# Public Health Assessment

**Final Release**

**WRIGHT CHEMICAL CORPORATION NPL SITE**
**ADJACENT TO LIVINGSTON CREEK**
**RIEGELWOOD, COLUMBUS COUNTY, NORTH CAROLINA**

EPA FACILITY ID: NCD024766719

**Prepared by**
**North Carolina Department of Health and Human Services**

APRIL 26, 2013

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

## THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 60-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.



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North Carolina Department of Health and Human Services
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Occupational and Environmental Epidemiology Branch
under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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**Acronyms**

| | |
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| AF | Attenuation factor |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| CDC | Centers for Disease Control and Prevention |
| CF | Conversion factor |
| cm | Centimeter |
| CREG | ATSDR Cancer Risk Evaluation Guide |
| CR | Contact rate |
| CV | Comparison Value |
| DAF | Dermal absorption efficiency |
| DENR | N.C. Department of Environment and Natural Resources |
| DHHS | N.C. Department of Health and Human Services |
| DPH | N.C. DHHS Division of Public Health |
| DWM | N.C. DENR Division of Waste Management |
| DWQ | N.C. DENR Division of Water Quality |
| ED | Exposure duration |
| EF | Exposure frequency |
| EMEG | ATSDR Environmental Media Evaluation Guide |
| EPA | U.S. Environmental Protection Agency |
| HACE | N.C. DPH Health Assessment, Consultation and Education Program |
| HG | Health Guideline value |
| IUR | Inhalation Unit Risk factor |
| kg | Kilogram |
| L | Liter |
| LOAEL | Lowest Observed Adverse Effect Level |
| LTHA | EPA's Lifetime Health Advisory Level for drinking water |
| MCLG | EPA Maximum Contaminant Level Goal |
| MCL | EPUSA Maximum Contaminant Level |
| m | Meter |
| mg | milligram |
| µg | microgram |
| NA | Not applicable |
| NOAEL | No Observed Adverse Effect Level |
| PAH | Polycyclic aromatic hydrocarbons |
| PCB | polychlorinated biphenyl |
| ppm | Parts per million |
| ppb | Parts per billion |
| RfC | Reference Concentration |
| RfD | Reference Dose |
| RMEG | ATSDR Reference Dose Media Evaluation Guide |
| SVOC | Semi-volatile organic compound |
| VOC | Volatile organic compound |

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

# Foreword

The North Carolina Division of Public Health (DPH) Medical Evaluation and Risk Assessment Unit's (MERA) Health Assessment, Consultation and Education (HACE) program has prepared this Public Health Assessment in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for evaluating public health issues related to environmental exposures to hazardous waste. This public health assessment was prepared in accordance with the methodologies and guidelines developed by ATSDR and N.C. DPH.

The purpose of this Public Health Assessment (PHA) is to identify and prevent harmful health effects resulting from exposure to hazardous substances in the environment. Public health assessments focus on health issues associated with specific exposures that have happened in the past, are currently occurring, or are believed to be possible in the future based on current site conditions. The HACE Program evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur in the future, reports any potential harmful effects, and then recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time this public health assessment was conducted and may not be applicable if site conditions or land uses change in the future.

For additional information or questions regarding the contents of this public health assessment or the MERA unit, please contact:

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# SUMMARY

**INTRODUCTION**

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

The U.S. Environmental Protection Agency (EPA) proposed to add approximately 80-acres identified as the former Wright Chemical Corporation (WCC) site (the "site") to the National Priorities List ("NPL, or the "Superfund" list) in March 2010. The site was added to the NPL in March 2011. The site is in a rural / industrial area of Columbus County, NC, on State Road 1878 near Riegelwood. The site includes a northern parcel that was the site of 2 former sulfuric acid manufacturing plants that operated from 1883 until 1991. The site also includes a southern parcel that was the location of a former phosphate fertilizer manufacturing plant. No structures remain on the southern parcel. A portion of the site lies adjacent to Livingston Creek and associated wetlands. Livingston Creek flows into the Cape Fear River. A portion of the area of the former sulfuric acid plants has no vegetation and has dis-colored soil.

Elevated concentrations of metals and pesticides believed to be associated with historical operations on the Wright Chemical Corporation facility were detected in 2007 in the soils in an 80-acre area and sediments of Livingston Creek downstream from the site. Elevated concentrations of metals were reported in 2004 in fish and clams collected in Livingston Creek downstream of the site, as well as 2-miles downstream, where Livingston Creek joins the Cape Fear River. Both downstream areas are identified as fisheries.

Initial investigations by the N.C. Department of Environment and Natural Resources (DENR) and EPA included the area of the former sulfuric acid plants. The EPA has expanded its investigations beyond the original study area to identify the full extent of contamination associated with historical chemical manufacturing operations. The NPL-related investigation currently includes the former Wright Chemical fertilizer and specialty chemical manufacturing operations and associated runoff areas (the wetlands).

**OVERVIEW**

**The DPH reached two important conclusions about the Wright Chemical Corporation site adjacent to Livingston Creek:**

**CONCLUSION 1**

**The DPH cannot currently conclude whether persons that inhale, accidently ingest, or have direct contact with soils or sediments on the site could have been harmed in the past, or could now be harmed. The available environmental data is not adequate to make such a determination.**

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| **BASIS FOR DECISION** | Environmental investigations of the historical sulfuric acid manufacturing area have been limited to 3 soil samples collected in 2007. This data is not adequate to identify potential current health hazards and provides no information for past hazards. In addition, there are a number of other historical industrial operations in the area that could contribute to environmental exposures. This health assessment is not intended to identify exposures associated with these other operations. |
| **CONCLUSION 2** | **The DPH concludes that levels of mercury identified in fish are at levels that could cause adverse health effects to persons, especially women and children, eating meals of certain types of fish more frequently than recommended in existing N.C. fish consumption advisories. The source of the mercury in the fish is not known and has not been linked to the Wright Chemical Corp. NPL site.** |
| **BASIS FOR DECISION** | High levels of mercury were found in fish collected in 1994 through 2008 downstream of the 80-acre site in Livingston Creek and in nearby locations on the Cape Fear River. The level of mercury found in several species was greater than the level of concern identified by DPH. Persons that do not follow current recommendations, or that in the past consumed species that may have been contaminated before testing was done and advisories were developed, may have been exposed to levels of mercury that could cause harm. |
| **NEXT STEPS** | The DPH makes the following recommendations:<br>▪ EPA or N.C. DENR should perform a comprehensive analytical evaluation of surface soils (0 to 3 inches) on the 80-acre area and potential impacts to Livingston Creek and the associated wetland sediments relevant to human ingestion, inhalation and dermal exposures. Recommended analyses include: metals, volatile and semi-volatile organic compounds, pesticides and their degradation products, PCBs and Tentatively Identified (organic) Compounds (TICs). Investigations should include characterization of surface water and sediment samples (same analytical scans as for soil) collected immediately adjacent to the site in Livingston Creek and nearby wetlands to determine if site run-off or groundwater discharge is resulting in contaminant concentrations in surface water at potentially harmful concentrations.<br>▪ Current site owners or responsible parties should take measures to discourage access to the site. Measures could include posting "warning" or "no trespassing" signs, or fencing the area. DPH can assist with developing the language for signs.<br>▪ Persons that do come into contact with contaminated soils or sediments should, as soon as possible, remove soiled clothing and wash areas of skin that were in contact with soiled clothing or contaminated soils or sediments. Inhalation of dust generated from site soils should be avoided because site contaminants may be present and could be respiratory irritants. |

- EPA, DENR, or site owners should monitor groundwater contaminant levels where it discharges to Livingston Creek from under the site for exceedances of health screening values.
- A focused educational effort involving DPH, county health departments, and local health care providers about existing fish consumption advisories and the health effects of ingesting fish high in mercury will be made in the surrounding counties. Special attention should be given to inform mercury-sensitive populations (women between 15 and 44 years of age and children under the age of 15 years).
- DPH recommends similar consumption advice for freshwater shell fish (clams, crabs) collected in the area as recommended for fish tissue [*www.epi.state.nc.us/epi/fish/current.html* or *www.ncwildlife.org/Regs/Regs_Fishing.htm*]. For fish advisories, DPH considers 6 ounces of un-cooked fish as a meal, and a similar meal size would be protective for persons eating freshwater shell fish. If followed, DPH's fish consumption advisory for mercury will provide adequate protection for the other contaminants found in fish above the DPH or EPA action levels.
- DENR or EPA should collect finfish and shellfish in downstream waters that are judged as potentially impacted by run-off from the Wright Chemical NPL site and that are identified as common fishing areas. Continue to monitor fin fish and shellfish in identified fisheries in the area that may be impacted by other past and current industrial operations. DPH will continue to monitor fish tissue data collected by N.C. DENR or other organizations for potential public health impacts and will issue fish consumption advisories as necessary.
- DPH, Columbus County Health Department, and local health care providers should make available information to assist persons concerned about their intake of mercury from fish or shellfish and how it may impact their health.
- Well water near the historical spray irrigation fields as well as terrestrial and aquatic animals (or suitable surrogate organisms) should be tested for site-related contaminants and their degradation products. Community meetings and interviews with community members revealed concerns regarding potential exposures from these sources.
- As EPA, DENR, and DPH continue their investigations of this site and beyond the original 80-acre area and new data become available, the potential impacts of environmental exposures from these and other current and historical manufacturing operations in the vicinity should be included in the health considerations.
- Health impacts associated with combined exposures from multiple sources should be considered in evaluations of potential long-term health issues to this community.

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| | ▪ DPH will continue to evaluate health relevant data collected at this site and nearby sites and communicate findings to the community, the County, DENR and EPA. |
| **FOR MORE INFORMATION** | If you have concerns about your health as it relates to this site you should contact your health care provider. You can also call the N.C. Division of Public Health at (919) 707-5900, or send an e-mail to nchace@dhhs.nc.gov, and ask for information on the Wright Chemical Corporation NPL Site Adjacent to Livingston Creek Public Health Assessment. |

# PURPOSE AND HEALTH ISSUES

The Wright Chemical Corporation NPL site is located on State Road 1878, near Riegelwood, Columbus County, North Carolina (zip code 28456). In March 2010 the U.S. Environmental Protection Agency (EPA) proposed adding the site to the National Priorities List (NPL or "Superfund", EPA site ID: NCD024766719). The site was added to the NPL in March 2011. The site is the former Wright Chemical Corporation facility and its historic operations, including 2 sulfuric acid manufacturing plants that operated from 1883 until 1991 and a southern portion that was the location of a former phosphate fertilizer manufacturing plant. The full extent of contamination from historic chemical manufacturing processes will be defined in future EPA investigations. Some areas of the former sulfuric acid plants have no vegetation and have discolored soil. This area lies next to Livingston Creek and associated wetlands. Livingston Creek flows into the Cape Fear River.

The National Priorities List (NPL or "Superfund") is a federal program to clean-up abandoned hazardous waste sites that threaten to harm the environment or people. The program is administered through the U.S. Environmental Protection Agency (EPA). Superfund also authorizes the Agency for Toxic Substances and Disease Registry (ATSDR), a federal agency under the U.S. Department of Health and Human Services (U.S. DHHS), to evaluate public health impacts associated with Superfund and other releases of harmful substances to the environment. In North Carolina, ATSDR investigations of NPL sites are conducted through a cooperative agreement program with the N.C. DPH, under the Health Assessment, Consultation and Education (HACE) program (www.epi.state.nc.us/epi/oee/hace.html).

The objective of the N.C. Division of Public Health's (DPH) Public Health Assessment is to determine if the Wright Chemical Corporation NPL site presents a health hazard to the community and to identify and coordinate the implementation of actions to minimize exposures and protect public health. The Public Health Assessment was initiated in response to the site being proposed to the NPL. In a Public Health Assessment, concentrations of substances contaminating a site in the soil, groundwater, surface water, sediment, drinking water, air and biota are evaluated. An important component of a Public Health Assessment is the determination of a person's possibility to come into contact with any potentially harmful substances, how that contact may occur, and for how long that contact may have occurred in the past, or may occur in the future. This information is used to determine whether past, current, or future contact with the contamination may result in adverse (negative) health effects. To optimize the probability of identifying the potential for negative health effects and being protective of sensitive populations, highly health protective methods and values are used by DPH throughout the health assessment process.

The DPH evaluated all available analytical data and site investigations gathered by other organizations and their contractors, including the N.C. Department of the Environment and Natural Resources (DENR), the U.S. Environmental Protection Agency (EPA), and site owners and operators available at the time of the report. This information included a very limited number of soil, sediment, groundwater, surface water, and fish tissue analytical data for samples collected from 1984 through 2008. The DPH also evaluated fish and shellfish tissue data

collected in 2003-04 for a University of North Carolina-Wilmington (UNC-W) study of the Lower Cape Fear River system. DPH has concluded that the available environmental data is not adequate to fully characterize the potential health hazards associated with the site.

# BACKGROUND

## SITE DESCRIPTION AND HISTORY

The Wright Chemical Corporation site is located in a rural / industrial area of Columbus County, near Riegelwood, NC, sitting adjacent to tidal wetlands along Livingston Creek (see Appendix A, Figure 1). Livingston Creek flows to the north and winds approximately 3 miles through extensive wetlands north to the Cape Fear River [HRS 2010]. The addition of the site to the NPL is related to releases from a former sulfuric acid manufacturing operation [HRS 2010].

The Wright Chemical Corp. NPL site (WCC) consists, generally, of the former Wright Chemical Corporation fertilizer, sulfuric acid, and specialty chemical manufacturing operations, along with the areal extent of contamination. The site is part of a larger property consisting of approximately 760 acres with a regional rail corridor running through it. The portion of the site that lies north of the rail corridor contains two former sulfuric acid manufacturing plants, an acid equalization pond, approximately four wastewater impoundments (the spill basin, aeration pond, resin pond, and outfall pond), two spray irrigation fields (10 and 20 acres), the "monofill" waste pile, and three lined wastewater lagoons (known as the "Kelly ponds"). The portion of the site that lies south of the rail corridor was the site of a former acid phosphate fertilizer manufacturing plant.

Acme Fertilizer Company owned and operated both the sulfuric acid manufacturing plant north of the rail corridor and the acid phosphate fertilizer plant south of the rail corridor from the 1880s to the 1960s. Wright Chemical Corporation, n/k/a William Gilchrist Wright Properties, Inc. took over operation of the northern sulfuric acid plant in 1959 and subsequently constructed a second sulfuric acid plant approximately 300 feet to the east. The second sulfuric acid plant reportedly operated until 1991. Wright Chemical Corp. constructed additional facilities on the northern portion of the site to manufacture specialty chemicals, including formaldehyde, hexamine and chloropicrin. Kaiser Aluminum and Chemical Corporation (Kaiser) took over operations on the southern plant from the 1960's through the early 1980's. In 1968 Wright Chemical Corp. merged with Acme and became owner and operator of the site to the south of the rail corridor.

In 1990 the Wright Chemical Corp. purchased Silar Labs LLC (Silar) and built the Silar Lab facility in 1993 in the northeast corner of the manufacturing area (see Appendix A, Figure 2). Koch Sulfur Products Company leased a portion of the site facility during the 1990s. In November 2004, Oak Bark Chemical Corporation acquired all of the Wright Chemical Corp. property. In November 2006, Hexion Specialty Chemicals, Inc. acquired a 20-acre portion of the site which included the formaldehyde, hexamine and resin manufacturing operations. In the purchase agreement, Oak Bark retained responsibility for historical environmental issues that occurred on the property. In October 2010, Hexion changed its name to Momentive Specialty Chemicals Inc. (Momentive). Oak Bark continues to own the land that includes the wastewater lagoons and sludge de-watering area to the north and east of Momentive's operations. In addition, Oak Bark operates a manufacturing facility on its property west of Momentive's

operations. In April 2009 Oak Bark sold the Silar operation to MPD Holdings. Oak Bark retains ownership of the 6.5 acre Silar property located northeast of the Momentive operations (see Appendix A, Figure 2) [EPA 2012, MSC 2012, SL 2012].

The WCC site NPL listing is a result of soil contamination and release of contaminants from the former sulfuric acid plants area into the sediment of the wetlands and Livingston Creek [ESI 2008]. Some areas of the site are characterized by a lack of vegetation and magenta / purple colored soil that is characteristic of high levels of lead and arsenic, the primary contaminants identified in the soil. Other metals, inorganic chemicals, and low levels of several pesticides have also been observed in soil samples collected in 2007 from the parcel. Elevated levels of metals have been observed in the adjacent and downstream sediments. The source of the contamination is stated to have been the former Acme Fertilizer Co. "lead-chamber" sulfuric acid plant that began operation on the parcel in 1883 and continued until 1991 [HRS 2010].

The site is accessible from Livingston Creek, but no signs of trespassing were noted by the N.C. Department of Environment and Natural Resources (DENR) in their 2010 site report [HRS 2010], or during DPH's site visit in June 2011. Livingston Creek and the Cape Fear River are designated fisheries with documented consumption of fish caught in the local waters [HRS 2010, ESI 2008]. DENR has documented releases of elevated levels of the metals arsenic, barium, cadmium, copper, lead and zinc, and the pesticides 4,4'-DDD, dieldrin and gamma-chlordane into the sediment of Livingston Creek [ESI 2008]. A clam and fish tissue study was conducted by the University of North Carolina-Wilmington's Center for Marine Science (UNCW) in 2003-04. Samples were collected in Livingston Creek near the Cape Fear River. UNCW reported arsenic, cadmium, mercury, selenium and dieldrin in tissue samples at levels of potential harm if ingested [UNCW 2011].

The nearby former Kaiser Farmmarket facility (NCD980557847) south of the rail corridor was associated with pesticide retail sales (see Appendix A, Figure 3). There is no history of metals contamination on this site [HRS 2010]. There are 2 nearby large industrial facilities down gradient of the site – International Paper and Holtrachem. A 978-acre International Paper (Federal Paper Board Co., Inc.) facility is located north of the site, across Livingston Creek and bordering the Cape Fear River. EPA references note Livingston Creek downstream of the WCC site may be impacted by potential seeps from International Paper-associated landfills [ESI 2008]. Also adjacent to International Paper and the Cape Fear River is the former mercury cell chlor-alkali Holtrachem facility (aka: LCP Chemicals, Honeywell, Allied Signal) currently owned by Honeywell International [ESI 2008].

In 1984, the EPA investigated groundwaters associated with the former Kaiser Fertilizer Plant (NCD 980 842 470), a former fertilizer manufacturing facility. EPA identified low-level contamination by arsenic, cadmium, copper, lead and zinc. The former fertilizer plant is associated with the Wright Chemical Corporation and constitutes the 38 acre southern parcel of the WCC site.

EPA completed a Preliminary Assessment (PA) in 1986 and a Screening Site Inspection (SSI) in 1989 at the WCC site. The SSI identified elevated levels of metals and pesticides in surface soils, groundwater, and impoundment pond sediments on the WCC facility. The SSI also noted elevated levels of copper, lead and several pesticides in Livingston Creek sediments. A December 1989 spill of 2,200 gallons of sulfuric acid resulted in acidic run-off to Livingston

Creek for several days. There are documented spills and un-permitted discharges to Livingston Creek that included formaldehyde and other chemicals. Elevated lead and arsenic levels were identified in un-permitted surface water discharges to Livingston Creek observed at the time by DENR. In the early 1990s the surface water impoundments were closed. A 2002 DENR Site Screening report identified the old acid manufacturing plant as a likely source of metals contamination and recommended further sampling [ESI 2008]. A 2005 Site Reassessment (SRR) prepared by NCDENR for the EPA recommended further investigation. Since 1997, Oak Bark has conducted a voluntary site remediation using "monitored natural attenuation" (MNA) to reduce concentrations of organic and inorganic contaminants in groundwater on the site. Elevated sulfate, iron and TDS (total dissolved solids) were identified in the groundwater, but determined to not be impacting Livingston Creek. In 2000, elevated ammonia and low pH were identified in the groundwater. A 2002 DENR Site Screening report identified the old acid manufacturing plant as a likely source of metals contamination and recommended further sampling [ESI 2008].

