



Public Health Assessment for

**NUCLEAR FUEL SERVICES, INC.
ERWIN, UNICOI COUNTY, TENNESSEE
EPA FACILITY ID: TND003095635
MAY 29, 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.

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

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

Cooperative Agreement and Program Evaluation Branch Richard E. Gillig, M.C.P., Chief

Exposure Investigations and Site Assessment Branch Susan M. Moore, M.S., Chief

Health Promotion and Community Involvement Branch Susan J. Robinson, M.S., Chief

Site and Radiological Assessment Branch Sandra G. Isaacs, B.S., Chief

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PUBLIC HEALTH ASSESSMENT

NUCLEAR FUEL SERVICES, INC.

ERWIN, UNICOI COUNTY, TENNESSEE

EPA FACILITY ID: TND003095635

Prepared by:

**Site and Radiological Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry**

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, is an agency of the U.S. Public Health Service. It 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. (The legal definition of a health assessment is included on the inside front cover.) 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.

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 then evaluate whether or not there will be any harmful effects from these exposures. The report focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries. 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 research studies are needed.

Conclusions: The report presents conclusions about the level of health threat, if any, posed by a site and recommends ways to stop or reduce exposure in its 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.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies

are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

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:

Attention:
Manager, ATSDR Records Center
Agency for Toxic Substances and Disease Registry
1600 Clifton Road (E-60)
Atlanta, GA 30333

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Summary

The Agency for Toxic Substances and Disease Registry (ATSDR) received a petition from an individual (the petitioner) to evaluate the Nuclear Fuel Services, Inc. (NFS) site for inclusion on the Superfund list. The concerns listed by the petitioner include contamination of groundwater with volatile organic compounds (VOCs) and the use of radioactive materials. Other concerns included cancer rates in the community and concern for the contamination of the Nolichucky River and releases to the air from plant operations. The petitioner also raises issues related to the NFS history of operational violations.

This public health assessment will only address the concerns raised regarding the presence of volatile organic compounds. The concerns regarding radioactive materials will not be addressed as explained in the following paragraph.

ATSDR Legislative Authority

ATSDR derives its authority to address environmental contaminant issues at this site from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as codified at 42 USC 9601 within the United States Code. However, CERCLA excludes any releases of specific radioactive materials that are considered source, byproduct, or special nuclear material (42 USC 9601(22)). Therefore, those portions of the petition request concerning the use, releases, or potential releases of various types of nuclear materials can not be addressed by ATSDR. ATSDR is investigating other avenues by which the petitioners' concerns for the nuclear and radiological issues can be addressed. ATSDR will address the releases of volatile organic compounds to the air, surface water, and groundwater as well as the presence of uranium and other naturally occurring radioactive materials in the groundwater.

Background

Site Description and History

Nuclear Fuel Services, Inc. (NFS) operational history began in 1957 in Erwin, Tennessee. Initially, the facility was operated as the Davison Chemical Division of W.R. Grace Co. prior to being renamed as NFS (1).

Erwin is a town of about 6,000 people located in Unicoi County about 15 miles south of Johnson City and 120 miles northeast of Knoxville. Unicoi County covers about 200 square miles in northeast Tennessee and has a population of about 20,000. The area surrounding Erwin is mostly within the Cherokee National Forest.

The land area of NFS, itself, covers approximately 64 acres in the southern part of Erwin. The site is bordered by Interstate 26, the Riverview Industrial Site, and property belonging to the CSX Railroad, both to the west. Interstate 26 lies north of the facility and the Love Chapel Elementary School is about 1 mile south of the site. NFS sits about 30 feet above the Nolichucky River that runs by Interstate 26; whereas, the mountains rise to about 5,000 feet a few miles from the site.

The town of Erwin and surrounding areas include residential, commercial, industrial, and farming areas. The site is underlain by unconsolidated alluvium at various depths consisting of silts and clays, clayey sand, and sand with varying amounts of gravel and cobble. The alluvium coarsens with depth into cobbles and boulders. Alluvium is sediment such as a riverbed deposited by flowing water. This cobble/boulder zone overlies weathered, fractured bedrock consisting of steeply sloping beds of shale or shale interbedded with dolomite and siltstone (2).

One of the primary activities of NFS's Erwin Plant is to prepare high-enriched uranium to be processed into fuel for the Department of Energy's Naval Reactor Program. The US Department of Energy supplies the uranium processed at NFS for this and other purposes. Other activities performed at this facility include the processing of high-enriched uranium scrap to recover the uranium, laboratory operations for manufacturing support and new development, and waste treatment and packaging for shipment. NFS also performs commercial work for the private sector and leases space to the private sector at their facility. These activities include cleaning of uranium hexafluoride cylinders and downblending of high-enriched uranium and converting it to low-enriched uranium compounds (BLEU) to be used in the commercial sector. Other site activities include, or once included, converting uranium hexafluoride to either uranium oxides, uranium tetrafluoride, and/or metallic uranium. NFS also in the past manufactured reactor fuel materials composed of either uranium or thorium, and recovery of these isotopes, production of thorium metals, and production of mixed oxide fuels containing uranium.

NFS currently is regulated for environmental corrective action and decommissioning activities by the US Nuclear Regulatory Commission (NRC), the state, and the US Environmental Protection Agency (EPA). The facility is a licensee of the NRC and a permitted EPA Resource Conservation and Recovery Act (RCRA) facility. As such, the facility must establish a system for controlling hazardous waste from its generation until its ultimate disposal. NFS is an active facility and CERCLA regulations do not necessarily apply as the law specifically excludes any releases from the nuclear fuel operations. These nuclear releases are under regulatory authority of the NRC and the hazardous waste and hazardous waste constituents are regulated by the EPA and the State of Tennessee.

Under regulatory oversight by the NRC, NFS is in the process of decommissioning on a project-by-project basis. This includes the former pond area in the unused northern portion of the site or areas and buildings in need of decontamination to protect the environment, in accordance with NRC, EPA, Tennessee Department of Environment and Conservation (TDEC), and all applicable federal and state regulations. Decommissioning is the process converting a nuclear facility to a condition that is safe to public health and safety or the environment. The decommissioning activities at NFS include removal of contaminated soils, sediments, debris, and disassembly of equipment and buildings. The wastes generated are recycled when possible or are containerized and then transported to EPA and NRC approved radioactive waste burial grounds in other states.

The site also generates low-level radiological waste generated from laboratory processes and trash. This waste also contains elemental mercury used during analytical testing of its products. This results in the generation of mixed wastes which are regulated both by the NRC and the EPA as well as the state. The laboratory trash consists generally of paper, gloves, and discarded laboratory equipment. EPA documentation states that the analytical procedure is necessary to confirm that the sample of NFS product meets applicable customer quality standards. The nature of the product and specifics regarding the analysis are considered Confidential Restricted Data

per the United States Department of Energy as it is related to national defense and security. The mercury is recycled as much as possible during the analytical procedure to limit the amount of mixed mercury waste generated.

NFS also operates an outdoor firing range is in nearby Jonesborough, Tennessee for training and maintaining proficiency of its security forces. The range is in residential area and adjacent to a business.

In the early history of NFS, several processes required the use of degreasing agents containing volatile organic compounds (VOCs)¹ such as tetrachloroethylene (PCE). Since the 1970s, NFS reportedly stopped the use of VOCs in their processes although during its use, a large amount of VOCs were released to the environment via either spills (such as in the maintenance areas) or venting. Per applicable laws and permits in effect at the time, NFS also released radioactive materials into the waste holding areas, the on-site ponds which ultimately reached the Nolichucky River. In 1991, NFS began partial remediation of the site. These activities included removing the sludges from Ponds 1, 2, and 3, and removal of accessible waste in the Pond 4 area. The wastes identified in Pond 4 groundwater inflowing prior to this remediation included VOCs, tributyl phosphate, and phthalates (3). The removal was and continues to be under authorization from the NRC, EPA, and the state. Excavation of the low-level waste burial area began in 1997.

In 1992-1993, a RCRA permit was jointly issued to NFS by EPA and the state for the operation of a mixed waste storage area. Additionally, this RCRA permit required the systematic investigation of releases of hazardous wastes constituents to the environment and the subsequent correction action and cleanup.

¹ In this document the term volatile organic compound, VOC, refers only to perchloroethylene (PCE) and its breakdown products produced in the environment.

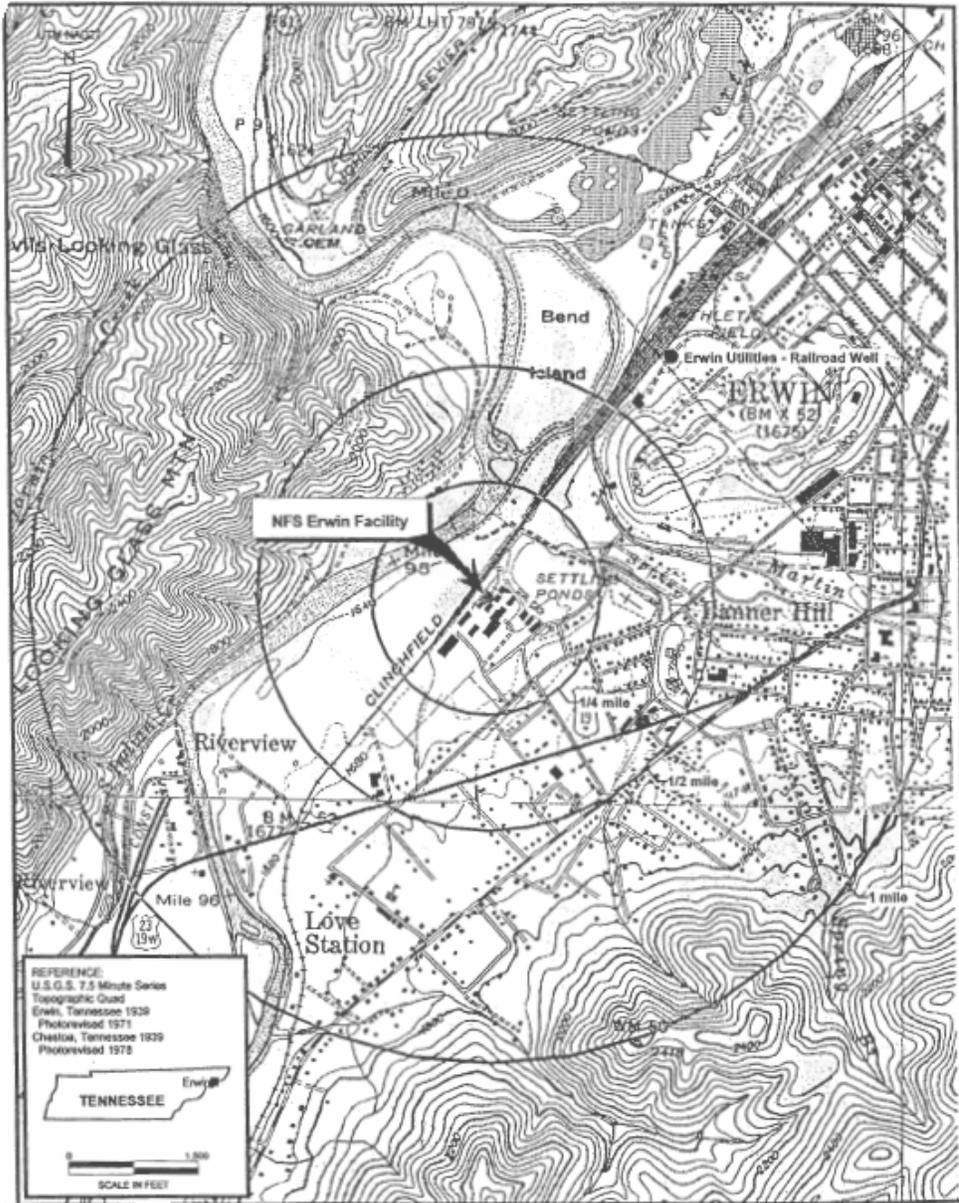


Figure 1. NFS site location.

In September 1996, pursuant to the RCRA permit investigations, the US EPA Region IV concluded that there was a plausible pathway for human exposure to the PCE plume in groundwater, but there was no current exposure. A pump and treat system was installed and operated to remediate the contaminant plume and prevent further migration.

In 2000, as part of a RCRA Corrective Measures Study, NFS developed a pilot study to enhance the anaerobic degradation of the VOCs contaminating the groundwater as this would accelerate the remediation. The field pilot study involved the injection of a molasses carbon source into the groundwater. As a carbon source, the molasses stimulates the naturally occurring bacteria in the groundwater to more efficiently degrade the VOCs. Besides reducing the concentration of VOCs, the system also immobilizes uranium migration by converting the uranium to an insoluble precipitate in the groundwater using a patented technology (4).

Current activities on the site include the processing of nuclear fuel products and the chemical conversion of these materials with the potential for production of ammonia gases or other nitrogen containing compounds.

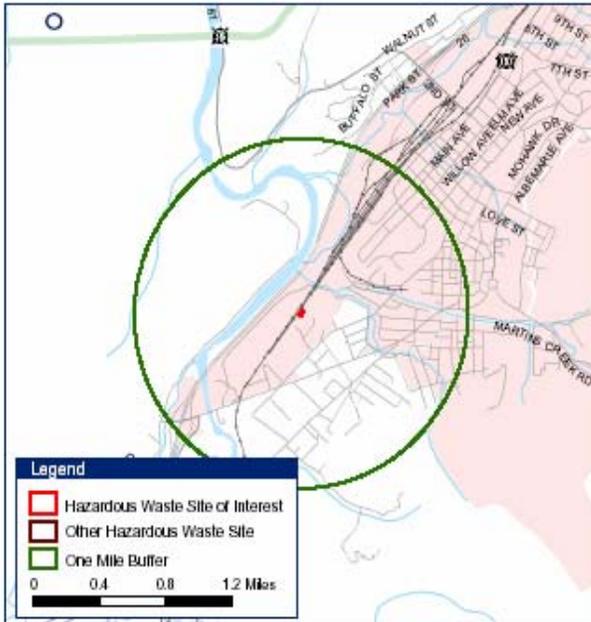
NFS has had numerous NRC violations resulting from poor documentation of chain of custody and location of special nuclear material. None of these violations was for actual loss of material, but for a lack of accounting for where quantities of material were moved within the facility.

Site Visit

In February 2006, representatives from ATSDR traveled to Erwin to meet with representatives from NFS, local officials, state and federal (NRC and EPA) regulators, the Tennessee Department of Health representative, a local plastics company in the industrial park downgradient from the site, and members of the public. During this visit, ATSDR collected community concerns. These concerns include releases of radioactive materials, safety issues, and emergency response and notification of the surrounding area. ATSDR also placed public announcements in local media outlets advertising the meetings and methods whereby community concerns could be relayed to ATSDR.

Demographics, Land Use, and Natural Resource Use

In the 2000 census, Unicoi County's population was 17,667 of which 51.2% were female. Its racial makeup was 98% white and 1.9% Hispanic or Latino. The average household size was 2.3 individuals. The population of Erwin was 5,610 with 53.7% of the population female. The racial composition was 97.8% white with 125 individuals of other racial backgrounds as defined by the US Census Bureau. Furthermore, 97.3% of the Erwin population lived in 1559 single family households with an average family of 2.2 individuals. Those between the ages of 18 and 65 numbered 4,503 with 299 below the age of 5 and the remaining population, 1283, 65 years of age or older (5). The population within a one mile radius of NFS was estimated to be 2,638 consisting of 186 children under the age of 6 and 472 females between the ages of 15 and 44, child-bearing age (Figure 2).

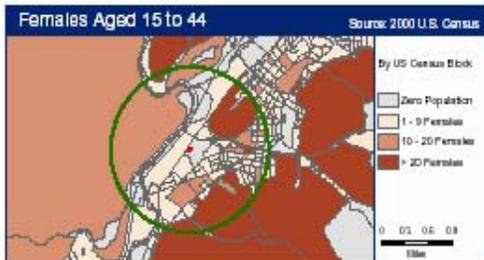
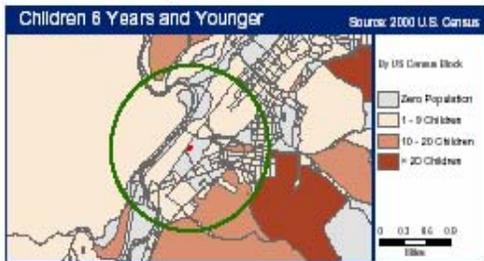
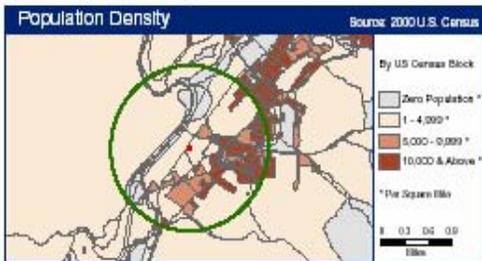


Demographic Statistics Within One Mile of Site*

Total Population	2,638
White Alone	2,598
Black Alone	2
Am. Indian & Alaska Native Alone	4
Asian Alone	0
Native Hawaiian & Other Pacific Islander Alone	3
Some Other Race Alone	9
Two or More Races	22
Hispanic or Latino**	53
Children Aged 6 and Younger	185
Adults Aged 65 and Older	618
Females Aged 15 to 44	472
Total Housing Units	1,234

Base Map Source: Geographic Data Technology, May 2005.
 Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
 Coordinate System (All Panels): NAD 1983 StatePlane Tennessee FIPS 4100 Foot

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.



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Figure 2. Demographic distribution around the NFS facility

Within the vicinity of NFS lie three bodies of surface water--Banner Spring Branch, Martin Creek, and the Nolichucky River. Banner Spring Branch is completely contained within the NFS property boundary and is thought to arise from fracture flow originating in the surrounding mountains. Banner Spring flows toward the north and west ultimately flowing into Martin Branch at the northwest corner of the site. At one time Banner Spring Branch flowed through the site but NFS diverted and channelized the spring. Now it follows the site boundary prior to emptying into Martin Creek. Prior to the channelization of Banner Spring Branch, the land was marshy and NFS constructed holding ponds in this area (1). Martin Creek forms in the Unaka Mountains southeast of Erwin, flows into North Indian Creek which enters the Nolichucky River about 1.5 miles north of NFS. The flow rates of these creeks range from 300 to 5,000 gallons per minute.

The state of Tennessee Wildlife Resources Agency, Fisheries Management Division maintains a state fish hatchery specializing in both rainbow trout and brown trout within a mile northeast of NFS. It has 14 outdoor concrete raceways, a hatchery building, and a manager's residence. The facility's water supply consists of about 30 artesian wells that are hydrologically upgradient from the NFS operations. The source of the artesian well water is thought to be produced by the down gradient flow of groundwater associated with the surrounding mountains. This same flow may form the Banner Spring Branch.

The Nolichucky River is a major river draining the Blue Ridge Mountains of western North Carolina and upper East Tennessee and is considered a receiving stream for surface water runoff. The river enters Unicoi County, Tennessee, flowing through ranges known locally as the Bald Mountains and the Unaka Mountains. The flow rate of the river averages about 14,000 gallons per minute at Embreeville about 8 miles up river from the facility. The Nolichucky River ultimately flows into the French Broad River that merges with the Holston River, forming the Tennessee River outside of Knoxville, Tennessee. The majority (64%) of the Nolichucky River watershed is in Tennessee with the remainder in North Carolina. Many of the streams in the watershed are impaired by silt accumulation and livestock grazing (6).

The City of Erwin obtains its drinking water from both springs and wells; 6 public supply wells are within 5 miles of NFS. The closest well, the Railroad Well, however, is about 3500 feet northeast of NFS and hydrological tests indicate that this well does not draw from beneath the NFS nor from areas downgradient of the facility. NFS reports that there are no private wells between their operation and the river (7). Furthermore, Erwin Utilities informed ATSDR that they are aware of only one private well in Erwin and that well is both upgradient and uphill from NFS.

The geology underlying the area consists of bedrock formations and karst features. Karst geology has been defined as areas where chemical dissolution has enlarged joints, fractures, bedding planes, or other openings in soluble, underlying bedrock; karst is also characterized by sinkholes, caves, and disappearing streams (8).

