Site 2 currently do not pose a health hazard, given that residents cannot access ABL property. The remedy selected for this site is expected to ensure that contamination does not pose unacceptable health risks in the future.

Site 3: Previous Burning Ground (1950 to 1958)

Between 1950 and 1958, open burning activities at ABL were conducted in the area now known as Site 3, which is also located in the Industrial Area of Plant 1. Environmental samples were collected at Site 3 during the Initial Assessment Study and subsequent remedial investigations. Sampling results revealed limited evidence of surface soil contamination, though a single surface soil sample collected near a former solvent storage shed had elevated concentrations of selected VOCs. The Navy continues to study the environmental contamination at Site 3 and has not yet proposed its final remedy. Nonetheless, due to the access restrictions at ABL, the contamination that remains at Site 3 currently does not pose a health hazard to residents.

Site 4B: Spent Photograph Developing Solution Site

Photographic developing operations at ABL previously occurred in Building 181 in the Industrial Area. Spent photographic solutions, which contain silver, cyanide, and phenols, were reportedly discharged through a series of pipes and channels before eventually flowing into a stormwater ditch. Multiple environmental sampling investigations have since found

elevated concentrations of silver in surface soils at Site 4B; low levels of VOCs and SVOCs were also identified. Soil removal actions were planned at the time of ATSDR's site visit, but a final remedial action has not been selected for this site. The levels of environmental contamination currently do not pose health hazards to nearby residents, because current site access restrictions prevent residents from being exposed to this contamination.

Site 5: Inert Landfill

Between the 1960s and 1985, ABL disposed of various wastes in a 4-acre landfill in the Undeveloped Area along the North Branch Potomac River, now known as Site 5. The total volume of wastes disposed of has not been documented. Wastes in this landfill include empty drums, laboratory chemicals, garbage, metal machining wastes, and construction and demolition debris. Wastes contaminated with explosives were handled separately and not disposed of at Site 5. In the 1980s, when disposal practices ended, the landfill was covered with 1 to 2 feet of crushed limestone. Environmental sampling investigations conducted since the 1980s have detected VOC contamination in the groundwater beneath and adjacent to the landfill. For instance, trichloroethylene (TCE) was found at concentrations up to 110 µg/L in the alluvial aquifer and up to 19 µg/L in the bedrock aquifer. This groundwater contamination extends approximately 800 feet north of the landfill and is flowing toward the North Branch Potomac River.

The Navy is addressing contamination at Site 5 in two phases. First, a ROD was signed in 1997 to address the landfill contents and soil contamination. This ROD required, among other things, installation of an impermeable cap with passive gas venting, landfill gas monitoring, long-term groundwater monitoring, and implementation of operations and maintenance activities (EPA 1997b). By minimizing the amount of precipitation that flows through the landfill, these measures have reduced the migration of contaminants from Site 5 in the groundwater. In the second phase, the Navy is investigating options for remediating contaminated groundwater. Though that investigation is ongoing, the available sampling data suggest that no one is exposed to these contaminants, thus no hazard currently exists. Refer to the main body of the text (see Potential to Encounter Explosive Gases, page 21) for ATSDR's evaluation of potentially explosive gases at Site 5.

During the site visit, ATSDR noted several dead trees in the vicinity of Site 5. Consistent with this observation, the Navy has also reported that 14 dead trees are located near the north end of the landfill; one site report attributes the tree deaths to changes in drainage characteristics that occurred after the landfill cap was constructed (CH2M Hill 2002a). Monthly landfill inspection reports indicate that the number of dead trees has remained constant, which suggests that the original cause of the tree deaths has not affected other trees in the area. Continued fulfillment of the ROD requirements should help detect any future tree deaths or identify potential causes (e.g., migration of contaminants) that might be of concern for human health.

Site 7: Beryllium Landfill

During the 1960s, wastes containing beryllium were occasionally disposed of in a small, 6-foot deep earthen pit in the Undeveloped Area that was excavated down to bedrock. The types of waste disposed of at the landfill included spent personal protective equipment and empty containers. These wastes were estimated to contain less than 2 pounds of beryllium and beryllium compounds. After several environmental sampling investigations, the Navy eventually excavated the entire contents of Site 7 and its associated soils in 1994, replaced the contents with clean fill, and shipped the waste material off site for disposal. Multiple confirmation samples collected after this removal action found no evidence of environmental contamination remaining at Site 7. In 2001, a ROD was signed concluding that "no further action" was needed at Site 7 to protect human health and the environment (EPA 2001).

Site 10: Area Around Building 157

Between the 1950s and 1960s, degreasing operations and other industrial activities in Building 157 of the Industrial Area released chlorinated solvents, which have since been detected in the alluvial and bedrock aquifers beneath the site. The measured groundwater concentrations of TCE have been the highest (up to 830 µg/L), with several other VOCs found at considerably lower levels. After the Navy extensively studied the groundwater plume, an interim action ROD was signed that required the Navy, among other things, to pump and treat the contaminated groundwater in the alluvial aquifer (EPA 1998). This treatment system at Site 10 became operational in 1999. In 2005, a final ROD for Site 10 groundwater was signed. That ROD required the Navy to, among other things, pump and treat contaminated groundwater in both the alluvial and bedrock aquifers beneath Site 10. This system continues to operate today. The Navy continues to study contamination that remains in subsurface soils and groundwater and further action for this site may be pending. The fact that studies are ongoing has little bearing on the findings of this PHA, given that there is no completed exposure pathway for the contamination at this site: the groundwater plume appears to remain entirely within ABL's site boundary and is far from any wells used for drinking water purposes.

