



WATAUGA COUNTY

2007 COMMUNITY HEALTH ASSESSMENT

Volume Two: Environmental Data

**Final Technical Report
October, 2007**



North Carolina Institute for Public Health



WATAUGA COUNTY

2007 COMMUNITY HEALTH ASSESSMENT

Volume Two: Environmental Data

**Final Technical Report
October, 2007**

by

**Sheila S. Pfaender, M.S.
Senior Analyst**

**Elizabeth Nelson, M.P.H.
Research Assistant**

Table of Contents

Introduction	7
Chapter One: Water Quality	8
Surface Water	8
Watersheds	12
Water Quality in the Watauga River Basin	14
Water Quality in the New River Basin	15
Water Quality in the Yadkin-Pee Dee River Basin	16
Water Quality in the Catawba River Basin	16
Impaired Water Bodies in Watauga County	17
Ambient Monitoring System Data	18
Fish Kills	19
Fish Consumption Advisories	19
Groundwater	20
Bacteria in Well Water	20
Groundwater Incidents	20
Chapter Two: Air Quality	21
Outdoor Ambient Air	21
Criteria Air Pollutants	21
Annual CAP Maxima	22
Air Quality Index	23
EPA Air Quality Non-Attainment Areas	25
Vehicle Inspection Mandates	26
Vehicle Miles Driven	26
Vehicles Powered by Alternative Fuel	26
Mass Transportation	27
Hazardous Air Pollutants	27
Indoor Ambient Air	29
Carbon Monoxide	29
Carbon Monoxide Poisoning Deaths	29
Radon	30
Environmental Tobacco Smoke	31
Indoor Air Regulations and Policies	33
Smoke-Free Workplaces	33
School-Focused Policies	34
Tobacco-Free Schools	34
The Northwest Tobacco Prevention Coalition	34

Health Effects of Air Pollution	35
Sick Building Syndrome/Building-Related Illness	35
Asthma	36
Asthma Mortality	37
Asthma Morbidity	37
Cardiovascular and Respiratory Events	38
Chapter Three: Toxic Chemical Releases	39
Toxic Release Inventory	39
Land Contamination	40
Superfund Sites	40
Brownfields	40
Inactive Hazardous Sites	41
Hazardous Substances Emergency Events	41
Chapter Four: Lead Hazards	43
Housing Units at Risk	43
Childhood Blood Lead Levels	43
Chapter Five: Agricultural Pollution	45
Watauga County Agricultural Census	45
Pesticides	46
Pesticide Usage on Crops	46
Health Effects of Pesticides	47
Pesticide Residues in Food	47
Pesticide-Related Poisonings	47
Viticulture	47
Horticulture	49
Agricultural Animal Waste	51
Chapter Six: Waste Management	53
Solid Waste Management	53
Landfills, Waste Drop-Off, and Recycling	53
Wastewater Management	53
On-Site Wastewater Management	54
Chapter Seven: Drinking Water	55
Water Usage	55
Drinking Water Systems	55
Drinking Water Standards Violations	56

Chapter Eight: Food-, Water- and Vector-Borne Diseases	58
Arboviral Diseases	58
Rabies	60
References	61

List of Tables

Table 1. Watauga County Clean Water Act Status, 1998	9
Table 2. Watauga County Leading Sources of Water Quality Impairment, 1998	11
Table 3. Bioclassification of Water Bodies located in Watauga County.....	17
Table 4. DWQ Ambient Monitoring System stations in Watauga County	18
Table 5. National Ambient Air Quality Standards.....	21
Table 6. Health and Environmental Effects of Criteria Air Pollutants	22
Table 7. North Carolina Annual High Levels of Criteria Air Pollutant Emissions, 2005.....	23
Table 8. General Health Effects and Cautionary Statements, Air Quality Index..	23
Table 9. Watauga County Criteria Air Pollutant Emissions, in Tons, 1999.....	24
Table 10. Annual Vehicle Miles Traveled (in millions of miles), 2004.....	26
Table 11. Number of Vehicles in the US Powered by Alternative Fuels, 2002- 2004.....	27
Table 12. Lifetime Risk of Lung Cancer Death (per person) from Radon Exposure in the Home.....	31
Table 13. Prevalence of Cigarette Smoking Among Adults, and Children's Exposure to Environmental Tobacco Smoke, North Carolina and United States, Percent of Households except as noted, 1996.....	32
Table 14. BRFSS Results: Household Smoking Policies, Percent of Responses, 2004 and 2005.....	32
Table 15. Comparison of TRI Pollution, 2002.....	39
Table 16. Watauga County Lead Hazard Indicators, 1999	43
Table 17. Watauga County Childhood Lead Screening Results, Ages 1 and 2 years.....	44
Table 18. Watauga County Childhood Lead Screening Results, Ages 6 Months to 6 years	44
Table 19. Crops Grown in Watauga County, 2006.....	45
Table 20. Livestock Raised in Watauga County, 2002	46
Table 21. Cash Receipts in Watauga County, 2004	46
Table 22. Commonly Used Grape Pesticides.....	48
Table 23. Commonly Used Christmas Tree Pesticides	49
Table 24. Inventory of Livestock Animal Head and Waste Production for Watauga County, 1997 and 2002.....	51
Table 25. Percent of Total Livestock Number and Waste Production for Watauga County, 1997 and 2002.....	52
Table 26. Average Annual Rate of Water Usage, Watauga County, 1995 and 2000 (Millions of gallons per day).....	55
Table 27. Watauga County Community Water Systems (April, 2007)	56
Table 28. Watauga County Public Drinking Water Systems Reporting Health- Based Violations, 2000-2006	57
Table 29. Watauga County Reported Cases of Food-, Water-, and Vector- Borne Diseases in Humans, 2002-2005	58
Table 30. Watauga County Cases of Rabies in Animals, 2001-2006.....	60