The geology consists of 3 limestone (dolomite) formations and a formation consisting of sandstones, siltstones, shale, limestone, and other dolomitic species of rock. The bedrock is also covered with deep soils and alluvium which is made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel (12). The depth of the alluvium ranges from 6 to 15 feet with cobbles and boulders at the deeper depths. Below the alluvium lies

tilted beds of shale that are fractured so groundwater flow is directed downward until solid bedrock is reached. Although the groundwater is replenished mostly from rain and surface waters, there is some upward flow as a result of the surrounding groundwater flow down the mountains with their fractured geological formations (9,11).

Groundwater under NFS and immediately downgradient is not used as a supply either to NFS or other industrial activities associated with the industrial park. In general the groundwater is moving toward the river as discussed in the groundwater model report released in 1997. Furthermore, it appears that the upward gradient from the bedrock aquifer would limit the downward migration of the contaminants.

The nearest well is to the north of the site and upgradient (Railroad Well) and hydrological tests indicate that this well is not affected by draw down from water withdrawn beneath the NFS (Figure 3) (9, 10). The groundwater typically flows toward the north-northwest (7). Other water features include ephemeral springs that rapidly appear following local rains that average about 45 inches per year. The US Geological Survey estimates that about 22% of the rain recharges the groundwater in the area. An environmental indicator assessment states that groundwater beneath NFS enters the backwater area of the river via an upflow (11).

Meteorological information for the Erwin area was obtained from documentation prepared for the Nuclear Regulatory Commission (12). The typical wind direction at the facility follows the valley topography in a southwest to northeast direction with an average wind speed of less than 8 miles per hour during daylight. Typically, the wind direction reverses directions during the evening hours. This reversal is related to unequal land heating and the presence of the mountains in the area.

Health Outcome Data

Typically, health outcome data consist of information derived from databases such as morbidity/mortality data, cancer incidence, birth defects data or any site-specific community health records and/or health studies. Health outcome data can provide information on various aspects of the health of people living around site. It may reveal whether people living or working near a site are experiencing adverse health effects at a rate higher than would be expected to occur. Health outcome data can constitute a key source of information for conducting public health assessments. However, site-specific health outcome data are rarely available or of sufficient or adequate quality to enable linking health outcomes with site-related exposures; health outcome data will not prove a cause or an effect. Discussions were held with representatives of the Tennessee Department of Health, Johnson City office, and from the East Tennessee State University in Johnson City. The state has limited reliable health data for this area of Tennessee.

The state of Tennessee is in the process of improving its cancer registry; however, the existing registry is neither certified by the North American Association of Central Cancer Registries, Inc. (NAACCR) nor the CDC². Other registries, such as morbidity, mortality, birth defects, and other disease registries are not available for the state of Tennessee. NAACCR is a professional organization that “develops and promotes uniform data standards for cancer registration;

² Information from the CDC NPCR program at <http://www.cdc.gov/cancer/npcr/naaccr.htm> and accessed on April 27, 2007.

provides education and training; certifies population-based registries; aggregates and publishes data from central cancer registries; and promotes the use of cancer surveillance data and systems for cancer control and epidemiologic research, public health programs, and patient care to reduce the burden of cancer in North America.” NAACR further states that “one of the fundamental necessities of cancer surveillance is for users of cancer information to be assured that case definitions, coding practices, and conversions of medical terminology to useful categories is standardized. This enables compilation of case-specific information into useful and meaningful registers. It also enables meaningful comparison of data across different registries.”³

The CDC has maintained a National Program of Cancer Registries since 1994. The program develops data sets for member states (including Tennessee). However, as the Tennessee Cancer Registry is not certified as discussed above, the expanded dataset for the state is not included. The program web site can be accessed via the internet at the following address <http://www.cdc.gov/cancer/npcr/datarelease.htm> (accessed on April 27, 2007).

³ Information from the NAACCR web site, <http://www.naacr.org/> accessed on April 27, 2007.

Community and Petitioner Health Concerns

Based on information received from the petitioner, the major community concern is cancer with 36 cancers reported in a self-administered survey in the area bordering the facility. The other concerns raised by the petitioner include degradation of the air and quality, and the perceived lack of environmental monitoring of these two potential pathways. ATSDR received additional public health concerns at two public meetings held in Erwin in February and August 2006. These concerns and the ATSDR response are included in Appendix A.

Concerns of the petitioner and the community related to the nuclear operations at the site were forwarded to the appropriate federal agency, the Nuclear Regulatory Commission (NRC). ATSDR met with the NRC to discuss these concerns.

Environmental Contamination and Other Hazards

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as codified at 42 USC 9601 within the United States Code gives the legislative authority to ATSDR to evaluate releases from hazardous waste sites. CERCLA further defines a release in many ways such as a spill, leak, emptying, discharge, leaching, dumping, or disposing of hazardous material in an uncontrolled manner. *However*, CERCLA also excludes any releases of specific radioactive materials that are considered source, byproduct, or special nuclear material (42 USC 9601(22)). By definition, source material is uranium and/or thorium in any physical or chemical form that contain by weight 1/20 of one percent (0.05 percent) or more of these elements. Source material does not include special nuclear material (SNM). SNM is material containing among other radionuclides, enriched uranium or plutonium. By-product material is any material made radioactive following exposure to SNM or the waste associated with ore processing.

ATSDR receives its authority to address hazardous releases from the CERCLA; therefore, those portions of the petition request concerning releases or potential releases of various types of nuclear materials can not be addressed by this public health assessment nor by ATSDR. ATSDR is investigating other avenues by which the petitioner concerns for the nuclear and radiological issues can be addressed. ATSDR will address the releases of volatile organic compounds to the air, surface water, and groundwater.

NFS conducted a remedial alternatives analysis (RAA) to select an appropriate technology for controlling and/or remediating groundwater. The RAA identified enhanced anaerobic bioremediation and reductive precipitation (EABRP) as the selected technology that would best remove the organic contaminants from the groundwater. This technology involves enhancing the natural biological degradation of the PCE and its degradation products. The system works by supplying an additional organic carbon source (molasses) as an energy substrate to the naturally occurring bacteria within the groundwater system. The molasses accelerates oxygen depletion in the water that is conducive to the degradation of the PCE through the removal of chlorine atoms (reductive dechlorination), replacing them with hydrogen atoms. NFS also adds ferrous sulfate that precipitates the soluble uranium as insoluble precipitate, thus immobilizing any uranium in the water.

On-Site Contamination

The Nuclear Fuel Services site was not required to perform environmental sampling for non-radioactive materials for many years. These non-nuclear materials included organic and inorganic chemicals and metals. ATSDR, however, reviewed quarterly and annual RCRA Facility Investigation and Interim Measures Progress Reports submitted to the regulatory authorities for the years 1997 through 2004. Other documents reviewed included water sampling data for the Nolichucky River for the years 1993 through 2004 and National Pollution Discharge Elimination System (NPDES) reports covering the 1999 through 2004 time frame. Not all the reports reviewed are referenced in this public health assessment; however, the data reported in this public health assessment covers the three year period 2002, 2003, and 2004.

Prior to 1984, NFS disposed of various materials on their property as allowed by the laws in effect at that time. The disposal areas included landfills, ponds, and other types of impoundments such as trenches. To enable proper site assessment and site remediation, EPA initially divided the waste operations into 23 solid waste management units (SWMUs) and 7 areas of concern (AOC). Based on analyses of the SWMUs as required by the RCRA permit, 11 required no additional actions, 5 units are under institutional controls with the remaining SWMU requiring interim measures to alleviate waste issues. The AOC remedial activities included 4 areas under institutional control, 2 areas requiring either interim actions or remediation, and the remaining AOC, required no further action.

In 2005, planned activities for the SWMU and AOC locations included soil removal and confirmatory sampling, quarterly and annual inspections, groundwater remediation and related activities including pilot testing, installation of tanks to assist in the groundwater remediation, and additional sampling of surface water and sediments in the Nolichucky River (7).

Releases from NFS have contaminated the groundwater beneath the facility. An extensive monitoring program identified PCE, TCE, cis-1,2 DCE, vinyl chloride, and uranium in the water beneath the plant that flows toward the river. NFS installed a series of monitoring wells within their operational boundaries and another 21 monitoring wells off-site. Many of the well locations are depicted in Figure 4. In 1997, the NFS groundwater monitoring program consisted of sampling approximately 54 monitoring wells. The program's purpose was regulatory in design and helped to further define areas of groundwater contamination as well as its movements. Groundwater contamination is mostly associated with the former pond areas (SWMU 1, 2), underground storage tanks (SWMU 18), Building 130 Scale Pit (SWMU 20), and the radiological waste burial grounds (SWMU 9) (9). According to the Environmental Indicator assessments (13, 14, 15), the plume in 1996-2004 covered an area of approximately 13 acres (600 feet by 900 feet) in the northernmost portion of the facility and extended an additional 5 to 8 acres off the NFS property toward the Nolichucky River. The contaminants in the on-site plume included PCE, TCE, cis-1,2 DCE, vinyl chloride, and uranium; whereas, the off-site plume contains PCE, TCE, cis-1,2 DCE and vinyl chloride.

From these monitoring wells, NFS reported the concentrations of the contaminants in the groundwater within the facility boundary. The results of the onsite sampling, shown in Table 1, indicated that the average concentration of PCE was 1.7 milligrams per liter (mg/L) with the maximum measured concentration of 8.4 mg/L. The maximum concentrations of the PCE degradation products ranged from 1.6 mg/L for dichloroethylene to 0.01 mg/L for trichloroethylene and vinyl chloride. These results are also given in Table 1.

Monitoring data for the groundwater plume in 2002, indicated that the maximum concentration of PCE in the alluvial aquifer exceeded 13,000 micrograms per liter ($\mu\text{g/L}$) and extended beyond the west boundary of the facility toward the industrial park. According to the EPA, the apparent source of the PCE plume is one of the maintenance shop areas within the NFS fence line.

Environmental sampling and analyses of groundwater collected during RCRA activities indicated the presence of uranium, PCE, and its degradation products in the groundwater beneath the NFS facility. The uranium plume was about 0.7 acre (250' by 120') and exceeded the EPA Maximum Contaminant Level (MCL; 30 micrograms per liter; $\mu\text{g/L}$). Uranium concentration in the groundwater plume ranged from approximately 30 to 1,100 pCi/L. The area of the PCE groundwater plume exceeding the National Drinking Water Maximum Contaminant Level (MCL = 0.005 mg/L) was approximately 19 acres (1200 ft by 700 ft). PCE concentrations in this plume ranged from approximately 0.005 milligrams per liter (mg/L) to 14 mg/L. Associated PCE degradation product concentrations are also present in portions of the PCE groundwater plume (15). The EPA also has a Maximum Contaminant Level Goal (MCLG) that is not enforceable and the MCLG for the contaminants is zero.

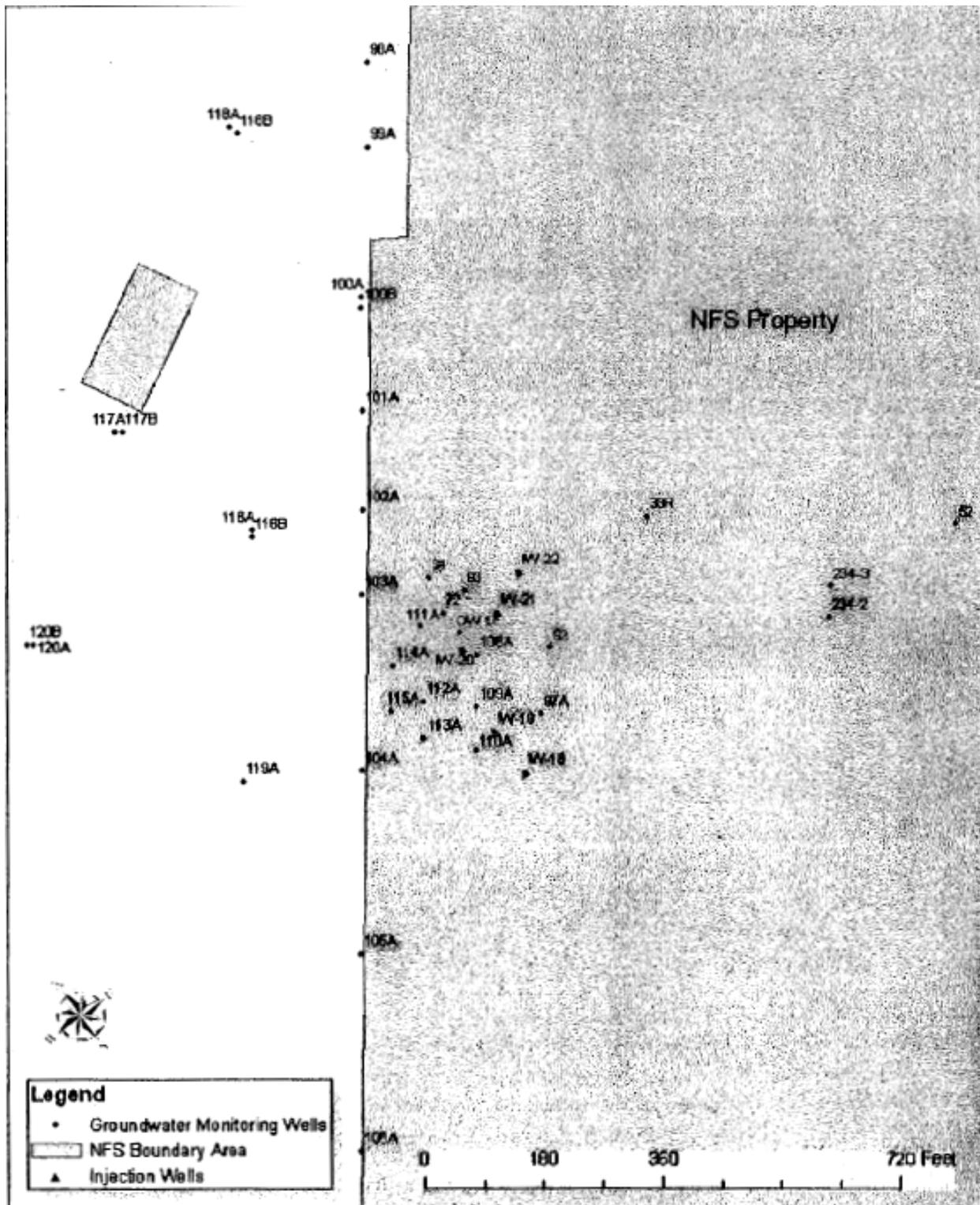


Figure 4. On-site and off-site monitoring well locations

Table 1. Contaminant concentrations in on-site wells

Well Number	PCE	TCE	DCE	Vinyl Chloride	Tributyl phosphate
71	0.021	0.011	1.324	0.728	18.43
72	0.585	0.115	0.507	0.07	6.21
93	0.005	0.09	1.665	0.515	81
94	0.03	0.005	0.005	0.01	0.01
108a	4.8	0.005	0.005	0.01	0.55
109a	0.34	0.077	0.22	0.03	0.01
111a	8.4	0.005	0.6	0.01	0.01
112a	0.099	0.013	0.01	0.01	0.01
114a	0.009	0.005	0.005	0.01	0.01
114b	0.92	0.073	0.059	0.01	0.01
28	1.27	0.157	0.433	0.101	0.07
102a	0.944	0.028	0.029	0.006	0.02
103a	4.956	0.223	0.401	0.021	0.02
average	1.721	0.062	0.405	0.118	8.182
geometric mean†	0.294	0.027	0.095	0.029	0.103
MCL‡	0.005	0.005	0.07	0.002	--

*values expressed as milligrams per liter; data from the Groundwater risk assessment at Nuclear Fuel Services, Inc. and adjacent industrial park site (9)

†The geometric mean represents the central tendency of a distribution if the numbers do not appear to be evenly distributed.

‡MCL – maximum contaminant level, a legally enforceable concentration of contaminants in drinking water.

Off-Site Contamination

Monitoring of organic contaminants outside the property boundary of NFS has been very limited. RCRA reports indicate there are 9 monitoring wells outside the fence line and west of the railroad property. Of these wells, Well 120 lies inside the boundary of the Riverview Industrial Park. The other wells, 116 through 118, are either outside the industrial park or between the park and NFS (Figure 4).

The sampling results have been reported in numerous RCRA Facility Investigation reports from the EPA. In 2002, a private engineering and environmental services company was hired by a facility in the industrial park to sample the monitoring well installed by NFS outside their boundaries and within the industrial park area.

The private company's results indicated the presence of volatile organic compounds as well as the presence of radioactive materials in the groundwater obtained from the industrial park. Table 2 shows the results of the sampling in these off-site wells and the Maximum Concentration Level (MCL) for these contaminants. The MCL is the federal limit for contaminants in drinking water. EPA has also established a goal for these contaminants in drinking water, the Maximum Contaminant Goal Level (MCGL) and that value is set at zero (0). Table 3 gives the 3 year

averages in these wells. During the sampling and monitoring effort in 2000, the extent of the groundwater plume was mapped with the results shown in Figure 5. At that time, the maximum concentration of PCE was 13 mg/L and the lowest concentration found was below the MCL for this contaminant and below the analytical limits of detection.

Within a year of the 2000 sampling round and following the bioremediation with molasses and iron, the plume had expanded as expected. However, the maximum contamination of PCE in the monitoring wells decreased, the maximum detected concentration was greater than 5 mg/L beneath the CSX property; the lowest concentration detected was less than 0.1 mg/L, was below the MCL for this contaminant and below the analytical limits of detection (Figure 6).

The naturally occurring radioactive elements uranium and thorium were detected in wells below the MCL for these contaminants. Other radioactive materials detected included technetium-99 and various plutonium isotopes. The technetium-99 was below the MCL for that radionuclide, as was the plutonium.

Releases to the atmosphere from NFS were not reported in any documentation supplied to ATSDR from the state or EPA. However, the EPA Toxic Release Inventory (TRI) database contains release information on over 500 chemicals or chemical categories from industrial processes. NFS reports their total chemical releases to the TRI system; however, neither uranium nor plutonium are required to be included in the TRI list of reported chemicals. Furthermore, concentrations are not reported, only the total amounts of materials released are given. The TRI data are available from the EPA on their internet site at the following web address: <http://www.epa.gov/tri/tridata/tri04/index.htm#what> (accessed on April 27, 2007).

The TRI data reported for 2004 indicates that NFS released 103 pounds of nitrates and nitrogen compounds to the air, 25,620 pounds to surface waters, and 4,050 pounds were sent to EPA approved landfills. NFS does not perform environmental air sampling for non-radiological materials as this is not required by the EPA for their operations.

ATSDR received data from the Tennessee Department of Environment and Conservation on annual sampling of the Erwin Utilities Railroad Well located north of the site. The well was sampled for both regulated and unregulated volatile organic compounds. Chloroform was detected at 0.00114 milligrams per liter (mg/L) and 0.00151 mg/L in 2006 and 2007, respectively. There is no established MCL for this unregulated contaminant. For regulated contaminants, tetrachloroethylene (PCE) was detected at 0.000856 mg/L and 0.00158 mg/L in 2006 and 2007, respectively. The established MCL for this contaminant is 0.005 mg/L. No other volatile organic compounds were detected in the Railroad Well.

Table 2: Contaminant concentrations in off site groundwater; 3 year average*

Contaminant and MCL [†]	Quarter 1 average mg/L	Quarter 2 average mg/L	Quarter 3 average mg/L	Quarter 4 average mg/L	3 year Average mg/L
Tetrachloroethylene 0.005 mg/L	0.442	0.484	0.479	0.413	0.455
Trichloroethylene 0.005 mg/L	0.02	0.019	0.019	0.017	0.019
Cis 1,2 dichloroethylene 0.07 mg/L	0.032	0.027	0.024	0.048	0.033
Trans 1,2 dichloroethylene 0.1 mg/L	0.013	0.009	0.008	0.009	0.010
Vinyl Chloride 0.002 mg/L	0.019	0.017	0.015	0.018	0.017

* data expressed in milligrams per liter of water; data derived from USEPA RCRA Facilities Investigation reports covering 2002, 2003, and 2004 for off-site monitoring wells

[†]Maximum Contaminant Level – legally enforceable concentration allowed in public drinking water

Physical and Other Hazards

No physical hazards to the public were observed at the site as the site has a physical security force to limit any trespassing. Worker safety and health is addressed by the site's health and safety plan associated with regulatory oversight by both the Nuclear Regulatory Commission and the Tennessee Occupational Safety and Health Administration.

No noticeable odors were detected during the site visit and facility tour which included portions of the blending facility.

Other hazards associated with the site are the presence of hazardous chemicals and radioactive materials, heavy equipment used in the ongoing remediation work and in normal plant operations.