Site 11: Production Well F

In the late 1950s, a boiler house and a fuel storage area operated in the Industrial Area at a location now known as Site 11. A deep bedrock production well was constructed in this area but was never put into use because sand flowing into the well prevented water from pumping properly. Environmental sampling investigations in the 1990s detected contamination in some soils and in the alluvial and bedrock aquifers at Site 11. Specifically, this sampling found both light- and dense-non-aqueous phase liquids in the groundwater. Recent reports, however, have suggested that sampling activities during the remedial investigations might have removed most of these liquids (CH2M Hill 2002a). Regardless of the status of this removal action, remedial investigation activities at Site 11 are still ongoing. The available information suggests that the environmental contamination at Site 11, both in soils and groundwater, does not currently pose a health hazard to residents, given the lack of a completed exposure pathway.

Site 12: Building 167 Area

Site 12 includes five solid waste management units located near Building 167. These include miscellaneous wastewater treatment tanks and waste storage areas, most of which are no longer operating. Soils in this area have been found to contain elevated levels of chromium and selected SVOCs. At the time of ATSDR's site visit, a soil removal action was planned to address this contamination, and ABL anticipated that no further action would be necessary once these removals were completed. Regardless of the status of this removal action, remedial investigation activities at Site 12 are still ongoing. The available information suggests that the environmental contamination at Site 12, both in soils and groundwater, does not currently pose a health hazard to residents, given the lack of a completed exposure pathway.

II. **Other site-wide occupational and environmental health concerns.** ATSDR identified several other potential health concerns during its site visit to ABL. Examples of occupational health concerns included those associated with working in environments that might contain asbestos, beryllium, lead, nitroglycerin, and other toxic chemicals. However, discussions during the site visit strongly suggested that measures are in place in accordance with applicable regulations to ensure that workers are protected from such hazards. Additional environmental health issues identified included chemicals that drip from steam pipelines onto surface soils and the possibility of encountering unexploded ordnance. Neither of these issues, nor others considered, was found to be of health concern due largely to the site access restrictions. Thus, ATSDR concludes that, under current access restrictions, these additional facility-wide issues do not pose public health hazards to community members. The Navy and regulatory agencies should carefully review future plans that would allow residents unrestricted access to any part ABL property, though ATSDR is not aware of any such plans being contemplated.

Appendix C. Background Information on Perchlorate

This appendix presents background information on perchlorate, one of the chemical contaminants at ABL. Background information is given on this particular chemical, because perchlorate has been the focus of considerable attention in recent years since advances in environmental sampling methods revealed that perchlorate is found at trace levels in numerous drinking water supplies across the country. Last year, the National Research Council released a detailed report on perchlorate in the environment and its associated health effects (NRC 2005). ATSDR thoroughly reviewed this extensive report when assessing the environmental health issues at ABL.

What is perchlorate?

Perchlorate is a negatively charged ion (ClO_4^-) that is found naturally in the environment and is also synthesized for use in many industrial applications. Perchlorate is an environmental contaminant that is seldom known to occur naturally. Perchlorate compounds contain the perchlorate anion (perchlorate) and include both inorganic and organic perchlorate salts (perchlorates) and perchloric acids. Perchlorate compounds may also be found as impurities in other manufactured and natural compounds or possibly may form over time in compounds that include oxygen and chlorine such as chlorine bleach. Most of the perchlorate made in the United States is used as a propellant (or "fuel") for rockets and missiles, though the chemical is also found in other products, such as safety flares, some commercial explosives, fireworks, and perchloric acid.

Perchlorate salts dissociate completely in water and aqueous tissues and are highly soluble in water. Dissolution of perchlorate salts yields the perchlorate anion, which is highly stable and mobile in surface and groundwater systems and may result in the uptake by plants, animals, and humans. Perchlorate salts are strong yet stable oxidizing agents that vary by compound. Due to perchlorate's solubility and the fact that the chemical adheres poorly to mineral surfaces and organic material, it can be very mobile in surface and subsurface aqueous systems. Moreover, perchlorate is relatively inert in typical groundwater and surface water conditions, and perchlorate contamination may therefore persist for extended periods of time. Thus, once perchlorate is released into the environment, it tends to remain in the water phase, whether surface water or groundwater. Unlike other common environmental contaminants, like volatile organic compounds, perchlorate is not easily removed from water — a fact that complicates efforts to clean up groundwater or surface water that contains elevated levels of perchlorate.

How does the perchlorate anion move in groundwater?

In dilute concentrations typically found in groundwater, perchlorate behaves conservatively, with the center of mass of the plume moving at the same average velocity as the water, and dispersion will result in the contaminant front actually moving faster than the average groundwater velocity (DTSC 2005). Perchlorate is kinetically very stable under environmental conditions and will not react or degrade in solution under ambient conditions. Biodegradation of perchlorate in groundwater generally will not occur unless multiple conditions are met (e.g., significant levels of organic carbon are present, oxygen and nitrate are depleted, and perchlorate-degrading anaerobic bacteria are present) (DTSC 2005). If perchlorate is released as a high concentration

brine solution, the movement of the brine in a groundwater system may be controlled by density effects. Specifically, depending on site release history, perchlorate can be distributed in the subsurface as a source area of undiluted perchlorate-contaminated brine, along with a plume of more dilute perchlorate contaminated groundwater (Flowers and Hunt 2000).