In 2007 DENR collected surface soil and sediment samples for an Expanded Site Inspection (ESI). Three soil samples were collected in the area of the former lead chamber sulfuric acid plant and sediment samples were collected up-gradient and down gradient from the 80-acre area. Elevated levels of metals and pesticides were identified. The ESI recommended further investigation [ESI 2008].

Groundwater data provided by Oak Bark in 2009 indicates groundwater contamination on the portion of the site north of rail corridor with ammonia, sulfate, nitrate, lead, arsenic, formaldehyde and methanol [EPA 2012].

## CURRENT SITE CONDITIONS

There are no structures remaining in the 80-acre area originally cited in the NPL listing, which included the area of the former sulfuric acid plants north of the rail corridor and the fertilizer manufacturing plant south of the rail corridor. These areas are currently owned by Oak Bark Corp. Large areas of the original 80-acre NPL parcel have no vegetation, likely due to the metals and acid contamination. The area is accessible from Livingston Creek, but DENR has noted they saw no indication that persons ("trespassers") had accessed the area [HRS 2010] and DPH did not see evidence of trespassing during our site visit in June 2011. Overland run-off from the former sulfuric acid plants north of the rail corridor or fertilizer manufacturing plant south of the rail corridor is not controlled and flows to Livingston Creek and its wetlands bordering the area to the west and northwest. The extent of the area ultimately included as the NPL siting continues to evolve as the full extent of the contamination is defined by EPA and DENR.

The 20-acre Momentive and Silar manufacturing facilities are adjacent to the former sulfuric acid plants area. The Momentive and Silar operations are enclosed by a chain link fence. The access gate to the facilities remains closed at all times to control access to the site.

## DEMOGRAPHICS

According to the EPA's Environmental Justice View tool, 36 residents live within ½-mile of the Wright Chemical Corporation NPL site. The ½-mile radius is sparsely populated with a population density of approximately 14 households in 48 square miles. Seventy-nine percent own their home, while 21% rent. Eighty-one percent of the population is White and 18% is African-American. Six percent of the population is below the poverty level. Four percent of the population speaks a language other than English. Five percent of the population is five years of age or younger, 18% is 17 years and younger, 82% is 18 years and older, and 11% is 65 years and older. Two percent of the population has a $9^{th}$ grade education or less, 17% have $9^{th}$-$12^{th}$ grade, 50% have a high school diploma, 27% have some college, and 4% have a college degree or more.

## SITE GEOLOGY AND HYDROGEOLOGY

Groundwater under the site is shallow (13 to 27 feet below the surface) and found in predominantly sandy soils near the surface. Deeper soils (to 1000 feet) include sandy sediments containing the deeper groundwater, and clay and sedimentary rock layers over bed rock. Site geological and hydrogeological descriptions provided in the site investigative reports follow.

There are no downstream surface water intakes for drinking water supplies within 15-miles of the site. Groundwater from the WCC site flows west toward the adjacent Livingston Creek and wetlands. There are no groundwater wells for drinking purposes that can be impacted by groundwater contamination from the site [HRS 2010].

The site is located in the Atlantic Coastal Plain region, and is underlain by a 1,000-foot thick sequence of unconsolidated sedimentary rocks resting on crystalline bedrock. The principal hydrogeologic unit beneath the site consists of sandy sediments of the Penholoway Formation, which contains the surficial aquifer. The underlying Peedee Formation contains clay rich strata, which regionally isolates the surficial aquifer from other water-bearing units. An irregular erosional surface separates the Penholoway and Peedee Formations. Red and black peat has been noted by well drillers near the site at Livingston Creek. A 1997 water table map indicated the depth to groundwater was approximately 26 - 27 feet below land surface near the railroad tracks and 13.6 feet near the former acid chambers [ESI 2008].

## SITE VISIT

DPH staff visited the Wright Chemical Corporation NPL site location on August 9, 2010, and on June 1, 2011. The June 1, 2011 site visit included a walking tour of the site with U.S. EPA, N.C. DENR, and representatives of the Momentive, Oak Bark and Silar facilities. The area immediately adjacent to the site is mostly industrial. Current chemical manufacturing operations (Momentive and Silar) are fenced and access is through a locked gate. The only direct access to the former sulfuric acid manufacturing area designated as the NPL area is from the wetlands and Livingston Creek. The area surrounding the site is mostly rural, with residential properties sparsely located throughout. Single family homes, farm houses and horse stables were observed in the community. The 2011 visit included the location of two wastewater treatment lagoons (the "Kelly ponds") located remote from the WCC NPL site, approximately 1 mile to the

north/northeast accessed off of Neils Eddy Road. The lagoons were accessed through 2 locked gates off of a private, un-paved drive. Between the road and the 2 lagoons there is a recreational property that includes a small pond and shelter that was identified as often rented for weddings and other gatherings. Pictures taken during the 2011 site visit are included in Appendix E.

There was no evidence of trespassers accessing the site during the June 2011 site visit. DENR personnel noted they had not seen evidence of trespassers in previous visits to the site. Access to the site that is outside the fenced area of the current manufacturing facility would be very difficult, requiring traveling through native shrubs and high grasses and several fences. Navigation on Livingston or Mill Creek would be treacherous because of their width and depth, their meandering pathways, and numerous "snags" in the creek. The wetlands are densely overgrown with high grasses and shrubs. Accessing the area for fishing would be unlikely due to the numerous other locations in the area that are easier to reach and would likely be more productive fishing spots. There two small areas (each estimated at 150 $ft^2$) near the unpaved road that run east of the manufacturing facility and lead to Livingston Creek that is not covered by vegetation, providing direct access to contaminated soils. Again, these are not areas that can be easily reached by, or would likely be attractive to "trespassers".

# DISCUSSION

## THE ATSDR HEALTH EFFECTS EVALUATION PROCESS

This section provides an outline of the N.C. DPH and ATSDR health effects evaluation process. A more detailed discussion is provided in Appendix F.

The health effects evaluation process consists of two stages. The first stage involves gathering and reviewing available environmental monitoring data and evaluation of how the community may come into contact with the identified substances. The second stage involves a more in-depth evaluation to determine possible public health implications of site-specific exposure conditions.

The first stage involves determining which substances ("contaminants") a person may come into contact with and how that contact may occur. This "screening analysis" provides a consistent means to identify site contaminants to be further evaluated for potential negative health effects. The screening analysis is the "environmental guideline comparison" which involves comparing site contaminant concentrations to water, soil, air, or food chain "comparison values". Comparison values (CVs) are developed by ATSDR as chemical concentrations in water, soil, or air. Generally, the highest concentration of a chemical found in a particular sample type (water, soil, air) is compared to a chemical's CV to provide a highly health protective "worst-case" exposure estimate. The average concentration for chemicals found in more than one sample of a particular type may also be compared to CVs to provide an average exposure estimate. ATSDR's comparison values are set at levels that are highly health protective, well below levels known or anticipated to result in adverse health effects. Contaminant concentrations at or below the CV may reasonably be considered safe and require no additional evaluation. When chemicals are found on a site at concentrations greater than the comparison values it does not mean that adverse health effects would be expected, but it does identify that a more in-depth evaluation is warranted.

The second stage of the process is the "health guideline comparison" and involves looking more closely at site-specific exposure conditions, estimating exposure doses, and comparing the exposure dose estimate to dose-based health-effect comparison values. Contaminants exceeding CVs are selected for a more in-depth site-specific analysis to evaluate the likelihood of possible harmful health effects by comparing an estimated exposure dose against ATSDR health guidelines (Minimal Risk Levels or MRLs). If MRLs are not available, other agency guidelines are used such as EPA Reference Doses (RfDs) or Reference Concentrations (RfCs). An exposure dose is an estimate of the amount of a substance a person may come into contact with in the environment during a specific time period, expressed relative to body weight. MRL values represent daily human exposure levels to a substance that is likely to be without appreciable risk of adverse health effects during specified exposure duration. EPA reference values (RfDs and RfCs) represent daily lifetime dose of a substance that is unlikely to cause harm. RfDs are for oral or ingestion exposures and RfCs are for inhalation/breathing exposures. Factors included in determining exposure dose estimates include the concentration of the chemical, the duration of exposure, the frequency of the exposure and the route of exposure. To determine exposure dose when site-specific information is not available, DPH uses standard assumptions about typical body weights, ingestion or inhalation rates, and duration of exposure. Highly health protective site-specific dose estimates are developed for both children and adults. These values are then compared to ATSDR or other agency health guideline values.

To determine if adverse (negative) health effects are indicated for the calculated site-specific doses for children and adults, these values are compared to data collected in animal and human health effect studies for the chemicals of concern. The health study data is generally taken from ATSDR or EPA references that summarize laboratory and work-place studies that have undergone extensive validation review. Comparisons are made on the basis of the exposure route (ingestion/eating, inhalation/breathing, or dermal/skin contact) and the length of the exposure. Preference is given to human study data and chemical doses or concentrations where no adverse health effects were observed. If human data or no-adverse-effect data is not available, animal data or the lowest chemical dose where adverse health effects were observed, may be used.

There are limitations inherent to the public health assessment process. These include the availability of environmental contaminant concentration data collected for a site, the type and quantity of health effect study information, and the risk estimation process itself. To overcome some of these limitations, highly health protective (i.e., "worst-case") exposure assumptions are used to evaluate site data and interpret the potential for adverse health effects. ATSDR CVs and MRLs incorporate large margins-of-safety to protect groups of the exposed population that may be particularly sensitive, such as children, the elderly, or persons with impaired immune response. Large margins-of-safety are also employed when comparing exposure dose to health effect study data. The objective of the assumptions, interpretations and recommendations in this public health assessment is to provide a realistic, reasonable, site-specific, scientifically valid assessment of the potential for adverse health effects to known or suspected populations. The lack of environmental data is a significant limitation for this assessment.

## REVIEW OF SITE ENVIRONMENTAL DATA

DPH reviewed all available relevant analytical data generated by DENR, EPA, past and present property owners, or their contractors. Data sets discussed in this PHA include:

- Surface soils collected in 2007 from the 38-acre northern area of the NPL site
- Livingston Creek sediment collected in 2007 downstream of the site
- Livingston Creek fish tissue data collected downstream of the site from 1994 through 2008

***Soils Collected from the 38-Acre Northern Portion of the NPL Site –*** Three soil samples (0 to 2 feet below ground surface) were collected by DENR in the area of the former sulfuric acid production on the northern 38-acre area of the NPL site in April 2007. One background sample was collected from nearby soils outside of the area of the contamination investigation. All 4 soils were analyzed for 22 metals, cyanide, and 21 pesticides or pesticide degradation products. Sample locations are identified in Appendix A, Figure 4 (green squares). The 3 samples collected in the 38-acre area are numbers 11, 12, and 13. The background soil is number 14. The DPH considers "surface" soils most appropriate for human exposure considerations to be those collected from 0 to 3 inches below ground surface. Since no "surface" soil samples were collected for this site, the above samples were considered for the human health evaluation.

***Sediments Immediately Adjacent to the 38-Acre Area –*** Only sediments immediately adjacent to the 38-acre area of contaminated soils were evaluated for potential health effects. It was anticipated that persons would come into contact with sediments in this area while accessing the site from a boat. One sediment sample was collected in duplicate at this location by DENR in 2007 (sediment sample location number 3 identified on Appendix A, Figure 4, pink triangle). This location was identified as the "release" area from the site into the wetlands. The sediment was analyzed for 22 metals, cyanide, and 21 pesticides or pesticide degradation products.

***Surface Waters of Livingston Creek –*** Four Livingston Creek surface water samples were reported in April 1990. Maps and specific sample locations or date of collection are not available for these samples. Three samples are identified as collected at Wright Chemical, and upstream and downstream (of Wright Chemical). The fourth sample was identified as Livingston Creek at the Cape Fear River. The surface water samples were analyzed for inorganic chemicals including water quality parameters, metals, semi-volatile organic compounds and pesticides. Eight metals and 5 organic compounds, including 2 pesticides, were detected in the 3 Livingston Creek surface water samples collected downstream from WCC in the 1990 samples [ESI 2008].

In March 1997, Livingston Creek surface waters were collected to determine surface water quality. Three samples were collected in the area of WCC and 4 were collected downstream of the site prior to Livingston Creek joining the Cape Fear River. Sample analyses included general water quality parameters and did not include metals or organic chemical analyses. As a result, the data does not provide information pertinent to this human health evaluation.

***Groundwater Discharging to Livingston Creek –*** There have been 3 groundwater investigations undertaken for the WCC manufacturing facility (1989, 1996, 1997). There was also a 1984 groundwater study conducted on the former Kaiser Agricultural Chemical site to the south/southeast of the WCC site. The 1996 and 1997 samples were analyzed only for inorganic substances (dissolved solids, sulfate, and nitrogen species) and were not relevant to the human health evaluation.

Shallow groundwater under the WCC facility flows toward Livingston Creek and the associated wetlands. Groundwater in the area of the former Kaiser facility also flows toward the WCC facility and Livingston Creek. For this health evaluation, only the 3 groundwater samples collected in 1989 adjacent to the WCC site are considered. These samples were considered to best represent what groundwater may discharge to Livingston Creek and the wetlands and present a potential exposure source for persons with access to Livingston Creek. The three 1989 samples were analyzed for metals, volatile and semi-volatile organic compounds.

There were a total of 18 metals, 10 volatile organic compounds, and 23 semi-volatile organic compounds detected in the 3 samples collected in 1989. There were also 28 organic compounds reported with identifications and concentrations that could not be confirmed and were considered "suspect" identifications [ESI 2008, HRS 2010]. Five of the volatile organics compounds and 13 of the semi-volatile organic compounds were reported as estimated concentrations.

***Fin Fish and Shellfish Collected in Livingston Creek Downstream from the WCC site*** – In 1994 DENR collected 15 samples of 5 species of fish from the Cape Fear River at Neils Eddy Landing. The data set included 6 largemouth bass samples analyzed for 8 metals, including mercury. The other samples were analyzed only for mercury. Neils Eddy Landing is downstream of the confluence of Livingston Creek with the Cape Fear River. In 2008, DENR collected 11 total samples of 3 species of fish in the Cape Fear River at the mouth of Livingston Creek. North Carolina analyzes fish fillets (rather than whole fish) to best simulate the portion of the fish people eat [DENR Fish 2011].

From 1998 through 2003 DENR collected a total of 62 fish samples, including 11 different species, in the Cape Fear River near Riegelwood. All were analyzed for 8 metals, including mercury. This collection location is upstream of Livingston Creek but was considered in this study to provide a comprehensive evaluation of potential human health issues for persons frequenting the area in recreational activities.

The University of North Carolina - Wilmington (UNCW) collected 2 bowfin (blackfish) and 2 clam samples from Livingston Creek at the confluence with the Cape Fear River in 2003-04. Bowfin liver and fillets and clam tissue were analyzed for 9 metals (mercury, arsenic, cadmium selenium, chromium, copper, nickel, lead and zinc), total PCBs, total PAHs, total DDT, dieldrin and Lindane. Data was reported as the average of the 2 samples [UNCW 2011]. The bowfin fillet and clam tissue data were evaluated for the purposes of this health evaluation.

Sample locations are identified on Appendix A, Figure 5.

## EXPOSURE PATHWAY ANALYSIS

An exposure to a chemical and the possibility of adverse health effects requires persons come into contact with the chemical through:

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

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

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

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

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

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

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

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

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

- an **exposed population** of persons that can come into contact with the contaminants

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

## SUMMARY OF ENVIRONMENTAL EXPOSURE POTENTIAL AT THE SITE

The population of concern for the WCC site includes persons that may come into contact with:

- contaminated surface soils on the site
- contaminated Livingston Creek / wetlands sediments adjacent to the site
- contaminated shellfish or fish tissue taken from Livingston Creek downstream of the site

Children and adults, involved in "recreational" or "trespassing" activities may come into contact with the site soils and sediments. Access to the contaminated area, or the adjacent impacted sediments or biota, for activities such as fishing or hunting is assumed to be infrequent. Exposure pathways identified for the WCC site and the status of those pathways are summarized below.

**Completed** human exposure pathways for the site include:

1. **Fin fish and shellfish** – Exposure to persons catching and ingesting (eating) fish caught in the vicinity of the site. Contaminant run-off from the site toward Livingston Creek and the wetlands has been documented. Livingston Creek and the Cape Fear Rivers downstream of the site are identified as "fisheries" by DENR. DENR noted brim, catfish and bass were caught and consumed from the creek [ESI 2008].

**Potential** human exposure pathways for the site include:

1. **On-site surface soils** - Exposure to persons trespassing on the site might occur by accidental ingestion of surface soil, inhalation of soil particles suspended in the air, or direct skin contact with the contaminated soils. N.C. DPH saw no evidence of trespassing on the site during our site visit in June 2011.
2. **Off-site sediments** - Exposure to persons accessing Livingston Creek adjacent to the site might occur by direct skin contact with contaminated sediments.
3. **Off-site surface water** – Persons could be exposed to surface waters of Livingston Creek or the wetlands during recreational activities, such as fishing. This exposure could be through incidental ingestion or direct (dermal) contact.

4. **On-site groundwater** – Persons could be exposed to contaminated groundwater flowing under the site and discharging to Livingston Creek adjacent to the site through incidental ingestion and direct (dermal) contact. Site investigation documents from 1989 indicate that contaminated groundwater beneath the site had not reached the wetlands or Livingston Creek. It is not known for certain that contaminated groundwater will reach the adjacent surface waters in the future.

**Eliminated** human exposure pathways for the site include:

1. **Off-site groundwater** – There are no private drinking water wells in the area that are being impacted by the contaminated groundwater flowing away from the site.
2. **Off-site soils** – Because of the location of the NPL site adjacent to the wetlands and Livingston Creek there are no off-site soils for consideration.

## SITE-SPECIFIC EXPOSURE CONDITIONS USED FOR HEALTH EVALUATIONS

Site-specific exposure scenarios were developed to estimate how much contact persons may have with the contaminated media (soil, sediment, surface water). These included health-protective estimates of potential exposure scenarios for persons participating in recreational activities near the site (the "recreational" scenario) such as fishing on Livingston Creek. For the purposes of this public health evaluation, it was assumed that these persons ("trespassers") would have access to the contaminated soils associated with the former sulfuric acid plant on the northern portion of the site that lies adjacent to Livingston Creek. Both adults and children (identified as 1 to 6 years old) were included in the potentially exposed populations. The 1-6 year old child scenario was selected for evaluation because it represents the maximum dose relative to body weight for non-adults.

To be health protective, the highest concentration of each individual contaminant detected in each type of environmental media (soil, surface water, sediment) was used in calculation of site-specific estimates of potential exposure dose. Detailed descriptions of the exposure dose calculation methods are provided in Appendix F.

Contaminants detected in the 3 soil samples collected in 2007 were evaluated for possible adverse health effects resulting from an un-intentional ingestion (eating) exposure to the site soils or sediments, such as may occur by hand-to-mouth activity. Livingston Creek sediments immediately adjacent to the NPL site were considered for this health evaluation. Other down stream sediments were not considered to have potential for contact based on the size of Livingston Creek. In the area of the site and downstream, Livingston Creek is typically 29 feet wide and 3 feet deep [ESI 2008]. The screening levels were adjusted for the "recreational angler / trespasser" exposure frequency. The exposure parameters for the recreational angler / trespasser scenario (Appendix C, Tables 2 and 3) were used to calculate site-specific comparison values for children and adults. The site-specific comparison values were adjusted by the site-specific exposure factor parameter in the estimated dose calculation, and compared to the maximum contaminant concentrations in media to identify contaminants requiring additional investigation.