Table 3. Contaminant concentrations in off-site monitoring wells in 1997*

Well Number	Tetrachloro-ethylene (mg/L)	Trichloro-ethylene (mg/L)	Cis 1,2 dichloroethylene (mg/L)	Trans 1,2 dichloroethylene (mg/L)	Vinyl Chloride (mg/L)
116a	0.48	ND	ND	ND	ND
116b	2.4	0.091	0.11	ND	ND
117a	0.15	ND	ND	ND	ND
117b	0.5	ND	ND	ND	ND
118a	ND	0.005	0.003	ND	ND
118b	ND	0.011	0.007	ND	0.0002
119a	0.13	0.011	0.003	ND	ND
120a	0.29	0.016	0.012	ND	ND
120b	0.46	0.018	0.014	ND	ND
121a	0.062	0.005	0.003	ND	ND
121b	0.097	0.005	0.003	ND	ND
Average	0.416	0.022	0.022	ND	ND
MCL	0.005	0.005	0.07	0.01	0.002

*Data from Nuclear Fuel Services (1997).

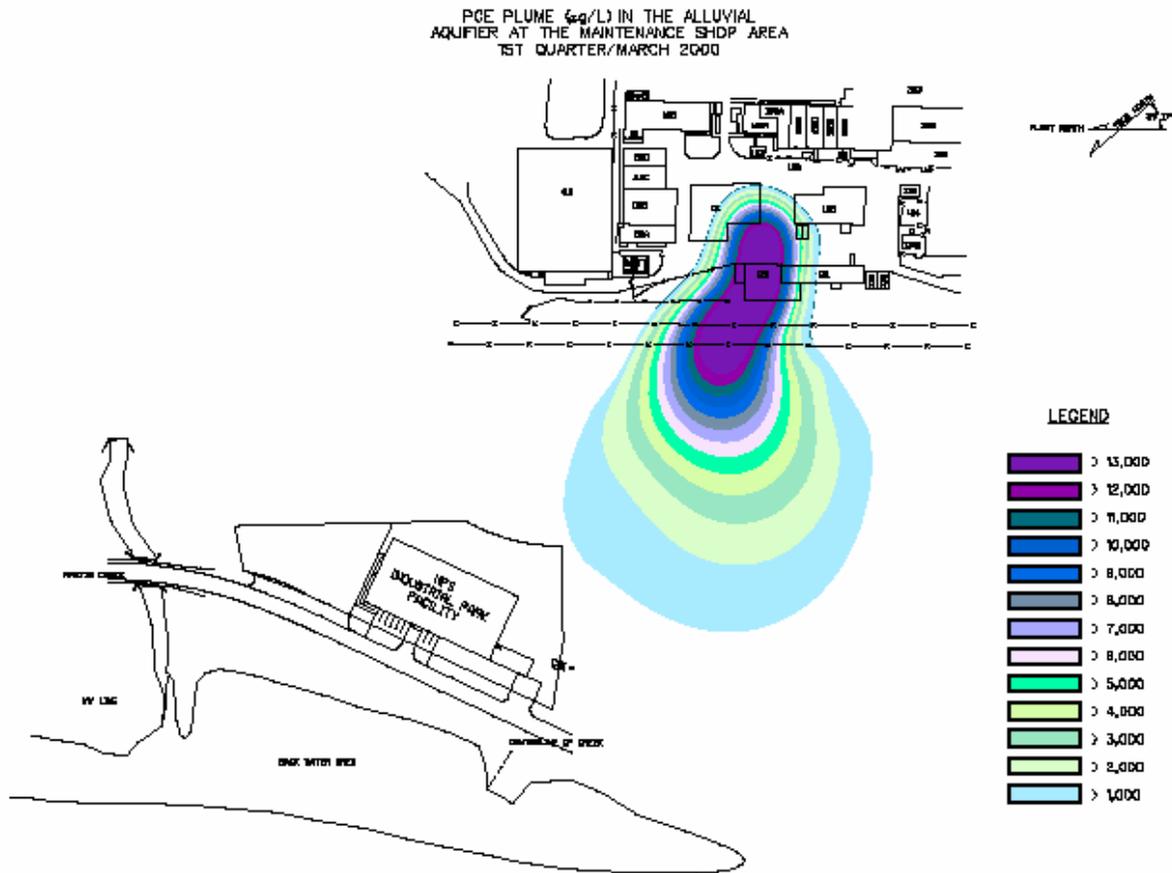


Figure 5. Off site contamination, March 2000

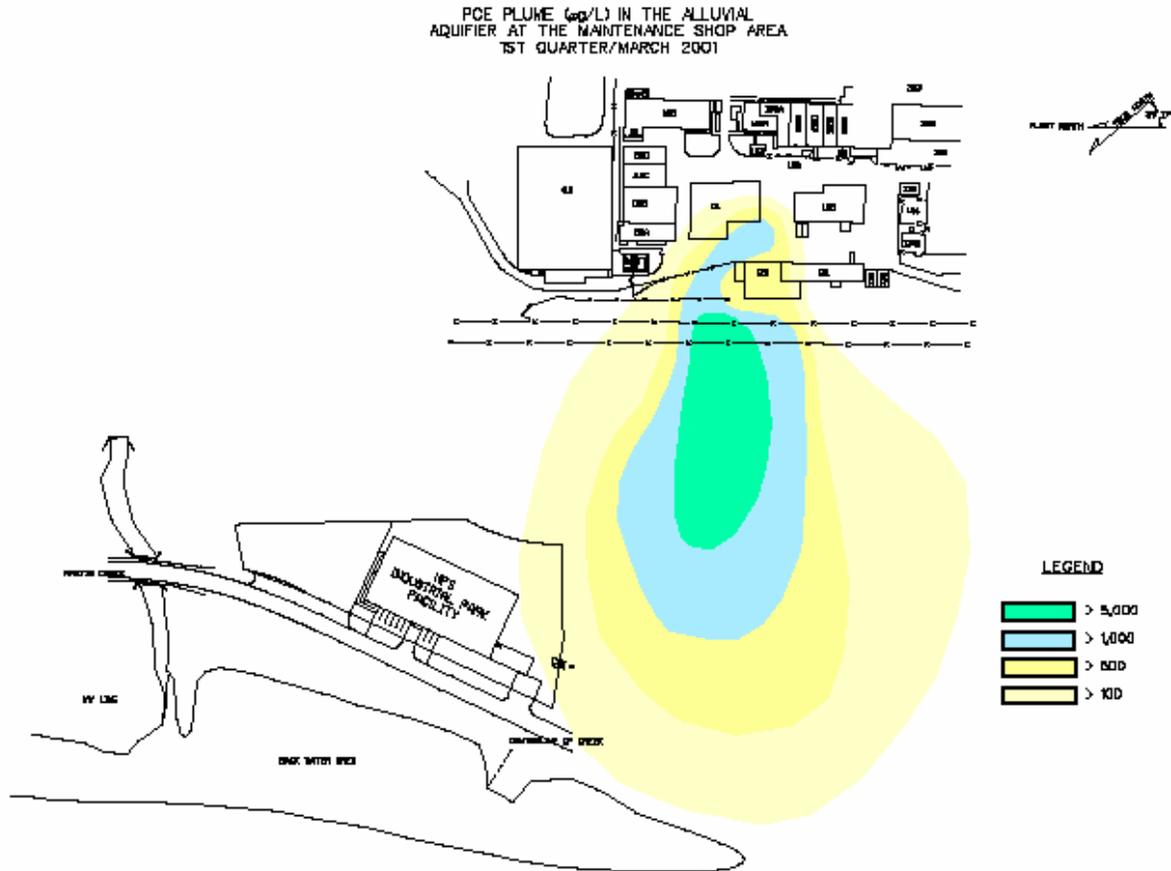


Figure 6. Off site contamination, March 2001

Pathways Analysis

An environmental exposure pathway consists of five elements:

(1) a source of contamination; (2) an environmental medium in which the contaminants may be present or into which it may migrate; (3) points of human exposure; (4) routes of human exposure, such as inhalation, ingestion or dermal absorption; and (5) a receptor population. A completed exposure pathway exists in the past, present, or future if all five of the elements of an exposure pathway link the contaminant source to a receptor population. A potential exposure pathway exists if there is insufficient data for one or more of the five elements linking the source of the contamination to the receptor population or if modeling replaces sampling data. A pathway can be eliminated if one or more of the five elements do not exist or the pathway is unlikely to occur. A future completed exposure pathway occurs when the contamination at a point of exposure exists and that contamination would expose a receptor population if the population were present. Future potential pathways exist if the contamination does not currently exist at a point of exposure but might migrate to some point of exposure. Figure 7 represents typical exposure pathways for a generic hazardous waste site.

The fact that completed exposure pathways exist at hazardous waste sites, does not necessarily suggest the potential for adverse health effects. The evaluation of the exposure pathways with respect to health effects appears in a subsequent section of this public health assessment.

This section contains discussion of the potential for contaminants to present public health hazards via environmental exposure pathways in the past, in the present, and in the future.

Exposure Evaluation Process

A release of a contaminant from a site does not always mean that the substance will have a negative impact on a member of the off-site community. For a substance to pose a potential health problem, exposure must first occur. Human exposure to a substance depends on whether a person comes in contact with the contaminant, for example by breathing, eating, drinking, or touching a substance containing it. If no one comes into contact with a contaminant, then no exposure occurs and thus no health effects can occur. Even if the site is inaccessible to the public, contaminants can move through the environment to locations where people could come into contact with them.

ATSDR evaluates site conditions to determine if people could have been or could be exposed to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, water, air, waste, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation.

ATSDR also identifies an exposure pathway as *completed* or *potential*, or *eliminates the pathway from further evaluation*. Completed exposure pathways exist if all elements of a human exposure are present. A potential pathway is one that ATSDR cannot rule out because one or more of the pathway elements cannot be definitely proved or disproved. A pathway is eliminated if one or more of the elements are definitely absent.

The five elements of an exposure pathway are (1) source of contamination, (2) environmental media, (3) point of exposure, (4) route of human exposure, and (5) receptor population. The source of contamination is where the chemical or radioactive material was released. The environmental media (e.g., groundwater, soil, surface water, air) transport the contaminants. The point of exposure is where people come in contact with the contaminated media. The route of exposure (e.g., ingestion, inhalation, dermal contact) is how the contaminant enters the body. The people actually exposed are the receptor population.

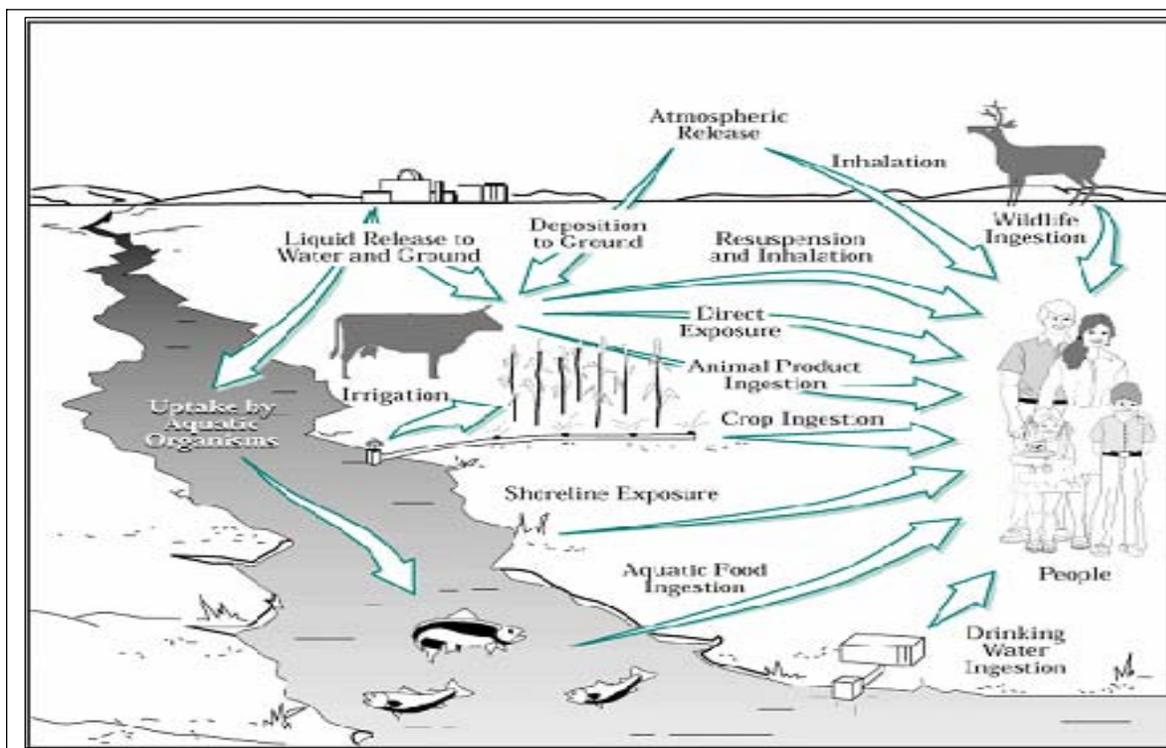


Figure 7. Potential Exposure Pathways

Assessing Health Effects

Exposure does not always result in harmful health effects. The type and severity of health effects that a person can experience depend on the dose, which is based on age at exposure, the exposure rate (how much), the frequency and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of contaminants). Once a person is exposed, characteristics such as his or her age, gender, nutritional status, genetics, lifestyle, and health status influence how he or she absorbs, distributes, metabolizes, and excretes the contaminant. The likelihood that adverse health outcomes will actually occur depends on site-specific conditions, individual lifestyle, and genetic factors that affect the route, magnitude, and duration of actual exposure—an environmental concentration alone will not cause an adverse health outcome.

More information about the ATSDR evaluation process can be found in ATSDR’s Public Health Assessment Guidance Manual at <http://www.atsdr.cdc.gov/HAC/HAGM/> or by contacting ATSDR at 1-888-42-ATSDR. An interactive program that provides an overview of the process ATSDR uses to evaluate whether people will be harmed by hazardous materials is available at <http://www.atsdr.cdc.gov/training/public-health-assessment-overview/html/index.html>.

A. Completed Exposure Pathways

This public health assessment focuses on exposures to volatile organic compound releases to the environment by way of the surface water, groundwater, and air. As stated earlier in this section, exposure pathways are complete when contaminants are traceable through the 5 elements comprising an exposure pathway.

Environmental sampling has shown the presence of volatile organic compounds in the groundwater. An evaluation of scenarios whereby an individual would consume this water indicates that groundwater is not a source of drinking water. Nor do data suggest that contaminants have migrated against the normal groundwater flow toward the Railroad Well that serves as a source of drinking water for the community. No data were identified indicating contamination of private wells by these contaminants.

NFS has sampled the Nolichucky River for the presence of volatile organic compounds. The sampling location was along the backwash areas near the mouth of Martin Creek. These data do not indicate the presence of volatile organic compounds contamination at levels of public health concern. Furthermore, this portion of the river is not used because of the nature and conditions of the marshy backwash area.

Data suggest that the groundwater beneath the NFS facility migrates toward the Nolichucky River and flows into the river. The State of Tennessee reported that the downstream quality of public water processed from the river is considered excellent.

The EPA Toxic Release Inventory data reports that NFS has released nitrate and other related compounds to the atmosphere. However, air sampling for these contaminants and other non-radiological contaminants has not occurred.

B. Potential Exposure Pathways

Nuclear Fuel Services, Inc. reported that they have not used PCE and its breakdown products since the 1970s. However, past uses resulted in spills, releasing the chemicals to the air and to the soils ultimately contaminating the groundwater. Groundwater sampling results and concentration maps for VOCs show very high levels of the contaminant suggesting that large volumes of these compounds were spilt on the ground around the maintenance areas prior to the 1970s on the NFS property. ATSDR did not locate any surface soil sampling or atmospheric sampling around these areas that occurred at the time of these spills. As VOCs are no longer used, there will be no current or future exposures to these contaminants via the air pathway. No current uses of groundwater occur in the downgradient areas and restrictions to the use of groundwater in this area are restricted.

Other potential exposure pathways that could result in human exposures include the release of nitrates and nitric acids as well as ammonia compounds to the surface and the air.

NFS is currently seeking a waste water permit to allow them to divert processing water, currently stored on site, to the municipal sewage system. Until that permit is granted, the potential for exposures to waste water containing nitrogen compounds such as ammonia exists.

Not directly related to site contaminants but associated with NFS is the firing range in Washington County used by their security forces. The contaminants associated with this type of activity include residue from spent gunpowder including various heavy metals and the heavy

metals associated with the fired bullets. These heavy metals include, but are not limited to, copper, lead, zinc, steels, and brass. The concerns expressed to ATSDR include migration of these contaminants to local surface waters that serve as sources of public water supplies to downstream communities.

Public Health Implications

The Nuclear Fuel Services, Inc. site released volatile organic compounds to the ground, contaminating both surface soils on site and the groundwater. Although these releases occurred in the past, there are no current or future uses for the off-site groundwater as the community is on public water supplies. Furthermore, the public well closest to the facility is hydraulically upgradient and has not been impacted by these releases. Additionally, the facility-wide enhanced bioremediation and reductive dechlorination project (RCRA corrective action) has proven to be very effective at remediating the PCE contaminated groundwater.

Without a completed exposure pathway, adverse health effects related to these releases are unlikely.

C. Community Health Concerns Evaluation

Members of the community in Erwin and surrounding cities and towns have expressed a variety of concerns to ATSDR. The concerns ranged from impacts on environmental quality (air, water) in Erwin, other towns in Tennessee and North Carolina, perceived increases in cancer rates and self-reported cancer including colon and multiple myeloma, thyroid disease, Alzheimer's Disease, multiple sclerosis, skin, and joint ailments. Concern also was raised regarding the firearms training facility located in Washington County.

ATSDR addresses these comments and concerns in Appendix A, entitled "Public Concerns received by ATSDR following the February and August 2006 site visits."

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.

The evaluation performed by ATSDR at the Nuclear Fuel Services, Inc. site did not find any current exposure pathways for any chemical. Moreover, there is insufficient evidence to show completed exposure pathways to organic chemicals.

Conclusions

ATSDR has evaluated the releases of volatile organic compounds to the environment surrounding the Nuclear Fuel Services, Inc. facility in Erwin, Tennessee. The releases of these

materials may have occurred in the 1950s, 1960s, and 1970s; there was little or no monitoring of the environmental media at that time.

Current conditions related to the groundwater indicate that the groundwater is not being used as a source of drinking water nor has the contamination impacted public water sources. The levels of contaminants in the bordering Nolichucky River are not at levels of a public health hazard.

Using the protocols developed by ATSDR to evaluate pathways of exposure to populations around potentially contaminated or contaminated sites, ATSDR considers the NFS facility hazard rankings as such:

1. Past Conditions – There is no verifiable information that groundwater was not used prior to the 1980s. Furthermore, there is a historical lack of both on-site and off-site sampling of atmospheric releases. ATSDR considers the site an **Indeterminant Public Health Hazard**. This category applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard from past exposures.
2. Current and Future Conditions –ATSDR ranks this site as **No Apparent Public Health Hazard**. As there are no completed exposure pathways existing whereby the groundwater would be used as a source of public water. The lack of knowledge about the karst formations is of concern for there is insufficient data to determine if the contaminants associated with groundwater in this area will impact public wells in the future. Because the contaminants present in the groundwater are a mixture of many volatile organic compounds, health effects of mixtures may be an issue. However, no available studies directly characterize health hazards and dose-response relationships for exposures to “whole” mixtures containing 1,1,1-trichloroethane, 1,1-dichloroethane, trichloroethylene, and tetrachloroethylene. Furthermore, physiologically based pharmacokinetic (PBPK) models have not been developed to predict dispositional and toxicological outcomes of joint action of mixtures of these four chemicals. Similarly, interactions of heavy metals with other heavy metals or organic compounds are unknown at this time.
3. Based on all available information, ATSDR concludes that although some exposure might be occurring as a result of site conditions via the atmospheric exposure pathways, exposures are not at levels likely to cause adverse health. Say something about mixtures.
4. As previously stated, CERCLA legislation directing ATSDR activities excludes the evaluation of the radioactive materials released from this site. The conclusions of this public health assessment do not apply to the issues surrounding the use of radioactive materials by the Nuclear Fuel Services, Inc

Recommendations

ATSDR has evaluated the issues associated with the release of organic contaminants associated with the Nuclear Fuel Services, Inc. facility. Based on concerns received by ATSDR, the following recommendations are made:

1. A community education plan should be initiated by the appropriate agency to inform the area residents as to the nature and migration of the contaminants. This should include the movement of contaminants in the groundwater
2. ATSDR should meet with the public to discuss the findings of this public health assessment
3. If ATSDR receives any requests for a basic radiation safety and information presentation from the communities, those requests will be routed to both the Nuclear Regulatory Commission and Nuclear Fuel Services.
4. Inform the EPA about the concerns about lead exposure and migration as related to the gun range in Washington County.