How fast dose perchlorate move compared to VOCs (volatile organic compounds) and how can scientists "fingerprint" perchlorate anion and identify the source of perchlorate?

ATSDR accessed a publication (Motzer 2005) that provides information on how scientists have used perchlorate to track groundwater plumes. Relevant insights from that publication follow: Perchlorate has been used as a tracer for evaluating the flow of volatile organic compounds and metals in groundwater. This is because perchlorate moves at groundwater flow rates, while the other contaminants are significantly more retarded. There are also techniques available to fingerprint sources of perchlorate. One technique is to look at the isotopic ratios of the chlorine and oxygen atoms in the perchlorate in groundwater. These ratios have been used at some sites to distinguish perchlorate attributed to rocket fuel sources, as compared to those from nitrate fertilizer and other sources. Another technique is to consider metals and stable isotopes associated with the perchlorate compounds used in the original manufactured products from which the releases occurred. For example, metals are commonly included in pyrotechnics to add color to the explosive display, and elevated levels of certain levels might suggest pyrotechnics as the original source of perchlorate contamination. There are also ways that isotopes of strontium, oxygen, and hydrogen can be used to pinpoint the original sources of contamination. Readers are referred to the original publication (Motzer 2005) for more information on this topic.

How does exposure to perchlorate affect humans?

Perchlorate exposure, when at high enough levels, can interfere with our thyroid gland's ability to produce hormones, which play important roles in proper development and metabolism. By inhibiting the process by which the thyroid uptakes iodide to make hormones, perchlorate disrupts how the thyroid functions. However, at low levels, this disruption is a temporary condition that does not result in adverse health effects. In adults and children, the thyroid helps to regulate metabolism. In children, the thyroid also plays a major role in proper development. Impairment of thyroid function in pregnant mothers may impact the fetus and may result in such effects as changes in behavior, delayed development, and decreased learning capability.

Studies have measured the amount of perchlorate exposure required to impair thyroid hormone production in healthy individuals, which is considered a precursor event that would occur before any adverse health effects might be observed (NRC 2005). EPA has used this information to establish a reference dose for perchlorate of 0.0007 mg/kg/day. This reference dose represents an exposure level that humans are believed to be able to tolerate without experiencing any adverse noncancer effects. EPA has concluded that "perchlorate is not likely to be carcinogenic to humans," at least at exposures below the reference dose (EPA 2005e).

What happens to perchlorate that enters animals?

The following text provides some observations of perchlorate in certain mammals. This is not intended to be an exhaustive literature review. Rather, the text is meant to offer some technical insights on the exposure scenarios considered in this public health assessment.

First, ATSDR accessed a publication (Capuco et al. 2005) that documented the fate of perchlorate that was ingested by dairy cows. This publication reports on a study of dairy cows that were dosed at known levels of perchlorate for 5 weeks. The study found that up to 80% of the perchlorate in the administered doses was metabolized by the cows. More importantly, the study found "no evidence for the accumulation of perchlorate in tissues," such as those that might be consumed if these animals were used for food supply. Additionally, the study found a relatively short half-life of perchlorate in both the blood and urine, suggesting that most perchlorate consumed by these animals would not be found in these fluids soon after exposure. The results of this study are reasonably consistent with the judgments that ATSDR made in its evaluation of potential contamination cuts of meat from deer and game harvested from the ABL area (i.e., perchlorate would most likely be found in the milk and thyroid of deer, which humans typically do not consume).

Second, ATSDR reviewed a publication (Cheng et al. 2004) that examined the extent to which beef cattle absorb perchlorate found in their feed. The study considered beef cattle reared at a site where they were exposed to water containing approximately 25 ppb perchlorate. At the conclusion of the study, animals were processed in a manner identical to that found in a commercial beef processing operation. The following tissue samples were obtained from each animal and were subsequently analyzed for perchlorate levels: thyroid, liver, and various meat cuts (e.g., sirloin steak, round steak, t-bone steak). Even though the cattle were constantly exposed to perchlorate, no measurable perchlorate residues were observed in these tissues. This finding is also generally consistent with the conclusions that ATSDR reached in this PHA, though ATSDR acknowledges that study conditions differed slightly from conditions at ABL in terms of contamination levels in vegetation, spatial extent of contamination, and other factors.

Taken together, these two studies provide further support ATSDR's main findings regarding consumption of cuts of meat from locally harvested deer at ABL. While there are limitations associated with these studies, such as the applicability of findings in ruminant cattle to deer, there appears to be a number of rigorous scientific research projects suggesting that this exposure pathway (i.e., ingestion of cuts of meat from deer) is not of public health concern for the ABL site.

Do the measured levels of perchlorate at ABL present a health hazard?

When preparing this public health assessment, ATSDR considered the concentrations of perchlorate listed above, as well as those documented in several other site reports. Overall, ATSDR found that the perchlorate contamination does not present a health hazard, either because it is found at a location where residents cannot access or because the estimated exposure occurs at levels not expected to cause harmful health effects, based on the current state of the science regarding perchlorate toxicity. However, due to some uncertainty associated with groundwater flow near ABL, ATSDR has recommended that the Navy sample private wells

serving homes located along McKenzie Tower Road in Maryland for perchlorate to verify the effectiveness of ongoing remediation measures.

What are state and federal sampling requirements relevant to perchlorate?