Introduction

This volume presents an overview of data describing major features of the natural environment of Watauga County. It is intended to complement Volume I of the Watauga County Community Health Assessment, *Demographic, Socioeconomic and Health Data*, by describing the environmental context in which the people of Watauga County are living. An environmental assessment of this type has not been a part of the County's previous community health assessment process. Therefore, it does not serve as a trend document but rather as a baseline for future comparisons.

The information in this report is broadly based on the Center for Disease Control's (CDCs) list of environmental public health indicators (EPHIs). These indicators identify specific areas that should be evaluated in order to track environmental exposures and adverse health effects within a community. The report describes in general terms the quality of water, air, and land in Watauga County, using primarily data from the public domain supplemented by local data where appropriate and available. It lists the major contaminants and pollutants affecting ambient and drinking water quality and outdoor ambient and indoor air quality in the County, and names the sources of the pollutants. It describes chemicals and wastes affecting the County's land and soil, and describes municipal waste management and water and wastewater sanitation practices. The report also identifies community exposure to lead, pesticides, and toxics. Finally, it contains data on environment-related health issues such as water-, food- and vector-borne diseases.

Chapter One: Water Quality

One measure of a community's environmental health is the status of its waters as evaluated according to the process established by the Federal Clean Water Act of 1972. Water is a renewable resource, but clean water is in limited quantity; as the population continues to grow, the demand for clean water rises every year.

The Division of Water Quality (DWQ) in the NC Department of Environment and Natural Resources (DENR) operates the Ambient Monitoring System (AMS) in order to monitor and assess the State's water quality. The AMS consists of a network of stations established to provide site-specific, long-term water quality information on significant rivers, streams, and estuaries throughout the State (1). Program objectives include:

- To monitor water bodies of interest for determination of levels of chemical, physical, and bacterial pathogen indicators for comparison to a selection of the State's water quality standards and action levels.
- To identify locations where exceedances of water quality standards and action levels for physical and chemical indicators occur in more than 10% of samples/measurement (20% for coliforms).
- To identify long-term temporal or spatial patterns.

In response to the stipulations of Section 303(d) of the Clean Water Act, NC DWQ is charged with submitting a biennial report to the US Environmental Protection Agency (US EPA) that assesses water quality in North Carolina according to standards set by the State. This report traditionally describes the quality of surface waters, groundwaters, and wetlands, according to how well they support the designated uses (e.g., swimming, water supply) and what might be causes and sources of impairment for those designated uses. North Carolina conducts its water quality assessment and planning on a watershed-based schedule, with each of the State's existing 17 watershed basins being monitored once in a five-year rotation (2).

In order to understand water quality monitoring in North Carolina it is necessary first to understand the terminology and ecological and hydrogeological principles that apply.

Surface Water

A geographic area's surface waters are its fresh flowing water (rivers, streams and creeks), and its fresh standing waters (lakes, ponds and reservoirs). Also included among surface waters are the estuaries, bays and coasts of oceanic environments, which, of course, do not pertain to Watauga County. Surface waters serve many purposes that affect the quality of life in a community: sources of water for human and industrial consumption, sources of food, sites for recreation, routes for transportation and commerce, and sites for disposal of byproducts and wastes of manufacturing and sewage treatment.

As of 1998, Watauga County ranked among the 30% of counties in the nation with the cleanest surface waters (that is, having a low *percentage* of waters with threatened or impaired uses). However, when the *number* of water bodies in Watauga County that are actually impaired are compared to the rest of the nation, the County above the national average, indicating it has a higher quantity of impaired water bodies than 70% of the nation

(3). A water body is considered *impaired* if it does not attain minimum EPA water quality standards. Standards may be violated due to an individual pollutant, multiple pollutants, thermal pollution, or an unknown cause of impairment. A water body is considered *threatened* if it currently attains water quality standards but is predicted to violate minimum water quality standards by the time the next assessment is submitted to EPA (4).

According to the 1999 list of impaired waters, which was compiled on the basis of state data from 1997-1998, three percent of the surface waters in Watauga County had reported water problems (.). For comparison, the North Carolina county with the highest percentage (80-90%) of impaired water bodies in that report was Richmond County, which was also in the top percentile of counties, ranked nationwide, with threatened and impaired water bodies.

The following table describes the 1998 Clean Water Act status of Watauga County as well as the leading pollutants and stressors for the 39 impaired rivers, streams, and creeks. There are no lakes, reservoirs, or ponds listed as impaired in Watauga County. Note that there are possible inconsistencies in data on impaired water bodies and the percentage of water bodies assessed. For further explanation, see http://www.scorecard.org/env-releases/def/water_inconsistency.htm.