Public Health Action Plan

ATSDR will coordinate with local officials and media outlets to set up public meetings to disseminate the findings of this public health assessment.

ATSDR will begin formulating an action plan to discuss the health impacts of the site to present to the public.

ATSDR will forward the concerns regarding the gun range to the site and to the EPA for their evaluation.

ATSDR will contact the local emergency response organizations and hospital for the purposes of their activities in event of NFS accidents.

Author

Paul A. Charp, Ph.D.

Senior Health Physicist

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2007)).

Appendix A

ATSDR Response to
Public Concerns received following the February and August 2006 site visits

Comment	Response
<p>I would like to know what became of the CDC study that took place many years ago in Erwin regarding the possible impact on public health by Nuclear Fuels Services. I personally know that this investigation took place, but there wasn't a public report citing the results of this study. Please inform me of those results.</p>	<p>ATSDR is unaware of any CDC studies performed many years ago. ATSDR did check with the National Institute of Occupational Health and Safety, CDC (NIOSH). They have been evaluating NFS as part of the Energy Employees Occupational Illness Compensation Program. Many of the NFS employees may qualify as Atomic Worker Employees. NIOSH met with several workers and former workers on July 21, 2005, to discuss this program. On February 14, 2006, NIOSH released their evaluation and the report is available at their web site: http://www.cdc.gov/niosh/ocas/wrgrace.html</p>
<p>My family is very concerned regarding the project in Erwin, Tenn. So much of what Tenn. does negatively impacts its neighbors in the valley.</p> <p>Please reconsider this project as I believe it could have a negative impact on our beautiful mountains.</p>	<p>Thank you for your concern. ATSDR accepted the petition request because of the concerns raised and the potential impact the contaminants could have on the surrounding area.</p>
<p>I, as so many others, have to work on the 16th and will not be able to attend the meetings that day concerning the health effects of the NFS site in Erwin, Tn.</p> <p>We live in Greeneville and Greene County Tn. (this is downstream on the Nolichucky river) this river is near the NFS site, and supplies our public water systems. We are VERY concerned with any health effects from this site.</p> <p>What are the known human health effects from exposure to the substances released at this NFS site in Erwin Tn.? When will the "public health assessment" be done? Will this be public information? Will appreciate your expedient reply on this matter</p>	<p>ATSDR has reviewed the contaminants from the site and the water quality of the Nolichucky River. The river data was obtained from the Tennessee Department of Environmental Conservation and the Southern Appalachian Man and the Biosphere Program. As stated in the public health assessment, there are no current completed exposure pathways at levels associated with human hazards; therefore, no adverse health effects would be expected.</p>
<p>I read the article published in The Erwin Record, Erwin, TN, on February 21, 2006, titled "Health agency hears concerns over illnesses feared from NFS". I live on Washington Street and I have been diagnosed with Multiple Sclerosis. I have had several lymph nodes removed due to unexplained fevers, weight loss, lymphadenopathy, etc. My illness developed when I moved to Washington Street. My house was built in the 1930's and we have done extensive remodeling</p>	<p>Although multiple sclerosis (MS) is the most common neurological disease disabling young adults in the United States, the cause of this disease is unknown. Evidence indicates that it is a complex disease with multiple causes determined by both environmental factors and genetic susceptibility. The ATSDR Division of Health Studies is</p>

<p>since we moved in. I worked inside this home doing medical transcription spending all my time there from the time we moved in until approximately a year ago. My health continued to deteriorate during this period of time. I began working outside my home a year ago and I have improved considerably since then. I have been told by many well-educated individuals that there may be something in my home environment that caused my illness. With the continued improvement in my health after getting away from the house during the day and now this article, I believe there may be something to this assumption.</p>	<p>currently working on two studies concerning MS. These are “Determining Prevalence of Multiple Sclerosis and Amyotrophic Lateral Sclerosis (ALS) in Communities Living Around Hazardous Waste Sites” and “Case-Control Study of Environmental Exposures and Genetic Susceptibility with Multiple Sclerosis.” You can reach the division by calling toll-free 1-888-422-8737 (1-888-42-ATSDR)</p>
<p>I grew up in the big green two-story house which I think is now owned by NFS. When W.R. Grace built “the plant” down where Mrs. Home’s frog pond used to be, we had no idea what was in store. The security and regulations then were few and far between. As kids, we would still go down there and walk around the fence to see the stuff that leaked out of the big tanks. The ground was always wet. When we heard the alarm go off, we ran to the upstairs bedroom to watch the men in white suits run up the hill. Orange smoke came out of the smokestacks. My aunt was a secretary there and one night came and took us away from our house because “something” was about to happen “down at the plant”. Never knew what. I know we ate radiation straight from Mama’s garden. Our beloved little dog died of cancer. My dad died at 56 with colon cancer. Our next door neighbor died of colon cancer; I doubt she was 60. A friend and close neighbor had extensive colon cancer in his early 30’s. I had a huge lymphoma removed from my heart at the age of 30. My brother had kidney failure in his early 30’s. My sister and I both have thyroid nodules and weird protein levels in our blood that can lead to multiple myelosis. These all have to be watched closely. At the age of only 64, I also have an autoimmune disease that makes life difficult. People in Erwin are still brainwashed about NFS. Those that know the truth have died or moved away. My mother died of heart failure at 65. I believe her heart was broken.</p>	<p>According to the American Cancer Society (www.cancer.org), colon cancer is the third most common cancer in the country and risk factors include family history of colon cancer or polyps, diet, weight, alcohol consumption, and smoking. The risk of colon cancer also increases after age 50.</p> <p>ATSDR has had much experience with issues related to the thyroid gland. Thyroid nodules are common in the population with their presence in women greater than in men, the cause of which are usually unknown. What is known, however, is that radiation-induced thyroid disease is associated with the intake of radioactive iodine. These were not present at NFS in the past nor are they currently present, based on the operational history and nuclear materials used at the site.</p> <p>The autoimmune organizations, (www.aaarda.org) indicate that about 75 percent of autoimmune diseases occur in women, most frequently during the childbearing years. These types of diseases are the 4th leading cause of disability in women. As with cancer, little is known about the causes of autoimmune disease.</p>

<p>I live in the NC county (Yancey) adjacent to and downwind from Erwin TN. As a (now retired) health care professional, I have observed over many years what appears to be higher than average occurrences per capita of several debilitating diseases here. Multiple sclerosis, various unusual types of cancer, spina bifida, clefting/midline developmental disabilities among others are more prevalent in the local population than would be expected. While nobody is yet able, or willing to point the finger toward the Erwin plant (or Oak Ridge for that matter) there is suspicion that airborne products from this facility passing through this area in highest concentration could be a factor in these statistics. Certainly further study is warranted.</p>	<p>Wind data collected during the 1990s show that the predominant wind direction at the plant is from the southwest to the northeast during the day, reversing at night. This places Yancey County outside the area that would be influenced by any air releases as the county is southeast of the site and separated by the mountains.</p> <p>ATSDR is in the process of completing public health assessments for Oak Ridge facilities operated by the Department of Energy. Besides soil, water, and biota, the agency also evaluated air releases. Our findings were that no air releases would have impacted Yancey County for several reasons. These include the fact that wind directions in the Oak Ridge area follow the valleys running from the west to the east. The height of the Oak Ridge releases was not sufficient for any contaminants to travel the approximate 125 miles between your county and the facility, especially as the mountain terrain would effectively block those releases.</p>
<p>We have been concerned for years about the nuclear fuel plant in Erwin. We are downwind here in Yancey County and we have a higher than normal incidence of certain cancers. I object to any expansion of that facility, and also to the recently announced plans to ship more waste to Barnwell SC.</p> <p>If you are looking for answers to specific questions, contact me.</p>	<p>The weather data for Erwin shows that the predominant wind direction is from the south or southwest at about 10 miles per hour. Yancey County is southeast of Erwin would not receive sufficient winds because of its direction and the intervening mountains.</p>
<p>I would like to send an email to Marilyn Palmer re growing up very close to NFS</p>	<p>Marilyn Palmer's email address is myr4@cdc. She can also be reached by calling toll-free 1-888-422-8737 (1-888-42-ATSDR)</p>
<p>My daughter lived almost all of her childhood in Yancey County. She had thyroid cancer. Her thyroid was removed and she had to take iodine radiation two times. She seems to be fine now.</p> <p>I also had two cats die of cancer.</p> <p>If you need to contact me, do so by e-mail. I am living in Mexico at this point.</p>	<p>Typically thyroid cancer is associated with the intake of radioactive iodine, produced by nuclear reactors or atomic weapons testing. There is no indication in NIOSH documents that NFS used radioactive iodine in their processes.</p>

I am the sister of [name withheld – medical confidentiality] and all she has stated is true. I have two friends that worked in the chemical department at NFS before regulations were implemented. Both now have a lot of health issues. One friend has hand skin problems and the other friend has growths on hand and feet joints and also has muscle problems.

Thank you for your concern. We have passed your comment on to the Tennessee Department of Health

<p>Before I begin please let me apologize for using all capital letters. I cannot type, I use one finger to type and I am also a bad speller.</p> <p>I am writing about Nuclear Fuel Services, Inc. in Erwin, Tn. They process radioactive material that is too dangerous a practice to continue.</p> <p>There location near the Nolichucky River where the Jonesborough water department gets their water could be harmed by contaminants leaching into the river. The river is also used for white water rafting and sport fishing.</p> <p>I live about seven miles by road from their site and probably closer if there was an accident that could contaminate the air.</p> <p>I would also like to make you aware of another problem I have with Nuclear Fuel Services lack of concern for people and the environment</p> <p>Nuclear Fuel Services located in Unicoi County needed a shooting range so that there rent a cop security force could train/qualify. According to Nuclear Fuel Services to meet federal regulations.</p> <p>Some how they got Washington County (where I live) to let them have it here. This shooting range is at the foot of Cherokee National Forest. It is right next to a road, along side a sawmill, very close to peoples homes and within a quarter mile of the Nolichucky River. There is also a stream called dry creek only a short distance away which flows into the Nolichucky River. The roadside ditches which flow into dry creek and the Nolichucky River are down hill from where they are shooting. This is the same river where Jonesborough gets its water and the same river that they can contaminate in Erwin.</p> <p>There is a pump station on the river that pumps water to the treatment plant, all in close proximity to the shooting range, about a quarter mile each way.</p> <p>The problem with this range is that it is wide open! They shoot lead bullets into the ground. There is no way to stop a stray round from killing people.</p>	<p>The EPA does not certify, approve, or manage the lead migration issues associated with gun ranges. However the EPA has published national guidance on best management practices to assist owners and operators of lead issues associated with gun ranges located outdoors. The guidance can be found at http://www.epa.gov/region2/waste/leadshot/ (accessed on May 2, 2006). The US Department of Interior also has information on gun range management that can be found at http://www.doi.gov/greening/sustain/shooting.html (accessed May 2, 2006. Lead bullets also must dissolve before they enter the water supply. Acidic soils and acid rain can result in a very slow dissolving of these bullets. The acidic conditions at the range can be controlled with the application of materials such as lime. We will inform NFS of your concern.</p> <p>ATSDR was established by Congress to review the health effects resulting from exposures to chemical contaminants present in the environment from hazardous waste sites. Noise is considered a physical hazard and noise level limits are established by the National Institute for Occupational Safety and Health. We will inform them of your concern.</p>
<p>Nuclear Fuel Services not only has their people shooting there they also let many of the local and state cops use it, they use hand and long guns plus full automatic weapons. There is also grenades used and the Tennessee highway patrol explodes bombs.</p> <p>All the lead and powder residue end up leaching into the drinking water used by</p>	

thousands of people. There are also a lot livestock, cows and horses that drink untreated ground water. This also effects the fish in the Nolichucky River along with other wildlife, deer, birds and any other living things that need water.

I would like to comment on something I noticed while reading about ATSDR. Why do you not include noise as a community health concern, I think it should be included. If you were here when Nuclear Fuel Services rent a cops, the Tennessee highway patrol or the Unicoi swat team were shooting, exploding bombs and grenades I think you would agree that noise is a pollution.

Please help!

<p>I was not able to attend your open meeting concerning Nuclear Fuel Services in Erwin, TN on Feb.16, 2006. I do have the following comments to make concerning NFS. My back ground includes military service as an optometrist and being trained as the Nuclear, Biological and Chemical Warfare Officer for Bassett Army Hospital in Fairbanks, Alaska. Since living in Erwin I have served on The Unicoi Co. Board of Health, The School Board and as a County Commissioner:</p> <p>My family and I moved to Erwin in May of 1974. At that time we lived in a house adjacent to NFS property. I had looked at the NFS facility and made the decision that I was not placing my family's health in jeopardy by living close to NFS. We lived adjacent to NFS for more than two years with no unusual health problems. I raised three children at that house arid all of them are in good health. Two of the three have healthy children of their own.</p> <p>I provided safety glasses for NFS employees from 1976 through 1999. I was not an employee of NFS, but I was a contractor for safety glasses. In my optometry practice in Erwin since 1974, I have not noticed any unusual ocular health problems which would indicate any damage related to radiation. The cataract rate of persons living in the NFS Plant vicinity does not seem to be higher than the general Unicoi County area, and the Unicoi County rate does not seem to be higher than the national averages. I had one employee of NFS with a benign iris tumor arid I do not recall any retinal tumors from NFS employees. I find it interesting that people from outside of our community seem to complain the most If there is a health issue It is mental stress placed on our citizens by people from other locations.</p> <p>It is my opinion that NFS is a good member of our community. They have demonstrated their concerns for our community by being active in the United Way, Chamber of Commerce and have added a lot of support for our school system. They have also provided the best job opportunities for Unicoi County residents of any of our plants. I am proud to have NFS in our community.</p> <p>I appreciate the positive attitude that you displayed on your trip to Erwin.</p>	<p>Thank you for your comment.</p>
<p>Erwin drinking water contamination -- especially of the Railroad Well -- is the main issue that the ATSDR needs to investigate, in my opinion. In a package postmarked April 1st, you will receive materials that support my concerns about</p>	<p>ATSDR reviewed various data sources in which groundwater was tested, sampled, and characterized with respect to groundwater flow. In these documents, the evidence is clear</p>

<p>the health impacts of heavy metal, chemical & radiologic contaminants that have entered Erwin's ground and drinking water due to NFS's operations in Erwin. NFS also discharges into the Nolichucky River, the source of Jonesborough's & Greeneville's municipal water supplies. The Blended Low Enriched Uranium project at NFS is projected to increase the discharges into the Nolichucky of Uranium, Thorium and Plutonium -- the latter two by hundreds of thousands of times. Please look for my package of materials early in the next business week.</p>	<p>that the contamination in the groundwater associated with NFS does not impact the Railroad Well. As you know, this well is about ½ mile north of the facility. Studies of the water-table height indicate that the well is up-gradient (up-stream). Sampling of the Railroad Well has shown the presence of chloroform and PCE; however, the levels of these contaminants are not considered a public health hazard.</p>
<p>hi, questions on what contaminants and their results in humans if exposed during childhood to adult. In reference to personal issues dealing with children born around 1955. I know several people ages 50-60 that were born and raised in Erwin that now suffer from Alzheimer symptoms with no parental history of Alzheimer's. Seems to be more than just happens stance for such a small town with so many people in the average age group of early 50-60 to be having memory loss and unable to function.</p>	<p>ATSDR has no information regarding an association of the site organic contaminants in groundwater and the occurrence of Alzheimer's Disease. According to the Alzheimer's Association, the disease is the most common form of dementia. Age is the greatest known risk factor and most individuals with the illness are 65 and older. The likelihood of developing Alzheimer's approximately doubles every five years after age 65. After age 85, the risk reaches nearly 50 percent. For more information, please visit their internet site at www.alz.org</p> <p>Furthermore, ATSDR was not able to identify any pathway whereby organic contaminants could have impacted the population around the site as the ground water is not used as a public water supply.</p>

<p>It seems that weekly we hear of more who are victims of cancer, some very young children. Since I am not a health professional, I do not know why. Did the Japanese not have much cancer after World War II?</p> <p>Our drinking water comes from the Nolichucky River, some 25-30 miles downstream from Erwin. If it is allowed to continue to operate it could cause unhealthy, lasting results for an extended area since the river flows finally into the Gulf.</p>	<p>It is true that the Japanese survivors of the atomic bombing did develop cancer. However, the doses they received were quite different from the doses of radiation released by NFS as reported to state and federal regulators. By law, ATSDR is not permitted to evaluate radionuclide releases from sites such as NFS.</p> <p>ATSDR, however, did evaluate the water quality of the Nolichucky River as it is a source of drinking water for both the towns of Greeneville and Jonesborough. The evaluation used data from the state as well as a public/private group, Southern Appalachian Man and the Biosphere Program, indicates that although the river itself has pollution issues, the quality of the drinking water produced by these two towns is of excellent quality.</p>
<p>My concern is for the school children in Erwin and for those of us who must drink the water from the Nolichucky River.</p> <p>What provisions do you have in place to protect the school children in Erwin, and those of us who must drink the water from the Nolichucky River in the event of a nuclear release from NFS. Last winter, floodwater rose to within one foot of Highway 81 near the Devil's Looking Glass, a rock formation over the fault line.</p> <p>What is the travel time via groundwater from the NFS plant to the Nolichucky River? What is the setback distance from the plant for land-based unauthorized vehicles? And what protection is in place to deter saboteurs from using weapons of war aimed at this plant?</p> <p>I suggest that you get some gas masks that fit the school children in Erwin along with a supply of potassium iodide tablets.</p> <p>I further suggest that you see that the water companies have filters that filter out nuclear contamination.</p> <p>We need an immediate warning system to inform school authorities, and the water companies of nuclear releases, i.e., telephone backed up by ham radio.</p>	<p>ATSDR is aware of the water quality of the Nolichucky River. The City of Erwin obtains their drinking water from groundwater wells that are not impacted by operations at NFS. The Tennessee Division of Water Supply considers the intakes at Jonesborough and Greeneville to be a high susceptibility based on the upstream industrialized areas as well as both urban and rural areas. The Clean Water Act classifies the river as not meeting water quality standards or which has impaired uses. Nonetheless, the City of Jonesborough does have an excellent water quality in their drinking water supply.</p>

<p>NFS owns 17 acres in Washington County for a firing range where target practice and explosives may be causing the ground and surface water to become contaminated with lead and other toxins. The range is across from Dry Creek which runs into the Nolichucky River just upstream of the town of Jonesborough drinking water intake pipe.</p> <p>My personal concern that the surface and groundwater sources of Erwin, Jonesborough, and Greeneville municipal drinking water supplies may be tainted by a cocktail of chemicals and radionuclides deposited on the ground or discharged into surface water.</p> <p>I believe it is imperative for the ATSDR to analyze the constituent elements in the Railroad Well especially. That well could be the mechanism by which groundwater contamination is distributed to Erwin homes and businesses. The Sierra Club and the Tennessee Clean Water Network wanted to pay for analysis of a water sample from the well. We were hoping to test for Technetium-99.</p>	<p>ATSDR has reviewed various data sources concerning the drinking water quality for both Jonesborough and Greeneville. The state of Tennessee has classified the Nolichucky River as an impacted stream. However, the quality of the water following treatment by the water utilities is considered excellent quality.</p> <p>If one is on a private well, ATSDR recommends that a test of the well water be performed to include not only chemical contamination but coliform contamination.</p> <p>Currently, the Railroad Well is not supplying water to the public distribution system for the city of Erwin.</p>
<p>We grew up in Erwin, back in the early 60's where the nuclear plant is. We swam in the swimming pool that had water furnished from the water that was a drain off from the nuclear plant. Now we all have these diseases and want to know if they are related. We don't think they had the regulations in the 60's that they do now. Any information would be appreciated. A lot of people have moved away so we don't know their status, but would love to know any information you could provide. The plant is called Nuclear Fuel Services in Erwin, Tn.</p>	<p>ATSDR is attempting to locate the position of the swimming pool as current documentation does not indicate its presence.</p> <p>You are correct with regards to the regulations. Nuclear regulations as well as chemical regulations have changed since the 1960s. The Nuclear Regulatory Commission updated their protection regulations (10 CFR 20) in the 1970s and again in the 1990s.</p>