EPA is still trying to determine appropriate maximum contaminant levels for perchlorate. Per Federal Register dated August 22, 2005, "Unregulated Contaminant Monitoring Regulation for Public Water Systems Revision; Proposed Rule," assessment monitoring should start in 2007 through 2010. EPA lab approval process starts in 2006. States will be contacting systems with monitoring requirements.

Appendix D. Summary of Perchlorate Sampling Data at ABL

This appendix presents information on the levels of perchlorate that have been measured in various environmental media at ABL. At the time ATSDR prepared this report, perchlorate levels in selected environmental media were reported in many site documents, including the following multi-media results from three extensive studies (Dean et al. 2004; DoD 2006; Parsons Engineering Science 2001).

ABL Drinking water: No perchlorate detected (detection limit = 4 ppb) in any sample

ABL Wastewater: Perchlorate concentrations range from non-detectable to 1,900,000 ppb. The highest result occurred following an unexpected breakthrough in a wastewater treatment unit.

ABL Surface water: Perchlorate concentrations in the North Branch Potomac River and in various on-site ditches ranged from non-detectable to 690 ppb. This highest level was found in a direct discharge to the river. Levels found in the river water have always been substantially lower at the sampling locations selected. On ABL, The 2001 study results ranged from not detectable (ND) to 280 (ug/L).

In a more recent study (CH2M Hill 2006a), grab samples were collected from the North Branch Potomac River monthly between February and July 2006. Perchlorate was consistently detected downstream from the main ABL wastewater outfall at concentrations ranging from 7.2 to 74 ppb. However, perchlorate was also consistently detected at similar concentrations at a location upstream from the outfall.

ABL Groundwater: Out of 327 samples collected for this study, perchlorate was detected in 157 samples, with the highest detected concentration being 34,900 ppb (34.9 ppm). The detection was in an on-site monitoring well, which is not used for drinking water purposes.

ABL Soil: The 2001 study reported results on an adjusted wet weight (ww) basis, with concentrations ranging from ND to 22,100 ppb (ug/kg). Measurements at specific locations at ABL follow, all of which are expressed on a wet weight basis:

Burn Area: 117 to 22,100 ug/kg
Former Building 105 (SWMU 37L): ND
Building 446 (SWMU37E): 88 to 990 ug/kg
Upstream of Weir (WWTP): ND
Down Stream of Weir (WWTP): ND to 112 ug/kg
CERCLA Site 1 Outfall: ND

ABL Sediment: The 2001 study reported results on an adjusted wet weight basis, with concentrations ranging from non-detectable to 119 ppb (ug/kg). Measurements at specific locations at ABL follow, all of which are expressed on a wet weight basis:

SSL2: ND to 104 ug/kg
Upstream of Weir (WWTP): ND to 119 ug/kg
Downstream of Weir (WWTP): ND
Storm Drain: ND
CERCLA Site 1 Outfall: ND

ABL Pore Water: The 2001 study reported results ranging from 14.0 to 23.0 ug/L approximately (ppb). All measurements were collected at a location downstream of the weir from the wastewater treatment plant outfall.

ABL Plants (Terrestrial Vegetation):
The 2001 study reported results on an adjusted wet weight basis, with concentrations ranging from not detectable to 300,000 ug/kg (ppb). Measurements at specific locations at ABL follow, all of which are expressed on a wet weight basis:

Burn Area: 9,920 to 300,000 ppb
Former Building 105 (SWMU 37L): ND to 290 ppb
Building 446 (SWMU37E): ND to 1,160 ppb

ABL Plants (Aquatic Vegetation):
The 2001 study considered samples from many locations at ABL, but perchlorate was not detected in any of the samples. The sampling locations considered were upstream and downstream of the weir at the outfall from the wastewater treatment plant.

ABL Fish: The 2001 study reported results on an adjusted wet weight basis, with concentrations ranging from ND to 451 ug/kg (ppb). Fish tissue samples were collected at only two locations, with the range of concentrations (on a wet weight basis) as follows:

Upstream of Weir (WWTP): ND to 451 ppb
Down Stream of Weir (WWTP): ND

Northern Branch Potomac River Fish:

Not sampled

ABL Amphibians: Perchlorate was not detected in any of the amphibian samples collected as part of the 2001 study. The only sampling location was upstream of the weir from the wastewater treatment plant outfall.

ABL Terrestrial Invertebrates:

Perchlorate was not detected in any of the terrestrial invertebrate samples collected as part of the 2001 study. This finding is based on samples from two onsite locations: the former Building 105 (SWMU 37L) and a storm drain.

ABL Terrestrial Mammals:

Perchlorate was not detected in any of the mammal tissue samples collected as part of the 2001 study. This finding is based on samples from two onsite locations: the burn area and an area upstream of the weir from the wastewater treatment plant outfall. Larger mammals including raccoons, opossums and deer were not sampled

ABL Terrestrial Birds:

Perchlorate was measured in bird samples collected from a single location at ABL: the burn area. The measured concentrations at this location ranged from ND to 423 ug/kg (ppb) on an adjusted wet weight basis. Wild turkeys were not sampled.