Table 1. Watauga County Clean Water Act Status, 1998

Leading Pollutants and Stressors	Number	Percentage of all Impairments
Not Reported	13	33%
Sediments	10	26%
Pathogens	8	21%
Impaired Biological Community	6	15%
Ammonia	4	10%
Other Habitat Alterations	3	8%
Mercury	1	3%
Nutrients	1	3%
Total	39	-

Source: Environmental Defense Scorecard, Pollution Locator, Water. Available at http://www.scorecard.org/env-releases/water/cwa-county.tcl?fips_county_code=37189#report. (Accessed January 2007).

A complete list of the 39 water bodies with reported problems can be found at http://www.scorecard.org/env-releases/water/cwa-waterbodies-in-region.tcl?fips_county_code=37189.

The major stressor of water bodies in Watauga County is sedimentation. Sedimentation occurs when soil particles enter the water from eroding land, or sometimes through agricultural production. Because of the high clay content of North Carolina soil, most rivers have a high natural sediment load after a rainfall. Sedimentation is considered a pollutant when it exceeds this natural level and has detrimental effects, such as clogging and abrading fish gills, suffocating fish eggs and aquatic insect larvae, or reducing water clarity and so interfering with recreational activities. Nutrients and chemicals may attach to sediment

particles on land and enter the surface waters, where pollutants settle with sediment or detach and become soluble (5).

Other leading stressors include pathogens (8%), impaired biological community (6%), ammonia (4%), other habitat alterations (8%), mercury (3%), and nutrients (3%). Pathogens, such as waterborne bacteria, viruses and protozoa can enter waters through inadequately treated sewage, storm water drains, septic systems, runoff from livestock pens, and sewage dumped overboard from recreational boats. Regulatory agencies usually measure indicator bacteria, because it is impossible to test waters for every disease causing organism. The presence of indicator bacteria like *E.coli* suggests that the water may be contaminated with untreated sewage and that other dangerous organisms *may* be present ().

Impaired biological communities are aquatic ecosystems that provide habitat for a variety of species but have been adversely affected by human activities. Ammonia is an inorganic form of nitrogen, which in conditions of increased temperature and pH, can become de-ionized and therefore be toxic to aquatic life. Other habitat alterations include the degradation, loss, or alteration of aquatic habitat due to “physical degradation, riparian alteration, channel modification, or hindrance of fish passage or migration” ().

Mercury is “a naturally occurring element that can be toxic when consumed by animals and humans. Sources of mercury include weathering of the earth's crust, the burning of garbage and fuels, and industrial emissions” ().

Nutrient availability is typically a limiter of plant growth. However, when nitrogen and phosphorus are introduced into water bodies in levels higher than what is naturally occurring, aquatic plants, including algae, productivity may increase the amount of organic material in the water which leads to unpleasant odors, interference with recreational activities such as swimming and boating, and depleted oxygen supply which can affect the quality of fish habitat thereby impacting the ecosystem and food chain ().

Impairment cause was not reported for 33% of Watauga County impaired rivers, streams, and creeks.

The following table indicates the leading sources of water quality impairment in Watauga County for the 39 rivers, streams, and creeks listed as impaired.

Table 2. Watauga County Leading Sources of Water Quality Impairment, 1998

Source of Water Quality Impairment	Number	Percentage of all Impairments
Nonpoint Sources	19	49%
Agriculture	10	26%
Municipal Point Sources	8	21%
Urban Runoff/Storm Sewers	7	18%
Not Reported	4	10%
Construction	3	8%
Hydromodification/Habitat Modification	2	5%
Resource Extraction	1	3%
Silviculture	1	3%
Unknown	1	3%
Total	39	-

Source: Environmental Defense Scorecard, Pollution Locator, Water. Available at http://www.scorecard.org/env-releases/water/cwa-county.tcl?fips_county_code=37189#report. (Accessed February 2007).

In Watauga County in 1998, water quality problems arose primarily from non-point sources, which affected 49% of the impaired water bodies in the County. Agricultural sources accounted for 26%, municipal sources accounted for 21%, urban runoff/storm sewers for 18%, construction for 8%, hydromodification for 5%, resource extraction for 3%, and silviculture for 3%. Ten percent of sources were not reported while 3% of sources are unknown ().

Non-point source pollution occurs when rainfall or snowmelt picks up chemicals, biological agents and sediments and carries them to surface and ground waters. These inputs include agricultural and residential fertilizers, herbicides and insecticides; oil, grease and toxic chemicals from urban run-off and energy production; sediment from construction sites, crop and forest lands; and bacteria and nutrients from livestock, pet wastes and faulty septic systems (6).

Agriculture can cause pollutants that affect water quality. Agricultural activities that can contribute to pollution include confined animal facilities, grazing, plowing, pesticide spraying, irrigation, fertilizing, planting, and harvesting. These activities can result in sediment, nutrients, pathogens, pesticides, and salts, as well as damage habitat and stream channels ().