Contaminant concentrations identified in the 3 soil samples collected in 2007 from the northern portion of the site were also compared to EPA's Regional Screening Levels for adverse effects

associated with direct skin (dermal) contact [EPA RSL 2010]. The screening levels were adjusted for the "recreational angler / trespasser" exposure frequency.

U.S. EPA [EPA EFH 2009] and U.S. Fish and Wildlife Service (USFWS) [USFWS 2006] information was used to develop estimates of the frequency of fishing activity anticipated for persons in the vicinity of the site. These sources indicate that the average number of days spent fishing per year by all North Carolina anglers is 17. To be health protective, DPH doubled this to 34 days for site-specific exposure estimates. DPH also assumed that all the fish a person ate were only from this area. A list of the parameters used for the site-specific exposure calculations is included in Appendix C, Tables 2 and 3.

## EVALUATION OF POTENTIAL PUBLIC HEALTH ISSUES

The substances detected in environmental samples collected at the site are discussed below. The tables in Appendix C summarize important study information. The tables include a summary of substances detected in site samples (Table 1) and the health protective factors selected to identify how much contact persons may have with the site contaminants without an expectation of harm (Tables 2 and 3). Additional tables list mercury concentrations detected in fish collected in waters near the site (Table 4).

***Soils Collected from the 38-Acre Northern Portion of the NPL Site –*** Three soils (collected from 0-2 feet below ground surface) were collected in the northern site area in 2007. Fourteen metals were detected in each of the 3 contaminated area surface soils, and 9 were detected in the background soil. Three pesticides (DDT, dieldrin and gamma-chlordane) were detected in one of the samples (sample WC-012-SS, see Appendix A, Figure 1); no pesticides were detected in the other two samples. All detected substances were at concentrations greater than the range of the expected background levels. Six metals (antimony, arsenic, cadmium, copper, iron, lead) were detected at concentrations greater than health comparison values. EPA Region four's current industrial soil screening level was selected as a comparison value for this site. ATSDR has not developed a lead comparison value. Recent studies have indicated that current lead screening levels used for health effect evaluations may not be adequately protective, especially for children who are more sensitive to the effects of lead than adults. Based on the Centers for Disease Control and Prevention's (CDC) recommendation current screening and health values for lead are being re-evaluated. Currently, the best approach to determining lead exposure levels is with blood lead testing, however; for the circumstances at this site, DPH considers the use of EPA's industrial screening level most appropriate for this site. The potential for persons ("trespassers") to access this area, especially children, is extremely limited. While the soil lead concentrations exceed the EPA industrial screening value DPH does not consider the soils to present an ingestion risk. Site-specific exposure dose estimates for the other 5 metals that exceeded comparison values were less than ATSDR health guideline values. Arsenic was the only substance detected that is identified as a human carcinogen by ATSDR. A low increased cancer risk was estimated (8 additional cancers for 100,000 persons exposed). Adverse health effects are not indicated for persons that may on occasion inadvertently ingest small amounts of the surface soils during recreational activities under the projected frequency parameters.

Surface soil analytical data and comparison values are summarized in Appendix C Table 5, exposure dose estimates and health guideline values are summarized in Table 9, and increased cancer risk estimates in Table 12.

At the time of the assessment the only soil samples collected on the 80-acre NPL area were the 3 samples collected in 2007. This number of samples is not adequate to fully evaluate the area for potential health effects. Past concentrations of contaminants, or concentrations in other areas of the NPL site, may have been higher. The impact of past contaminant levels on the local community through potential contact with the contaminated soils is unknown. Because of the very limited sampling, the DPH recommends additional surface soil sampling (preferably 0-3 inches below ground surface) and analysis in this area to better evaluate the extent of the contamination and potential human health impacts associated with Livingston Creek, the wetlands and the local fisheries. Recommended soil analyses include metals, semi-volatile organic compounds, pesticides and pH. Analyses should include chemicals previously and presently manufactured on the site and their potential degradation products. Posting warning signs indicating the presence of environmental contamination and potential hazards are recommended to prevent persons from accessing the 80-acre area from Livingston Creek.

***Sediments Immediately Adjacent to the 38-Acre Northern Portion of the NPL Site –*** Only sediments immediately adjacent to the northern portion of the site were evaluated for potential health effects. It is anticipated that persons involved in recreational / trespassing activities may come into contact with sediments in this area while accessing the site from a boat or on foot. Because of the reported depth of Livingston Creek and the extensive wetlands, the potential to come into contact with downstream sediments is not considered a likely exposure pathway.

Two (arsenic and lead) of the 7 detected sediment metals were at concentrations exceeding ATSDR health comparison values for soil. There were no pesticides reported at concentrations greater than comparison values. Site-specific exposure dose estimates for arsenic were less than the ATSDR health guideline value. A very low increased cancer risk was estimated for arsenic (3 additional cancers for 1 million persons exposed). Lead is not considered a health risk based on the EPA industrial screening value 800 mg/kg, the dose estimate, and limited potential for exposure. Adverse health effects are not indicated for persons that may have on occasion inadvertently ingested small amounts of Livingston Creek sediments adjacent to the 38-acre area during recreational activities under the projected frequency parameters.

Livingston Creek sediment data and comparison values are summarized in Appendix C Table 6, exposure dose estimates and health guideline values are summarized in Table 11, and increased cancer risk estimates in Table 12.

The same uncertainties and unknowns influencing potential impacts to human health exist for the sediments associated with the 38-acre contaminated area as expressed above for the soils. An inadequate number of samples have been collected to characterize the sediments. Therefore, DPH also recommends additional sampling and analytical evaluation of the sediments adjacent to the 38-acre area and immediately downstream for human health monitoring purposes. Analyses should include the same scans recommended above for site soils.

***Surface Waters of Livingston Creek Immediately Downstream from the WCC site –*** Two organic compounds (formaldehyde and phenol) and the pesticide alpha-benzenehexachloride (or "alpha-BHC", also identified as alpha-hexachlorocyclohexane or "alpha-HCH"), were detected in the Livingston Creek surface water samples collected downstream from WCC NPL site in 1990 at concentrations greater than health comparison values. Site-specific exposure dose

estimates for all 3 substances were less than the ATSDR health guideline value. Alpha-BHC is identified as a probable human carcinogen. No increased cancer risk was indicated for alpha-BHC (less than 1 additional cancer for 1 million persons exposed). Adverse health effects are not indicated for persons that may have on occasion inadvertently ingested small volumes of the surface water during recreational activities under the projected frequency parameters.

Livingston Creek surface water data and comparison values are summarized in Appendix C Table 7, exposure dose estimates and health guideline values are summarized in Table 10, and increased cancer risk estimates in Table 12. Drinking water comparison values and health guideline values were used to assess possible surface water exposures.

There is little surface water data that has been collected that is applicable to determinations of potential human health impacts associated with the NPL site. Based on the chemical nature of the contaminants that have been identified on the site, the contaminants are not expected to be present in high enough concentrations in the surface water to result in adverse human health impacts. Yet, there is not enough information about past discharges from the site, historical WCC facility activities, or potential historical human exposure situations to these surface waters to know for certain. DPH recommends collection of surface water samples to characterize surface run-off (and groundwater discharge) into Livingston Creek immediately adjacent to the site.

***Groundwater Discharging to Livingston Creek Immediately Adjacent to the WCC site –*** Twelve metals and the organic chemical, benzene, were detected at concentrations greater than drinking water health comparison values in the samples collected in 1989. Site-specific exposure dose estimates for the 12 metals and benzene were less than ATSDR health guideline values. Arsenic and benzene are identified as probable human carcinogens. A moderate level of increased cancer risk is estimated for arsenic ingestion (6 additional cancers in 10,000 persons exposed).

No increased cancer risk was estimated for benzene (less than 1 additional cancer for 1 million persons exposed). The groundwater health risk estimates assume no dilution of the groundwater as it discharges to Livingston Creek. As a result, the potential health risks associated with incidental ingestion of the diluted groundwater would be much less than indicated by this analysis. Adverse health effects are not indicated for persons that may have inadvertently ingested small volumes of surface water mixed with shallow groundwater discharged from the direction of WCC during recreational activities under the projected exposure frequency parameters.

Groundwater data and comparison values are summarized in Appendix C Table 8, exposure dose estimates and health guideline values are summarized in Table 11, and increased cancer risk estimates in Table 12.

Evaluations of historical groundwater contaminant health impacts are uncertain. There is a lack of historical data regarding groundwater contaminant concentrations and human activities that may have put people into contact with contaminants in groundwater discharging into Livingston Creek and the wetlands. Since there are no well water intakes in the vicinity of the site, direct ingestion of significant volumes of contaminated groundwater emanating from the 80-acre site or the historical WCC operations are unlikely to have occurred.

***Direct Skin ("Dermal") Contact with Surface Soils on the Northern Portion of the WCC Site*** – Based on the 2007 analytical data, adverse health effects are not indicated for persons that occasionally come into contact with the surface soils on the 38-acre northern portion of the site during recreational activities under the projected frequency parameters. But, as noted above, the available data is not adequate to characterize the 80-acre area. The analytical data (pH measurements) are not available to make a determination, nor is there knowledge of under what circumstances people may have come into contact with the soils in the past on the site. It is reported that sulfuric acid spills moved across the area of concern and residuals may remain in the soil [ESI 2008].

The posting of warning signs along potential access points to the 80-acre area from Livingston Creek and the wetlands will increase awareness and reduce the potential for adverse health impacts related to direct contact with the soils. Washing the skin to eliminate prolonged contact with the soil will reduce the potential for skin irritations from acid residuals in the soil.

***Fin Fish and Shellfish Collected Downstream of the WCC site*** – Three of 3 bowfin (blackfish) and 2 of 6 largemouth bass collected by the DENR Division of Water Quality (DWQ) in 1994 from the Cape Fear River at Neils Eddy Landing had mercury levels greater than the N.C. DPH fish consumption advisory level (0.4 mg/kg mercury). Two of 3 channel catfish and 1 of 6 largemouth bass collected in 2008 by the DENR DWQ in the Caper Fear River at the mouth of Livingston Creek had mercury levels greater than the advisory level [DENR Fish 2011]. The average mercury value for the species of fish collected in 1994 were all less than the DPH's mercury fish consumption advisory level, except for the bowfins.

Twenty-seven of the 62 samples collected by the DENR from 1998 through 2003 in the Cape Fear River near Riegelwood, including 6 different species, had mercury concentrations greater than DPH's mercury fish consumption advisory level. All 6 bowfin and 5 of 6 largemouth bass collected in 1998 exceeded the mercury advisory level. Three of 3 largemouth bass collected in 2000, and 4 of 9 collected in 2001, exceeded the mercury advisory level. In each instance, the species average mercury level also exceeded the advisory level. None of the 13 largemouth bass samples collected in 2002 exceeded the advisory level.

The reported value for the bowfin fillets collected by UNCW in 2003-04 in Livingston Creek at the confluence with the Cape Fear River were greater than the DPH fish consumption advisory level for mercury. EPA health comparison values for fish tissue were exceeded for estimated inorganic arsenic levels in both the bowfin fillets and clams, as well as the pesticide dieldrin in the bowfin fillets [EPA RSL 2010].

Fish tissue data are summarized in Appendix C, Table 4.

DPH issued a state-wide bowfin (blackfish) consumption advisory for mercury in 1997. It advised no more than two meals per person per month, and children, pregnant women and women of childbearing age were advised not eat bowfin collected in North Carolina. Around 2001, DPH issued a statewide advisory for largemouth bass. Subsequently, the mercury advisory was expanded to identify fish low and high in mercury with consumption advisory levels for each. The current mercury advisory is:

**N.C. DPH's current mercury fish consumption advice for fish caught in N.C. waters.[1]**

| **Women 15 to 44 years, pregnant women, nursing mothers and children under age 15** | **All other persons** |
|---|---|
| Do not eat fish **HIGH** in mercury | Eat not more than 1 meal per week of fish **HIGH** in mercury |
| Eat up to 2 meals a week of fish **LOW** in mercury | Eat up to 4 meals a week of fish **LOW** in mercury |
| In addition: **Women 15 to 44 years, pregnant women, nursing mothers and children under age 15 should NOT EAT the following:** | |
| South and east of **I-85** | bowfin (blackfish), catfish, chain pickerel (jack fish), warmouth, yellow perch |
| South and east of **I-95** | black crappie |

[1]See Appendix D for complete current DPH mercury in fish recommendations, including fish species low and high in mercury. Source: web page: www.epi.state.nc.us/epi/fish/current.html

A copy of the DPH mercury in fish factsheet *What Fish Are Safe To Eat?* is included in Appendix D. The factsheet includes lists of freshwater and ocean fish that are low and high in mercury.

DPH fish consumption advisories are posted on the DPH's *Fish Consumption Advisory* web site (www.epi.state.nc.us/epi/fish/current.html) and published annually in the N.C. Wildlife Resource Commission's (WRC) *North Carolina Inland Fishing, Hunting and Trapping Regulations Digest* available from the WRC fishing web page (www.ncwildlife.org/Regs/Regs_Fishing.htm). DPH's web page focused on the state wide mercury in fish consumption advisory may be accessed at: www.epi.state.nc.us/epi/fish/safefish.html.

If followed, DPH's fish consumption advisory for mercury will provide adequate protection for the other contaminants found in fish above the DPH or EPA action levels. DENR does not collect samples for shell fish and DPH has not issued consumption advisories for shell fish. Based on the clam data collected by UNCW in 2003-04, DPH recommends similar consumption advice for freshwater shell fish (clams, crabs) collected in the area as recommended for fish tissue. For fish advisories, DPH considers 6 ounces of un-cooked fish as a meal, and a similar meal size would be protective for persons eating freshwater shell fish. It is not known if freshwater clams are a food source for persons in the area. It is likely that persons are eating crabs from the area. To be health protective it was assumed a similar contaminant concentration would be found in crabs in the area.

The elevated arsenic and dieldrin reported in fin-fish and shell fish in the UNCW study may be attributable to the study site or former adjacent operations. The source of the elevated mercury in fin-fish collected in the vicinity of the WCC site is not known. It may be related to local sources or regional atmospheric deposition sources. There is no data to indicate that the elevated mercury concentrations found in the regional fish samples are related to the site. Elevated mercury concentrations are common in some species of fish in central and eastern North Carolina. Fish mercury concentrations are thought to be greatly influenced by environmental conditions in these regions that enhance movement of mercury into the fish.

There is no way of knowing what historical levels of mercury in the tissue of fish collected prior to 1994 might have been. There is a lack of knowledge regarding historical and current levels of mercury in other species of fish persons may catch and eat in this region of North Carolina. We also do not know the effectiveness of DPH's attempts in this part of the state to disseminate our recommendations on consumption rates of fish containing low and high levels of mercury and whether those that are aware of the advisories heed those recommendations.

Conversations with the Columbus County Health Director and results from surveys conducted by different programs within DHHS, show that language minorities and other vulnerable populations are not aware of fish consumption advisories in the state. The DPH recommends a comprehensive and targeted effort to provide fish consumption advisory information to the public around this site. The effort should focus on vulnerable populations such as subsistence fishermen, cultural minorities whose diet is based on fish, language minorities and any other vulnerable groups particular to this area. The DPH can assist in the development of a comprehensive educational intervention to increase the awareness of the potential health risks of eating contaminated fish from this area and surrounding counties. The DPH also recommends that the DENR or EPA collect finfish and shellfish in downstream waters that are judged as potentially impacted by past run-off from the WCC site and that are identified as common fishing areas. Continued monitoring of fin fish and shellfish in identified fisheries in the area that may be impacted by other past and current industrial operations is also recommended. The DPH will continue to monitor fish tissue data collected by the N.C. DENR or other organizations for potential public health impacts and issue fish consumption advisories as necessary.

***Potential Inhalation Issues*** – While there is no analytical or health data to assess this possible exposure pathway, the DPH is concerned with the potential inhalation of contaminated soil particles to persons that may have access to the 80-acre site. During dry conditions disturbance of the unvegetated soil may result in soil particle suspension in the air and persons, especially children because they are closer to the ground, breathing this dust. The elevated metals concentrations and possible acid residues in the soils could potentially act as respiratory irritants or as a source for oral exposure to the contaminated soil.

***Other Facilities and Sites in the Area with Potential Environmental Issues*** – The EPA and DENR documents for the WCC NPL site make numerous mention of other facilities and sites with known and potential environmental impacts in the area. Several are up gradient and adjacent to the WCC NPL site:

- Momentive Specialty Chemicals Inc. (formerly Hexion Specialty Chemicals)
- Silar Laboratories
- Oak Bark operations
- the former Kaiser Agricultural Chemicals operation
- the former Kaiser Acme Farmarket operation

Other nearby facilities includes:

- International Paper (Federal Paperboard)
- Holtrachem Chemical

Potential historical environmental impacts may be associated with these past operations adjacent to the WCC site. These include historical manufacturing areas, and waste disposal and treatment areas, including remote waste water treatment areas. The two wastewater treatment lagoons are located at approximately 1 mile north/northeast of the current chemical manufacturing facilities, on property rented for private gatherings. While access to the lagoons from the recreational areas are some what controlled by a locked gate across the un-paved path, access is possible on foot and would likely present a curiosity factor to children or adult trespassers. The lagoons present a potential exposure point to process wastes in liquid and vapor form. Organic odors were prevalent at the lagoons during the site visit and potential inhalation or dermal contact hazards may be present.

DPH recommends that future investigations at this site and other sites in the area include consideration of all other points of potential exposure to environmental contaminants and the impact potential for combined exposures from all regional industrial sources, particularly inhalation (breathing) of airborne contaminants and irritants.

## CONCERNS IDENTIFIED DURING THE MARCH 2012 COMMUNITY MEETING

The community has a substantial reliance on hunting and fishing to provide food. Noted sources include: turtles, beavers, ducks, frogs, raccoons, opossums, squirrels, and deer. These food sources can provide an exposure route to persons that eat them if they have taken up the contamination.

It was noted that fishing off the old NC Highway 87 bridge where it crosses over Livingston Creek was common although there is limited boat access to Livingston Creek. One person from the community noted a decline in the area in the mink population. While not considered a food source, mink consume fish and frogs, animals that may have direct contact with contaminated surface waters and sediments, and can serve as indicators of environmental impacts.

Persons that in the past lived near the chemical manufacturing facilities expressed a concern with the frequent exposure to odors and mist clouds coming from the facilities. Others were concerned with the safety of well waters near the plant and the potential impacts of former waste disposal and treatment areas, including the spray irrigation fields used for waste water disposal. The community noted that while municipal water is available in the area, some residences remained on well water because of the expense of running extended connection lines. The community also expressed concerns with the number of persons with cancer in the community.

## HEALTH EFFECTS OF SELECTED SUBSTANCES

Following is a discussion of the potential adverse health effects of contaminants identified on the Wright Chemical Corp. NPL site. Having contact with a chemical does not necessarily result in adverse (harmful) health effects. To result in adverse health effects, the chemical must be present at concentrations high enough and for long enough to cause harm. Exposures at concentrations or time periods less than these levels do not cause adverse health effects.

*Mercury* – The following text is taken from N.C. DPH's web page *Fish Consumption Advisory – Questions and Answers about Mercury in Fish* (www.epi.state.nc.us/epi/fish/mercuryhealthfacts.html). Additional information on mercury in fish is available at: www.epi.state.nc.us/epi/fish/.

Mercury is a metal that occurs naturally at low levels in rock, soil and water throughout North Carolina. Mercury is also released into the air, water and land when fossil fuels (coal, oil and natural gas) are burned; when municipal solid waste or medical waste is incinerated; during forest fires; and during some manufacturing processes.