<p>Although not directly related to ATSDR – an individual believes that cancer rates in Unicoi county have tripled since 1980.</p>	<p>ATSDR received several comments and correspondence regarding the cancer rates in Unicoi County and Erwin. Many of these concerns were based on knowledge or interviews with local residents. These are called door-to-door surveys and are not considered usable. Cancer is a group of diseases with many potential causes and affected tissues such as the prostate, lung, breast, liver, and colon.</p> <p>States attempt to establish and maintain cancer registries; however, the Tennessee registry is not of sufficient quality to verify local assertions.</p>
<p>According to the Guinness Book of World Records, in 1981 or 1982, NFS released tons of uranium. The following year edition of the book did not have the information.</p>	<p>ATSDR is attempting to contact the Guinness publisher to obtain copies of the report. We have also tried to find documentation on the internet and various library sources in Atlanta.</p>
<p>Surface water monitoring in 2002 indicated cyanide in Banner Spring Branch, a creek that flows through NFS's reservation then into the Nolichucky River.</p>	<p>In the information you supplied, the cyanide was attributed to Solid Waste Management Unit (SWMU) 1 in the north part of the site. As of 2006, Banner Spring Branch has been rerouted and is not in contact with that portion of the site. SWMU 1 is currently undergoing remediation with the contaminated soil being removed.</p>
<p>There are a number of fault lines in close proximity to NFS. It is my understanding that those fault lines could enable contaminants to travel a considerable distance. Please also note that many area residents (like me) take their drinking water from wells.</p>	<p>The fault line maps you provided to ATSDR show that the site lies between two fault lines. Since they do not extend through the NFS property, it is highly unlikely that contaminants would move through the fault lines directly.</p> <p>If one is on a private well, ATSDR recommends that a test of the well water be performed to include not only chemical contamination but coliform contamination.</p>
<p>In 1998, NFS underestimated the wastewater COD (chemical oxygen demand). The site claims it was based on an incorrect calculation method. This error was not noticed by TDEC (Tennessee Department of Environmental Conservation).</p>	<p>This issue is of a regulatory nature. ATSDR suggests you contact either the Tennessee Department of Environmental</p>

<p>What other discharges has NFS failed to report or has NFS under-reported?</p>	<p>Conservation or the US EPA.</p>
<p>An indication of the very generic and infrequent sampling (only monthly) done by TDEC is attached.</p> <p>Greeneville also samples for gross alpha and gross beta, but only monthly and with so large a margin of error to make the data almost useless for public oversight.</p> <p>Data prepared by the commentor indicates that NFS contributes to water and sediment significant alpha emitters, especially in Banner Spring Branch and Martin's Creek – both of which flow into the Nolichucky River</p>	<p>Under typical environmental monitoring guidelines, monthly surface water samples are normal, even around nuclear and non-nuclear power plants. The EPA regulations for drinking water outline the steps of the analyses to be performed on drinking water samples. Since the concentrations of gross alpha radiation and gross beta radiation reported by the state are below the Maximum Contaminant Levels, no further analyses are warranted.</p>
<p>A letter to Tennessee Congressman Bill Jenkins requesting that he direct ATSDR to conduct a thorough analysis of the rate of cancer in Erwin even if the ATSDR needs to perform primary data collection to fulfill this mandate. This request relates to the claim of the commentor that on Washington Street there are 40 households and 19 cancers and non-Hodgkins lymphomas are directly linked to exposure to radioactivity.</p>	<p>ATSDR considers additional health activities if the pathway analysis indicates contaminants have intercepted a media that is used for human consumption and that the concentration in that medium is present at a level considered a public health hazard. The evaluation of the chemical contaminants at the Nuclear Fuel Services site showed to ATSDR that the organic chemicals in the groundwater do not impact the public water supplies in Erwin and the public water quality of the communities downstream is classified as excellent by the State of Tennessee.</p>
<p>I am concerned that Nuclear Fuels has no method of informing the public of any emergencies. There does not appear to an alert system. I would also like a public meeting to discuss radiation and health, detection, emergency response (verbal communication to ATSDR during the February 2006 meetings).</p>	<p>ATSDR will contact the local emergency responders and hospitals to ascertain the plans in place with NFS. ATSDR will be glad to hold meetings to discuss the radiation and health issues in a general discussion. However, as mentioned in this document, we cannot legally discuss operations at the NFS facility.</p>

ATSDR also received concerns regarding the use of nuclear materials at NFS. However, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, Superfund) excludes facilities such as Nuclear Fuel Services, Inc. from evaluation by ATSDR. ATSDR has forwarded these concerns to the US Environmental Protection Agency (EPA), the US Nuclear Regulatory Commission (NRC), the State of Tennessee, and Nuclear Fuel Services, Inc. for their information.

Appendix B

Response to Community Comments Public Comment Release

Comments received during Public Comment period are presented here along with the ATSDR response. Unless the comments are from government agencies, ATSDR does not public the names or affiliations of those who submitted comments.

Comments received that pertain to the use of radioactive materials or other issues related to the Nuclear Regulatory Commission (NRC) and its license with Nuclear Fuel Services, are not included in this table. However, ATSDR has supplied those comments, after removing identifiers, to the NRC, EPA, and the state of Tennessee. As has been stated in this document, ATSDR is prohibited from addressing these issues by law unless the site is listed on the National Priorities List of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Comment Received	ATSDR Response
<p><u>Failure to Include Radioactive Substances in the Assessment</u></p> <p>It is disturbing to note that ATSDR failed to assess the public health risks associated with radioactive substances at the Nuclear Fuel Services (NFS) site, claiming a lack of legislative authority to do so under 42 USC 9601 (22). This is particularly confusing since ATSDR has included radioactive substances in Public Health Assessments (PHAs) at numerous other sites. In fact, one such site is Oak Ridge, TN (EPA Facility ID: TN18900900003), which handled many of the same substances as NSF, including special nuclear material (SNM), enriched uranium and plutonium. The Agency’s most recent PHA for the Oak Ridge facility was dated November 18, 2005. The following (with emphasis added) is an excerpt from page 1 of that PHA:</p> <p><i>To expand on the efforts of TDOH, ATSDR scientists conducted a review and a screening analysis of TDOH’s Phase I and Phase II screening-level evaluation of past exposure (1944 to 1990) to identify contaminants of concern for further evaluation. Based on this review, ATSDR scientists are conducting public health assessments (PHAs) on the release of iodine 131, mercury releases from the Y-12 plant, PCBs, radionuclides from White Oak Creek, uranium releases from the Y-12 plant, uranium and fluoride releases from the K-25 complex, and other topics such as the Toxic Substances Control Act (TSCA) incinerator and off-site groundwater. In conducting these PHAs, ATSDR scientists are</i></p>	<p>The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA; Superfund) is very specific as to what issues can be addressed by ATSDR unless the site is listed on the National Priorities List. The federal regulation can be found in the United States Code, Title 42, Section 9601 (22) where a release is defined. The code specifically excludes <i>“release of source, byproduct, or special nuclear material from a nuclear incident, as those terms are defined in the Atomic Energy Act of 1954 [42 U.S.C. 2011 et seq.], if such release is subject to requirements with respect to financial protection established by the Nuclear Regulatory Commission under section 170 of such Act [42 U.S.C. 2210], or, for the purposes of section 9604 of this title or any other response action, any release of source byproduct, or special nuclear material from any processing site designated under section 7912(a)(1) or 7942(a) of this title, and (D) the normal application of fertilizer.”</i></p> <p>ATSDR did perform public health assessments of many of the former Atomic Energy Commission (AEC) sites such as the Oak Ridge Reservation because those locations were listed on the National Priorities List of the Superfund. The AEC was dissolved ultimately forming the Nuclear Regulatory Commission and the Department of Energy.</p> <p>The legislative directive in 42 USC 9601(22) defines releases for the purposes of Superfund and this referenced section specifically excludes Nuclear Regulatory Commission (NRC)-licensed sites. ATSDR derives its authority from Superfund. The Office of General Council, CDC/ATSDR has affirmed on many occasions that ATSDR does not have the legal authority to evaluate NRC-</p>

<p><i>evaluating and analyzing the information and findings from previous studies and investigations to assess the public health implications of past and current exposure. This PHA documents ATSDR's screening of recent (1990 to 2003) environmental data, addresses whether additional chemicals require further evaluation, and discusses the public health implications related to estimated exposures. Polychlorinated biphenyls (PCBs), mercury, and the groundwater pathway are not addressed in this PHA; those chemicals will be evaluated in separately released PHAs.</i></p> <p>Further, it is not clear that there is any legislative directive in 42 USC 9601 (22) that would prohibit ATSDR from including radioactive substances, including SNM, in their PHA of the Nuclear Fuel Services site. If there is anything in the statute that specifically precludes ATSDR from including these radioactive substances, please direct us to that text.</p> <p>Neglecting to assess risk to public health from radioactive substance is particularly troubling since "ATSDR derives its authority to address environmental contaminant issues at this site from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)..." The CERCLA Priority List of Hazardous Substances (http://www.atsdr.cdc.gov/cercla/05list.html) includes many of the toxic and radioactive substances likely to be associated with past and present operations at the Nuclear Fuels Services facility.</p>	<p>license holders.</p> <p>ATSDR agrees with your comment regarding the neglecting of radiological materials at this site; however, health issues are not overlooked at this site since both the state of Tennessee and the NRC have expertise in the evaluation of radiation induced human health effects.</p>
<p>Site Description</p> <p>The ATSDR report discussed the geological features of the site,</p>	<p>ATSDR geologists and hydrogeologists re-evaluated both the groundwater modeling around the site as well as US Geological Survey data and the link you provided. We have modified our</p>

<p>acknowledging that the site is underlain by unconsolidated alluvium consisting of silts, sands, cobble, and gravel. These medium typically allow rapid movement of shallow ground water. It was noted that the alluvium overlies fractured bedrock, consisting of “steeply sloping beds of shale or shale interbedded with dolomite and siltstone.” According to a state geologic map of Tennessee (http://www.state.tn.us/environment/tdg/bigmap.shtml), the site may also consist of limestone. While features, such as fractured bedrock mentioned in the ATSDR report clearly provide a mechanism for downward movement of ground water, limestone offers additional attributes for migration of contaminated ground water through solution channels. Unfortunately, these features, as well as nearby fault lines and runoff from the mountains, provide excellent mechanisms for rapid lateral and downward movement of contaminated groundwater and consequential migration of contaminants.</p>	<p>discussion on the underlying site geology as appropriate.</p>
<p>Volatile Organic Compounds (VOC) and Ground Water Contamination</p> <p>Despite the fact that ATSDR’s PHA could have included numerous non-radioactive chemicals associated with NFS, the agency chose to focus on only Tetrachloroethylene (PCE) and its degradation products: Trichlorethylene (TCE) , Cis 1,2 dichloroethylene, Trans 1,2 dichloroethylene and Vinyl Chloride (VC), stating, “Since the 1970’s, NFS stopped the use of VOCs in their processes.” While the report was careful to note that the author’s use of VOC referred only to PCE and its breakdown products (including TCE), it is misleading to say that the use of this solvent ceased in the 1970s. In fact, documents on file at TN Department of Environment and Conservation (TDEC) indicate</p>	<p>ATSDR utilizes a process whereby environmental contamination is evaluated through a pathway analysis. This analysis helps identify how contaminants move through the environment, how they might come in contact with humans and at what concentrations. Once these factors are evaluated, the next step is to choose those contaminants that exceed a health based screening value. If a contaminant exceeds that health based screening, it then becomes a contaminant of concern. For this site, only PCE and its degradation products met those requirements. ATSDR realizes that NFS uses many other chemicals in their activities; however, releases to the environment of these other chemicals are within the legal limits of their permits obtained from both the EPA and the state of Tennessee.</p>

that TCE was still being used in 1987. For the sake of public trust, the report should have mentioned this fact.

Based on sampling data provided in the PHA, there was no evidence that sampling had been done for trichloroacetic acid. This is troubling since this metabolite of TCE is considered teratogenic and associated with congenital heart malformations.

While we are deeply concerned that PCE was the sole focus of ATSDR's PHA, we are sorely disappointed that the agency neglected to mention the far-reaching potential for the public's exposure to this chemical and its breakdown products, given the geologic makeup of the site. To add perspective to our concern, we cite former EPA Administrator Carol Browner:

"Given that a five gallon bucket of TCE spread throughout an aquifer could contaminate up to 800 million gallons of groundwater at levels above drinking water standards, leading to enormous cleanup costs, it is imperative to control and minimize such sources."

(Excerpted from Statement of EPA Administrator Carol Browner before the House of Representatives Subcommittee on Water Resources and Environment, October 29, 1997)

While Ms Browner provided a hypothetical example, widespread contamination of TCE has been well documented across the country. One dramatic example occurred in Le Roy, NY. In Dec 1970, a train derailment caused a spill of 30,000 gallons of TCE. Volunteer firefighters responded by flushing the area with a million gallons of water, in an effort to dilute the solvent. Twenty years later, contaminants found their way to about 40 households and businesses that required alternative water supplies, first bottled water, then water treatment systems. According to the

Thank you for your comment. ATSDR was not aware of the data indicating that TCE was still being used as late as 1987. The reports received by ATSDR were required under the Resource Conservation and Recovery Act (RCRA) and TCE was not listed in those reports for the years ATSDR requested. We contacted and visited the local state office for additional information.

TCE in humans is metabolized to trichloroacetic acid. However, in groundwater TCE is metabolized to dichloroethylene and vinyl chloride but only in groundwater with anaerobic environments. Aerobic conditions in groundwater do not result in TCE biodegradation to DCE and VC. Therefore, there is no reason to sample for the trichloroacetic acid.

ATSDR received and reviewed the environmental data to which we were limited to by law. We also reviewed public drinking water data quality reports from the state of Tennessee for the downstream communities of Jonesborough and Greenville. The state reports indicated there were no contaminants related to the releases from NFS detectable in those water systems.

Thank you for your comments from the EPA.

It is true that DNAPLs do not necessarily follow groundwater flow and that the geology around NFS most probably consists of karst (fractured) rock formations. According to the US Geological Survey in a 1997 report on karst regions of Tennessee, DNAPL movement in karst formations has been studied in several locations, but only a few reports have been published. In most cases, field data show that DNAPL descended until the fracture system pinched out. In other cases, confining units stopped or deflected DNAPL movement. For more information, please see the USGS report available at <http://pubs.usgs.gov/wri/wri974097/index.html> (accessed on

New York State Department of Health, contaminants had spread at least 3 miles and to three counties. One well, 3 miles from the spill site had TCE levels over 120 ppb.

It is well known that PCE and TCE are a dense non-aqueous phase liquids (DNAPLs). DNAPLs are chemicals that are heavier than water and fairly insoluble in water. DNAPLs do not readily mix with water and tend to sink, finding their way, often in pure phase, through even tiny cracks in rock. Once in fractured bedrock, they can move both horizontally and vertically, making it nearly impossible to predict their path of migration, let alone remove them from geologically complex environments. Ground water studies of the site indicated a large plume of solvent contamination. In 1996-2004, it was estimated to cover 13 acres on site and an additional 5-8 acres off site toward the Nolichucky River. It is highly likely that fractured bedrock and other complex geological features at the site have provided mechanisms for extensive migration of contaminants beyond those identified in the plume. While pump and treat systems, such as the one installed at the site, are often effective in hydraulically controlling migration of contaminants, they have not proven to be effective in recovering DNAPLs that have found their way into the deeper ground water system. Therefore, it is very possible that PCE and its metabolites have already migrated far from the site, including to private and public water supplies. As was mentioned in the PHA, the city of Erwin obtains its drinking water from springs and wells and there are six public supply wells within 5 miles of NFS. There are three surface water bodies within the vicinity of NFS, including the Banner Spring Branch, Martin Creek and the Nolichucky River, as well as “ephemeral springs that rapidly appear following local rainfalls that average about 45 inches per year.” All of these water features can play a significant role in the movement of contaminants.

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An ATSDR geologist/hydrogeologist reviewed this report and supplied the following statement that has been incorporated into the public health assessment:

The elevated concentrations of PCE as mentioned in the public health assessment are above the limits set forth under the Safe Drinking Water Act. The monitoring wells around NFS are not used as public supply so the elevated levels cannot be enforced under that law. While the EPA has established goals for drinking water, the MCGL, only the MCL values are legally enforceable. Nonetheless, we have added a statement in the public health assessment to indicate the contaminant goal of the EPA for these contaminants.

We are unaware of any regulation determining the number of monitoring wells at a Superfund site. Typically, the number of wells is determined for each site based on numerous assessments such as environmental assessments, groundwater assessments and other types of environmental investigations.

The ATSDR comment is meant to include all potential contaminants that might be present in an individual’s private well. ATSDR suggests that you contact the state health or environmental department.

Water quality issues are released by the Tennessee Department of Environment and Conservation (TDEC), Division of Water Supply (615-532-0191) and Division of Water Pollution Control (615-532-0625). These divisions are in Nashville. TDEC also has an environmental field office in Johnson City (423-854-5400).

PCE contamination was found in the alluvial aquifer at levels exceeding 13,000 µg/L, extending beyond the west boundary of the facility in 2002. The legally enforceable limit (MCL) for PCE in drinking water is 5 µg/L. However, ATSDR neglected to explain that the maximum contaminant level goal (MCLG) for PCE is 0 µg/L. A MCLG is a level of a contaminant in drinking water below which there is no known or expected risk to health. The same MCLG of 0 µg/L has been established for TCE and vinyl chloride, which are both breakdown products of PCE.

While 54 monitoring wells have been installed on site and 21 off-site, there are inherent problems with relying on monitoring wells to characterize DNAPL contamination. In addition to the propensity of DNAPLs to migrate through fractured rock, PCE has a tendency to form an arrowhead shaped plume in saturated zones, with Vinyl chloride at the front end of the plume. According to groundwater experts at Waterloo University, incorrect placement and depth of the wells can lead to mischaracterization of a plume. It is not unusual at CERCLA sites to place up to five monitoring wells per acre. The strategically placed wells, at varying depths, aid in determining contaminants and their movement.

However, to adequately assess and protect public health, it seems prudent to ensure that public and private water supplies are regularly tested for the full range of toxic and radioactive substances associated with past and current activities at NFS. Therefore, it was disturbing to read ATSDR's Response to Public Concerns (Appendix A of the PHA) "*If one is on a private well, ATSDR recommends that a test of the well water be performed to include not only chemical contamination but coliform contamination.*" There was no clear message to residents to have their well water tested for radioactive materials, nor was there guidance on how such tests could be obtained. Comprehensive

<p>analyses for all contaminants of concern would likely to be cost-prohibitive for most area residents, especially if they were to test periodically to ensure consistent water quality. For these reasons, it seems appropriate for ATSDR to recommend that the State Health Department produce a fact sheet on water quality concerns, well as a establish water testing program for area residents on private wells.</p>	
<p>While the PHA noted that past and/or present industrial activities at the site involved high-enriched uranium, uranium hexafluoride, thorium and mercury, the report made no mention of a major plutonium processing project, which operated at NFS for several years until 1970. According to information gathered for and during the <i>Hearing on Erwin Nuclear Fuel Services before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce House of Representatives</i>, (Sept 18, 1986) plutonium disposal occurred on the plant property (page 12). Based on testimony contained in the hearing record, it is likely that plutonium contamination is widespread on plant property. While decommissioning of the interior of the building took place in the 1990's, the building itself was torn down by contractors, reportedly without proper decommissioning. It is very possible that this activity caused widespread contamination of plutonium off site through fugitive releases. There was also no mention that an incinerator was in operation at the facility for a number of years, which no doubt added to area deposition of contaminants.</p> <p>The PHA report noted that NFS has had numerous NRC violations, claiming that they were a result of accounting errors and "poor documentation of chain of custody" but that "none of these violations was for actual loss of material."</p>	<p>The plutonium activities associated with the site as well as any uranium and thorium operations are exempt from Superfund as stated at the beginning of these comments and in the public health assessment. If allowed by law, ATSDR would evaluate the operations using the radioactive materials at the Nuclear Fuel Services, Inc. site.</p> <p>ATSDR has met with the Nuclear Regulatory Commission Region II office in Atlanta. This office oversees activities for NFS. Your comment has been relayed to their senior staff.</p> <p>Thank you for your comment. ATSDR has informed the NRC of your comment.</p>

<p>In fact, “NSF has a history of significant accidental releases. In 1962, over *10 kilograms of UF6 was released. In 1964, over 4 kilograms of UF6 was released. In 1979, over 3 kilograms of UF6 was released and in 1981 over 150 grams (exact amount to be determined) was released.” (Source: Hearing before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce House of Representatives, Ninety-Ninth Congress Sept 18, 1986 Serial No, 99-178). In 1979, NSF lost 48.4 pounds of highly enriched uranium. While initially there was great concern about theft of the material, through a series of calculations based on assumptions, the NRC was able to account for all but 11.26 pounds of it by estimating how much of it had vaporized to the air, was absorbed into flooring, remained as residue or had been disposed of. (Source: Associated Press, Oct. 31, 1980, “Report Supports Theory of No Security Breach in Uranium Loss”). This long and well-documented history of “loss” of radioactive materials should have prompted ATSDR to call for a full and comprehensive Public Health Assessment, especially since material loss was attributed to environmental releases.</p> <p>* Due to poor quality of copy, the exact number is not legible and could be more than 10 kilograms.</p>	
<p>Health Outcome Data</p> <p>ATSDR’s PHA noted: “The state has limited reliable health data for this area of Tennessee.”</p> <p>In Oct, 1988, the National Institute of Health (NIOSH) released a report of their Health Hazard Evaluation (HHE) for Nuclear Fuel Services. The HHE investigators found that “Several health problems related to kidney disease are unusually common in both</p>	<p>ATSDR was aware of the NIOSH study and reviewed that study prior to the release of the public health assessment. That worker study is only one small part of the overall health of the Unicoi and Tennessee health data. The state of Tennessee is in the process of developing a cancer registry; however, the existing registry is neither certified by the North American Association of Central Cancer Registries, Inc. nor the CDC. Other registries, such as morbidity, mortality, birth defects, and other disease</p>

NFS workers and in dairy workers from a nearby plant” and suggested that the health problems “apparently reflect[ed] a regional rather than an occupational problem.” The report recommended further study “to understand and prevent kidney problems in the region.”