Municipal point source pollution is discharged from publicly owned waste water treatment plants. Agricultural production involves many activities that lead to the emission of pollutants: confined animal facilities, grazing, plowing, pesticide spraying, irrigation, fertilizing, planting and harvesting. The pollutants may include sediment, nutrients, pathogens, pesticides and salts ().

Urban Runoff/Storm sewers can erode streambanks, damage streamside vegetation, and widen stream channels leading to lower water depths during non-storm periods, higher than normal water levels during wet weather periods, increased sediment loads, and higher water temperatures. Additionally, pollutants from urbanization can be transported by runoff including oil, grease, and toxic chemicals from automobiles; nutrients and pesticides from turf management and gardening; viruses and bacteria from failing septic systems; road salts; and heavy metals. Aquatic life cannot survive in urban streams severely impacted by urban runoff.

Construction activities, land development, and road maintenance are often responsible for nonpoint source pollution as well as increased sedimentation due to land disturbances ().

Hydromodification/Habitat modifications refer to any activities, whether on land, shore, or in water, that alter the physical structure of aquatic ecosystems thereby adversely impacting aquatic life. Examples of habitat modifications to streams include: "removal of streamside vegetation that stabilizes the shoreline and provides shade, which moderates instream temperatures; excavation of cobbles from a stream bed that provide nesting habitat for fish; stream burial; and excessive suburban sprawl that alters the natural drainage patterns by increasing the intensity, magnitude, and energy of runoff waters. Hydrologic modifications can alter the flow of water. Examples of hydrologic modifications include channelization, dewatering, damming, and dredging" ().

Resource extraction refers to industrial activities in the environment that potentially disturb large amounts of material and land area. Adverse effects can include acid mine drainage, erosion and sedimentation, chemical releases, hydrologic changes, and drawdown – the reduction of water available for recharging wetlands and surface water ().

Silviculture refers to forestry activities that can impair water quality through the removal of streamside vegetation, road construction and use (the primary source of non point pollution), timber harvesting, and mechanical preparation for the planting of trees. Harvesting trees in the area beside a stream can affect water quality because it can reduce the shading that regulates water temperature. Also, it can affect the erosion of streambanks because vegetation stabilizes the soil. These changes can harm aquatic life by limiting sources of food, shade, and shelter ().

Watersheds

The majority of Watauga County lies in the Watauga and New River Basins. However, Watauga County also contains a small portion of the Yadkin-Pee Dee and the Catawba River Basins (7, 8, 9).

As noted previously, North Carolina monitors water quality on a watershed basin basis. A watershed is a geographic region with elevations and topographical features that cause flowing waters (creeks, streams, rivers) to drain into a common destination. Every river, stream and creek belongs to a particular watershed, and smaller watersheds can join together naturally to become larger watersheds, called river basins. North Carolina contains a portion of 58 different smaller watersheds which drain into 17 river basins. Water moves downstream in a watershed, so any activity that affects the water at the head, or anywhere else upstream, can also affect the characteristics of the downstream waters. The most

downstream points in a watershed may, in fact, bear and demonstrate the cumulative results of upstream affects.

According to the 1998 EPA Clean Water Act Data, 26 of the 58 small watersheds in North Carolina have “better” water quality and are at low vulnerability for impairment. Nine North Carolina watersheds have “better” water quality but are at high vulnerability for deterioration. This means that designated uses for the rivers are largely met and other indicators show few problems, but that significant pollution and stressors exist in the area and heighten the vulnerability of aquatic health (10). The EPA uses nine indicators to profile the vulnerability of aquatic resources to future degradation and classify them into one of seven categories (11):

1. Better Water Quality - Low Vulnerability:

Designated uses are largely met and other indicators of watershed condition show few problems. Pollutants or other stressors are low, so there is a lower potential for future declines in aquatic health. Actions to prevent declines in aquatic conditions in these watersheds are appropriate, but at a lower priority than in watersheds with higher vulnerability.

2. Better Water Quality - High Vulnerability:

Designated uses are largely met and other indicators of watershed condition show few problems. Significant pollution and other stressors exist, so there is a higher vulnerability to declines in aquatic health. These watersheds have the greatest need for actions to protect quality and prevent decline.

3. Less Serious Water Quality Problems - Low Vulnerability:

Watersheds with aquatic conditions below water quality goals and with problems revealed by other indicators. Pollutants or other stressors are low, so there is a lower potential for future declines in aquatic health. Actions to prevent declines in aquatic conditions in these watersheds are appropriate, but at a lower priority than in watersheds with higher vulnerability.

4. Less Serious Water Quality Problems - High Vulnerability:

Watersheds with aquatic conditions below water quality goals and with problems revealed by other indicators. Significant pollution and other stressors exist, so there is a higher vulnerability to declines in aquatic health. These watersheds have the greatest need for actions to protect quality and prevent decline.

5. More Serious Water Quality Problems - Low Vulnerability:

Watersheds with aquatic conditions well below water quality goals and with serious problems exposed by other indicators. Pollutants or other stressors are low, so there is a lower potential for future declines in aquatic health. Actions to prevent declines in aquatic conditions in these watersheds are appropriate, but at a lower priority than in watersheds with higher vulnerability.