Most mercury pollution is released into the air and then falls directly into water bodies or onto land, where it can be washed into waterways. When mercury gets into water, bacteria can change it into a form called methyl mercury, which is absorbed by tiny aquatic organisms. When fresh water and ocean fish eat those organisms, the mercury begins to build up in their bodies. When larger fish eat smaller fish, mercury can build up to high levels in the tissues of the big fish. Because it binds to the protein in fish muscles - the 'meat' of the fish - mercury cannot be removed by cooking or cleaning the fish

Mercury mostly affects nerve cells in the brain and spinal cord, especially in unborn babies and young children. The more mercury that gets into a person's body, the longer the exposure time, and the younger the person, the more severe the effects are likely to be. Mercury is most harmful to the developing brains of unborn children and young children. Mercury can interfere with the way nerve cells move into position as the brain develops, resulting in abnormal brain development. Prenatal exposure to mercury can affect the way children think, learn, and problem-solve later in life. Effects can also occur in adults at much higher doses. The earliest obvious signs of mercury poisoning in adults are tingling or numbness of the lips, tongue, fingers, or toes; fatigue; and blurred vision.

Fish is an excellent, low-fat source of protein and other nutrients and an important part of a balanced diet. But some fish also contain unsafe levels of mercury. The amount of mercury in fish varies depending on the type of fish; their size, weight and age; what they eat; and where they live. Smaller, non-predatory fish with shorter life spans tend to have lower levels of mercury. Larger, older fish that eat smaller fish tend to have the highest levels. Fish with an average level of less than 0.4 milligram of mercury per kilogram of body weight are considered safe for eating.

North Carolina encourages people to eat fish low in mercury because of the health benefits to the heart as well as to the developing brains of children. While most freshwater fish in North Carolina contain very low levels of mercury and are safe to eat, some ocean fish and freshwater fish may contain high levels of mercury and may be unsafe.

## HEALTH OUTCOME DATA

In addition to studying exposure and chemical-specific toxicity data as part of the public health assessment process, DPH also considers health outcome data, such as mortality and morbidity data. The following criteria are evaluated when determining if a review of health outcome data is reasonable:

- presence of a completed human exposure pathway,
- high enough concentrations of contaminants to result in measureable adverse health effects,
- sufficient numbers of exposed people in the pathway for effects to be measured, and
- an available health outcome database where health impacts for the population of concern can be identified

Based on the limited available environmental data, there is no evidence that persons have been exposed to the site contaminants at levels that could elicit detectable health impacts. In addition, it would be impossible to separate the influence of exposures associated with this site from a person's other sources of exposure. Fish tissue data is available, but the contaminants identified in the fish collected in this area can not be assumed associated with this site only because of the other current and historical industrial operations in the immediate area.

## COMMUNITY HEALTH CONCERNS

The DPH met with the local community on March 8, 2012 regarding specific concerns they have associated with the Wright Chemical Corporation site. The DPH has communicated with the Columbus County Health Director and Environmental Health Director to learn of particular concerns community members may have voiced through these agencies. According to these contacts, no specific concerns have been raised by the community regarding this site, although general concerns with the number of persons with cancer in the community have been expressed. General air and groundwater quality issues for the area have been voiced. It was also noted that large numbers of persons catch and consume fish from the area. The DPH has done its best to consider all relevant exposure scenarios for this particular site, but realize there are a number of other operations and facilities in this area that may be of concern to the community regarding exposures to potential environmental hazards.

The DPH provided a public availability session on March 3, 2012 to meet one-on-one with community members during the PHA public comment period to discuss the process and preliminary findings of this assessment. On July 24, 2012 a program titled *Cancer and the Environment* was presented to community members by the HACE program Health Educator. A DPH physician also was present to meet with the community. This program was provided to respond to the community's concern of the number of cancers in the neighborhood. The presentation intended to provide information about environmental causes of cancer and the process of evaluating cancer clusters in North Carolina. Thirteen people from the community attended the presentation.

HACE will continue to work with the community and Columbus County agencies to identify additional exposure scenarios that may be relevant to historical, current and future activities that may lead to potentially detrimental contact with environmental contaminants associated with this NPL site. At that time, we also anticipate that concerns voiced by the community regarding environmental hazards will include concerns with other industrial past and present operations and facilities in this area. This information will be used by DPH to guide the selection of future public health evaluations in this area of Columbus County and southeast North Carolina.

## CHILD HEALTH CONSIDERATIONS

The ATSDR recognizes there are unique exposure risks concerning children that do not apply to adults. Children are at a greater risk than are adults to certain kinds of exposures to hazardous substances. Because they play outdoors have frequent "hand-to-mouth" activity, children are more likely to be exposed to contaminants in the environment. Children are shorter than adults and as a result, they are more likely to breathe more dust, soil, and heavy vapors that accumulate near the ground. They are also smaller, resulting in higher doses of chemical exposure per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Probably most important, however, is that children depend on adults for risk identification and risk management, housing, and access to medical care. Because of this, adults should be aware of public health risks in their community so they can guide their children accordingly.

Child-specific exposure situations and health effects are taken into account in N.C. DPH health evaluations. For the purposes of this PHA, DPH utilized child-specific health protective values where they were available. Typically, health protective values for children will be lower than those identified for adults. DPH's mercury in fish consumption advisory identifies children (as well as women of child-bearing age and women who may be pregnant or nursing) as particularly sensitive to mercury and recommends reduced ingestion of mercury-containing fish as compared to the "general" population.

## UNCERTAINTIES AND LIMITATIONS

Uncertainties are inherent in the public health assessment process. These uncertainties fall into the following categories:

- the imprecision of the risk assessment process,
- the incompleteness of the information collected and used in the assessment,
- present knowledge of the toxicological properties of the identified contaminants, and
- the differences in opinion as to the implications of the information.

These uncertainties can result in an over or under estimation of potential health risks. They are addressed in public health assessments by using worst-case exposure assumptions when estimating or interpreting health risks (i.e., assume people are exposed to the highest concentrations of contaminants for the longest feasible time period). The public health assessment calculations, comparison values, and health-effect values also incorporate safety margins. The assumptions, interpretations, and recommendations made throughout this public health assessment favor those in the direction of protecting public health.

Uncertainties and limitations specific to this site and the health evaluation include:

- The available environmental contaminant data for the 80-acre area and associated environmental matrices (sediment and surface water) is not adequate to fully evaluate current or historical environmental contaminant concentrations or potential adverse health effects that could have resulted from coming into contact with these contaminants or their degradation products.

- There are no data for mercury levels in fish in the area prior to 1994. There are very limited shellfish data.
- Fish and shellfish samples were not collected in close proximity to the 80-acre site. If persons are eating fish from areas closer to the site that are not represented by contaminant concentrations in the evaluated fish, then they may be exposed to higher (or lower) levels of contaminants.
- The source of the elevated mercury in the fish tissue samples identified in this study is not known and may not be related to historical local industrial processes.
- It is possible that the chemical analyses run on the samples in this study did not include all chemicals present at concentrations of concern. There may not be analytical methods available for all chemical contaminants on the site or their degradation products that may be potential hazards.
- Health effect information does not exist for all chemicals identified on this site.
- Analytical method detection limits were elevated in many of the site soil and sediment analyses. Some reporting limits were greater than the health-effect comparison values. This could result in an under-estimation of the potential for adverse health effects.
- There are a number of other historical and current industrial operations in the area of this site that may contribute to environmental contaminant exposures to persons currently or in the past living or visiting the area. The impact of these exposures, either individually, or in combination with environmental contaminants from other sources is not known.
- Adverse health effects that are ultimately experienced by persons exposed to environmental contaminants will be impacted by their general health, lifestyle choices, their genetic make-up and other chemicals to which they may be exposed. While highly health protective parameters and methods have been employed for this study, these issues may result in particular sensitivities for some persons that are not predicted by the methods used in this evaluation.

# CONCLUSIONS

DPH evaluated all available environmental data for the Wright Chemical Corporation NPL site in Columbus County, North Carolina. The data included samples collected from 1984 through 2008 on a 38-acre northern portion of the designated NPL area. No samples have been collected in the remaining 45-acres that include a specialty chemical manufacturing facility. DPH evaluated the past and current environmental data for "recreational angler / trespasser" exposure situations using health protective factors for both children and adults. The environmental data included site surface soil; sediment, surface water and groundwater samples collected adjacent to the site; and fish and shellfish tissue collected in nearby waters. While review of the available information did not indicate the potential for adverse health effects, DPH does not believe the available information is adequate to know for certain.

The DPH concludes:

- There is not enough information about past and current levels of environmental contaminants associated with the 80-acre site and adjacent areas, or how people may have come into contact with these areas, to know for certain if people may have been harmed by inhaling, accidently ingesting, or having direct contact with the contaminated soils and sediments.

- Concentrations of mercury greater than the current DPH fish consumption advisory levels have been identified in fish and shellfish in waters in the vicinity of the site (Livingston Creek and the Cape Fear River). These levels could cause adverse health effects to persons, especially women and children, eating meals of certain types of fish more frequently than recommended in existing N.C. fish consumption advisories. The source of the mercury in the fish is not known and has not been linked to the Wright Chemic Corp. site.

## RECOMMENDATIONS

The DPH makes the following recommendations:

- The EPA or DENR provide more comprehensive contaminant analysis of the WCC site and Livingston Creek and the associated wetlands relevant to human ingestion, inhalation and dermal exposures. Characterization should include on-site surface soil and sediment analyses for metals, semi-volatile organics, pesticides and PCBs. As analytical methods are available, pesticide and organic analyses should include parent compounds and their degradation products that have been manufactured on the adjacent properties. Tentatively Identified Compounds (TIC) library searches should be included with the organic scans. Investigations should include of characterization of surface water and sediment samples (same analytical scans as for soil) collected immediately adjacent to the site in Livingston Creek and the wetlands for DPH to determine if site run-off or groundwater discharge is resulting in contaminant concentrations in surface water at potentially harmful concentrations.
- The WCC property owners or responsible parties take measures to discourage access to the 38-acre southern portion of the NPL area that is not fenced and may be accessible from Livingston Creek. Measures could include posting “no trespassing” or “warning” signs, or fencing the area. DPH can assist with developing the language for signs.
- Persons coming into contact with contaminated soils or sediments should, as soon as possible, remove soiled clothing and wash areas of skin that were in contact with soiled clothing or contaminated soils or sediments. Inhalation of dust generated from site soils should be avoided because of potential acid or metals residues that could be respiratory irritants
- Monitor groundwater contaminant levels where it discharges to Livingston Creek from under the former Wright Chemical Corporation property. If contaminants exceed health screening values, prevent discharge of the contaminants to the surface waters.
- Initiate a focused educational effort for the potential health effects of eating fish high in mercury in the surrounding counties. Special attention should be given to inform sensitive populations (women between 15 and 44 years of age and children under the age of 15 years).
- The DENR or EPA should collect finfish and shellfish in downstream waters that are judged as potentially impacted by past run-off from the Wright Chemical NPL site and that are identified as common fishing areas. Continue to monitor fin fish and shellfish in identified fisheries in the area that may be impacted by other past and current industrial operations. DPH will continue to monitor fish tissue data collected by N.C. DENR or other organizations for potential public health impacts and issue fish consumption advisories as necessary.

- DPH recommends similar consumption advice for freshwater shell fish (clams, crabs) collected in the area as recommended for fish tissue (*www.epi.state.nc.us/epi/fish/current.html* or *www.ncwildlife.org/Regs/Regs_Fishing.htm*). For fish advisories, DPH considers 6 ounces of un-cooked fish as a meal, and a similar meal size would be protective for persons eating freshwater shell fish. If followed, DPH's fish consumption advisory for mercury will provide adequate protection for the other contaminants found in fish above the DPH or EPA action levels.
- Well water near the historical spray irrigation fields as well as terrestrial and aquatic animals (or suitable surrogate organisms) should be tested for site-related contaminants and their degradation products. Community meetings and interviews with community members revealed potential exposure from these sources.
- The DPH, Columbus County Health Department, and local health care providers should make available information to assist persons concerned about their intake of mercury from fish or shellfish and how it may impact their health.
- As the EPA and DENR continue their investigations of this site and beyond the original 80-acre area, the potential impacts of environmental exposures from these and other current and historical manufacturing operations in the vicinity should be included in the health considerations.
- Health impacts associated with combined exposures from multiple sources should be considered in evaluations of potential long-term health issues to this community.
- N.C. DPH will continue to monitor health, analytical data, or biological data generated by Federal, State, or County agencies, or other groups, relevant to this NPL site and other nearby sites or potentially affected communities near the NPL site.

## PUBLIC HEALTH ACTION PLAN

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

A. Public Health Actions Completed

- DPH has evaluated site information, environmental media analytical data, and health effects information to determine the potential for the health of the local community to be adversely impacted by substances identified on the Wright Chemical Corporation site.
- A *Public Comment Release Draft* copy of this Public Health Assessment (PHA) was made available on February 1, 2012 to the local community, U.S. EPA, N.C. DENR, and Columbus County officials prior to publication of the final release document. A 60 day comment submission period was provided. DPH has reviewed the submitted comments and made appropriate modifications to the *Public Health Assessment - Final Release*.
- The DPH prepared a fact sheet for health hazards associated with mercury contamination in fish and made the fact sheet available to the community through the DPH fish advisory web site and from Columbus County offices.

- The DPH conducted a public availability meeting on March 8, 2012 after the release of the *Public Comment Release* PHA. This provided the community the opportunity to talk directly with, and ask questions of, the DPH staff about how the PHA, how it was conducted and the conclusions. The conversations with the community also provided additional concerns of the community, identified other routes of potential contact with site contaminants, identified the scope of the community's awareness of current mercury fish advisories, and identified areas of additional support that DPH or the County may provide in regard to environmental impacts on public health.
- During the public availability meeting on March 8, 2012 HACE presented a slide presentation on environmental health.
- On July 24, 2012 HACE offered the presentation *Cancer and the Environment* to the community to respond to their cancer concerns. A DPH Public Health physician was also present to answer the community's questions about cancer.

B. Public Health Actions Planned

- Electronic copies of the *Final Release Public Health Assessment* will be available on the ATSDR and HACE web sites. Print copies can be requested through ATSDR. Hard copies will be made available to the public at the East Columbus Public Library document repository and at Columbus County offices.
- A summary factsheet for the *Final Release* PHA will be prepared by DPH and be made available to the public and government agencies. Availability will include print copies provided at the East Columbus Public Library document repository and electronic copies available from the HACE web site.
- The DPH will continue to work with the Columbus County Health Department to identify the local community's health concerns and determine if they may be associated with past exposures related to the WCC site or other nearby industrial sources.
- The DPH will continue to work with the County to improve knowledge among the community of the state-wide fish tissue consumption advisory. DPH will assist the County in developing a comprehensive and focused educational strategy that includes efforts to target vulnerable populations. DPH will provide factsheets in English and Spanish for the mercury in fish advisory that provide guidance on what fish are low / high in mercury. DPH will continue to work with the local health department to identify points of contact for the Spanish-speaking community and other language and cultural minorities. DPH will continue to monitor fish tissue data collected by N.C. DENR or other organizations for potential public health impacts and issue fish consumption advisories as necessary.
- The DPH will provide educational materials and points of contact for the local health care providers regarding the mercury in fish potential health issues and other environmental health issues in the area.
- The DPH will monitor the status of recommendations made in the Public Health Assessment to protect public health and work with the appropriate agencies or groups to facilitate their completion.
- DPH will work with future investigators of the site to insure that environmental data collected is adequate to assess potential public health impacts.

- The DPH will continue to monitor health or environmental data generated by Federal and State agencies, or other organizations, relevant to the WCC site and relay the public health implications of this information to the community.
- The DPH will monitor health or environmental data collected for investigations of other sites of environmental contamination and potential public health threats in the area. DPH will make an effort to work with investigators on these sites to insure that environmental data collected is adequate to assess potential public health impacts.
- The DPH will provide contact information to agencies, organizations, and the public desiring additional inquiries about this site or the Public Health Assessment.

## CONTACT INFORMATION

Contact information for additional inquiries regarding the Wright Chemical Corp. 80-Acre Site Adjacent to Livingston Creek Public Health Assessment, or to contact N.C. DPH Public Health physicians:

Web links:

| | |
|---|---|
| N.C. DPH HACE: | www.epi.state.nc.us/epi/oee/hace/reports.html |
| ATSDR: | Wright Chemical Corp. NPL Site Adjacent to Livingston Creek Public Health Assessment Final Release, www.atsdr.cdc.gov/HAC/Public Health Assessment/index.asp |
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HACE USPS mailing address:

Health Assessment, Education and Consultation Program
N.C. Division of Public Health/DHHS
1912 Mail Service Center
Raleigh, NC 27699-1912

DPH Fish Advisory Web Page:

www.epi.state.nc.us/epi/fish/current.html

DPH Mercury in Fish Consumption Advisory factsheets in English and Spanish:

www.epi.state.nc.us/epi/fish/safefish.html
www.ncdhhs.gov/espanol/salud/fish.htm

## REPORT PREPARATION

This Public Health Assessment for the Wright Chemical Corporation NPL Site was prepared by the North Carolina Department of Public Health (N.C. DPH) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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# Appendix A

## Figures

**Figure 1. Location of surface soil and sediment samples collected by DENR in April 2007. Soils were collected in the area of the former sulfuric acid plants and within the Wright Chemical Corporation site. Contaminated area surface soil locations are designated WC-011-SS, WC-012-SS and WC-013-SS. "PPE" denotes the "probable point of entry" of surface run-off from the 80-acre area into the wetlands. Source: [HRS 2010].**

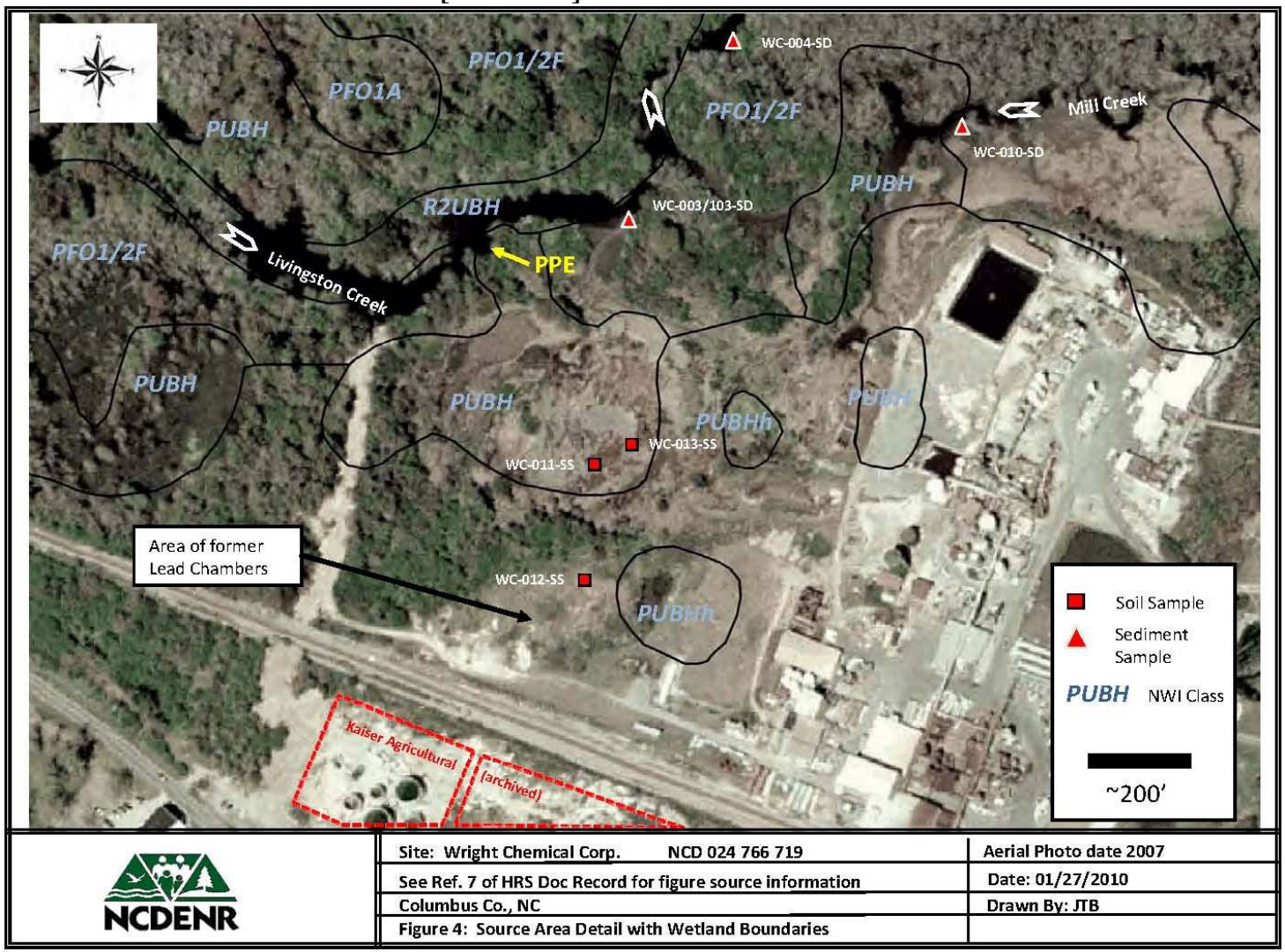


**Figure 2. Wright Chemical Corporation NPL site, satellite view, Oct. 2010. RR = railroad line]. Source: Google Earth. Site structure identification courtesy Momentive Specialty Chemicals Inc. and U.S. EPA.**