Curiously, the NIOSH HHE was not listed in ATSDR’s list of references, nor was it mentioned in their Public Health Assessment (PHA).

Workers and local residents have openly shared their health concerns with ATSDR and are convinced that the community has, for some time, experienced a high rate of specific cancers (lung, bone, liver, kidney and skin), as well as an increased incidence of multiple sclerosis, birth defects and kidney disease.

Despite the well-documented toxic and radioactive contamination issues associated with this site, as well as the antidotal information provided, it seems outrageous that ATSDR would rank this site as: **“No Apparent Public Health Hazard.”** The absence of data does not justify this ranking without strong recommendations for a full-scale epidemiological study of the workers and the community.

Since there are serious gaps in scientific knowledge about toxicity, bioavailability, exposure, and synergistic interaction effects, we recognize that is impossible to accurately assess the full impacts that toxic and radioactive substances are having on public health. However, we are disturbed that ATSDR’s PHA seemed intentionally limited in scope and did not include all relevant, available data. Therefore, we strongly urge ATSDR to revise their recommendations and call for a comprehensive health action plan that will truly assess the health risks of those who may be affected by historic releases from the NFS facility.

registries are available for the state of Tennessee. The Tennessee Department of Health has been working with ATSDR to address these health concerns

The NIOSH study focused on the nuclear operations and the use of uranium in the processing of materials at the site. As previously stated, ATSDR cannot address any issues associated with nuclear operations. Furthermore, the inclusion of the dairy farmers in the study and the results of that group would indicate that kidney issues are not associated with the facility and were related to a “stone belt” present in the southeastern United States. This was stated in the report. Nonetheless, because the study involved workers and the use of radioactive material, we did not cite this study.

ATSDR is aware of the issues associated with cancer and other illnesses in Erwin and the surrounding areas. We have spoken with the Tennessee Department of Health as well as the individual petitioning ATSDR. The state and the individual would like to perform a door-to-door survey of the residents to better define the health issues. ATSDR has also suggested that East Tennessee State University be involved in this endeavor as well.

ATSDR’s finding of “No apparent public health hazard” is only based on the information contained in the public health assessment; that is, the finding is based on the occurrence of volatile organic compounds in the groundwater and the chance that individuals would come into contact with the contamination at levels associated with levels of public health concern.

<p>First of all, I can't understand how or why the state of Tennessee and the County of Unicoi could issue [a] license to NFS to operate inside a city limits like they do; we are surrounded by mountains and when the wind is not blowing the air just sits here and [doesn't] move anywhere.</p> <p>I understand the NRC has rules and laws NFS has to go by or they [are] fined, but things at the plant still don't go just right. From reading the paper, NFS has fires, they have leaks inside the plant. They have accidents as most plants do. I worry they (NFS) could at any time have a bad accident at a time when the wind was just right and a lot of people in this small town would suffer because of [an] accident NFS had.</p> <p>And if NFS was not located inside a city not near[ly] as much harm to so many people would be felt. This plant and the work they do is well needed in the US. I am glad we have companies that do this kind of work; however, I think the companies or plants that work with substances such as nuclear fuel should not be placed in side a city where a lot of people live.</p> <p>I understand not even the CEO or president of Nuclear Fuel Services Inc. resides in this city or county nor most of the employees just under him do either. Does that tell you anything?</p> <p>Thank you; hope you will consider these comments.</p>	<p>Thank you for your comment. The granting of the license and the location of the facility are issues that are regulated by the Nuclear Regulatory Commission and the State of Tennessee. ATSDR has passed your concerns over to the appropriate individuals in those agencies.</p> <p>The internal operations as well as the health and safety of plant operations are under the regulatory auspices of the Nuclear Regulatory Commission and the on-site inspectors at the facility. As stated above, ATSDR has passed your concerns to that agency.</p> <p>Thank you for your comments and concerns.</p>
<p>Why is the NFS site not listed as a NPL or Federal Superfund Site?</p>	<p>A NPL site is a Superfund site. NFS is not proposed or listed as an NPL site because its major function as a nuclear operation is exempt from the Superfund law. For more information, please see the information supplied at the beginning of these comments.</p>
<p>In order to insure that the public's health and the environment is</p>	<p>ATSDR reviewed the environmental data that the agency was</p>

<p>protected, there needs to be more extensive review of existing environmental data. There also needs to be independent on and offsite environmental testing conducted in order to capture the extent of the pollution, and identify all pathways of exposure. This should include and incorporate all pollutants that have been identified to date. Pollutants released and or discharged by other companies on the NFS site should be reviewed as well.</p>	<p>legally allowed to review. Those data concerned the release of materials other than radioactive or nuclear material. Because the facility was not required to monitor non-nuclear materials in the past, environmental data are lacking in that area. Following the passage of the Resource Conservation and Recovery Act (RCRA), NFS apparently began record keeping for those chemicals regulated under RCRA. They now supply quarterly reports to both the USEPA and the Tennessee Department of Environmental Conservation (TDEC). These reports were reviewed and summarized in the public health assessment.</p>
<p>I am suggesting a participatory process be established in reference to health and environmental surveys/studies. The community, local elected officials, ETSU, State Dept. of Health as well as other agencies could work together and design a plan or model. This approach insures that the community has ownership in the process which means they would be willing to be more open about their health or their knowledge of the plant and the community. A project such as this could include academic disciplines and departments such as: Environmental Health, Appalachian Studies, Geography, Medical and Nursing Interns /Students. A participatory research project is far reaching and encourages partnerships with Universities through professors and students who can obtain a wealth of information and experience by working out in the field. The local medical community has an opportunity to gain knowledge as well. Participants can gather, share and exchange information. The fence line community gains knowledge, becomes more informed, which gives them the opportunity to make better life choices. We must also keep in mind that plant workers are also the community and have pertinent knowledge and information. Workers exposure in the plant as well as in the community should be included in this</p>	<p>During the public meetings in August 2006 ATSDR proposed this suggestion to faculty members of the East Tennessee State University (ETSU) Department of Environmental Health in Johnson City. We believe that this would be both a learning experience for senior level and graduate students and a benefit for the community-at-large. ATSDR and ETSU have discussed joint efforts that could be undertaken to assist the Erwin community. As a result of this meeting, ATSDR is evaluating the establishment of either an internship or Public Health Service co-op (COSTEP) for a student at the university. The project would work to develop a needs assessment and public health education program for the community.</p> <p>The identification of a cancer cluster and other health effects, however, are difficult because the population of Unicoi County is small. In the case of cancer in a town the size of Erwin, one would expect a cancer rate of 20 to 30% according to the American Cancer Society as well as government health agencies. Identifying clusters of the various types of cancer may not be possible, especially since the statistical rate of cancer is about 500 to 800 residents per year.</p>

<p>process. The agency needs to identify cancer clusters, birth defects, miscarriages, still born births and other symptoms and diseases that could be identified as related to exposure. Indicators of future illnesses once identified could prompt preventive measures and early detection in some diseases such as cancer.</p>	
<p>It is an insult to the intelligence of mountain folks to imply that there is “no problem”. We all know that the facility has been in Erwin since the late 50”s and we know that their practices have not been friendly to the environment or the public. Having said that, I respectfully thank you for accepting my comments.</p>	<p>Our conclusion was not meant to insult the area’s residents. The conclusion ATSDR derived in its public health assessment only pertained to the contamination in the groundwater. During the public meetings held by ATSDR, releases of nuclear material comprised the majority of the health and environmental issues associated with Nuclear Fuel Services and ATSDR was prohibited by law from evaluating these releases.</p>
<p>The agency should reverse its process from that described in the Foreword to a precautionary approach. If carcinogenic or other harmful contaminants are known to be released, the likelihood of their impacting water sources and human health should be assumed and detection vigorously investigated. The agency should not delay investigations of possible exposures. People who know “a hundred people who have died with cancer” in a small communities, should not have to live long with unresolved causes or sources for anxiety that might or might not be realistic. The Agency should act sooner rather than later and should, through direct and definitive assessment, assure that an exposure source the citizens’ fear can indeed be ruled out.</p>	<p>The precautionary principle is not universally accepted among scientists. Typically using the precautionary principle means taking action when scientific uncertainty rules out sufficient information. The Institute of Science in Society (http://www.i-sis.org.uk) states “The precautionary principle is actually part and parcel of sound science. Science is an active knowledge system in which new discoveries are made almost every day. Scientific evidence is always incomplete and uncertain. The responsible use of scientific evidence, therefore, is to set precaution.” In many cases assessors have sufficient information on environmental processes to determine the health threat. In reality, risk assessors and health assessors apply conservative (protective) variables to determine the likelihood of adverse health impacts.</p>
<p>It is extremely disappointing to note in the report that “the state has limited reliable health data or data of not sufficient quality.”</p>	<p>ATSDR agrees with the comment. The state of Tennessee is working to improve its current data collection system and data base.</p>

<p>I find it troubling, likewise, that the agency appears not to have performed direct testing/sampling for the VOC contaminants of concern. The public springs and wells which supply residents' drinking water are a short distance (less than 5-6 miles) from the facility and all (excepting the upgradient RR well) could be "a plausible pathway for human exposure." The report does not indicate, though, if all wells were tested and if dye- or other procedures were used to exclude spread of the contamination plume in the groundwater, to the areas, near the public-water intakes. As first action by your agency in determining possible exposure to waterborne contaminants, as citizens fear, one would expect that groundwater at the well sites, and "finished" water at the utility water-treatment plants, would be tested and the test results be make part of the public information.</p>	<p>ATSDR does not perform environmental sampling at hazardous waste sites. The agency relies on environmental agencies and organizations to perform sampling that can pass a rigorous quality assurance and quality control protocol. With respect to the public water sources, no public water supply sources are between the facility and the river (downgradient). The upgradient water sources are regulated by both the state and the US EPA who require testing the water quality on a regular basis.</p>
<p>Do not citizens have reason for consternation at lack of public-source water testing by your agency when you repeatedly state the need that private well owners perform this very testing "of chemical contamination" to insure health of their water?</p>	<p>The testing of public water supplies is a federally mandated requirement. The Safe Drinking Water Act states that "All public water systems must have at least 15 service connections or serve at least 25 people per day for 60 days of the year." Private wells are not required to be tested; therefore, ATSDR recommends these well owners test their wells.</p>
<p>Given the absence of direct, current testing, the conclusion that "there are no completed exposure pathways," and therefore, "no apparent public health hazard," seems unjustified in my opinion.</p>	<p>The finding is based on the fact that there are no current or future exposures as the groundwater downgradient from NFS is not now nor will it be in the future, used for a drinking water source.</p>
<p>The Schreiber report should be acknowledged by ATSDR. Should the Schreiber report not meet quality-assurance criteria for the testing and analysis performed, this should be so documented. If its procedures meet the standards that regulatory agencies normally expect, it is in the public's interest to have its data</p>	<p>ATSDR reviewed the Schreiber report prior to completing the public health assessment. When we called the company to discuss the report, we were told that they did not want to discuss the report with us nor did they want to be informed of our findings. Therefore, we did not include its results in the document.</p>

<p>considered, made public, and acted upon.</p>	
<p>I am puzzled by a number of statements in the report to the effect that groundwater is not being used as a source of drinking water,” as all the Erwin utility water comes from groundwater wells and springs. Likewise, in the demographics breakdown of the people exposed to that water, on page 6, why several groups, e.g. children older than 6, adults 45-64, excluded. Please provide clarification on these matters, as well, in your expanded, later report on the Public Health Assessment.</p>	<p>The current source of public water for the Erwin Utility system is upgradient from NFS and their supplies have not been impacted by the NFS releases of volatile organic compounds into the groundwater.</p> <p>The demographic breakdown is derived from US Census data sources. The data tables on page 6 do not exclude any age group. Of the total population, those under the age of 6 number 185 individuals; those over 65 number 618 and; females of child-bearing age number 472 individuals. The remaining 1363 individuals comprise the remaining population within the one mile radius of the site.</p>
<p>Review and analyze all existing data where appropriate. Also - where is the air pathway analysis?</p>	<p>In the past as in the present, NFS was not and is not required to monitor for chemical releases into the atmosphere. ATSDR has seen statements that the Tennessee Department of Environment and Conservation does not have any air monitoring stations in Unicoi County. NFS is required, however, to report releases for the EPA Toxic Release Inventory. The lack of air data is considered a data gap (missing data). However, as the contamination is limited to the groundwater, the air pathway would not and is not a viable pathway of exposure.</p>
<p>We later learned that Dr. Charp did not have full security clearance to view the entire NFS facility and were told by the press that he actually viewed it from the parking lot....We demand a full and credible site investigation.</p>	<p>Security clearances are never discussed with individuals who do not have security clearance nor are security issues discussed in a non-secure area such as hotel lobbies or public meetings. Therefore, we cannot confirm nor deny your comment. Nonetheless, the purpose of a security clearance is irrelevant for this document. Portions of the site can be toured without a security clearance. The nuclear operation for which a security</p>

	<p>clearance is required is exempt from ATSDR activities. Dr. Charp did tour the facility related to nonradiological releases. The information supplied by the press relates to the remediation activities that can be best observed from the parking areas.</p>
<p>Dr. Charp admitted, in both of his presentations to the public, that the Tennessee Cancer Registry is in no way held up as a “gold standard.” Sadly, it’s quite the contrary.</p>	<p>The Tennessee Cancer Registry does not meet the requirements of the North American Association of Central Cancer Registries, Inc. and is not certified by that organization. The CDC maintains a list of those states that are certified and that list can be found at the CDC web site discussing cancer registries: http://www.cdc.gov/cancer/npcr/index.htm. One can view a map of states that meet the requirements at http://www.cdc.gov/cancer/npcr/naaccr.htm (last accessed on February 16, 2007).</p> <p>The most recent data is for 2002 and the Tennessee registry did not achieve certification at that time.</p>
<p>Extensive review reveals the effectiveness of this EABRP process is still questioned in the scientific community. We note that EABRP is patented by Arcadis Garrigthy and Miller. Our personal water consultant’s simplistic dye test beat a Garrigthy and Miller expensive, weighty, theoretical model in a TN court of law.</p> <p>Further, extensive review of Wiley InterScience Journals and Remediation Journal(s), reveal this process EABRP process is still in test phases. The GAO reports a major test facility is at Dover Air force base where all the tests are in a test building with tightly controlled conditions.</p>	<p>We would appreciate receiving a copy of your consultant’s study as well as the court documentation. ATSDR is aware of other studies in which dyes have been used in attempts to evaluate flow in karst formations such as those underlying NFS and other parts of East Tennessee.</p> <p>The General Accountability Office (GAO) report GAO-05-666 discusses the Dover Air Force Base system as you state. In general, the Department of Defense has either implemented or field tested the 15 generally accepted methodologies for groundwater remediation. The Dover site is where the Air Force tests new processes prior to use in the field. However, the report also states that the Air Force, as well as other branches within the Department of Defense utilize the enhanced anaerobic bioremediation and reductive precipitation (EABRP) process. For</p>

	<p>example, molasses has been field-tested at Vandenberg and Hanscom Air Force bases during bioremediation to treat chlorinated solvents. Furthermore, molasses is used at many dry cleaning sites contaminated with PCE to bio-remediate those sites.</p>
<p>Why are monitoring wells drilled into the shallow aquifer only? Oddly, we know that the deeper you go, the higher the concentration of contamination will be, after all, we are dealing with DNAPLES.</p> <p>Why are there not test wells drilled into the bedrock aquifer, which clearly would give a better understanding of the contamination in the water?</p>	<p>The environmental indicator documents that that during attempts to drill well wells, the boreholes collapsed.</p> <p>As the DNAPLE migrate from the source, their density decreases; that is, the concentration is highest at the source.</p> <p>The geology of the shale underlying the facility is thought to direct the contamination down the fractures until the groundwater is stabilized upon reaching solid bedrock. However, with karst geology, the groundwater flow can vary seasonally.</p>
<p>ATSDR did not properly notify the citizens of Erwin of their visit to the area, and instead claimed that the Erwin Record discarded their email notices as spam.</p>	<p>For meetings in Erwin in February and August, the CDC Office of Communications sent out notices to the local news outlets both in Erwin and the surrounding communities. We later learned from the Erwin Record that their spam filters did indeed route our email to their trash. We were told that the best way to notify the newspaper was to call then send a fax notice.</p>
<p>We have been informed by our local Federally based officials, that any illegal discharge of a radioactive substance is an automatic and undeniable violation of CERCLA. We also find that another area with a facility of similar type: Babcock and Wilcox, is now a Federal Superfund Site. Per the EPA, said sites have a 50 year life expectancy with possible 20 year extensions sometimes granted. Nuclear fuels was founded in 1959.</p>	<p>Illegal discharges are subject to federal laws. In the case of radiological materials, releases are regulated by the NRC. With regard to Babcock and Wilcox (B&W), the company has several Superfund sites. The site in Apollo, Pennsylvania was an abandoned site but never listed on Superfund as it was also licensed by the NRC. There are no other B&W sites listed on the EPA Superfund web site. There are, however, several B&W sites</p>

	<p>listed as decommissioning sites on state levels but again, these are not Superfund sites.</p>
<p>One commenter questioned the ATSDR statement that NFS stopped using volatile organic compounds in their processes. They supplied a list of chemicals from a state of Tennessee correspondence dated August 2, 1990. The list included both organic and inorganic compounds</p>	<p>Volatile organic compounds are defined as organic materials that at room temperatures can produce vapors readily. They can include gasoline and solvents such as toluene, xylene, and tetrachloroethylene. The EPA, however, defines this class of compounds as any organic compound that participates in atmospheric photochemical reactions except those designated by EPA as having negligible photochemical reactivity. The Code of Federal Regulations defines the list of EPA compounds with negligible photochemical reactivity at 40 CFR 51.100. Of the compounds supplied by the commenter, only acetone is considered a VOC. The permit granted to NFS lists those compounds they can legally discharge; however, actual discharges do not have to include all listed compounds.</p>
<p>What is the efficiency of NFS’s WWTF in removing VOCs and other chemicals from the waste streams prior to discharges into surface water?</p> <p>What is the efficiency of the EPOTW in removing VOCs and other chemicals from the waste streams prior to discharges into surface water?</p> <p>What is done with the sludge from NFS’s WWTF and from EPOTW?</p>	<p>At the Waste Water Treatment Facility (WWTF), liquid effluents are batch treated, sampled, and discharged to the Nolichucky River in accordance with the regulatory requirements of a National Pollution Discharge Elimination System (NPDES) permit. The processing occurs in batches with the efficiency varying. In the treatment process, the non-volatile organics are reduced to carbon dioxide, water, and ammonia. Ammonia is removed from the liquid stream by “air stripping” in accordance with a state air pollution control permit. Sludge is packaged and sent out-of-state for burial at a licensed radiological waste disposal facility in another State.</p> <p>The efficiency of the Erwin Utilities waste treatment facility meets the requirements of their NPDES permit.</p> <p>As stated above, the sludge from NFS is sent out-of-state for</p>