ABL Terrestrial Insects:

During the 2001 study, terrestrial insects were collected at two sampling locations at ABL. Overall, concentrations on an adjusted wet weight basis ranged from ND to 12,600 ug/kg (ppb). Concentrations at the specific locations where measurements occurred were:

Burn area: ND to 12,600 ppb
Former Building 105 (SWMU 37L): ND

Appendix E. ATSDR's Responses to Public Comments

On May 4, 2006, the Agency for Toxic Substances and Disease Registry (ATSDR) issued the Public Comment Release of the public health assessment (PHA) for the Allegany Ballistics Laboratory. The Public Comment Release was distributed directly to numerous individuals and local organizations. Additionally, ATSDR issued a press release announcing the availability of the Public Comment Release at local records repositories. The public comment period lasted more than 6 weeks and ended on June 16, 2006. This appendix presents the comments that the public, local organizations, and other parties submitted during the public comment period, along with ATSDR's responses to those comments. Note that all page numbers cited in this appendix refer to page numbers in the Public Comment Release draft. The list of comments below does not include editorial comments, such as suggested word changes and spelling corrections.

Comment 1:

We concur with the findings and recommendations. We specifically agree with the recommended sampling for perchlorate, by the Navy, in private wells along McKenzie Tower Road. It is also our recommendation that private well owners have their drinking water tested for contaminants other than perchlorate.

Response 1:

ATSDR appreciates receiving this comment. No changes were made to the PHA in response to this comment.

Comment 2:

It is not necessary to sample private wells serving homes along McKenzie Tower Road because there is no mechanism for contaminated groundwater from ABL to affect these wells. Available studies support EPA's conclusion that groundwater from ABL does not affect areas in Maryland, as summarized on page 10 of the ATSDR report for ABL, specifically: (1) The Navy and EPA have concluded that contaminated water from ABL likely discharges to the North Branch Potomac River and does not flow beneath it. Comparison of groundwater levels between ABL and the monitoring wells previously along McKenzie Tower Road showed that the river acts as a groundwater divide. In other words, groundwater in the bedrock flows toward the river both in Maryland and at ABL in West Virginia. (2) ABL operates a groundwater treatment system that currently captures contaminated groundwater at ABL adjacent to the North Branch Potomac River. (3) Sampling of two groundwater wells along McKenzie Tower Road in 1994 and 1996 did not show any VOC contamination. At ABL, VOC and perchlorate contamination are consistently found in the same wells. Because no VOCs were detected in these wells, it is very unlikely that perchlorate would be present. [Note: A memo was submitted to ATSDR with additional information arguing that it may not be necessary to sample private wells for perchlorate (CH2M Hill 2006b).]

Response 2:

ATSDR was aware of all of the information included in this comment when preparing the PHA, and most of these arguments are included in the document. In addition, ATSDR carefully reviewed the memo with supplemental arguments for not sampling the private

wells located north of Site 1 at ABL. While the arguments presented in this comment and the memo are compelling, they do not confirm that the private wells have not been affected by past and possible ongoing releases of perchlorate from ABL. To clarify our position, ATSDR's rationale for recommending that the Navy sample private wells serving homes along McKenzie Tower Road was due to the uncertainty associated with the local geology and movement of perchlorate in water bearing fractures. ATSDR believes that contaminated groundwater might move through water bearing fractures other than those that the monitoring wells sample. Part of this uncertainty stems from ATSDR's experiences evaluating groundwater flow in such fractures and also from an EPA report on ABL that found: "Aquifer tests at Plant 1 and water-level data collected from the river and monitoring wells at Site 1 suggest varying degrees of hydraulic interconnection exist between the river and alluvium, the river and shallow bedrock, and the alluvium and shallow bedrock. In addition, water-level data collected from monitoring wells across the river from Site 1 suggest that [upper] bedrock groundwater from the western two thirds of the site clearly discharges to the river and does not flow beneath the river. These flow conditions are a result of the higher bedrock topography and related groundwater elevation heads that occur across the river in comparison to the bedrock on site. However, bedrock groundwater may migrate beneath the river from the eastern one third of the site. Water-level data from the bedrock wells on both sides of the river in this section of Site 1 are very similar, however the wells to the north have a slightly lower groundwater elevation head indicating potential flow in that direction. The wells across the river at this location have been sampled and no contaminants of concern detected at Site 1 were detected, so if groundwater does flow under the river Site 1 groundwater contamination has not reached that area. Similar to the alluvium, the river is most likely a discharge zone for shallow bedrock groundwater in the vicinity of Site 1" (EPA 1997a).

While the information that the Navy provided in its supplemental memo (CH2M Hill 2006b) reduces some of the uncertainty in the groundwater evaluation, this additional information still does not address concerns of potential releases of perchlorate to water bearing fractures or potential releases of perchlorate as a brine that could subsequently move through fractures to drinking water wells or movement of the perchlorate with the water in one or more fractures. Moreover, there is no indication whether the wells that have been tested are connected by fractures to ABL. Overall, ATSDR determined that the information available has enough uncertainty about groundwater flow directions that sampling is warranted to confirm that contaminants from ABL have indeed not affected the private wells in Maryland. Such sampling would be the best means for confirming that groundwater contamination from Site 1 at ABL is not affecting and has not affected the drinking water used by nearby residents. As noted in the text regional anthropogenic levels of perchlorate in wells would also need to be considered since perchlorate is present in the watershed up river from ABL and is likely present in wells drawing drinking water from water bearing fractured rock. If higher levels of perchlorate are present in private drinking water wells near ABL then up-gradient of ABL then additional evaluation by ATSDR and other agencies would be prudent.

Comment 3:

The PHA should have a figure showing the residential streets near ABL.

Response 3:

A new figure with this information has been included in the PHA (see Figure 3).

Comment 4:

Page 1, paragraph 5: Use of the terms “current” and “potential” is confusing.

Response 4:

ATSDR revised the sentences in question to clarify their meaning.