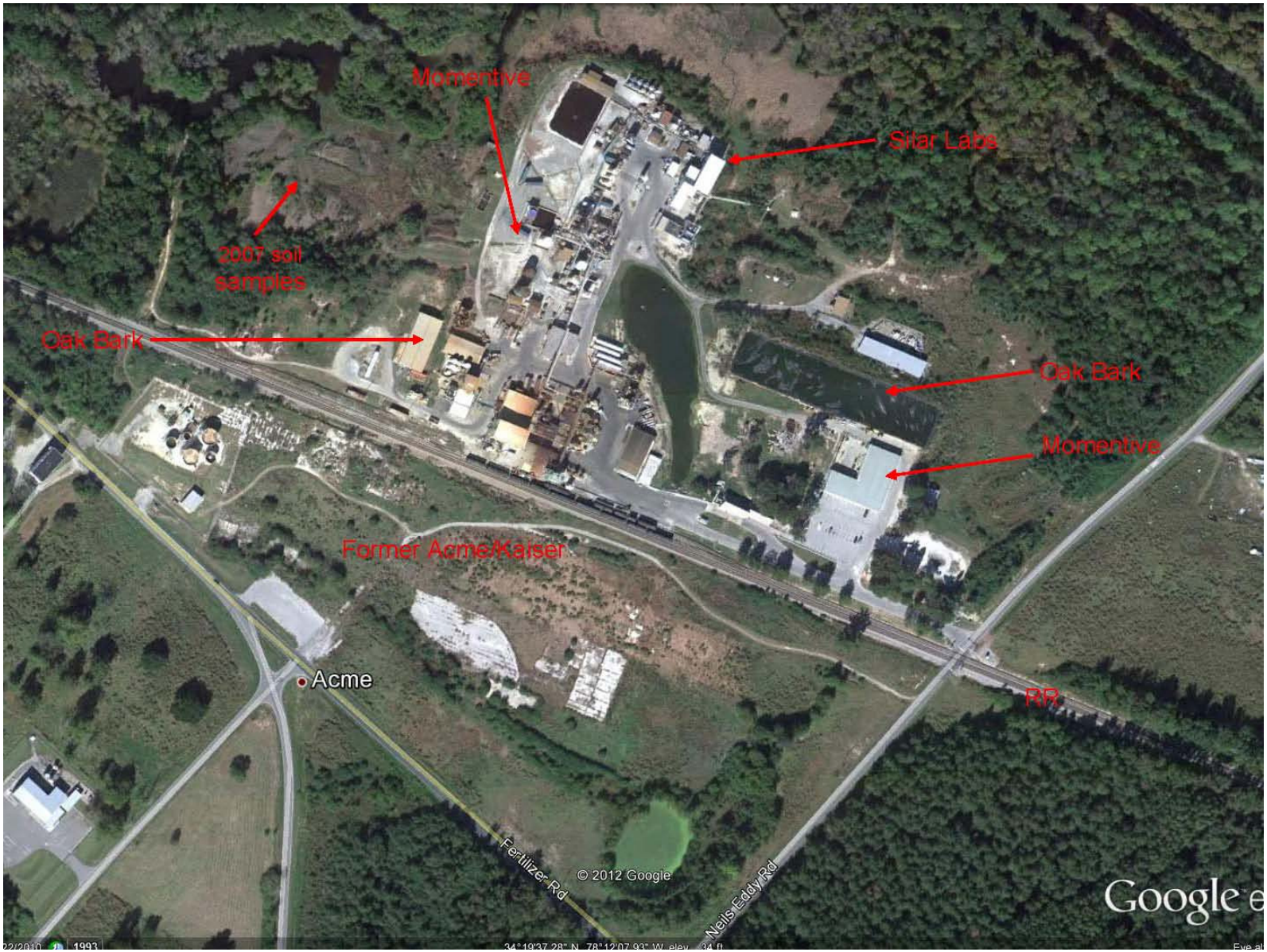


**Figure 3. Location of former Kaiser and Acme facilities south rail corridor on the Wright Chemical Corporation NPL site. Source: [SRR 2005]**

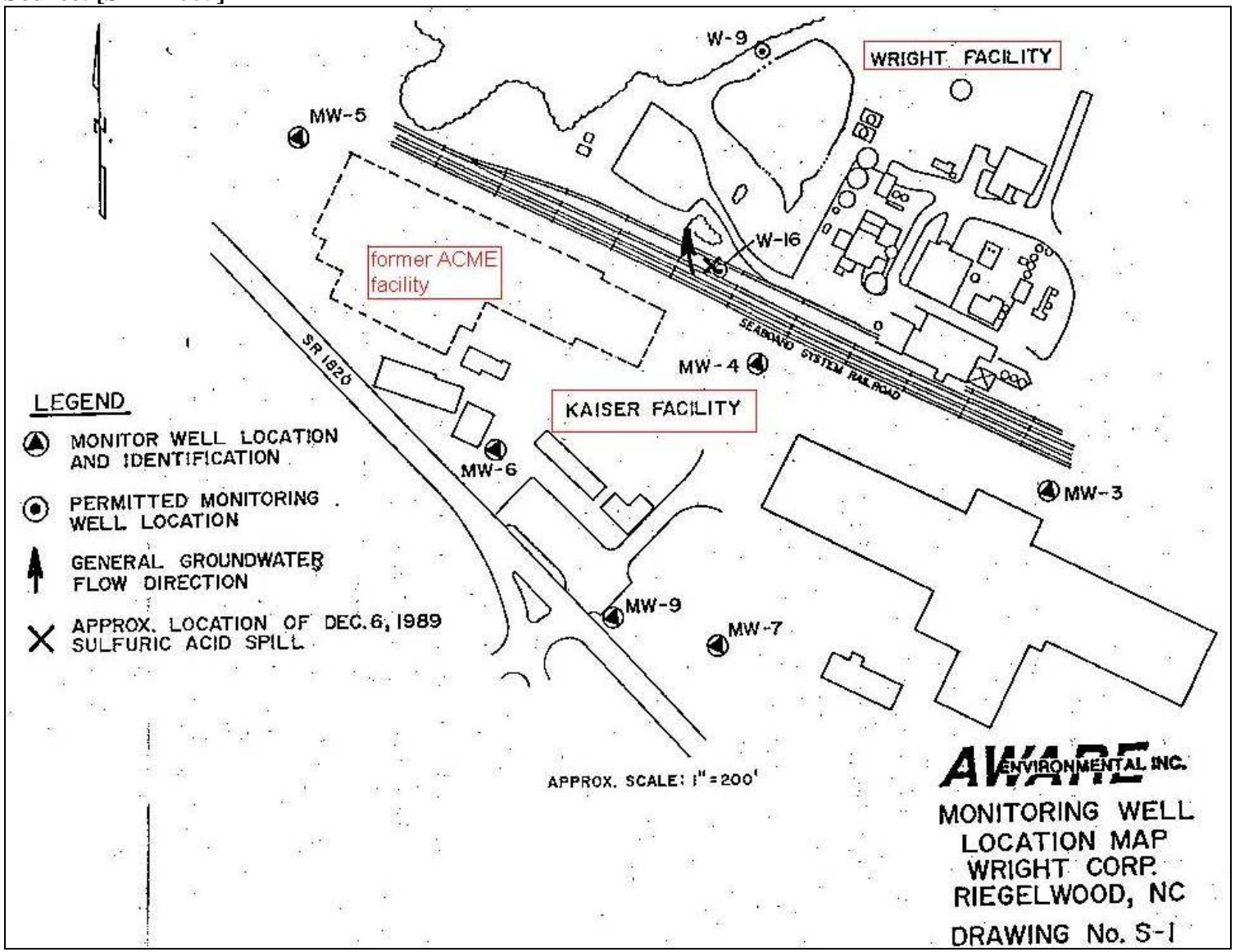


**Figure 4. Location of surface soil and sediment samples collected by DENR in April 2007. Contaminated soils were collected in the area of the former sulfuric acid plants and within the 80-acre parcel. Contaminated area surface soil locations are identified as 11, 12, 13. The background soil is identified as 14. Source: [HRS 2010].**

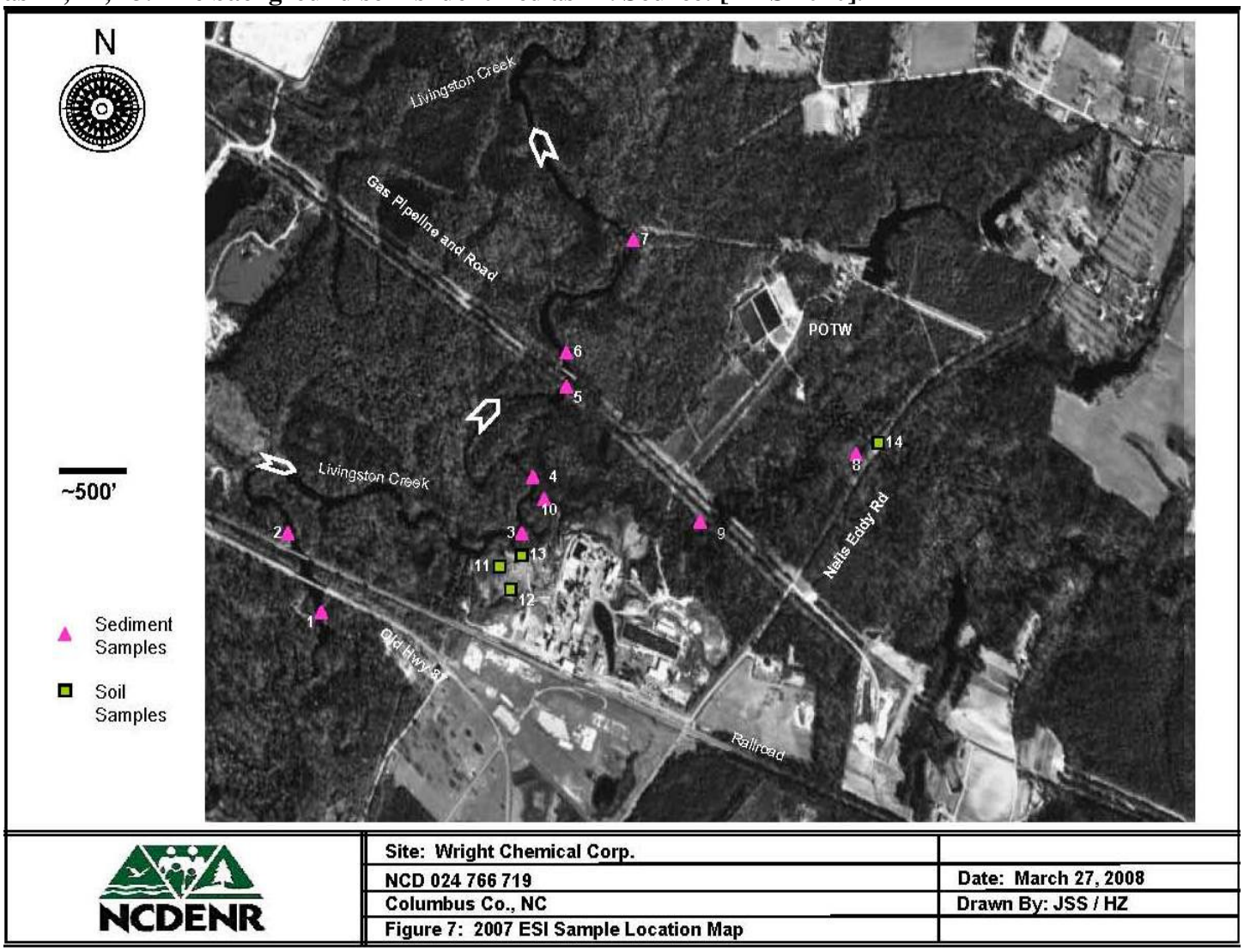
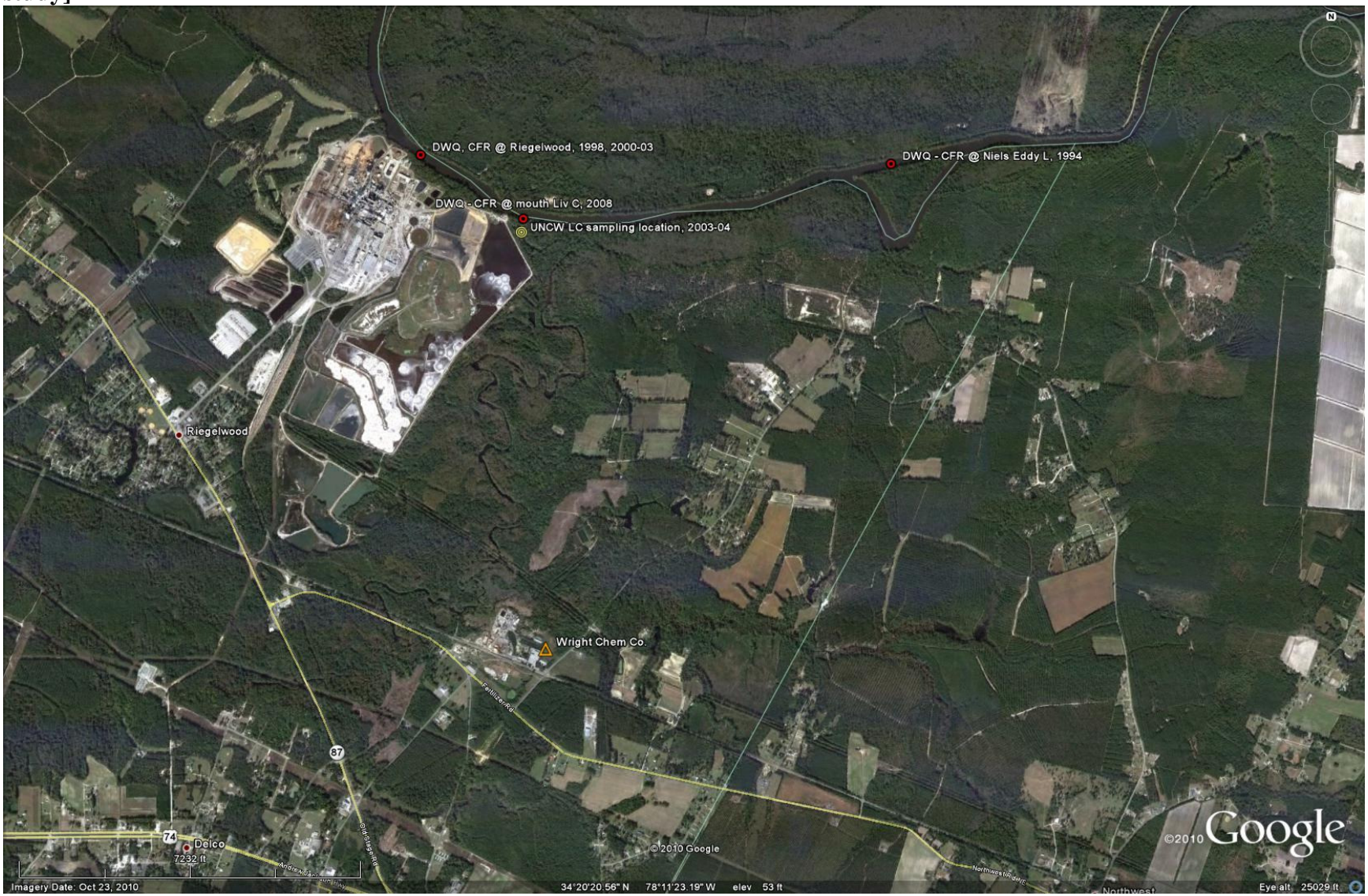


**Figure 5. Fish tissue sample collection locations. DWQ = N.C. DENR Div. of Water Quality; LC = Livingston Creek; CFR = Cape Fear River; UNCW = Univ. of North Carolina – Wilmington. [DWQ, CFR@ Riegelwood, 1998, 2003-04 data not included in this study]**



## Appendix B

## Demographic Data

**Demographic Data for the Wright Chemical Corporation 80-Acre Site, Near Riegelwood, Columbus County, N.C.**

According to the EPA's Environmental Justice View tool, 36 persons live within ½- mile of the Wright Chemical Corporation facility. The population density is 48 persons per square mile. The ½-mile area has approximately 14 households. Seventy-nine percent own their home while 21% rent. Eighty-one percent of the population is White and 18% is African-American. Six percent of the population is below the poverty level.

The age breakdown of the population is 5% five years or less, 18% is 17 and younger, 82% is 18 and older and 11% is 65 and older. Two percent of the population has a 9th grade education or less, 17% have 9th-12th grade, 50% have a high school diploma, 27% have some college, and 4% have a college degree or more.

Ninety-six percent of the population speaks English only. (Source: U.S. EPA Environmental Justice View Tool, webpage accessed February 2, 2011.)