6. More Serious Water Quality Problems - High Vulnerability:

Watersheds with aquatic conditions well below water quality goals and with serious problems exposed by other indicators. Significant pollution and other stressors exist, so there is a higher vulnerability to declines in aquatic health. These watersheds have the greatest need for actions to protect quality and prevent decline.

7. Insufficient Data:

There are insufficient data to accurately characterize the watersheds.

The major watersheds of Watauga County are the Watauga, Upper New, and Upper Yadkin watersheds. A smaller portion of the Upper Catawba watershed is also in Watauga County (12). The Watauga watershed is characterized by “better” water quality with “high” vulnerability. The Upper New and the Upper Yadkin watersheds are also characterized by “better” water quality but with “low” vulnerability. The Upper Catawba has “less serious” water quality problems with “high” vulnerability (13).

The EPA has classified three of the watersheds in Watauga County as highly vulnerable to hydrologic modification and with aquatic/wetland species at risk. Additionally, two watersheds are categorized as highly susceptible to agricultural runoff potential and population change ().

Hydrological modification is perhaps the most damaging human-induced impact in the aquatic environment. The construction of dams and the subsequent impoundment of water resources can compromise the health of the aquatic system in a watershed. Flowing waters become quiescent waters. Carbon, pollutants, and sediments accumulate in the bottom of dams, leading to algal blooms, because there is no way for materials to travel downstream. Oxygen cannot easily enter water that doesn't flow over rocks or riffle and so previously rushing streams turn into fetid ponds. Rivers that are downstream of a dam have controlled, limited or sometimes non-existent flow, which leads to habitat change and deterioration (14)

Aquatic/wetland species at risk indicates that in a given watershed, there are aquatic or wetland species that are classified by the Heritage Network as critically imperiled, or are listed as “threatened” or “endangered” under the federal Endangered Species Act. This indicator suggests that the watershed is highly vulnerable to water quality or habitat degradation and therefore jeopardizes the survival of susceptible aquatic or wetland species; it does not necessarily indicate poor watershed conditions but rather that there is not the exceptionally high quality habitat necessary to sustain these species ().

Agricultural runoff can cause water quality problems due to combinations of pesticides, nitrogen and sediment entering the rivers, creeks and streams. Lastly, growth of the human population can impact watersheds through increased pollution and land use changes which include construction, loss of wetlands, and increased sewage flows ().

Water Quality in the Watauga River Basin

The following section details the water quality of the Watauga River Basin as it pertains to Watauga County, providing further information on creeks and streams in the basin. This information was gleaned from the pertinent assessment report produced for each of the large watersheds in the State by the Division of Water Quality (DWQ) (15). The most recent assessment of the Watauga River Basin was completed in April 2005 (16).

The Watauga River Basin is situated between the French Broad River Basin to the south and the New River Basin to the north. The basin drains northwest into Tennessee where it drains into the Watauga River Reservoir. The Watauga River is a tributary of the Holston River which eventually flows into the Tennessee River. The basin is the second smallest in North

Carolina and contains 280 streams and encompasses 205 square miles. The Watauga River Basin has only one subbasin in North Carolina, Subbasin 01 (17).

Subbasin 01 is located in the Blue Ridge ecoregion and contains the town of Banner Elk and western portions of Boone. The subbasin is experiencing rapid development, particularly for second homes and recreational areas such as golf courses, near stream and river corridors. The subbasin has 28 permitted dischargers, the largest are Valley Creek wastewater treatment plant (0.9 million gallons per day [MGD] into Valley Creek) and Sugar Mountain wastewater treatment plant (1.0 MGD into Flattop Creek). Two wastewater treatment plants, Sugar Mountain and Beech Mountain (0.4 MGD into Pond Creek), are required to monitor their effluent toxicity ().

Water Quality in the New River Basin

The following section details the water quality of the New River Basin as it pertains to Watauga County, providing further information on creeks and streams in the basin. This information was gleaned from the pertinent assessment report produced for each of the large watersheds in the State by the Division of Water Quality (DWQ) (18). The most recent assessment of the New River Basin was completed August 2004 (19).

The headwaters of the New River Basin are in Watauga County, North Carolina. The river flows northeasterly towards Radford, Virginia, and from there it continues northwesterly to West Virginia where it flows into the confluence of the Gauley River to form the Kanawha River which is a tributary to the Ohio River. The basin is 115 miles in length from Blowing Rock, NC to Bluestone Dam near Hinton, WV (20). For assessment and monitoring purposes, the river basin is divided into three subbasins for North Carolina; Watauga County contains portions of subbasins 01 and 02 ().

Subbasin 01 contains portions of three ecoregions: the New River Plateau, Amphibolite Mountains, and Southern Crystalline Ridges and Mountains. The largest watershed in the subbasin is the South Fork New River, which receives runoff from the towns of Boone, Blowing Rock, and Jefferson. Land is primarily urban and suburban near Boone and Blowing Rock, but elsewhere is primarily forested, pasture, and managed herbaceous (Christmas tree farming). There are nine permitted dischargers, three of which exceed 0.1 MGD: Boone wastewater treatment plant, Blowing Rock wastewater treatment plant, and Jefferson wastewater treatment plant ().