Comment 5:

The references in Table 1 to people being exposed and to the “indeterminate public health hazard” are confusing. This text should be removed, clarified, or explained.

Response 5:

ATSDR removed the conclusion categories from Table 1 and instead included text that explains the main findings for each exposure pathway that was addressed. ATSDR conclusion categories with explanatory text are provided in the conclusion section.

Comment 6:

Table 1 and the text should discuss or mention that previous local concerns were due to soot coming from boilers at ABL, not open burning. A confounding factor with this concern is the fact that lots of people use coal in the area.

Response 6:

ATSDR considered air emissions from the boilers when reviewing the air permit and compliance information for ABL. The issue of soot from boilers has been added to Table 1 and is now also mentioned in the Summary section, the section on Air Emissions from Open Burning and Other Operations, and the Conclusions.

Comment 7:

Why does ATSDR recommend that the Navy sample just for perchlorate if other chemicals were released to the area? The document should mention if and why perchlorate is considered a surrogate for VOCs.

Response 7:

ATSDR recommended Navy perchlorate sampling because the chemical has never been sampled in the private wells and because perchlorate is likely more mobile than VOCs in the groundwater. ATSDR did not recommend VOC sampling in the private wells because such sampling has already been performed at some locations. Should perchlorate be detected at elevated levels in private wells in Maryland, further investigation would likely follow to determine if other site-related contaminants affect the particular wells.ATSDR

has recommended that private well owners sample for non-Navy -site related contamination that would include VOCs.

Comment 8:

Table 1 is confusing because some conclusion categories are applied to individual time frames while others apply to multiple time frames. Try to simplify this, if possible.

Response 8:

The comment correctly states that, for some exposure pathways, a single conclusion applies to multiple time frames, while for other exposure pathways, different conclusions apply to different time frames. Table 1 reflects this outcome and has not been reorganized. However, ATSDR has revised Table 1 to clarify the conclusions.

Comment 9:

On page 14, in Table 3, and in related text, not enough information is provided to allow meaningful comparisons for the air emissions data. ATSDR should consider adding columns to the table that indicate the range, minimum, and maximum emissions in tons per year for other facilities, if this is available. From the table, it is difficult to know if ATSDR is comparing the same thing, and no values are presented for comparison purposes. Also, ATSDR should consider including data for similar facilities.

Response 9:

Table 3 compares estimated air emissions from ABL to estimated air emissions from other industrial facilities and military installations across the state of West Virginia. The data summary is based on the annual emission rates reported in EPA's National Emissions Inventory. ATSDR has added the range of emission rates for these facilities to give some perspective on the magnitude of ABL's emissions. Also, ATSDR has included additional explanatory text to clarify precisely what these comparisons mean. ATSDR did not compare emissions to similar facilities, due to difficulties classifying what is meant by "similar" (e.g., should this include research and development facilities, production facilities, testing facilities, or all of these?) and difficulties associated with stratifying the National Emissions Inventory data.

Comment 10:

Regarding fish tissue contamination, when will we be able to eat as much fish as we want from the river and what can we do to clean up the river and fish faster? Who can we call and what can we do?

Response 10:

As the public health assessment notes, fish populations in the North Branch Potomac River have made a great recovery, from no fish being observed in long stretches of the river in the 1940s to sustainable populations being observed today. This recovery will presumably continue to occur, as pollutant loadings to the watershed decrease. However, ATSDR cannot predict precisely when residents will be able to eat as much fish as they would like from the river. The West Virginia Department of Health and Human

Resources (WVDHHR) issued the fish advisory that ATSDR quoted in the public health assessment. Residents can learn more about the advisory by visiting the WVDHHR website at: www.wbdhhr.org/fish.

Comment 11:

Will ATSDR evaluate the combined impact of past manufacturing and mining activities throughout the area? For instance, will ATSDR issue reports (separate or combined) to address issues from the Kempton Mine and various rubber plants?

Response 11:

The focus of this public health assessment is on residents' exposures to environmental contamination originating from ABL. Thus, ATSDR gathered data on contamination at and nearby the facility that one can reasonably attribute to ABL's operations. When reviewing this information, it became clear that some contamination likely originated from other sources, which the public health assessment acknowledges and evaluates, as appropriate. However, conducting a full evaluation of every source of environmental contamination throughout this region is beyond the scope of ATSDR's work for this site.

Comment 12:

The Kempton Mine is reportedly the largest source of acid mine drainage to the North Branch Potomac River watershed. The mine was above and to the west of ABL. Is it still having an impact on the river, and would it be a factor in evaluating contamination from other places that are mixing with it?

Response 12:

The public health assessment focuses on environmental contamination originating from ABL and considers other sources of contamination, when appropriate. For instance, ATSDR acknowledges in its evaluation of the North Branch Potomac River that the sampling data reflect contributions from many different sources, and ATSDR is aware that the Kempton Mine is one such source. Thus, discharges from this mine were implicitly considered in ATSDR's evaluation of contamination in the North Branch Potomac River. This public health assessment, however, should not be viewed as a comprehensive evaluation of environmental issues associated with the Kempton Mine. More information on ongoing measures to reduce acid mine drainage from the Kempton Mine is available from Maryland Department of the Environment's website (see: http://www.mde.state.md.us/Programs/WaterPrograms/MiningInMaryland/ReclamRevitalize/kemptonMine.asp).