**Overview of Demographic Data for 1/2 Mile Area Surrounding the Wright Chemical Corporation 80-Acre Site Adjacent to Livingston Creek**

Source: Tables taken directly from the U.S. EPA Environmental Justice View Tool, webpage accessed February 2, 2011.

| Overview | | | | | |
|---|---|---|---|---|---|
| Total Persons: | 36 | Land Area: | 96.2% | Households in Area: | 14 |
| Population Density: | 48.34 /sq mi | Water Area: | 3.8% | Housing Units in Area: | 15 |
| Percent Minority: | 19.3% | Persons Below Poverty Level: | 2 (5.6%) | Households on Public Assistance: | 1 |
| Percent Urban: | 0% | Housing Units Built <1970: | 51% | Housing Units Built <1950: | 10% |

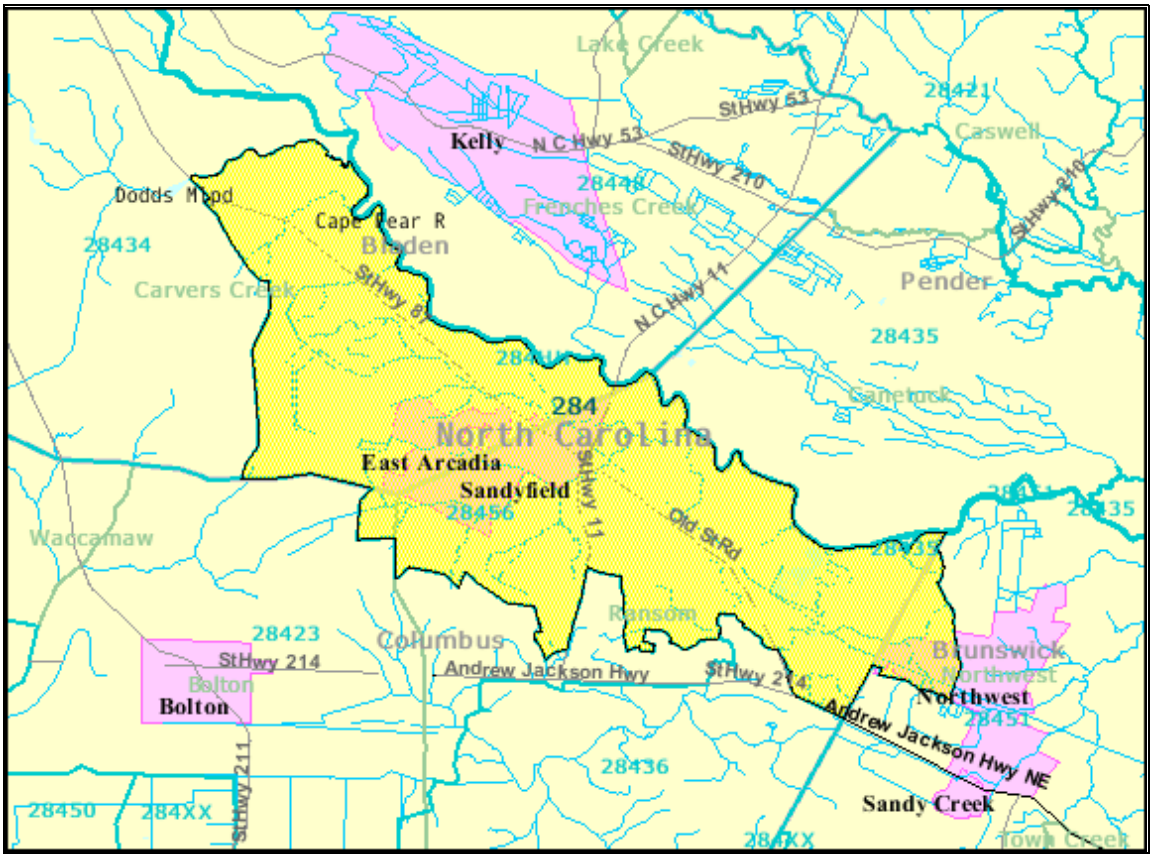
| Race and Age* (* Columns that add up to 100% are highlighted) | | | | |
|---|---|---|---|---|
| | Persons (%) | | Age Breakdown | Persons (%) |
| White: | 29 | (80.7%) | Child 5 years or less: | 2 (5.1%) |
| African-American: | 7 | (18.2%) | Minors 17 years and younger: | 7 (18.2%) |
| Hispanic-Origin: | 0 | (0.0%) | Adults 18 years and older: | 30 (81.8%) |
| Asian/Pacific Islander: | 0 | (0.0%) | Seniors 65 years and older: | 4 (11.1%) |
| American Indian: | 0 | (1.0%) | | |
| Other Race: | 0 | (0.0%) | | |
| Multiracial: | 0 | (0.0%) | | |

| Gender | |
|---|---|
| **Gender Breakdown** | **Persons (%)** |
| Males: | 16 (45.1%) |
| Females: | 20 (54.9%) |

| Education | |
|---|---|
| **Education Level (Persons 25 & older)** | **Persons (%)** |
| Less than 9th grade: | 0 (1.9%) |
| 9th -12th grade: | 4 (17.0%) |
| High School Diploma: | 13 (50.1%) |
| Some College/2 yr: | 7 (26.9%) |
| B.S./B.A. or more: | 1 (4.1%) |

| Language | |
|---|---|
| **Ability to Speak English** | **Persons (%)** |
| Population Age 5 and Over: | 35 |
| Speak only English: | 34 (95.9%) |
| Non-English at Home: | 1 (3.0%) |
| Speak English very well: | 0 (1.4%) |
| Speak English well: | 0 (1.1%) |
| Speak English not well: | 0 (0.5%) |
| Speak English not at all: | 0 (0.0%) |
| Speak English less than well: | 0 (0.5%) |

**Demographics for Zip code 28456 –**




Source: U.S. Census 2000 and U.S. EPA Environmental Justice View Tool, table prepared by N.C. DPH.

| | Zip code 28456 | Columbus County | North Carolina | U.S. |
|---|---|---|---|---|
| Total population | 3507 | 54,749 | 8,049,313 | 281,421,906 |
| Percent Minority | | | | |
| Ethnicity | | | | |
| White | 34% | 63% | 72% | 75% |
| African-American | 61% | 31% | 22% | 12% |
| Hispanics | 4% | 2% | 5% | 13% |
| Asians | 0% (1 person) | .2 | 1% | 4% |
| American Indians | 2% | 3% | 1% | 1% |
| Individuals below poverty level | 17% | 22% | 12% | 12% |

# Appendix C

## Tables

**Table 1. Substances detected in samples evaluated for the Wright Chemical Corporation 80-acre site. Table continued on the next page.**

| Chemicals Detected | Surface Soils, Collected 2007 | Sediments, Collected 2007 | Groundwater, Collected 1989 | Surface Waters, Collected 1990 |
|---|---|---|---|---|
| **Metals** | | | | |
| Aluminum | | | X | X |
| Antimony | X | | | |
| Arsenic | X | X | X | |
| Barium | X | X | X | X |
| Beryllium | | | X | |
| Cadmium | X | X | X | |
| Calcium | | | | X |
| Chromium | | | X | |
| Cobalt | | | X | |
| Copper | X | X | X | X |
| Iron | X | X | X | X |
| Lead | X | X | X | |
| Magnesium | | | X | X |
| Manganese | X | | X | X |
| Mercury | X | | | |
| nickel | X | | X | |
| Potassium | | | X | |
| Silver | X | | | |
| Sodium | X | | X | X |
| Thallium | X | | | |
| Vanadium | | | X | |
| Zinc | X | X | X | X |
| **Inorganic Compounds** | | | | |
| Ammonia | | | | X |
| Fluoride | | | | X |
| Nitrate, Nitrite Nitrogen | | | | X |
| Phosphorous | | | | X |
| Sulfate | | | | X |
| **Pesticides** | | | | |
| 4,4’-DDD | | X | | |
| 4,4’-DDE | X | | | |
| 4,4’-DDT | | X | | |
| Dieldrin | X | X | | |
| gamma-Chlordane | X | X | | |
| alpha-BHC | | X | | X |
| delta-BHC | | X | | |
| gamma-BHC | | X | | |
| Lindane | | | | X |

**Table 1, continued from previous page. Substances detected in samples evaluated for the Wright Chemical Corporation 80-acre site.**

| Chemicals Detected | Surface Soils, Collected 2007 | Sediments, Collected 2007 | Groundwater, Collected 1989 | Surface Waters, Collected 1990 |
|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | |
| Carbon disulfide | | | X | |
| 1,1-Dichloroethane | | | X | |
| 1,2-Dichloroethene | | | X | |
| Methyl ethyl ketone | | | X | |
| Trichloroethylene | | | X | |
| Benzene | | | X | |
| Ethylbenzene | | | X | |
| Dimethyl sulfide | | | X | |
| Formaldehyde | | | | X |
| Chloroform | | | | X |
| **Semi-Volatile Organic Compounds** | | | | |
| Dihydromethylindole | | | X | |
| Dihydromethylindole | | | X | |
| dimethoxymethane | | | X | |
| Dimethoxypropanol | | | X | |
| Indole | | | X | |
| Lenthionine | | | X | |
| Methylhexanoic acid | | | X | |
| Methylindole | | | X | |
| Naphthalene | | | X | |
| Oxybisbenzene | | | X | |
| Phenol(s) | | | X | X |
| Phenylpropanedioic acid | | | X | |
| Tetrathiepane | | | X | |
| Trihiane | | | X | |
| Trioxane | | | X | |
| **Tentatively Identified (organic) Compounds (TICs)** | | | | |
| Compounds | | | Total of 28 for all 3 samples | |

**X = detected**

**Table 2. Site-specific parameters used for the Wright Chemical Corporation exposure estimates – exposures occurring during "recreational angler / trespassers" activities, frequency and duration of fishing activity.[1]**

| Exposure Scenario | Frequency of Exposure (Days per Year) | Exposure Duration per Event (Hours) | Years of Exposure |
|---|---|---|---|
| Recreational Angler / Trespasser | | | |
| Adult | 34 | 10 | 32 |
| Child | 34 | 10 | 6 |

[1] Source: USFWS 2006

**Table 3. Additional site-specific parameters used for the Wright Chemical Corporation exposure estimates – exposures occurring during "recreational angler / trespassers" activities.[1]**

| Site-Specific Exposure Scenario | Recreational Angler / Trespasser - Child | Recreational Angler / Trespasser - Adult | Source of Exposure Parameter Value |
|---|---|---|---|
| Incidental surface water ingestion during swimming | 37 mL | 16 mL | EPA 2009, mL per event |
| Drinking water Ingestion | 1078 mL | 2811 mL | EPA 2009, Maximum mL - 95$^{th}$ percentile |
| Incidental soil Ingestion | 50 mg/day | 50 mg/day | EPA 2009, central tendency |

[1] Source: USFWS 2006
Child = 1 to 6 years old, Adult = all other persons
mL = milliliter, 100 mL equals approximately 3 ounces
mg = milligram, 100,000 mg equal approximately 3.5 ounces
16 ounces = 1 pound
EPA 2009 - see References

**Table 4. Fish tissue mercury levels for water bodies near the Wright Chemical Corporation 80-acre site. Collectors, date of collection and sample locations noted.**

| Species (*Scientific name*) | Frequency of NC Advisory Exceedances [1] | Average Tissue Mercury Concentration, mg/kg | Concentrations Exceeding Advisory Level, mg/kg |
|---|---|---|---|
| **N.C. DENR collected, Oct. 2008, Cape Fear River at Livingston Creek** | | | |
| Channel catfish (*Ictalurus punctatus*) | 2 / 3 | 0.30 | 0.42<br>0.40 |
| Largemouth bass (*Micropterus salmoides*) | 1 / 11 | 0.27 | 0.48 |
| **N.C. DENR collected, May 2001, Cape Fear River at Riegelwood** | | | |
| Largemouth bass (*Micropterus salmoides*) | 4 / 9 | 0.45 | 0.82 0.55<br>0.61 0.49 |
| Bowfin (Blackfish) (*Amia calva*) | 2 / 2 | 1.06 | 1.30<br>0.81 |
| Flathead catfish (*Pylodictis olivaris*) | 1 / 1 | 0.52 | -na- |
| **N.C. DENR collected, June 2000, Cape Fear River at Riegelwood** | | | |
| Largemouth bass (*Micropterus salmoides*) | 3 / 3 | 1.11 | 1.50 0.54<br>1.30 |
| Bluegill sunfish (*Lepomis macrochirus*) | 1 / 2 | 0.40 | 0.43 |
| Carp (*Cyprinus carpio*) | 1 / 1 | 0.43 | -na- |
| Bowfin (Blackfish) (*Amia calva*) | 2 / 2 | 1.60 | 1.80<br>1.40 |
| **N.C. DENR collected, Sept. 1998, Cape Fear River at Riegelwood** | | | |
| White/striped hybrid bass (*Morone species*) | 1 / 1 | 0.73 | -na- |
| Striped bass (*Morone saxatillis*) | 1 / 1 | 0.50 | -na- |
| Largemouth bass (*Micropterus salmoides*) | 5 / 6 | 0.64 | 1.10 0.66<br>0.71 0.43<br>0.69 |
| Bowfin (Blackfish) (*Amia calva*) | 6 / 6 | 1.44 | 2.40 1.20<br>2.20 0.66<br>1.60 0.55 |
| **N.C. DENR collected, Sept. 1998, Cape Fear River at Neils Eddy Landing** | | | |
| Bowfin (Blackfish) (*Amia calva*) | 3 /3 | 1.13 | 1.20 1.10<br>1.10 |
| Largemouth bass (*Micropterus salmoides*) | 2 / 5 | 0.35 | 0.54<br>0.45 |
| **UNCW collected, 2003-04, Livingston Creek at Cape Fear River** | | | |
| Bowfin (Blackfish) (*Amia calva*) | 1 / 1 [2] | 1.77 | -na- |

[1] Number of samples greater than the N.C. DPH mercury in fish tissue consumption advisory action level (0.4 mg/kg) / Number of fish tissue samples collected

[2] Data reported as average of 2 samples

mg/kg = milligram per kilogram (equivalent to "parts per million", or ppm)

na = not applicable

N.C. DENR = N.C. Department of Environment and Natural Resources

UNCW = Univ. of North Carolina - Wilmington

**Table 5. Data summary and screening value analysis for surface soils (0-2 ft bgs) collected in April 2007 in the 38-acre northern area (site of former sulfuric acid plant) of the Wright Chemical Corp. NPL site.**

| Contaminant | Number of Samples | Number of Detections | No. of Detections Greater than CV | Range of Detections Greater than CV (mg/kg) | Comparison Values (CV), (mg/kg) | Type of CV |
|---|---|---|---|---|---|---|
| Antimony | 3 | 3 | 3 | 63 J – 86 J | 20 child<br>300 adult | RMEG |
| Arsenic | 3 | 3 | 3 | 430 – 900 | 20 child<br>200 adult | Chronic EMEG |
| | | | | | 0.5 | CREG |
| Barium | 3 | 3 | 0 | - na - | 10,000 child<br>100,000 adult | Intm. EMEG |
| Cadmium | 3 | 3 | 3 | 31 – 42 | 30 child<br>400 adult | Intm. EMEG |
| Copper | 3 | 3 | 3 | 720 – 890 | 500 child<br>7,000 adult | Intm. EMEG |
| Iron | 3 | 3 | 3 | 270,000 – 370,000 | 55,000 | EPA RSL |
| Lead | 3 | 3 | 3 | 3500 J – 10,000 J | 800 | EPA Region IV Industrial Soil |
| Manganese | 3 | 3 | 0 | - na - | 3000 child<br>40,000 adult | RMEG |
| Mercury | 3 | 3 | 0 | - na - | 310 | EPA Residential Soil (as mercury salts) |
| Nickel | 3 | 3 | 0 | - na - | 1000 child<br>10,000 adult | RMEG |
| Silver | 3 | 3 | 0 | - na - | 30 child<br>4000 adult | RMEG |
| Sodium | 3 | 3 | - na - | - na - | - na - | No CVs available |
| Thallium | 3 | 3 | -na - | - na - | - na - | No CVs available |
| Zinc | 3 | 3 | 0 | - na - | 20,000 child<br>200,000 adult | Intm. EMEG |
| 4,4'-DDE | 3 | 1 | 0 | - na - | 2 | CREG |
| Dieldrin | 3 | 1 | 0 | - na - | 5 child<br>70 adult | Intm. EMEG |
| gamma-Chlordane | 3 | 1 | 0 | - na - | 30 child<br>400 adult | Intm Surface soil. EMEG |

Notes: bgs = below ground surface
CV = Comparison value (ATSDR established screening values)
mg/kg = milligrams per kilogram (parts per million, "ppm")
J = estimated value
RMEG = Reference Dose Media Evaluation Guide
EMEG = Environmental Media Evaluation Guide
CREG = Cancer Risk Evaluation Guide
na = not applicable
Intm. EMEG = Intermediate EMEG
EPA Residential = U.S. Environmental Protection Agency Superfund health screening value for residential sites

**Table 6. Data summary and screening value analysis for Livingston Creek sediment collected in April 2007. Sample collected adjacent to the 38-acre northern area (site of former sulfuric acid plant) of the Wright Chemical Corp. NPL site. Concentrations reported as average of duplicate sample collections.**

| Contaminant | Number of Samples | Number of Detections | No. of Detections Greater than CV | Range of Detections Greater than CV (mg/kg) | Comparison Values (CV), (mg/kg) | Type of CV |
|---|---|---|---|---|---|---|
| Arsenic | 1 | 1 | 1 | 30 | 20 child<br>200 adult | Chronic EMEG |
| | | | | | 0.5 | CREG |
| Barium | 1 | 1 | 0 | - na - | 10,000 child<br>100,000 adult | Intm. EMEG |
| Cadmium | 1 | 1 | 0 | - na - | 30 child<br>400 adult | Intm. EMEG |
| Copper | 1 | 1 | 0 | - na - | 500 child<br>7,000 adult | Intm. EMEG |
| Iron | 1 | 1 | 0 | - na - | 55,000 | EPA RSL |
| Lead | 1 | 1 | 1 | -na- | 800 | EPA Region IV Industrial Soil |
| Zinc | 1 | 1 | 0 | - na - | 20,000 child<br>200,000 adult | Intm. EMEG |
| 4,4'-DDD | 1 | 1 | 0 | - na - | 3 | CREG |
| 4,4'-DDT | 1 | 1 | 0 | - na - | 30 child<br>400 adult | Intm. EMEG |
| | | | | | 2 | CREG |
| alpha-BHC [1] | 1 | 1 | 0 | - na - | 400 child<br>6000 adult | Chronic EMEG |
| | | | | | 0.1 | CREG |
| delta-BHC [2] | 1 | 1 | 0 | - na - | 0.4 | CREG [2] |
| Dieldrin | 1 | 1 | 0 | - na - | 5 child<br>70 adult | Intm. EMEG |
| gamma-BHC [3] (Lindane) | 1 | 1 | 0 | - na - | 0.5 child<br>7 adult | Intm. EMEG |
| gamma-Chlordane | 1 | 1 | 0 | - na - | 30 child<br>400 adult | Intm. EMEG |

Notes: CV = Comparison value (ATSDR established screening values)
mg/kg = milligrams per kilogram (parts per million, "ppm")
J = estimated value
RMEG = Reference Dose Media Evaluation Guide
EMEG = Environmental Media Evaluation Guide
CREG = Cancer Risk Evaluation Guide
na = not applicable
Intm. EMEG = Intermediate EMEG
EPA Residential = U.S. Environmental Protection Agency Superfund health screening value for residential sites
RSL = EPA Regional Screening Levels
[1] Reported as alpha-BHC (alpha-benzenehexachloride), same compound as alpha-hexachlorocyclohexane ("alpha-HCH")
[2] Reported as delta-BHC (delta-benzenehexachloride), same compound as delta-hexachlorocyclohexane ("alpha-HCH"); compare to CVs for Technical Grade HCH
[3] Reported as gamma-BHC (gamma-benzenehexachloride), same compound as gamma-hexachlorocyclohexane ("gamma-HCH"), also same compound as "Lindane"