Subbasin 02 is made up of the Southern Crystalline Ridges and Mountains ecoregion, the New River Plateau ecoregion, the Southern Sedimentary Ridges ecoregion, and the Amphibolite Mountains ecoregion. The subbasin includes the North Fork New River watershed whose major tributaries include Big Horse Creek, Helton Creek, Three Top Creek, Big Laurel Creek, Buffalo Creek, and Little Buffalo Creek. The majority of the subbasin is in Ashe County. Land use is 84% forest/wetland and 15% pasture/managed herbaceous cover (Christmas tree farming). Only a small portion of the land is urban or developed, and this is in the area surrounding West Jefferson. There are 5 permitted discharges in the subbasin, all with flow less than 1 MGD. The largest discharger is West Jefferson wastewater treatment plant which discharges into Little Buffalo Creek ().

Water Quality in the Yadkin-Pee Dee River Basin

The following section details the water quality of the Yadkin-Pee Dee River Basin as it pertains to Watauga County, providing further information on creeks and streams in the basin. This information was gleaned from the pertinent assessment report produced for each of the large watersheds in the State by the Division of Water Quality (DWQ) (21). The most recent assessment of the Yadkin-Pee Dee River Basin was completed in 2007 (22).

The Yadkin River originates in the eastern Blue Ridge Mountains and flows northeast for 100 miles, cutting across the southern half of Wilkes County (.). It turns southeast and forms the border between Yadkin and Forsyth, and Davie and Davidson counties. The South Fork of the Yadkin River begins in Alexander County and flows east, following the southern border of Yadkin County, before joining the main Yadkin River just above High Rock Lake in Davidson County. The Yadkin River joins the Uwharrie River to form the Pee Dee River south of High Rock Lake and continues toward the North Carolina/South Carolina border. The Yadkin-Pee Dee River Basin is the second largest basin in North Carolina. For assessment and monitoring purposes the entire river basin is divided into 17 subbasins; Watauga County contains a portion of Subbasin 01.

Subbasin 01 contains the mountainous headwaters of the Yadkin River that are primarily located within the Southern Crystalline Ridges and Mountain ecoregion. The subbasin also includes portions of the Eastern Blue Ridge Foothills ecoregion along its southern border. Major tributaries include Buffalo, Elk and Stony Creeks, North and South Prong Lewis Forks, Reddies River, Mullberry Creek, and Roaring River. The W. Kerr Scott Reservoir is also in the subbasin. In this area, the stream gradients are high: mountain streams are mostly classified as trout streams and considered mountain cold water, while foothills are considered cool water systems. Land use is predominantly forest. Major dischargers include the cities of Wilkesboro and North Wilkesboro, both of which have wastewater treatment plants discharging into the Yadkin River (4.9 MGD and 2.0 MGD respectively), and the Louisiana Pacific Corporation ABTCO plant that discharges 1.0 MGD ().

Water Quality in the Catawba River Basin

The following section details the water quality of the Catawba River Basin as it pertains to Watauga County, providing further information on creeks and streams in the basin. This information was gleaned from the pertinent assessment report produced for each of the large watersheds in the State by the Division of Water Quality (DWQ) (23). The most recent assessment of the Catawba River Basin was completed in 2003 (24).

The Catawba River basin is the eighth largest river basin in North Carolina and covers 3,279 square miles. Its source is in the eastern slopes of the Blue Ridge Mountains near the Town of Old Fort. It flows eastward and then southward to the state line near Charlotte. It encompasses part of twelve counties: Alexander, Avery, Burke, Caldwell, Catawba, Gaston, Iredell, Lincoln, McDowell, Mecklenburg, Union, and Watauga. For assessment purposes the basin is divided into nine subbasins, Watauga County contains part of subbasin 31 ().

Subbasin 31 is in the Northern Inner Piedmont ecoregion; its major tributaries are the Warrior Fork, Lower Creek, and the Johns Rivers. Approximately 85% of the subbasin is forested, other land use includes agriculture (particularly cultivation of ornamental shrubs and trees). The subbasin includes the cities of Morganton, Lenoir, Drexel, and Granite Falls. Urban

development and runoff from the former two have impacted tributaries of the river, particularly in the southeastern portion of the subbasin ().

Impaired Water Bodies in Watauga County

There are no water bodies in the four river basins of Watauga County that have been classified as impaired according to section 303(d) of the CWA.

The DWQ gives each creek, stream, lake and river a bioclassification, based on the number of intolerant, or sensitive species, particularly macroinvertebrates, present in the water. The presence of intolerant species indicates higher quality water than can support such sensitive organisms, while their absence signifies possible water quality or habitat problems. Excellent, good and good-fair waters are fully supportive of benthic macroinvertebrates; fair waters are partially supportive; poor waters are not supportive of such life. Loss of canopy, increase of stream temperature, increased nutrients, toxicity or sedimentation all affect the benthic (bottom dwelling) community. Table 3 shows the bioclassifications for the river subbasins that pertain to Watauga County. The thirteen monitoring sites in the Watauga River Basin, the nine sites in the New River Basin, and the one site in the Yadkin-Pee Dee River Basin were all rated Good-Fair or better. There were no monitoring sites in the Catawba River Basin pertaining to Watauga County.