Comment 13:

Everyone goes after the paper mill. Why are you picking on the paper plant and not mentioning the other companies instead? The paper plant meets all regulatory requirements and goes beyond its permit requirements in protecting the workers and the community. Retirees lost health benefits to pay for additional pollution control devices and this resulted in loss of health care. This is a real and bigger health problem for the former workers than the pollution that is under control.

Response 13:

The public health assessment does mention the paper mill. That sentence reads: "Upstream of ABL, pollutants enter the river and its tributaries from various sources, including abandoned and active mines, railroads, a large paper mill, agricultural operations, and several additional industrial and municipal dischargers." While ATSDR is certainly sensitive to concerns that residents might have about loss of retiree benefits, we believe this sentence is technically accurate, and we have not revised the document in response to this comment.

Comment 14:

Why can we still smell the current paper plant when the wind is from the paper plant and the plant is located many miles away?

Response 14:

As the responses to previous comments explain, the public health assessment focuses on environmental contamination originating from ABL. Conducting a full evaluation of every source of environmental contamination throughout this region is beyond the scope of this document. Please see response 11 for additional information on ATSDR regional considerations.

Comment 15:

How did ATSDR evaluate mercury above and below the dam and ABL? How did ATSDR evaluate dioxin in private wells, livestock, and fish and game near ABL and the paper plant?

Response 15:

This comment raises multiple issues about mercury and dioxin. When evaluating potential exposures to toxic chemicals such as these, ATSDR generally considers the contaminants that would most likely be released from the site's operations.

In the case of mercury, ATSDR found no evidence that ABL released this contaminant in appreciable quantities. Therefore, ATSDR judged that an extensive evaluation of ABL-related mercury contamination was not warranted. The public health assessment does acknowledge that the state has issued a fish consumption advisory for the North Branch Potomac River due to mercury levels found in certain species of fish. ATSDR included this information in the public health assessment because the advisory applies specifically to the region of the river near ABL, even though the contamination does not appear to be site-related and rather originates from a wide range of sources, both within and beyond the watershed. Readers interested in the precise data that were used to establish the fishing advisory can contact WVDHHR, which published the advisory (www.wbdhhr.org/fish).

The comment also asks several questions about dioxin. Regarding dioxin levels near the paper plant, readers should note that this public health assessment focuses primarily on environmental contamination near and associated with ABL. Accordingly, a comprehensive evaluation of contamination near the paper plant (more than 10 miles

from ABL) is outside the scope of work for this public health assessment. The following paragraphs describe ATSDR's approach to evaluating dioxin levels closer to ABL:

- *Private wells.* Based on the chemical and physical properties of dioxin, ATSDR judged that it is extremely unlikely that aerial deposition of dioxin to soils and subsequent leaching into groundwater would cause the chemical (and its congeners) to enter private wells in significant concentrations, let alone at levels high enough to pose a health concern.

- *Fish.* After reviewing fish tissue sampling data collected in the area, the West Virginia Department of Health and Human Resources determined that a fish consumption advisory was warranted for the North Branch Potomac River. ATSDR's findings are based entirely on that agency's conclusion.

- *Livestock, game, and other animals.* While analytical data are not available on the specific levels of dioxin in livestock, game, and other animals in the vicinity of ABL, ATSDR believes adhering to recommendations by other health and regulatory agencies to reduce exposure to dioxins should greatly minimize any risks that might be presented by this exposure pathway. Generally, people should eat healthy diets, and potential exposure to dioxin (and many other chemicals) will be reduced by eating a variety of foods that are low in fat and by using food preparation methods and cooking techniques that remove fat from food items. Adjusting diets to fall within the Dietary Guidelines for Americans (see: www.health.gov/dietaryguidelines) should lead to multiple health benefits, including limited exposure to persistent environmental contaminants, like dioxin. Additional information on dioxin in a question and answer format is also available from the U.S. Food and Drug Administration website (see: http://www.cfsan.fda.gov/~lrd/dioxinqa.html). Concerned residents may also discuss dietary concerns with their health care providers.

Comment 16:

What are the levels of dioxin in all media up and downstream of ABL and on ABL? How do you know the levels of environmental contamination if no sampling has occurred?

Response 16:

The comment implies that one must have sampling data from all environmental media throughout a region in order to reach conclusions about a site. While having a truly comprehensive sampling data set would obviously be useful, such a data set rarely exists due to practical limitations and other constraints and it is not uncommon for agencies to reach conclusions about sites based on limited data sets while considering the uncertianites associated with the data. Our response to the previous comment describes the approach ATSDR took to address dioxin contamination near ABL.

Comment 17:

Is or was depleted uranium (DU) ever used at ABL? If so, how was it used? Was it ever used in test firing of munitions? How did ATSDR, the Navy, EPA, and other federal agencies evaluate DU and other types of radiation that might be near, on, or off ABL?

Response 17:

DU is not processed or manufactured at ABL. Rather, ABL receives DU-containing material as a finished part. This part is then assembled into munitions with no further processing. No destructive testing occurs on the finished munitions before they are shipped off site. In addition to state and EPA oversight, ATK (who operates ABL for the Navy) has a license from the Nuclear Regulatory Commission (NRC), which posts its inspection reports on their website (run searches at: http://adamswebsearch.nrc.gov/scripts/securelogin.pl). The last safety inspection in March 2006 indicates no items of noncompliance were found relative to the storage and use of DU. The Navy, state of West Virginia, and EPA have not identified DU concerns at this site.