**Table 7. Data summary and screening value analysis for Livingston Creek surface waters collected in April 1990 in Livingston Creek immediately downstream of the Wright Chemical Corp. NPL site.**

| Contaminant | Number of Samples | Number of Detections | No. of Detections Greater than CV | Range of Detections Greater than CV (µg/L) | Comparison Values (CV), (µg/L) | Type of CV |
|---|---|---|---|---|---|---|
| Formaldehyde | 3 | 3 | 1 | 7000 | 3000 child<br>10,000 adult | Intm. EMEG |
| Phenol | 3 | 2 | 1 | 4000 | 3000 child<br>10,000 adult | RMEG |
| | | | | | 2000 | MCL |
| Sulfate | 3 | 3 | 0 | - na - | 250,000 | EPA[1] |
| Ammonia | 3 | 3 | 0 | - na - | 30,000 | EPA LTHA |
| Nitrate + Nitrite | 3 | 3 | 0 | - na - | 10,000 | MCL, MCLG |
| Copper | 3 | 2 | 0 | - na - | 100 child<br>400 adult | Intm. EMEG |
| | | | | | 1300 | MCL |
| Zinc | 3 | 3 | 0 | - na - | 3000 child<br>10,000 adult | Intm. EMEG |
| Barium | 3 | 3 | 0 | - na - | 2000 child<br>7000 adult | Intm. EMEG |
| Aluminum | 3 | 3 | 0 | - na - | 10,000 child<br>40,000 adult | Intm. EMEG |
| Iron | 3 | 3 | 0 | - na - | 26,000 | EPA RSL |
| Magnesium | 3 | 3 | 0 | - na - | - na - | No CVs available |
| Manganese | 3 | 3 | 0 | - na - | 500 child<br>2000 adult | RMEG |
| | | | | | 300 | LTHA |
| Sodium | 3 | 3 | 0 | - na - | 20,000 | EPA |
| Fluoride | 3 | 3 | 0 | - na - | 1500 | EPA |
| Chloroform | 1 | 1 | 0 | - na - | 1000 child<br>4000 adult | Intm. EMEG |
| | | | | | 80<br>70 | MCL<br>MCLG |
| Lindane [2] | 2 | 2 | 0 | - na - | 0.1 child<br>0.4 adult | Intm. EMEG |
| alpha-BHC [3] | 1 | 1 | 1 | 0.04 | 80 child<br>300 adult | Chronic EMEG |
| | | | | | 0.006 | CREG |

Notes: CV = Comparison value (ATSDR established screening values). Drinking water CVs used for analysis.
µg/L = micrograms per liter (parts per billion, "ppb")
J = estimated value
RMEG = Reference Dose Media Evaluation Guide
EMEG = Environmental Media Evaluation Guide
CREG = Cancer Risk Evaluation Guide
na = not applicable
Intm. EMEG = Intermediate EMEG
RSL = EPA Regional Screening Levels
LTHA = Lifetime Health Advisory for Drinking Water (EPA)
MCL = Maximum Contaminant Level for drinking water, EPA regulatory value
MCLG = Maximum Contaminant Level goal for drinking water, EPA non-regulatory value
[1] EPA Secondary Drinking Water Standard
[2] Reported as gamma-BHC (gamma-benzenehexachloride), same compound as gamma-hexachlorocyclohexane ("gamma-HCH"), also same compound as "Lindane"
[3] Reported as alpha-BHC (alpha-benzenehexachloride), same compound as alpha-hexachlorocyclohexane ("alpha-HCH")

**Table 8. Data summary and screening value analysis for groundwater discharging to Livingston Creek. Samples collected in 1989 down gradient and adjacent to the Wright Chemical Corp. NPL site. Table continued on next page.**

| Contaminant | Number of Samples | Number of Detections | No. of Detections Greater than CV | Range of Detections Greater than CV (µg/L) | Comparison Values (CV), (µg/L) | Type of CV |
|---|---|---|---|---|---|---|
| Aluminum | 3 | 3 | 3 | 18,000 – 860,000 | 10,000 child<br>40,000 adult | Intm. EMEG |
| Arsenic | 3 | 3 | 3 | 30 J – 1800 J | 3 child<br>10 adult | Chronic EMEG |
| | | | | | 0.02 | CREG |
| Barium | 3 | 3 | 0 | - na - | 2000 child<br>7000 adult | Intm. EMEG |
| Beryllium | 3 | 3 | 2 | 24 – 33 | 20 child<br>70 adult | Chronic EMEG |
| Chromium | 3 | 3 | 1 | 420 | 100 | MCL, MCLG |
| Cobalt | 3 | 3 | 1 | 150 J | 100 child<br>400 adult | Intm. EMEG |
| Copper | 1 | 1 | 1 | 1100 | 100 child<br>400 adult | Intm. EMEG |
| Iron | 3 | 3 | 3 | 250,000 – 390,000 | 26,000 | EPA RSL |
| Lead | 3 | 3 | 3 | 18 J – 720 J | 0 | MCLG |
| | | | | | 15 | MCL AL |
| Magnesium | 3 | 3 | - na - | - na - | - na - | No CVs available |
| Manganese | 3 | 3 | 2 | 1200 – 4200 | 500 child<br>2000 adult | RMEG |
| | | | | | 300 | LTHA |
| Nickel | 3 | 3 | 0 | - na - | 200 child<br>700 adult | RMEG |
| Potassium | 3 | 3 | - na - | - na - | - na - | No CVs available |
| Sodium | 3 | 3 | 3 | 85,000 – 650,000 | 20,000 | EPA |
| Vanadium | 3 | 3 | 3 | 250 – 1700 | 100 child<br>400 adult | Intm. EMEG |
| Zinc | 3 | 3 | 1 | 4100 | 3000 child<br>10,000 adult | Intm. EMEG |
| Carbon disulfide | 3 | 1 | 0 | - na - | 1000 child<br>4000 adult | RMEG |
| 1,1-Dichloroethane | 3 | 1 | - na - | - na - | - na - | No CVs available |
| 1,2-Dichloroethene [4] | 3 | 1 | 0 | - na - | 3000 child<br>10,000 adult | Intm. EMEG [5] |
| Methyl ethyl ketone (2-Butanone) | 3 | 1 | 0 | - na - | 6000 child<br>20,000 adult | RMEG |
| Trichloroethylene | 3 | 1 | 0 | - na - | 5 | MCL |

**Table 8, continued from the previous page. Data summary and screening value analysis for groundwater discharging to Livingston Creek. Samples collected in 1989 down gradient and adjacent to the Wright Chemical Corp. NPL site.**

| Contaminant | Number of Samples | Number of Detections | No. of Detections Greater than CV | Range of Detections Greater than CV (µg/L) | Comparison Values (CV), (µg/L) | Type of CV |
|---|---|---|---|---|---|---|
| Benzene | 3 | 1 | 1 | 1 J | 5 child<br>20 adult | Chronic EMEG |
| | | | | | 0.6 | CREG |
| Toluene | 3 | 2 | 0 | - na - | 200 child<br>700 adult | Intm. EMEG |
| Ethyl benzene | 3 | 1 | 0 | - na - | 5000 child<br>20,000 adult | Intm. EMEG |
| | | | | | 700 | MCL, MCLG |
| Thiobismethane (Dimethyl sulfide) | 3 | 1 | - na - | - na - | - na - | No CVs available |
| Phenol | 3 | 1 | 0 | - na - | 3000 child<br>10,000 adult | RMEG |
| | | | | | 2000 | MCL |
| Naphthalene | 3 | 1 | 0 | - na - | 6000 child<br>20,000 adult | Intm. EMEG |
| | | | | | 0.006 | CREG |

Notes: CV = Comparison value (ATSDR established screening values). Drinking water CVs used for analysis.
µg/L = micrograms per liter (parts per billion, "ppb")
J = estimated value
RMEG = Reference Dose Media Evaluation Guide
EMEG = Environmental Media Evaluation Guide
CREG = Cancer Risk Evaluation Guide
na = not applicable
Intm. EMEG = Intermediate EMEG
RSL = EPA Regional Screening Levels
LTHA = Lifetime Health Advisory for Drinking Water (EPA)
MCL AL = Maximum Contaminant Level for drinking water, EPA regulatory value
MCLG = Maximum Contaminant Level goal for drinking water, EPA non-regulatory value
AL = Action Level
[1] EPA secondary Drinking Water Standard
[2] Reported as gamma-BHC (gamma-benzenehexachloride), same compound as gamma-hexachlorocyclohexane ("gamma-HCH"), also same
compound as "Lindane"
[3] Reported as alpha-BHC (alpha-benzenehexachloride), same compound as alpha-hexachlorocyclohexane ("alpha-HCH")
[4] Use CVs for trans-1,2-dichloroethene

**Table 9. Exposure dose estimates and health guideline comparison for surface soil and sediment samples collected in April 2007 in the 38-acre northern area (site of former sulfuric acid plant) of the Wright Chemical Corp. NPL site. Dose estimates are for incidental ingestion during site-specific "recreational / trespasser" exposure situations.**

| Contaminant | Calculated Maximum Exposure Dose (mg/kg-d) [1] | Health Guideline / Type [2] (non-cancer) (mg/kg-d) | Are non-cancer harmful health effects indicated? [3] |
|---|---|---|---|
| **Surface Soil** | | | |
| Antimony | 0.000025 child<br>0.000011 adult | 0.0004 EPA Chronic | NO |
| Arsenic | 0.00026 child<br>0.00012 adult | 0.005 Acute MRL | NO |
| Cadmium | 0.000012 child<br>0.0000056 adult | 0.00005 Intermediate MRL | NO |
| Copper | 0.00026 child<br>0.00012 adult | 0.01 Intermediate MRL | NO |
| Iron | 0.11 child<br>0.049 adult | 0.70 EPA $RfD_{oral}$ | NO |
| Lead | 0.0029 child<br>0.0013 adult | - na - | NO |
| **Livingston Creek Sediment** | | | |
| Arsenic | 0.0000087 child<br>0.0000040 adult | 0.005 Acute MRL | NO |
| Lead | 0.00014 child<br>0.000064 adult | - na - | NO |

Notes:
[1] Child is defined as 1-6 years of age
[2] Alternative health guideline values are identified by source when there is no ATSDR value
[3] Assessment of the potential for adverse health effects is based on a very limited number of samples available at the time of this evaluation.
ATSDR = Agency for Toxic Substances and Disease Registry
EPA = U.S. Environmental Protection Agency
MRL = Minimum Risk Level, ATSDR health guideline value
mg/kg-d = milligrams per kilogram per day
HG = Health Guideline value
na = not applicable
RfD = Oral Reference Dose

**Table 10. Exposure dose estimates and health guideline comparison for Livingston Creek surface water samples collected in 1990 downstream of the Wright Chemical Corp. NPL site. Dose estimates are for child incidental ingestion during site-specific "recreational / trespasser" exposure situations.**

| Contaminant | Calculated Maximum Child Exposure Dose (mg/kg-d) [1] | Health Guideline / Type [2] (non-cancer) (mg/kg-d) | Are non-cancer harmful health effects indicated? |
|---|---|---|---|
| Formaldehyde | 0.0015 | 0.3 Intermediate MRL | NO |
| Phenol | 0.00086 | 0.3 Chronic MRL | NO |
| alpha-BHC [4] | $8.6 \times 10^{-9}$ | 0.008 Chronic MRL | NO |

Notes: [1] Child is defined as 1-6 years of age
[2] Alternative health guideline values are identified by source when there is no ATSDR value
[3] Assessment of the potential for adverse health effects is based on a very limited number of samples available at the time of this evaluation.
[4] Reported as alpha-BHC (alpha-benzenehexachloride), same compound as alpha-hexachlorocyclohexane ("alpha-HCH")
ATSDR = Agency for Toxic Substances and Disease Registry
EPA = U.S. Environmental Protection Agency
MRL = Minimum Risk Level, ATSDR health guideline value
mg/kg-d = milligrams per kilogram per day
HG = Health Guideline value
na = not applicable
RfD = Oral Reference Dose

**Table 11. Exposure dose estimates and health guideline comparison for groundwater discharging to Livingston Creek adjacent to the Wright Chemical Corp. NPL site. Groundwater collected in 1989. Dose estimates are for child incidental ingestion during site-specific "recreational / trespasser" exposure situations.**

| Contaminant | Calculated Maximum Child Exposure Dose (mg/kg-d) [1] | Health Guideline / Type [2] (non-cancer) (mg/kg-d) | Are non-cancer harmful health effects indicated? [3] |
|---|---|---|---|
| Aluminum | 0.18 | 1 Intermediate MRL | NO |
| Arsenic | 0.00039 | 0.005 Acute MRL | NO |
| Beryllium | $7.1 \times 10^{-6}$ | 0.002 Chronic MRL | NO |
| Chromium | 0.000090 | 0.005 Intermediate MRL | NO |
| Cobalt | 0.000032 | 0.01 Intermediate MRL | NO |
| Copper | 0.00024 | 0.01 Intermediate MRL | NO |
| Iron | 0.084 | 0.70 EPA RfD | NO |
| Lead | 0.00016 | - na - | NO |
| Manganese | 0.00090 | 0.05 Chronic MRL | NO |
| Sodium | 0.14 | - na - | NO |
| Vanadium | 0.00037 | 0.01 Intermediate MRL | NO |
| Zinc | 0.00088 | 0.03 Intermediate MRL | NO |
| Benzene | $2.2 \times 10^{-7}$ | 0.005 Chronic MRL | NO |

Notes: [1] Child is defined as 1-6 years of age
[2] Alternative health guideline values are identified by source when there is no ATSDR value
[3] Assessment of the potential for adverse health effects is based on a very limited number of samples available at the time of this evaluation.
EPA = U.S. Environmental Protection Agency
MRL = Minimum Risk Level, ATSDR health guideline value
mg/kg-d = milligrams per kilogram per day
HG = Health Guideline value
na = not applicable
RfD = Oral Reference Dose

**Table 12. Summary of increased cancer risk estimates for Wright Chemical Corp. NPL site samples. Risk estimates as the estimated number of additional cancers for the indicated number of persons exposed to contaminated site material.**

| Contaminant | Cancer Slope Factor (CSF), 1/(mg/kg-d) | Estimated Increase Cancer Risk Estimate (cancer cases per number persons exposed) | Increased Cancer Risk |
|---|---|---|---|
| **Surface Soil** | | | |
| Arsenic | 1.5 | 8/100,000 | Low |
| **Sediment** | | | |
| Arsenic | 1.5 | 3/1 million | Very Low |
| **Surface Water** | | | |
| alpha-BHC [1] | 6.3 | Less than 1/1 million | No Increase |
| **Groundwater [2]** | | | |
| Arsenic | 1.5 | 6/10,000 [2] | Moderate [2] |
| Benzene | 0.055 | Less than 1/1 million | No Increase |

Notes: [1] Reported as alpha-BHC (alpha-benzenehexachloride), same compound as alpha-hexachlorocyclohexane ("alpha-HCH")
[2] Estimated cancer risks assume no dilution of groundwater at Livingston Creek. No risk indicated after dilution of groundwater with surface water
mg/kg-d = milligrams per kilogram per day

**Appendix D**

**N.C. DPH**
**Fish Consumption Advisory**
**Fact Sheet for Mercury**

# What Fish Are Safe To Eat?

## Advice on Eating Fish

From the North Carolina Division of Public Health

Most fish are good to eat and good for you - high in protein and other nutrients, and low in fat. But some kinds of fish contain high amounts of mercury, which can cause health problems in people, especially children. To help you make the healthiest choices, North Carolina offers the following advice. For more information, see www.epi.state.nc.us/epi/fish/ or call (919)707-5900.

**Avoid or limit fish consumption based on the following:**

| **Women of childbearing age (15 to 44 years), pregnant women, nursing mothers and children under age 15** | **All other people** |
|---|---|
| Do not eat fish from the HIGH in mercury list. | Eat only 1 meal of fish per week from the HIGH in mercury list. |
| Eat up to 2 meals per week of fish from the LOW in mercury list. | Eat up to 4 meals of fish per week from the LOW in mercury list. |

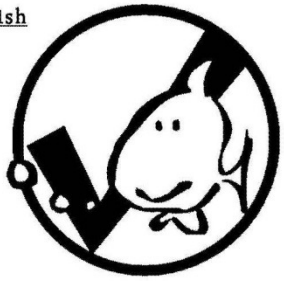
### Eat Fish **LOW** in mercury

**Ocean Fish**

Black drum
Canned light tuna
Cod
Crab
Croaker
Flounder
Haddock
Halibut
Herring
Jacksmelt
Lobster
Mahi-mahi
Ocean perch
Oysters
Pollock
Pompano
Red drum
Salmon (canned, fresh or frozen)
Scallops
Sheepshead
Shrimp
Skate
Southern kingfish (sea mullet)
Spot
Speckled trout (spotted sea trout)
Tripletail
Whitefish
White grunt

**Freshwater Fish**

Bluegill sunfish
Farm-raised catfish
Farm-raised trout
Farm-raised crayfish
Tilapia
Trout



### Avoid Fish **HIGH** in mercury

**Ocean Fish**

Albacore (white) tuna** fresh or canned
Almaco jack
Banded rudderfish
Cobia
Crevalle jack
Greater amberjack
South Atlantic grouper (gag, scamp, red and snowy)
King mackerel
Ladyfish
Little tunny
Marlin
Orange roughy
Shark
Spanish mackerel
Swordfish
Tilefish
Tuna, fresh or frozen**

**Freshwater Fish**

Blackfish (bowfin)*
Black crappie***
Catfish (caught wild)*
Jack fish (chain pickerel)*
**Largemouth bass (statewide)**
Walleye in Lake Fontana & Lake Santeetlah (Graham & Swain counties)
Warmouth*
Yellow perch*

*High mercury levels have been found in blackfish (bowfish), catfish, jack fish (chain pickerel), warmouth, and yellow perch caught south and east of Interstate 85.
**Different species from canned light tuna
***High mercury levels have been found in black crappie caught south and east of Interstate 95.

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Occupational & Environmental Epidemiology ▲ www.ncpublichealth.com
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## Appendix E

## Photographs from June 2011 Site Visit

**Photo 1. Former sulfuric acid plant location on the Wright Chemical Corp. NPL site, located outside fenced manufacturing area. Source N.C. HACE/DPH, June 2011.**

**Photo 2. Looking north out over the 38-acre northern parcel of the Wright Chemical Corp. NPL site. Source N.C. HACE/DPH, June 2011.**

**Photo 3. Livingston Creek adjacent to Wright Chemical Corp. NPL site. Source N.C. HACE/DPH, June 2011.**

# Appendix F

# The ATSDR Health Effects Evaluation Process

## THE ATSDR HEALTH EFFECTS EVALUATION PROCESS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Ingestion of contaminants present in drinking water**

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

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

Where:

$ED_w$ = exposure dose water (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated medium (liters/day)
AF = bioavailability factor (unitless, i.e., 1% = 0.01)
EF = exposure factor
BW = body weight (kilograms)

**Ingestion of contaminants present in soil**

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

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

Where:

$ED_s$ = exposure dose soil (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated medium (kilograms/day)
AF = bioavailability factor (unitless, i.e., 1% = 0.01)
EF = exposure factor (unitless)
BW = body weight (kilograms)

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

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

Where:

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

**Inhalation (breathing) of contaminants present in air**

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

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

Where:

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

**Calculations of Contaminant Exposures During Showering**

When showering in contaminated water a person may be exposed to the chemicals in the water by breathing a portion of the chemical that comes out of the water into the air (inhalation exposure), or by absorbing the chemical from the water through their skin (dermal exposure). Inhalation and dermal exposures to volatile organic compounds (VOCs) in the shower or bath may be equal to or greater than exposures from drinking the contaminated water. ATSDR uses conservative assumptions to estimate "worst case" exposures to VOCs during showering with contaminated water. The maximum concentration of VOC in the bathroom air is estimated with the following equation (Andelman 1990).

$$C_a = (C_w \times f \times F_w \times t)/V_a$$

Where:

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

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

Health guidelines represent daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during the specified exposure duration. The potential for adverse health effects exists under the representative exposure conditions if the estimated site-specific exposure doses exceed the health guidelines and they are retained for further

evaluation. A MRL is an estimate of daily human exposure to a substance (in milligrams per kilogram per day [mg/kg/day] for oral exposures) that is likely to be without non-cancer health effects during a specified duration of exposure. Exposures are based on the assumption a person is exposed to the maximum concentration of the contaminant with a daily occurrence.