	<p>disposal in a licensed low level radioactive waste facility. The sludge from Erwin Utilities is centrifuged to dry the sludge which is sent to the Iris Glen landfill in Johnson City.</p>
<p>Can ATSDR get a copy of the 12/18/87 TDHE letter to NFS?</p> <p>Can ATSDR determine if the “new process activity planned to begin in 1988” actually came to fruition at NFS?</p> <p>If TCE was, in fact, used again by NFS in 1988, can ATSDR provide the public with information on the annual amounts of TCE consumed, processed in NFS’s WWTF, and discharged into surface water since the installation of NFS’s WWTF?</p> <p>If TCE was, in fact, used again by NFS in 1988, can ATSDR provide the public with information on the annual amounts of TCE consumed, “processed” in NFS’s settling ponds, and discharged into surface water or allowed to seep into ground-water?</p> <p>Who was ATSDR’s source for ATSDR’s statement that “NFS stopped the use of VOCs”?</p> <p>If ATSDR does find that disinformation was provided to it, are there any consequences to the source or sources?</p> <p>Can ATSDR inquire if TDHE ever pursued the curiosity of TAW and discovered anything (possibly that NFS discharged TCE without authorization through NPDES TN 0002038), and cited NFS with any violation?</p> <p>If NFS were contacting TDHE in early 1987 about discharging 50-75 ppb of TCE, yet the 12/18/87 Fulkerson letter had not yet been written setting regulated limits, and NFS had not yet applied for an amendment to NPDES TN 0002038 through its 01/08/88 letter, were NFS’s discharges of TCE in 1987 (and prior) actually</p>	<p>The letter dated December 18, 1987, to which you are referring is from the Tennessee Department of Environment and Conservation to Mr. Dale Gergely of NFS. The letter established technology-based limits for the discharge of TCE and 1,1,1-TCE. The state would apply these limits to the steam stripping unit at NFS. Discharges from existing treatment at NFS would have to be adjusted. The limits established for both compounds were 0.5 mg/L as a monthly average and a daily maximum release of 1 mg/L.</p> <p>ATSDR has learned that the details of the process are classified in accordance with the Atomic Energy Act , the “new process” refers to the start-up of a Research and Development (R&D) process in November of 1988 which was operated for a relatively short time.</p> <p>During the R&D process, TCE was used with trace amounts being carried over into the process’ waste water. The water then was sampled to meet NPDES permit requirements prior to transferring to NFS WWTF for further treatment. At the completion of the project, approximately 30 gallons of Trichloroethylene (TCE) remained in the process. The 30 gallons of TCE were not disposed through the WWTF but instead were put into a drum and properly disposed of at an off-site licensed disposal facility. None of the TCE used during the R&D process initiated in November 1988 was discharged to the settling ponds or allowed to seep into the groundwater.</p> <p>ATSDR was informed by both the facility and the EPA that TCE</p>

<p>within regulatory limits?</p>	<p>was no longer used. ATSDR was informed by both the facility and the EPA that PCE was no longer used as a degreasing agent</p> <p>ATSDR is not a regulatory agency and therefore cannot assess any penalties for the misinformation if it supplied to the agency. ATSDR will attempt to work out the discrepancies and if this is not possible, we report the information in the public health assessment.</p> <p>NFS was not discharging TCE in its wastewater in 1987. Planning for the short-term R&D project, including contacting TDHE about what was needed to potentially discharge TCE, was initiated long before the start of operations in November 1988. TCE was not discharged until the NPDES Permit Modification was issued.</p>
<p>ATSDR, p.7, P.4: “The closest well, the Railroad Well ... does not draw from beneath the NFS (sic) nor from areas downgradient of the facility.”</p> <p>A map of the zone of influence or of the area of “draw” for the Railroad Well would be very useful to include in the final report.</p> <p>Can ATSDR provide the public with independent studies (i.e., not paid for by NFS or conducted by EcoTek, an NFS company) that prove that the Railroad Well “does not draw” from beneath NFS?</p> <p>Is it possible that the “draw” of the Railroad Well reaches to the Indian Creek Fault which is about 2000 feet from the Railroad Well?</p>	<p>In 1996, a modeled capture zone analysis indicated that the draw down from the Railroad Well does not intersect the NFS property even if Erwin Utilities pumps upto 1000 gallons per minutes. The USGS is in the process of reviewing this report.</p> <p>ATSDR has included this map in the public health assessment.</p> <p>ATSDR and the USGS are not aware of any independent study of the capture zone or draw-down investigation related to the railroad well.</p>
<p>ATSDR, p.7, P.4: “NFS reports that there are no private wells between their operation and the river”.</p> <p>While it may be true that no private wells exist between NFS and</p>	<p>Fault lines can be a conduit for contaminant transport. Although ATSDR does not have the capability to test wells or springs, we relayed your concerns to the US Geological Survey regional</p>

the Nolichucky, the “Geologic Map of East Tennessee” (previously supplied) indicates that Wells #17 & 19 and Springs #16 & 18 are directly on the Indian Creek Fault which is about one-half mile from NFS.

Will ATSDR have those wells and springs tested for contaminants if it concludes that fault lines can and do serve as conduits for contaminant migration?

office in Nashville.

According to the USGS, the reports you to which you refer, are based on well and spring inventories conducted in the 1930’s and 1940’s. The two wells, #17 and #19 were both shallow wells and probably hand-dug water supplies. Well #17 is reported as 30 ft deep and 36 inches in diameter and well #19 is reported as 14 feet deep. The “probable water-bearing beds” listed for both wells is “Residual dolomite”. The residual dolomite is the clay and chert left after the dolomite has weathered and formed the deep soil and material over the bedrock. Even if these two wells were still available, neither well would be deep enough to sufficiently test flow through any fracture zones.

The two springs, #16 (Erwin Water Dept.) and #18 (Birchfield Spring) probably do occur along the fault because of fractures occurring along the fault and the connection with upgradient fractures and conduits.

Faults zones in East Tennessee can act to channel ground-water flow fractures associated with the faults. The faults can also restrict ground-water flow if the faulting has closed or plugged some of the existing fractures. The other significant components to ground-water flow along faults are the occurrence of recharge and discharge areas and water-level gradients from high elevations to lower elevations. If any ground-water flow does occur along fractures associated with the faults, the flow would most likely be towards the Nolichucky River. The reported land-surface elevations for the springs are 1760 feet at #16 and 1,650 feet at #18. Both elevations are higher than the land surface elevation at NSF (about 1,640 feet based on the topographic map) and indicate that flow would not occur from NSF toward the two springs.

<p>ATSDR, p.7, P.5: Citing a 2004 NFS report, ATSDR states that the “groundwater typically flows toward the north-northeast”.</p> <p>Comment 5-1: One of Erwin’s public drinking water wells -- the Railroad Well -- is about one-half mile northeast of NFS.</p> <p>Since the Railroad well is northeast of NFS and only about a half mile away from the settling ponds on NFS’s site, even if ATSDR is correct and the Railroad Well does not draw from as far away as NFS, couldn’t contaminants from 20 years of dumping in unlined settling ponds and seepage of extraordinarily heavy metals (such as uranium) have migrated along the north-northeast groundwater flow?</p> <p>If groundwater flow is toward the north-northeast, wouldn’t that be toward Erwin’s population center where wells and springs have been used for domestic water uses and where wells and springs might still serve some homes?</p> <p>In its final PHA, it would be helpful if ATSDR have an extensive discussion of groundwater flows in the alluvial, shallow bedrock and deep bedrock regions.</p>	<p>ATSDR rechecked the cited reference and corrected the mistake in the assessment. The proper direction for groundwater flow is toward the north-northwest. The flow from the site does not impact the draw-down from the Railroad Well.</p> <p>The dumping at the site impacted both groundwater and surface water; however, the contaminants would reach the river, not the well.</p> <p>As the groundwater flow is toward the north-northwest, the wells located north of the Railroad Well would not be impacted as the water flow under those wells would prevent flow from the NFS area mingling with those wells.</p> <p>ATSDR geologists and groundwater modelers have supplied additional information and that has been added to the final public health assessment.</p>
<p><u>ATSDR, p.7 on Natural Resource Use omits information on Banner Spring</u></p> <p>A discussion of Banner Spring and its history relative to the establishment of the Banner Hill neighborhood and the other south Erwin neighborhoods, if included in the section on Natural Resource Use, would help inform the reader on another environmental exposure medium.</p> <p>The 05/03/01 <u>Environmental Assessment</u> (EA) prepared in support of NFS’s application for an amendment to its SNM-124 license to approve the North Site Decommissioning Plan states on</p>	<p>The Banner Spring creek lies entirely within the site boundary of NFS and flows into Martin Creek. Prior to the establishment of NFS, part of the Banner Spring flowed into a marshy area. It was this marshy area where NFS established holding ponds and some disposal areas. The waste in these areas has impacted the groundwater associated with the Banner Spring. This information has been included in the public health assessment.</p>

<p>p.6 that the “source of Banner Spring is probably FRACTURE CONTROLLED GROUNDWATER from the mountains southeast of the site. Banner Spring has a continuous flow rate of about 300 gallons/minute.” (Emphasis added.) NFS’s August 2001 <u>RCRA Facility Investigation Workplan</u> states that “some upward component of flow is evident within the deeper bedrock (50+ feet) which is probably the result of higher elevation recharge THROUGH FRACTURE SYSTEMS in the mountains to the southeast”. (Emphasis added.)</p>	
<p>Even if it were only a folkloric tale that Banner Spring was a mountain-fed spring, its flow rate and proximity to a well-travelled road would have made it an attractive water source.</p> <p>Did the public have access to Banner Spring after NFS began operations in 1957?</p> <p>Were homes on Banner Hill supplied domestic water from Banner Spring?</p> <p>In what year was public access to Banner Spring terminated?</p>	<p>Holston Land Company, a part of the Clinchfield Railroad (now CSX) family, owned the spring from prior to 1957 to 1982. NFS believes that neither NFS nor the public had any access to the spring during that period. The Town of Erwin (Erwin Utilities) purchased Banner Spring from Holston Land Company on October 15, 1982. The spring was evaluated by Erwin Utilities as a potential potable water supply in the event a significant drought or other system stressor occurred but the spring was never placed into service as a potable water supply. The property was sold to NFS on July 31, 1989. During ownership by Erwin Utilities and NFS, there was fencing designed to prevent public access. Further details of the land use should be directed to the previous owners.</p> <p>Prior to 1957, a county road separated NFS property and private property on the east side where Banner Spring originates. Aerial photographs taken during the late 1950’s to early 1960’s indicate the presence of a fence surrounding the spring.</p>
<p>A diagram included by NFS in <u>Responses to NRC Questions Related to NFS Erwin Environmental Information Report</u> dated May 31, 1977 shows Banner Spring & Pump House behind a</p>	<p>Because the nature of fractured flow and karst topography, ATSDR cannot determine what water sources such as springs and wells intersect fractures. The US Geological Survey (USGS) is</p>

<p>barbed wire fence.</p> <p>When was the pump house at Banner Spring fenced off from the public?</p> <p>What other wells and springs in Unicoi County supplied water for household uses (including drinking water) that could have intersected the same fractures?</p> <p>Since NFS used unlined settling ponds to “treat” waste for approximately 20 years since beginning operations in 1957, could a groundwater contamination plume have formed and intersected bedrock fractures and fractures between beds such as the one that is the source of Banner Spring’s substantial flow?</p> <p>If there is a system of fractures (as the <u>RCRA Workplan</u> report indicates), could the contaminant plume possibly be intersected by more than the one fracture feeding Banner Spring?</p> <p>Could the same system of fractures also feed the Railroad Well?</p>	<p>the appropriate agency to determine the characteristics of the groundwater flow. As previously stated in these responses, the USGS has evaluated the karst topography in the Upper East Tennessee area with inconclusive results.</p> <p>The source of Banner Spring is both upland and upgradient of the NFS site. The water source is produced by downward flow of surface water in the mountains, recharging the upgradient groundwater. Therefore, the Banner Spring water source would not be impacted by contamination in the groundwater near the site.</p> <p>In a 1989 groundwater characterization study, the Banner Spring water is described as rarely having storm related turbidity, thus signifying relatively deep groundwater circulation. The settling ponds are in the unconsolidated deposits and intersect the shallow unconfined unconsolidated or water table aquifer. Additionally, the hydrogeologic characterization study demonstrated that Banner Spring is upgradient from the ponds area and the source of water for Banner Springs is derived from downward flow from the surrounding mountains. Therefore, the pond sludges are not a potential source for contaminating Banner Spring Branch.</p> <p>As stated in the public health assessment, the closest well to NFS is the Railroad Well about 3,500 feet northeast of the plant. A capture zone analysis was performed for this well in 1996 by Geraghty and Miller, Inc. indicated that the Railroad Well’s area of capture does not include the NFS Site.</p>
<p><u>ATSDR, p. 7 on Natural Resource Use omits information on karst terrain.</u></p> <p>No mention of Erwin’s karst terrain is mentioned in the section of</p>	<p>An ATSDR geologist has supplied information karst formations and this has been added to the public health assessment.</p>

<p>ATSDR’s draft report, nor are the major fault lines mentioned. A discussion of karst features and of the geology of Erwin would be useful in the final report.</p> <p>Is it possible that contaminants emanating from NFS have reached the Indian Creek Fault which is also about 2000 feet from NFS?</p> <p>Could contaminants run along a fault line or fracture in the bedrock?</p> <p>If yes, how far can contaminants travel along fault lines according to studies of comparable karst locations?</p>	<p>Contaminant migration could move through the fractures in the area. Comparable studies have indicated that contaminants will move along the fractures or other openings in karst locations until other geological features stop the migration.</p> <p>According to the USGS, it is not possible to compare movement in karst systems.</p>
<p>Comment 7-2: The possibility that vertical fractures exist in the bedrock was raised by Geraghty & Miller on page 2-5 of its <u>Revised Groundwater Flow and Solute-Transport Modeling Report</u> (February 1999): “Fractures BETWEEN the beds of the NEARLY VERTICALLY DIPPING DOLOMITE probably provide the easiest pathways for water to flow. Flow through FRACTURES ACROSS THE BEDS may be more restrictive relative to flow through fractures along the bedding planes.”</p>	<p>The US Geological Survey has reported that fractures or karst formations are abundant in the limestone formations under much of East Tennessee. These fractures serve as a “path of least resistance” so groundwater flow is most likely through these karst areas as indicated in the referenced model. Additional information is supplied in the next comment.</p>
<p>Comment 7-3: The karst Valley and Ridge physiographic province is described by the US Geological Survey (USGS) in <u>Circular 1205 (Water Quality in the Upper Tennessee River Basin, 2000)</u> as being “underlain by folded and extensively faulted limestone, dolomite, shale, and sandstones that occur in long subparallel belts trending southwest to northeast. The principal water bearing units are the carbonate-based dolomites” – the rock which Geraghty & Miller describe as “nearly vertically dipping” and existing beneath NFS.</p> <p>Comment 7-4: USGS Circular 1205 further states on page 8 that “ground-water systems such as the carbonate systems of the</p>	<p>The USGS did indeed state that the area is susceptible to contamination and the discussion on page 8 of Circular 1205 regarding bacterial contamination is very important. However, on page 18 of the same report, the USGS reported that volatile organic compounds detected did not exceed the drinking water standards. The entire report can be found at http://pubs.usgs.gov/circ/circ1205/pdf/circular1205.pdf (last accessed on February 21, 2007).</p>

<p>Upper Tennessee River Basin are particularly susceptible to contamination from surface sources” and “the common presence of bedrock outcrops, areas of thin overburden, and karst features such as sinkholes provide direct avenues for aquifer contamination.”</p>	
<p>Comment 7-5: Dye traces performed in Missouri’s karst regions have demonstrated that dyes injected into the ground can emerge from (1) one or more spring, (2) springs in other watersheds, (3) springs 20 or more miles away from the dye injection point. <u>Living on Karst</u> (published Dec. 2003 by the Nature Conservancy) also reveals that the recharge areas of springs in karst terrain vary from less than two-tenths of a square mile to over 500 square miles.</p> <p>Can ATSDR conduct dye traces in Unicoi and adjacent karst counties to determine the actual recharge areas of all of Erwin’s public drinking water wells and springs, with special attention to the Railroad Well?</p> <p>Can ATSDR conduct dye traces at various depths to determine alluvial and bedrock groundwater flows and their influence on all of Erwin’s public drinking water wells and springs?</p>	<p>ATSDR cannot perform the dye tests you requested. The best agency to perform these types of tests would be the US Geological Survey (USGS). ATSDR hydrogeologists have reviewed USGS databases to see if there are any recent dye studies in this area. The results of these reviews were added to the public health assessment. The USGS has performed several studies on karst formations in Tennessee. 1997 report indicated that no dye studies were available for Unicoi County (see reference 8 in the public health assessment). This study also stated that following a 200,000 gallon release of TCE over 7 years, no DNAPL were found.</p> <p>The USGS also reviewed the data we have on file and reviewed the dye-trace data base maintained by the Tennessee Division of Environment and Conservation (TDEC). Neither the USGS nor TDEC had information on dye-trace studies conducted at Erwin. Dye-trace tests in a karst setting can identify direct connections though the fracture and conduit (cave) systems that transmit ground-water. However, in a setting such as Erwin, with alluvium and weathered regolith occurring on top of the karst bedrock, dye-trace tests can be difficult to complete. Ground-water flow through the alluvium and regolith could take a much longer time than the dye-monitoring program. The best “tracer” tests for Erwin’s water supply wells and springs is the continued monitoring for the contaminants of concern and the contaminant break-down products.</p>

	<p>The USGS has collected water-quality samples from surface water, wells, and springs in Unicoi County. During the 1990's, samples from 5 wells or springs were collected and analyzed. The data are available at the Tennessee USGS site http://nwis.waterdata.usgs.gov/tn/nwis/qwdata (last accessed on April 17, 2007). Three of the 5 sites, including O'Brien Spring, include analyses for VOC's.</p>
<p>Comment 7-6: Finally, with respect to groundwater contaminants and their subsurface movements, researchers at Oak Ridge National Laboratories (ORNL) reported in the November 11, 1998 internet edition of <u>Environmental Science & Technology</u> that "radioactive contaminants can migrate over long distances faster than originally thought." ORNL scientist and lead author, John McCarthy, PhD., noted that "'The tracers moved at almost the same speed as the groundwater'" and were observed 10 to 80 meters from the injection site within a week or less. "This information opposed the results of laboratory tests that suggested contaminants strongly bind to the soil and move only centimeters a year'." <u>Environmental Science & Technology</u> is a journal of the American Chemical Society.</p> <p>Can ATSDR consult with or contract with the scientists at ORNL to do dye or tracer studies of the groundwater contaminant flows beneath Erwin?</p>	<p>The Oak Ridge National Laboratory (ORNL) has performed dye tests in its karst geology below the laboratory in an attempt to understand the difficult task of modeling the karst issues.</p> <p>The McCarthy report is a study of the transport of radioactive material by natural organic matter. The metals involved in this study were carried by the organic material and its movement was influenced by rain events and the movement through a shallow flow path was intermittent.</p> <p>ATSDR does not have the funding to contract with ORNL to perform the types of studies you request. The USGS would be the agency to perform these test; however, their experience in karst topography indicates the results would be inconclusive.</p>
<p>Comment 8-1: If atmospheric releases – accidental or routine -- of radiological or chemical contaminants occurred during daylight hours and the prevailing winds were blowing at all, then the fallout would be over Erwin's population center, according to the information on prevailing winds contained on p.7 of ATSDR's draft PHA.</p>	<p>That, in general, is correct for those materials that remain in a gaseous state. Those materials released into the atmosphere that are particulate in nature or after cooling, become particulate, would be deposited closer to the release point. The distances traveled are dependent on numerous factors other than wind direction such as their initial temperature at the point of release,</p>