Comment 18:

Mention of past exposure in Table 1 is misleading. It gives the false impression that the document will answer questions about past exposure, even though there are not data to support such evaluations. The best we can do is to address current environmental conditions.

Response 18:

ATSDR has clarified in the footnote to Table 1 what is meant by "past." ATSDR considered past exposures to the extent sufficient information (whether based on sampling data or judgment) was available to support an evaluation. While the agency could not assess environmental health issues dating back to the 1940s, when operations first began at what is now ABL, the available information does allow ATSDR to draw reasonable inferences about past exposures over the time frame that the agency has been involved with this site (i.e., approximately the last 15 years).

Comment 19:

Since perchlorate soil and insect levels are relatively high compared to other locations in West Virginia and Maryland are there any plans for research by EPA, the Navy or a University to determine the level of chemicals including those from perchlorate and munitions in insect eating fish, birds and mammals that eat insects or that have a mixed diet or are omnivorous.

Response 19:

ABL has performed environmental assessment evaluation with oversight from state and federal regulatory agencies**. Please read comment 20 and our response.** (Note that ATSDR conclusion relative to human consumption of fish in compliance with fish advisories applies to consumption of perchlorate in fish. Some fish—especially pan fish—are predominantly feeding on insects near ABL with high levels of perchlorate. ATSDR also considered that some parts of some fish may have higher levels of perchlorate in different parts of the fish. This includes the potential that some fish heads

may have higher levels of perchlorate and may be used to make broth or soup by some people)

Comment 20:

My great grandfather ate snapping turtles, frogs, wild turkeys, opossums, and raccoons. I don't know anyone that eats these. Still, I like having them around. Is anyone going to sample these to find out if there is an environmental impact on local wildlife from ABL using perchlorate and other explosives?

- Snapping turtles are active hunters that prey on anything they can swallow, including many invertebrates, fish, frogs, reptiles (including snakes and smaller turtles), unwary birds and small mammals.
- Frogs are carnivores. They eat other animals, insects, and other small invertebrates, such as worms, spiders, and centipedes. Aquatic frogs sometimes eat other frogs, tadpoles, and small fish. Larger frogs eat animals as large as mice or small snakes. Perchlorate keeps frogs legs from developing. How many species of adult frogs are found on ABL.
- Turkeys are also known to occasionally consume small vertebrates like snakes, frogs or salamanders. Poults (turkey chicks) have been observed eating insects, berries, and seeds. Wild turkeys often feed in cow pastures and the burn area looks like a pasture, especially if the deer are eating the grass. Also chickens that are not kept in a coop eat bugs especially grasshoppers.
- Possums or Opossums are mammals with pouches and are also marsupials. Opossums are opportunistic omnivores with a very broad range of diet.
- Raccoons are nocturnal and omnivorous, eating berries, insects, eggs and small animals.

Response 20:

ATSDR is aware of people in the U.S. that eat all of these animals as food and some families and individuals near ABL may also eat them. Adult frogs and snapping turtles do not appear to be present is the streams and ditches near the burn area on ABL, but are in the river. Currently as discussed in the PHA, The level of perchlorate in the river appears to be essentially the same up stream and down stream of ABL. Since only deer have been observed on a frequent basis in the burn area that has the highest levels of perchlorate and turkeys have not been seen in the burn area, ATSDR evaluated the consumption of meat from deer in the PHA

Copies of this PHA will be provided to the Navy, State and Federal regulator agencies and including the Environmental Protection Agency that are responsible for ecological risk assessments..

You may wish to contact the Navy, State of West Virginia, or the U.S. Environmental Protection agency to obtain copies of the ecological risk assessment additional information on the status of the ecological risk assessment for ABL. Or you may visit the libraries listed on page 5 of this PHA that are the local information repositories to read them.

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Those wanting more information on ecological impacts of perchlorate may be interested in reading material on the USEPA Technological Innovation Program, CLU-in technological website on the web at http://www.clu that includes information on Ecological Impacts at other locations. The following two articles or papers and a PowerPoint presentation may be of interest to those considering ecological impacts of perchlorate on wildlife.

Perchlorate Ecological Risk Studies: A Report on Literature Reviews and Studies Conducted by the Ecological Impact/Transport and Transformation Subcommittee of the Interagency Perchlorate Steering Committee
Long, G.C.; R.C. Porter; C. Callahan; M. Sprenger, Inst. For Environment Safety And Occupational Health Risk Analysis, Brooks AFB, TX.
Report Number: IERA-RS-BR-TR-2001-0004, DTIC: ADA397933. 23 pp, Nov 1998

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Perchlorate in the Environment - Ecological Considerations Smith, Philip N., Texas Tech University

Comment 21:

Is ATSDR aware of studies from a university in Texas that have shown that fish heads may have higher levels of perchlorate then other parts of the fish and that different fish with different diets have different levels of perchlorate. It is discussed on the internet at http://pubs.acs.org/subscribe/journals/esthag-w/2001/dec/science/rr_puzzle.html.

Response 21:

ATSDR has read the web page and associated papers. The West Virginia Department of Health and Human Resources (WVDHHR) issued the fish advisory that ATSDR quoted in the public health assessment. Residents can learn more about the advisory by visiting the WVDHHR website at: www.wbdhhr.org/fish. After reviewing fish tissue sampling data collected in the area, the West Virginia Department of Health and Human Resources determined that a fish consumption advisory was warranted for the North Branch Potomac River. ATSDR's findings are based entirely on that agency's conclusion. If families and individuals follow the advisory, ATSDR believes it will be protective.