Table 3. Bioclassification of Water Bodies located in Watauga County

Subbasin	Water Body	Location	Status 1	Status 2
	Watauga River	SR 1580	Good-Fair	Good
	Watauga River	NC 105	Excellent	Excellent
	Boone Fork	SR 1561	Excellent	Excellent
	Boone Fork	Off SR 1558	Good	Excellent
	Laurel Fork	SR 1111	Good-Fair	Good-Fair
	Cove Creek	SR 1149	Good	Good
Watauga 01	Watauga River	SR 1121	Good	Excellent
	Watauga River	SR 1200	Excellent	Excellent
	Laurel Creek	Off SR 1123	Good	Good
	Beaverdam Creek	SR 1202	Good	Good
	Beech Creek	US 321	Excellent	Excellent
	Elk River	Off NC 184	Good	Good-Fair
	Elk River	SR 1305	Excellent	Good
New 01	Middle Fork S Fork New River	SR 1522	Good	Good-Fair
	East Fork S Fork New River	SR 1522	Good	Good
	S Fork New River	US 421/221	Good-Fair	Good-Fair
	Winkler Creek	SR 1549	Good	Excellent

Subbasin	Water Body	Location	Status 1	Status 2
	Howard Creek	SR 1328	Excellent	Good
	Meat Camp Creek	SR 1340	--	Good
	Meat Camp Creek	SR 1333	Excellent	Good
	Norris Fork	SR 1337	--	Excellent
	Pine Orchard Creek	SR 1369	--	Excellent
Yadkin 01	Laurel Creek	SR 1508	--	Excellent

NB: Status 1 and Status 2 for the Watauga River Basin are the 1999 status and the 2004 status respectively. For the New River Basin, 1998 and 2003. For the Yadkin-Pee Dee River Basin, 2001 and 2006.

Source: NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report Watauga River Basin, April 2005. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).

Source: NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report New River Basin, August 2004. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).

Source: NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report Yadkin-Pee Dee River Basin, 2007. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).

Ambient Monitoring System Data

Of the 28 DWQ Ambient Monitoring System (AMS) stations in the Catawba River Basin and the 38 DWQ AMS stations in the Yadkin-Pee Dee River Basin, none are in Watauga County. However, one of the six stations of the New River Basin and both stations of the Watauga River Basin are in Watauga County (,). Table 4 provides information on each of these stations.

Table 4. DWQ Ambient Monitoring System stations in Watauga County

Subbasin	Station #	Location
New 01	K2100000	S Fork New River at US 221 and 421 at Perkinsville
Watauga 01	L1700000	Watauga River at SR 1557 near Shulls Mill
	L4700000	Watauga River at SR 1121 near Sugar Grove

Source: NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report Watauga River Basin, April 2005. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).

Source: NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report New River Basin, August 2004. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).

Source: NC Department of Environment and Natural Resources. Division of Water Quality. Environmental Sciences Branch. Monitoring. Network of Stations. NC Division of Water Quality Ambient Monitoring Network. Available at <http://h2o.enr.state.nc.us/esb/stations/ams.htm>. (Accessed February 2007).

Water Chemistry. Dissolved oxygen is an important parameter of water quality because sufficiently high levels are required to sustain aquatic life, and the more desirable aquatic species (e.g. trout) require the highest levels. None of the three AMS stations located in Watauga County showed more than 10 percent of measurements for dissolved oxygen below the minimum standard of 5.0 mg/L.

Similarly, there was no significant exceedance of pH at any of the three monitoring sites in Watauga County. Low pH values are indicative of waters rich in organic matter whereas high values are found during algal blooms.

Turbidity data values typically vary according to the intensity of rainfall events. No stations in Watauga County had more than 10 percent of observations greater than the standard of 50 NTU (National Turbidity Units).

Dissolved metals (arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel and zinc) can be toxic to living organisms, sometimes in very low concentrations, so they are included in water quality testing regimes. Elevated concentrations of metals were not a problem in the Watauga River Basin AMS sites, however, the AMS site in the New River Basin showed 17.2% of samples with levels greater than the action level for copper..

Fecal Coliforms. Fecal coliforms are usually harmless bacteria that live in soil, water, and the digestive system of animals. Fecal coliform bacteria are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals, and can enter water bodies from human and animal wastes.

Swimming in waters with high levels of fecal coliform bacteria increases the chance of developing illness (fever, nausea or stomach cramps). Diseases and illnesses that can be contracted in water with high fecal coliform counts include typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections. None of the AMS sites in Watauga County had fecal coliform counts exceeding the plate count reference standard of 200 colonies/100 ml.

Chlorophyll a. Chlorophyll a is used to estimate the amount of phytoplankton in water. The water quality standard is 40 µg/L and values greater than this indicate large volumes of phytoplankton. This parameter was not reported in either the Watauga River Basin Assessment or the New River Basin Assessment.

Nutrients. The introduction of nutrients, especially nitrogen and phosphorus, into water bodies can stimulate the growth of algae and aquatic weeds, which can in turn impart unpleasant appearance and taste to the water and, more importantly, deplete dissolved oxygen and imperil other aquatic life. The AMS sites of the Watauga River Basin did not show elevated levels of nutrients. However, the AMS site in the New River Basin has historically elevated concentrations of ammonia and nitrates due to its proximity to the Boone wastewater treatment plant.