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

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

**Polynuclear Aromatic Hydrocarbons (PAHs)**

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

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

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

Where:

$PAH_{BaP\text{-}eq}$ = Benzo(a)pyrene equivalent TEF adjusted PAH compound concentration, mg/kg

$PAH_{conc}$ = concentration of PAH compound, mg/kg

TEF = = Toxicity Equivalency Factor for PAH compound, unitless

Combined Cancer $Risk_{PAHs}$ = Summed cancer risk of all detected PAH compounds

$\sum PAH_{adj}$ = summed TEF-adjusted concentrations of all detected PAH compounds, mg/kg

CSF = Cancer Slope Factor, mg/kg-d

**PAH Toxicity Equivalency Factors ("TEFs")**

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

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

**Cancer Health Effect Evaluations**

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

The estimated cancer risk calculation is:

$$\text{Estimated Cancer Risk} = \text{Dose} \times \text{CSF}$$

or

$$\text{Estimated Cancer Risk} = \text{Air Concentration} \times \text{IUR}$$

Where:

| | |
|---|---|
| Estimated Cancer Risk | = Expression of the cancer risk (unitless) |
| Dose | = Site-specific cancer dose (mg/kg/d) |
| Air Concentration | = Site-specific air concentration ($\mu g/m^3$) |
| CSF | = Cancer Slope Factor ($[mg/kg/d]^{-1}$) |
| IUR | = Inhalation Unit Risk ($[\mu g/m^3]^{-1}$) |

The N.C. Central Cancer Registry states:

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

*Many people do not realize how common cancers are. It is estimated that <u>one</u> out of every <u>two</u> men and <u>one</u> out of every <u>three</u> women will develop a cancer of some type during his or her lifetime. As a result, it is common to find what appear to be cancer cases clustering in neighborhoods over a period of years. This will occur in any neighborhood. As people age,*

*their chance of getting cancer increases, and so as we look at a community, it is common to see increasing numbers of cancer cases as the people in the community age.*

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

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

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

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

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

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

## Limitations of the Health Evaluation Process

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

## Assessment of Chemical Interactions

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

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

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

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

$$HI = HQ_1 + HQ_2 + HQ_3 + .... HQ_n$$

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

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

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

**Reference:**

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

## Appendix G

## Response to Comments

**Response to Public Comments**

The *Wright Chemical Corporation NPL Site Public Health Assessment* was released as an *Initial/Public Comment Release* draft on February 1, 2012. Copies were made available to members of the local community, Columbus County N.C. officials, the N.C. DENR, and the U.S. EPA. The PHA was made available on the N.C. DPH HACE program and ATSDR web sites. Copies were also provided to the East Columbus Public Library, Riegelwood, NC. A press release notice of the release of the draft PHA and comment period was distributed to local media. A 60-day public comment period was provided from February 2 through April 2, 2012. Excerpts of the comments and N.C. DPH responses follow.

Written comments were received from:

- 2 members of the community
- the U.S. Environmental Protection Agency (EPA)
- the N.C. Department of Environmental and Natural Resources (DENR) Division of Waste Management (DWM)
- Momentive Specialty Chemicals Inc., Riegelwood, N.C.
- Silar Laboratories, Wilmington, N.C.

**A. Comments from community members:**

1. *Public Comment:* Comments were received from a former community member that had been employed at the Wright Chemical facility for a summer job in 1967. They indicated that they had suffered a rash on their arms and face they associated with handling hexamine and formaldehyde, as well as eye and respiratory irritation following formaldehyde tank breaches. They indicated that the hexamine and alum spills and formaldehyde or "acid" tank breaches were not actively contained or remediated.

   *N.C. DPH response:* N.C. DPH sympathizes with your concern for your possible negative and long-term impacts to your health that may have been a result of your employment at Wright Chemical Corp. Unfortunately, we have no way to determine the extent of your exposure and potential health impacts that may have occurred during your employment. N.C. DPH recommends that you make all your health-care providers aware of the specific chemicals or products you may have been exposed during your employment at Wright Chemical, as well as other potential chemical exposures associated with other places of employment or recreational activities. This will enable your health-care providers to take a pro-active approach to monitoring for and treating any potential adverse health effects. Persons may have their Physicians contact N.C. DPH or the Association of Occupational and Environmental Clinics [http://www.aoec.org/] for consultation.

   Studies indicate that low levels of formaldehyde can cause irritation of the eyes, nose, throat and skin [http://www.atsdr.cdc.gov/toxfaq.html]. The U.S. Department of Health and Human Services has identified formaldehyde as a "known human carcinogen" by the inhalation (breathing) route.

Symptoms noted for hexamine exposure include a cough following inhalation, redness and pain with skin or eye exposure, and abdominal pain, nausea and vomiting with ingestion [PAN (Pesticide Action Network) Pesticide Database, accessed May 15, 2012, http://www.pesticideinfo.org/].

2. *Public Comment:* The commenter noted a concern with a decrease in the mink population in the Cape Fear River area and questioned if the mink decline was an indication of adverse environmental effects accumulated through the food chain, including fish. The commenter indicated that the mink population was being studied by researchers at North Carolina State University. In addition to the mink decline, they noted concerns of health problems in the area including "birth defects, Downs [syndrome], inexplicable cancers, etc."

   *N.C. DPH response:* While minks are not a human food source and exposure point, it is possible for species such as mink to serve as "early warning systems" of accumulated adverse environmental effects, such as with the "canary in the mine" used to detect poisonous gases. There is no indication that the mink decline would be associated with releases from the Wright Chemical site. There likely will be no way to determine if the decline in the mink population is directly related to chemicals from the Wright Chemical NPL site, or to other environmental impacts in the area surrounding their habitat range. N.C. DPH will contact the mink researchers at NCSU to learn what they think is the reason for the mink population decline and to obtain any chemical analyses of mink tissues that may be available. N.C. DPH will use this information, if available, to determine if the mink may provide an indication of potential threats to human health. Possible explanations of the mink decline may include loss of suitable habitat and/or exposure to environmental contaminants, including mercury, in their diet which includes fish and other aquatic organisms that result in reduced reproductive rates.

**B. Comments from N.C. DENR:**

3. *Comment:* The Wright Chemical Corporation site was added to the National Priorities List ("NPL") in March 2010.

   *N.C. DPH response:* Text was corrected.

4. *Comment:* Text in *Site Description and History* section does not reflect correct ownership history of the 80-acre parcels designated in the NPL siting.

   *N.C. DPH response:* The *Introduction*, *Purpose and Health Issues*, and *Site Description and History* sections have been re-written to reflect corrected and updated information provided by U.S. EPA, Momentive Specialty Chemicals, and Silar Laboratories regarding the ownership and operations history of the area designated in the original NPL siting, as well as the adjacent manufacturing operations and properties.

**C. Comments from U.S. EPA:**

5. *Comments*: EPA identified that the site description in the *Public Comment Release PHA* did not correctly define the initial 80-acre area specified in the site proposal to the National Priorities List (NPL). EPA also commented that the full extent of the area to be included as the Wright Chemical Corp. NPL site has not been defined and will depend on

continuing investigations to fully define the nature and extent of the contaminated areas associated with historical chemical manufacturing operations. The text of the updated site description provided by EPA on March 5, 2012 follows:

*The Wright Chemical Corporation Superfund Site (Site) is located in an industrial/rural area of Riegelwood, North Carolina, adjacent to tidal wetlands along Livingston Creek, a tributary of the Cape Fear River. The Site consists, generally, of the former Wright Chemical Corporation fertilizer, sulfuric acid manufacturing operations, and specialty chemical manufacturing operations, along with the areal extent of contamination. The Site is part of a larger property consisting of approximately 760 acres with a regional rail corridor running through it. The portion of the Site that lies north of the rail corridor contains two former sulfuric acid manufacturing plants (one of which once thermally extracted sulfur from pyrite, the other manufactured sulfuric acid using elemental sulfur), an acid equalization pond, approximately four impoundments (known as the spill basin, the aeration pond, the resin pond, and outfall pond), two spray irrigation fields use to dispose waste water, a waste pile (known as the "monofill"), and three lined lagoons (known as "Kelly ponds"). The portion of the Site that lies south of the rail corridor once held an acid phosphate fertilizer manufacturing plant.*

*Acme Fertilizer Company (Acme) owned and operated both the sulfuric acid manufacturing plant north of the rail corridor and the acid phosphate fertilizer plant south of the rail corridor from the 1880s to the 1960s. Wright Chemical Corporation, n/k/a William Gilchrist Wright Properties, Inc. (Wright), took over operation of the northern acid plant in 1959 and subsequently constructed a second sulfuric acid plant approximately 300 feet to the east. The second acid plant reportedly operated until 1991. Wright constructed additional facilities on the northern portion of the Site to manufacture specialty chemicals, including formaldehyde, hexamine and chloropicrin. Kaiser Aluminum and Chemical Corporation (Kaiser) took over operations on the southern plant from the 1960's through the early 1980's. Wright merged with Acme in 1968 and became owner and operator of the Site.*

*On November 15, 2004, Oak Bark Chemical Corporation acquired all of the Wright property. Oak Bark, a specialty chemical producer, was formed as a result of a management buyout of the Wright Chemical Corporation. Oak Bark is a current owner and operator at the Site. On November 24, 2006, Hexion Specialty Chemicals, Inc., n/k/a Momentive Specialty Chemicals Inc. (Momentive), acquired a portion of the Site. Momentive is a current owner and operator, producing specialty chemicals at the Site. Koch Sulfur Products Company, n/k/a Koch Industries (Koch), leased a portion of the Site facility during the 1990s and is a former operator at the Site. Silar LLC (Silar), an organic chemical manufacturer, currently leases a portion of Site and is a current operator at the Site.*

*Sampling conducted during the Preliminary Assessment and Site Inspection (PA/SI) indicates the soil between the former acid plant on the northern parcel and the surface water pathway of Livingston Creek is contaminated with arsenic, lead, mercury and the pesticides dieldrin and gamma-chlorane. The source area drains to Livingston Creek, a freshwater creek that flows into the Cape Fear River. It contains*

*a fishery and wetlands. Sampling has revealed metals and pesticide contamination in Livingston Creek sediments as well as in clam and fish tissue. In 1997, a groundwater assessment of the Site revealed a groundwater plume of elevated sulfate, iron, and TDS existed at the Site. Groundwater data provided by Oak Bark in 2009 indicates groundwater contamination on the portion of the Site north of rail corridor with ammonia, sulfate, nitrate, lead, arsenic, formaldehyde and methanol. Sampling conducted in 1984 by EPA during an investigation of the Kaiser facility to the south of the rail corridor also revealed contamination by arsenic, cadmium, copper, lead, and zinc.*

*N.C. DPH response:* N.C. DPH has made substantial modifications to the Final Release version of the PHA to reflect the information provided by the EPA on the NPL site history and by Momentive Specialty Chemicals and Silar Laboratories and that of the adjacent chemical manufacturing operations and ownership.

**C. Comments from Momentive Specialty Chemicals:**

Momentive noted errors in the in the *Public Comment Release PHA* text regarding historical and current ownership descriptions of the properties identified as the original 80-acre area designated in the NPL siting, Momentive's facility and the adjacent properties. N.C. DPH modified the text of the Final Release PHA to correct these inaccuracies. Momentive representatives were provided an opportunity to review this text prior to publication of the *Final Release PHA*. Additional specific comments provided by Momentive on the *Public Comment Release PHA* were:

6. *Momentive comment:* There are no documented spills and unpermiteed discharges to Livingston Creek from Momentive's operations.

   Since Momentive (then Hexion) acquired its Acme (Riegelwood), NC operations in late 2006, the company has made significant efforts to improve the environmental condition of the Momentive Facility and associated operations. The Momentive Facility does not include the area that was historically operated as a sulfuric acid plant. Additionally, Momentive's operations are not the source of metals or pesticide releases that were the basis for the Wright Chemical Corporation NPL listing. We are disappointed that the Report, which was distributed to the public, incorrectly identifies Momentive as the primary owner of the WCC Site.

   *N.C. DPH response:* The spills and unpermitted discharges referenced in the *Public Comment Release PHA* were related to historical operations on the Wright Chemical Corp. site and not associated with Momentive's current operations.

7. *Momentive comment:* The first conclusion as summarized is incomplete and should include that available information does not indicate adverse health effects. The Report concludes on page 26 that the available information does not indicate the potential for adverse health effects, although the DPH does not believe the available information is adequate to conclude for sure. See also page 24 ("Based on the limited available environmental data, there is no evidence that persons have been exposed to the site contaminants at levels that could elicit detectable health impacts."). However, the conclusion in the executive summary includes only the portion that states that the

available information is insufficient to conclude for sure. It does not include that the information that is available does not indicate the potential for adverse health effects. The failure to include this information makes the summary of conclusion 1 incomplete and unnecessarily alarmist. As it is likely that members of the public may read only the summary and not the entire report, it is critical that the summary provide a complete and accurate representation of the conclusions of the Report. The statement from the conclusion on page 24 quoted above should be included in the summary.

*N.C. DPH response:* Conclusion 1 is appropriate given the specific circumstances for data availability at the time this health assessment was completed. An additional clarifying statement was added to further explain the basis of decision for Conclusion 1.

8. *Momentive comment:* There is no factual basis upon which to suggest that Momentive's operations have or are contributing to environmental exposures to persons in the area. While Momentive agrees that the health assessment is not intended to evaluate exposures associated with ongoing manufacturing operations outside of the WCC Site, there is no basis to conclude that current industrial operations could be contributing to environmental exposures. This conclusion should be removed, or at the least clarified.

   *N.C. DPH response:* The unique industrial history of the area surrounding the Wright Chemical Corp. NPL site was discussed because it may not be possible to associate some observed or suspected adverse health effects with specific historical operations. We believe that any health investigations in this area of the county must include the breadth of potential historical environmental exposures and their potential ecological and human health impacts on the overall health of community members.

9. *Momentive comment: There is no factual basis for Conclusion 2.* The purpose of the Report, as outlined on page 5, is to determine if the WCC Site presents a health hazard to the community. As the Report itself acknowledges, there is no linkage between the WCC Site and mercury levels identified in fish. In fact, the Report presents no evidence at all indicating that the WCC Site is a source of mercury. See, for example, page 21 :

   > The source of the elevated mercury in fin–fish collected in the vicinity of the WCC site is not known. It may be related to local sources or regional atmospheric deposition sources. There is no data to indicate that the elevated mercury concentrations found in the regional fish samples are related to the site.

   As such, there is no factual basis for including this conclusion in the Report and it should be removed.

   *N.C. DPH response:* We feel that addressing any and all public health issues identified during the course of a health assessment is appropriate, including those that we can not associate to a specific source being evaluation. While the elevated environmental contaminants observed in the fish tissue data may not be linked to the WCC NPL site, it is important that we make sure the community has the best available information to protect their health, understand the fish / shellfish exposure pathway and the potential harm to sensitive populations (women 15-44 years old and children).

10. *Momentive comment:* Purpose and Health Issues (page 5): *The information regarding the land owned by Momentive is incorrect.* As explained above, Momentive owns only a portion of the currently operating specialty chemicals manufacturing operations. Both Oak Bark and Silar also operate current manufacturing operations on land owned by Oak Bark. Momentive does not own 45-acres. The reference to Momentive should be removed from the first paragraph.

    *N.C. DPH response:* See the response for Comment 5 above.

11. *Momentive comment:* Site Description and History (pages 6-8): The information in this section regarding Momentive is incorrect and should be revised.

    As described above, Hexion Specialty Chemicals changed its name to Momentive Specialty Chemicals in 2010 - the corporate entity remained the same and there was no purchase. Further, Momentive/Hexion has never owned the property upon which the Silar Laboratories silanes-business is located.

    The second paragraph on page 6 states that uncontrolled surface water run-off from the WCC Site flows directly into Livingston Creek and its associated wetlands. It should be noted that all surface water run-off from the Momentive Facility is subject to North Carolina storm water discharge permit number NCS000156, including best management practice control requirements.

    Additionally, none of the former sulfuric acid manufacturing operations were conducted on land currently owned by Momentive and none of the soil samples analyzed in 2007 was collected from land currently owned by Momentive. Finally, the areas characterized by a lack of vegetation and magenta/purple colored soil are not located on land owned by Momentive.

    The statement on page 7 regarding Momentive Performance Materials Holdings LLC is also incorrect. Momentive Performance Materials Holdings LLC became the ultimate parent company of Momentive Specialty Chemicals in 2010, but ownership of the Momentive Facility has always been held by Momentive Specialty Chemicals Inc. (previously under the name Hexion Specialty Chemicals, Inc.).

    Finally, there are no documented spills or unpermitted discharges to Livingston Creek from the Momentive/Hexion operations.

    *N.C. DPH response:* See the response for Comment 5 above.

12. *Momentive comment:* Current Site conditions (page 8): The information regarding the current operations is incorrect and should be revised.

    As indicated above, the Momentive Facility consists of approximately 19.7 acres. In addition, both Oak Bark and Silar have currently operating specialty chemical manufacturing facilities adjacent to the Momentive Facility. As indicated above, overland run-off from the Momentive Facility is subject to a NC storm water permit, which includes best management practice controls.

*N.C. DPH response:* See the response for Comment 5 above.

**D. Comments from Silar, LLC:**

Silar Labs has operated in the vicinity of the Wright Chemical Corporation Superfund Site ("Site") since 1993, and not since 1972 as the PHA states. Wright Chemical purchased Silar Labs in 1990 and built the Silar Labs facility in 1993. Thomas H. Wright lll then sold Wright Chemical to Oak-Bark Corporation ("Oak-Bark") on December '1", 2004. Oak-Bark continued to operate as Wright Chemical until December 1tt, 2006, when Oak-Bark sold the formaldehyde, hexamine, and resins businesses, along with the real property associated with production, administration, and maintenance of those businesses, to Hexion (now, Momentive). Oak-Bark retained ownership of the remaining Wright Chemical real property. In 2009, Oak-Bark sold Silar Labs to MPD Holdings, parent company to Silar, and Silar has operated Silar Labs since Apri1 22, 2009. Oak-Bark retained ownership of the real property upon which Silar Labs operates, and Silar leases a 6.5 acre parcel from Oak-bark to continue the Labs' operations.

*N.C. DPH response:* See the response for Comment 5 above.

## Appendix H

## Glossary

## Glossary

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

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

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

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

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

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

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

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

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

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

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

**Carcinogen**
A substance that causes cancer.

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

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

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

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

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

**Completed exposure pathway** [see exposure pathway].

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

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

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

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

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

**Dose** (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An

"exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

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

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

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

**EPA**
United States Environmental Protection Agency.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Metabolite**
Any product of metabolism.

**mg/kg**
Milligram per kilogram.

**Migration**
Moving from one location to another.

**Minimal risk level (MRL)**
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

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

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

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

**PCBs** [see Polychlorinated biphenyls]

**Plume**
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

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

**Polychlorinated biphenyls (PCBs)**
Polychlorinated biphenyls are mixtures of up to 209 individual man-made chlorinated chemical compounds (known as congeners). PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

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

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

**ppb**
Parts per billion.

**ppm**
Parts per million.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**RfD See reference dose**

**Risk**
The probability that something will cause injury or harm.

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

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

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

**Safety factor** [see uncertainty factor]

**SARA** [see Superfund Amendments and Reauthorization Act]

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

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

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

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

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

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

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

**Substance**
A chemical.

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

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

**Tentatively Identified Compounds (TICs)**
A method to identify organic compounds in EPA GC/MS analytical methods for hazardous waste sites. TIC analysis is used to identify chemicals that may be in samples that are not among the compounds listed in the analytical methods that are to be identified and quantified. The chemical identification of a TIC is not absolute and the concentration is an estimated value.

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

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

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

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

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

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