<p>Comment 8-2: A discussion of NFS’s numerous planned and accidental releases, and the constituents emitted into the atmosphere, needs to be included in the discussion of local meteorological conditions as well as in the “Off-Site Contamination” sections of the final PHA.</p>	<p>their chemical properties, the wind speed, time of day, air temperature, atmospheric conditions such as upper atmosphere wind direction and speed, inversions, etc.</p> <p>Because of limitations placed on ATSDR by the CERCLA legislation, ATSDR was not able to find any atmospheric release data that was not related to the Nuclear Regulatory Commission license.</p>
<p>Comment 10-2: The radioactivity measured in Nolichucky River sediment downstream of NFS (10.84 picocuries/gram in the year 2000) was more than 54 times the radioactivity measured ten years prior (0.20 picocuries/gram in the year 1990), according to NFS’s June 2002 <u>Environmental Assessment</u>, p.D-1.</p> <p>If “most” radium concentrates in fish bones, does the rest accumulate in fish tissue?</p> <p>If yes, would eating fish caught in the Nolichucky result in ingestion of contaminants?</p> <p>Do any of the chemicals listed in pages 1 & 2 of these comments concentrate in fish tissue?</p>	<p>The concentration units you supplied to ATSDR typically represent the radiation associated with soils and sediments. The Nolichucky River is typically highly sedimented and contains much agricultural run-off. These sediments and agricultural products typically contain naturally occurring radioactive materials. The values you cite are not indicative of man-made contamination but of contamination from a naturally occurring process.</p> <p>Radium, upon intake into the body, behaves very similar to calcium. Therefore it concentrates in the bone. What is not deposited into the bones does not stay in the body. Unless one would eat the fish bones, then the intake of radium is minimal, perhaps less than the radium normally taken in by humans in daily activities.</p> <p>The NPDES permit lists those chemicals that can be released, not necessarily released. Of the contaminants you supplied in the comments,</p>
<p><u>12. ATSDR, p.19, P2: “The type and severity of health effects that a person can experience depend on the dose ... and the multiplicity of exposure (combination of contaminants).</u></p> <p>Erwin water customers, and those still taking their domestic water</p>	<p>ATSDR reviewed the issues of uranium in foods during the evaluation of the Oak Ridge Reservation Y-12 facility that released about 50,000 kilograms of uranium into the air alone. The nearest community where foods were raised was sampled by</p>

<p>needs from private wells and springs, seem to be consuming a chemical cocktail when they drink the water out of their taps. If they live or work downwind of NFS, they could also be inhaling contaminants emitted by the company during accidents or routine releases. If they garden or eat locally-grown fruits and vegetables, they might be ingesting crops that concentrated atmospheric fluoride (emitted by NFS as uranium hexafluoride gas) or consumed beef that grazed on forage crops with high fluoride concentrations. If they fish too, their skin could have come into contact with contaminants in the Nolicucky or Martin Creek, or in their sediments. If the water in which they bathe or shower is contaminated, they could be breathing in contaminated water vapor.</p> <p>Could a multiplicity of exposures to numerous contaminants cause a “Combined MCL” (for example, PCE + TCE + Chloroform + Gross Alpha + Fluoride) to be exceeded?</p> <p>Even if “Combined MCLs” are not yet codified in the Safe Drinking Water Act, wouldn’t prudence dictate that children at least be protected from a multiplicity of exposures even if each individual contaminant is well below its MCL?</p>	<p>Florida A&M. The analysis of those foods indicated that uranium would not be a public health hazard as uranium is not easily absorbed into the plants. Since cattle consume the vegetation, their uranium concentrations would be low as well.</p> <p>Yes that is possible. Since the MCL is for public drinking water supplies and not monitoring well water, care must be taken in applying the MCL to situations where no contamination has been detected in public water supplies.</p> <p>The Safe Drinking Water Act actually allows for combining contaminants using the “sum of the ratios” method. In this procedure, one determines each contaminant percentage of its associated MCL. If the sum total of these percentages exceed 100%, then the combined MCL is exceeded.</p>
<p>Proofreading and Editorial Comments are noted by page (abbreviated as p.) and paragraph (abbreviated as P.1). Even when a paragraph at the top of a page is incomplete, it is counted as Paragraph 1.</p> <p>p.1, P.3: Insert apostrophe in “petitioners” to indicate possessive nature of concerns.</p> <p>p.2, P.4: Change “all” applicable federal and state regulations to “other or “some” so as not to give the impression that NFS has never violated RCRA, Hazardous Waste or Special</p>	

<p>Nuclear Material license or permit requirements.</p> <p>p.2, P.4: Insert after NRC, “EPA and TDEC”.</p> <p>p.3, P.2: Insert after “Per applicable laws and permits in effect at the time” the phrase “and, in some cases, in violation of federal and state licenses and permits”.</p> <p>p.3, P.3: Insert after “the on-site ponds” the phrase “and into the Nolichucky River.”</p> <p>p.7, P.3: Insert an “h” in “Nolicucky”.</p>	
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<p>When did the city first start supplying water to the residents in Erwin?</p>	<p>Erwin Utilities began serving the county in 1945 supplying electricity. The following year, 1946, the existing water utility was purchased by Erwin Utilities.</p>
<p>In 1973 there were four houses (on NFS property today) that had a well in the backyard. They are not used but covered up.</p>	<p>Thank you for the information.</p>
<p>Concerns that there is no air monitoring. Orange smoke is coming out of the stack at night (nitric acid?)</p>	<p>Air monitoring by NFS for materials other than radioactive materials was not required by either state or federal regulators. NFS, however, reports releases of materials to the Toxic Release Inventory maintained by the EPA. That information was reviewed by ATSDR.</p>
<p>Hydrologist study done by a NFS contractor. Did EPA and ATSDR review – what were the results?</p>	<p>The reports were reviewed by both agencies. At ATSDR, the NFS study was reviewed by both a hydrogeologist with karst hydrogeology experience and by a groundwater modeler. Their review comments</p>

	were discussed and added to the public health assessment.
Was the Exposure Pathway of hunting and fishing looked at? There is a concern for downstream residents.	All pathways were evaluated following the procedures outlined in the ATSDR Public Health Assessment Guidance Manual. A completed exposure pathway consists of 5 elements: 1) a release; 2) movement through the environment; 3) an exposure point; 4) an exposure route to humans; and 5) exposed populations. The exposures need to be above screening levels that are derived from levels associated with adverse human health effects.
Who gave ATSDR the data to complete the PHA? How far back does the data go?	ATSDR received data from the US EPA as well as the State of Tennessee. The data received much of the 1990s through 2005.
Can ATSDR assist with the water quality testing?	ATSDR can only recommend to the appropriate agency to retest the water and notify the public of those findings. Currently, all data are reviewed by the state as required by law.
Did ATSDR review the Schreiber Report? What are the limits to that report?	ATSDR did receive a copy of the report. We reviewed the report and included some its data on the organic compounds in the public health assessment. Their reporting of the radioactivity did not meet the quality requirements used by ATSDR; therefore, that portion of the report was not evaluated further.
In 2003 there was a drought where the water level was below the plants.	The closest public well or public supply well is the

<p>Where are public wells in relation to the NFS plant?</p>	<p>Railroad Well located about ½ mile upgradient from the plant.</p>
<p>If there is a known VOC in private wells, can ATSDR do testing on public wells? Residents would like to see quality data (not from NFS) on other sources.</p>	<p>The public well testing is performed by the state of Tennessee, not NFS. The results of the water quality testing can be obtained from the state by calling the Tennessee Department of Environmental Conservation, Water Quality Division at (615) 532-0191</p>
<p>Why are there no more off-site monitoring wells?</p>	<p>Based on the groundwater data, more wells were not required as the concentration of the contaminant in the distant wells reached the federally enforceable limit, the Maximum Contaminant Level.</p>
<p>Facility was done for bio-remediation, what more information can you tell residents?</p>	<p>In discussions with the EPA, ATSDR was told that this process is also used to remediate many dry cleaning sites contaminated with perchlorethylene. At NFS, the full-scale operations of the bioremediation are progressing.</p>
<p>Mercury off-site, where is it going?</p>	<p>Based on your comment, we believe you are referring to mercury mixed with radioactive waste. This is considered mixed waste. NFS closed the operation in 2005 and presented a closure plan to the state of Tennessee who will oversee the disposal. The site was working on a process to separate the mercury from the radiological contaminants. Their report can be found at http://apps.em.doe.gov/ost/pubs/itsrs/itsr2407.pdf (last accessed on 02/16/2007).</p>

<p>Concerns for rafting on the Nolichucky. VOC's –how is it for fishing? Are there monitors?</p>	<p>There are no monitors on the Nolichucky River for monitoring VOCs; they are only monitored at the water supply points. The concentrations of VOCs in the river are not at levels known to cause adverse health effects so both rafting and fishing are not hazardous.</p>
<p>Would like to see a graph of how the water concentration travels from NFS to the River. How will the VOCs affect the future of the River? Is this good for the river plants and people (not yet detected)</p>	<p>The impact of VOCs on the river is expected to minimal as the site is currently using bio-remediation to reduce the contaminant concentrations. As the concentrations continue to drop, the amounts potentially entering the river should drop as well.</p>
<p>Are there any radioactive materials in the River?</p>	<p>The solubility of uranium varies with the water quality and the geology of the water system. Also some of its decay products may be in the water as well. Radioactive materials will also enter the river from fallout and naturally produced radioactivity in the atmosphere.</p>
<p>Potential concerns for workers when discussing Radiation concern. This is private information.</p>	<p>ATSDR agrees; except for documents related to medical issues and petition requests, all ATSDR documents are public.</p>
<p>Data plotted on plume maps from original research. Did this include wells? Was there a projection on models? Did this come from an NFS contractor?</p>	<p>The model was prepared by a contractor for the site and reviewed by the EPA. ATSDR received a copy of the report and it was reviewed by on-staff professional geologists with extensive hydrology experience. Their comments have been incorporated into the public health assessment.</p>

<p>29% of wells contained VOCs? Can US Geology Survey test the area?</p>	<p>The USGS does not have the funding to sample wells in the area. In discussions with Erwin Utilities, ATSDR was told they were only aware of one private well in the area served by the utilities and that well was upgradient and uphill from the Nuclear Fuel Services facility.</p>
<p>How can “no exposure” conclusion be drawn when no wells were tested?</p>	<p>The “no exposure” conclusion was derived from the following observations: 1) groundwater flows under the site toward the river; 2) there are no private wells between the facility and the river; and 3) the wells within the industrial park are capped (sealed) apparently as a result of the settlement between the site and Impact Plastic, Inc. (the actual findings are sealed under court order).</p>
<p>Page 7 of the report talks about the flow direction of groundwater in paragraph 3: Rail Road is ½ miles North of NFS, NFS is down gradient from RR and the water flows N-NE?</p>	<p>Thank you for finding this error. The correct distance for groundwater flow is toward the northwest as based on groundwater contours. The Railroad Well is north of the facility; however, the groundwater contours, as they migrate toward the river, do not intersect the flow contours of the railroad well.</p>
<p>NFS former owner was WRGrace? Not a good neighbor.</p>	<p>The W.R. Grace Company did operate NFS as the Davison Chemical Division. The company does have locations listed on the National Priority List (Superfund) in Montana and Massachusetts.</p>
<p>Who do people call for help with worker health and radiation issues?</p>	<p>The National Institute for Occupational Safety and Health is the organization responsible for worker issues. An employee can request an Health Hazard Evaluation</p>

	(HHE) if he or she is currently an employee at the workplace of concern and has the signatures of two other employees. Also, an officer of a labor union that represents employees for collective bargaining can request an HHE. The NIOSH HHE group can be reached at 1-800-356-4674.
What happened in the 1970s spill? What VOC were released?	ATSDR learned that during maintenance operations, workers would dispose of degreasing agents, VOCs, by pouring the wastes onto the ground outside the maintenance facility. The most commonly used VOC during this time was perchloroethylene.
40 ft deep “worker stuff” buried on site because of this spill.	The spill did not result in the burial of any spill-related materials as the liquid soaked into the ground. Worker materials from the nuclear operations at the facility were placed in on-site burial grounds. Some of this material did contain volatile organic compounds as discussed in NFS documents. Groundwater associated with Pond 4 contained chemical contaminants and this information has been added to the public health assessment.
Regarding the 1970s spill were there any immediate remediation efforts prior to 2003?	There does not appear to be any efforts to remediate the spill of volatile organic compounds prior to the initiation of the bioremediation project. The bioremediation pilot study began in 2001.
ATSDR should take a tour of the NFS shooting range. Shots are fired directions into Indian Creek. There are traces of lead and powder in the	ATSDR toured the outside area of the NFS shooting range. Its proximity to the sawmill and residential areas

creek.	is a concern. ATSDR is looking into the safety issues with the state as well as any federal firearms regulations.
Have concerns for NFS hiring un-skilled workers to complete work while others on strike?	The issue of unskilled workers performing skilled jobs within the plant has been transmitted to the appropriate agency; in this case, the Nuclear Regulatory Commission.
NRC not looking out for public. How can residents trust them?	Trust can be obtained through an open dialog with all the parties associated with this site. This would include the Nuclear Regulatory Commission, the state of Tennessee, and Nuclear Fuel Services.
NFS documents: who monitors the NRC?	NRC oversight is through its commissioners as well as other federal groups such as the Government Accountability Office and public watchdog groups.
Admiral of Navy pulls NFS chain for the weapons plutonium (U-235) classified information.	Thank you for your comment. ATSDR has relayed this to the Nuclear Regulatory Commission.
MS and cancer links for Erwin?	A review of the medical literature housed at National Library of Medicine did not uncover any connection between the two diseases. There is information, however, that some forms of multiple sclerosis respond in a positive manner when treated with some anti-cancer drugs.
Since 1957 (prior to NFS operations) are there any cancer death concerns in Unicoi Co? Prior to the plant opening versus now? A health study should be	Current cancer information for Unicoi County is very poor and the information for 1957 is perhaps non-

done.	existent. The information required for the health study would not be available so the study design would be very difficult if not impossible.
Health problems from exposure –you need to know what you are exposed to. It is hard to classify a health problem with out it.	We agree with this comment. A public health assessment serves many purposes. The selection of contaminants of concern and pathway analyses are very important in determining if exposures have occurred. If there is no completed exposure pathways or if the completed exposure pathway results in exposures below which have been shown to cause adverse health effects, then the community needs to be aware of this fact.
Seems to be a gap in information across agencies and with the public.	The exchange of information between ATSDR and the EPA operates smoothly through the work of the ATSDR regional representatives who are headquartered in the EPA offices. The sharing of information among other federal or state agencies; however, does not occur as smoothly.
There needs to be an Alert System for Evaluation Plans. NFS needs to be honest with the public	We agree the honesty is an important factor that will help the local residents with their concerns. The site does have an emergency plan on file with the county.
Concerns there are unskilled workers at NFS since the strike.	As stated above, ATSDR has transmitted these concerns to the Nuclear Regulatory Commission.
Honesty from NFS –who would you believe? How can Erwin residents be educated about NFS actions?	ATSDR believes that NFS, the state and the Nuclear Regulatory Commission should hold regularly scheduled informational and educational meetings with

	the community to discuss plant mission, safety issues, and other concerns that the community may have.
Safety Department, Radiation Experts, and Union reps have all been contracted out.	As ATSDR understands the process, all contracting employees are to have the appropriate qualifications to meet the requirements of the Nuclear Regulatory Commission. The on-site inspection teams of the NRC should be aware of the contractor qualifications, training, and abilities.
Are there safety monitors for Radiation workers? Is NFS a high exposure facility?	All radiation monitoring is under the auspices of the state of Tennessee and the Nuclear Regulatory Commission. As discussed in the public health assessment, ATSDR cannot comment on the radiation issues unless the site is placed on the National Priority List (Superfund).
Residents request a meeting with NRC/EPA and ATSDR to meet with the public on safety issues.	The author of this public health assessment passed this request up the chain of command. A letter was written to the Erwin mayor stating that the agency is continuing to pursue the public meeting request.
NFS has their own on-site Fire Dept. Erwin Fire Dept handles controls now due to NRC rule.	Thank you for your comment. ATSDR was informed that the Erwin Fire Department and Unicoi units serve as a backup to the NFS fire units.
Public Monitoring System? Beyond NRC and NFS, where can they do their own surveys?	There are several private organizations and universities that may assist the community in the surveys for which you are requesting.

<p>NRC is only responsible for NFS worker safety, we need to look inside the fence.</p>	<p>Issues associated with worker health and safety are handled by the National Institute for Occupational Safety and Health (NIOSH). ATSDR will pass these concerns to them for review.</p>
<p>City water testing. Can we test for different elements and compare to a different city to see if there is a difference in elements?</p>	<p>The state of Tennessee has listings for public water supplies and the sampling results. That information should be available. Please contact the local state office in Johnson City.</p>
<p>Concerns for cancer rates of people living near NFS and workers.</p>	<p>ATSDR will see if we can facilitate discussions with ETSU.</p>
<p>Concern for rare blood disorders in Erwin residents and workers. 1968 Spill led to 5 cancers with 4 now dead.</p>	<p>ATSDR will direct your comment to the Tennessee Department of Health for review.</p>
<p>Is there an increase of MS in Unicoi County and are they linked to cancer?</p>	<p>A review of the medical literature in the National Library of Medicine does not indicate a relationship between cancer and multiple sclerosis (MS). However, there are several drugs used to treat cancer that are being evaluated or used for the treatment of MS</p>
<p>Erwin Mayor would like to see a resolution that no unskilled workers be allowed to work at NFS. NRC sets the guidelines.</p>	<p>This issue was discussed at the public meeting in Erwin and the mayor indicated that he would look into drafting the resolution.</p>
<p>In 1985-86 NRC was not honest about safety issues at the plant (with workers or residents)</p>	<p>ATSDR met with representatives of the NRC Regional Office in Atlanta. These issues were relayed to them.</p>

<p>Right next door to NFS they are working on their license and we can't regulate or evaluate their rad data.</p>	<p>Issues associated with the neighboring facility should be expressed by the community to both the State of Tennessee and the Nuclear Regulatory Commission</p>
<p>Where is the raw data on Railroad Well? Air Strippers</p>	<p>By "raw data" we believe you refer to the laboratory data collected during the evaluation of the water quality. Those data should be held by the Erwin Utilities. They are required to report the results to the Tennessee Department of Environment and Conservation, Division of Water Supply in Nashville as well as the customer served by the utilities company. ATSDR met with the state and received copies of the the most recent Railroad Well sampling events as reported by the facility to the state. These results were added to the public health assessment.</p>
<p>Is there a link with NFS and Impact Plastics settlement agreement? IF there is groundwater contamination at that site, then others are exposed as well.</p>	<p>The legal agreement with NFS and Impact Plastics is not available to the public because of a court order. With regards to exposures, the groundwater evaluations reviewed by ATSDR indicate that contamination under the Impact Plastics site does not impact or influence any public or private drinking water wells other than the wells no longer used inside the industrial park.</p>
<p>Can residents go with TN when they sample water in Erwin, RR and Jonesboro? Do they sample at the tap and in the Nolichucky River?</p>	<p>The request to accompany the state during sampling of the drinking water supply should be made to the state or the local water utility. The river is probably not sampled as the river water is not used directly as potable water. It undergoes treatment prior to distribution. The federal drinking water regulations do not necessarily require</p>

	<p>sampling at the tap, not necessarily at the source. Tennessee state regulations, however, do require water systems to “prepare and annually update a contaminant source inventory of significant potential contaminant sources which may have any adverse effect on the health of persons and potential contaminant sources within the source water protection area”(Rule 1200-05-01-.34).</p>
Possible exposure of the Aquifer	<p>The aquifer beneath the facility, the Rome aquifer, is mostly recharged by subsurface movement of water migrating downhill from the surrounding mountains. Rainfall directly enters this aquifer, by filtering through the surface soils. The rain on the surrounding mountains and hills also enters those aquifers and migrates downgradient in the subsurface through extensive fracture and solution zones. The higher elevations where this water recharges the aquifers lead to the creation of the hydraulic pressure or head that creates the artesian wells and springs in the valley. Where the height of the hydraulic pressure exceeds the height of the bedrock, water is discharged to the surface. This discharge occurs throughout the NFS facility as well as other water bodies such as Banner Spring. This information was derived from Ecotek, Inc. (1989) Hydro geologic Characterization Study NFS Facility, Erwin, Tennessee Volume 1 Technical Overview.</p>