Fish Kills

There were two fish kill events reported in Watauga County between 1997 and 2006. In 1999, a fish kill of 120 brown trout, brook trout, and bluehead chub occurred in Sharp Creek due to the washing out of three 55-gallon drums of Percol by a private party. In 2003, a fish kill of 14,300 suckers, hogsuckers, trout, dace, sunfish, sculpin, stonerollers, largemouth bass, darters, and chubs occurred in the New River due to a 3,000 gallon spill of sodium hydroxide from the town of Blowing Rock water filtration plant (25).

Fish Consumption Advisories

The Epidemiology Section of the NC Division of Public Health maintains an Internet website listing current fish consumption advice and advisories across the State (26). As of March 2007 the Section listed a statewide advisory against women of childbearing age, pregnant

women, nursing mothers and children under age 15 eating any fish high in mercury; the section further advises all other persons to consume fish high in mercury no more than once a week and fish low in mercury no more than four meals per week. The fish with high mercury levels are primarily ocean species, and include: almaco jack, banded rudderfish, canned white tuna (albacore tuna), 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, and tuna (fresh or frozen). There are five freshwater species on the “avoid” list: blackfish (bowfin), catfish (caught wild), jack fish (also called chain pickerel), largemouth bass, and warmouth. Freshwater fish with the highest mercury levels have been found primarily south and east of Interstate 85.

In addition, the website also lists site-specific advisories regarding consumption of species with high levels of other chemicals such as polychlorinated biphenyls (PCBs) and dioxins. None of the referenced sites is in Watauga County.

Groundwater

Much less is known generally about groundwater than surface waters. Groundwater is the water basin beneath the soil surface that can be collected by wells and pumps and other man-made devices, or that flows naturally to the surface via seeps or springs. Groundwater is the primary source of water for 50% of the population in the US, with heavier dependency in rural areas. Despite the visual prominence of surface waters, the vast majority of the earth’s freshwater - 97% - is located underground.

Bacteria in Well Water

The North Carolina State Laboratory for Public Health analyzes samples of drinking water from wells and other sources for the presence of microorganisms and chemicals. Samples from private wells must be submitted through a local health department. From 2004-2006, the State Laboratory conducted only one microbiological analysis from a water sample in Watauga County. It was negative according to analysis for “total coliforms,” and therefore not tested for *E. coli* (27). Most Watauga County water samples are analyzed locally.

Groundwater Incidents

The NC Division of Water Quality Incident Management Office keeps track of leaks and spills of chemicals that present risks to health. No such incidents were reported in Watauga County between 2001 and 2006 (28).

Chapter Two: Air Quality

Outdoor Ambient Air

The US EPA categorizes outdoor air pollutants as “criteria air pollutants” (CAPs) and “hazardous air pollutants” (HAPs).

Criteria Air Pollutants

Criteria air pollutants (CAPS) are six chemicals that can injure human health, harm the environment, or cause property damage: carbon monoxide, lead, nitrogen oxides, particulate matter, ozone, and sulfur dioxide. The EPA has established National Ambient Air Quality Standards (NAAQS) that define the maximum legally allowable concentration for each criteria air pollutant, above which human health may suffer adverse affects (29). Table 5 lists the current NAAQS.

Table 5. National Ambient Air Quality Standards

Pollutant	Primary Standard	Averaging Times	Notes
Carbon monoxide (CO)	9 ppm (10 mg/m ³)	8-hour	Not to be exceeded > 1/year
	35 ppm (40 mg/m ³)	1-hour	Not to be exceeded > 1/year
Lead	1.5 µg/m ³	Quarterly average	--
Nitrogen dioxide	0.053 ppm (100 µg/m ³)	Annual mean	--
Particulate matter (PM ₁₀)	150 µg/m ³	24-hour	Not to be exceeded > 1/year on average over 3 years
	15.0 µg/m ³	Annual mean	To attain this standard, the 3-year average of the weighted annual mean PM _{2.5} concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m ³
Particulate matter (PM _{2.5})	35 µg/m ³	24-hour	To attain this standard, the 3-year average of the 98 th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m ³
	0.08 ppm	8-hour	To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm
Ozone (O ₃)	0.12 ppm	1-hour (applies only in limited areas)	This standard has been revoked in all areas except the fourteen 8-hour ozone nonattainment Early Action Compact (EAC) Areas (which include the Fayetteville, Greensboro/Winston-Salem/High Point, and Hickory/Morganton/Lenoir regions in North Carolina)
	0.03 ppm	Annual mean	--
Sulfur Oxides (SO _x)	0.14 ppm	24-hour	Not to be exceeded > 1/year

Source: Environmental Protection Agency. Air & Radiation. National Ambient Air Quality Standards (NAAQS). <http://www.epa.gov/air/criteria.html>. (Accessed January 2007).

Nationwide 77% of carbon monoxide (CO) emissions are from transportation sources, primarily highway motor vehicles, but other sources include wood-burning stoves, incinerators and industrial outputs. Lead (Pb) enters the atmosphere primarily from gasoline

additives, non-ferrous smelters, and battery plants. The proportion of atmospheric lead from cars and trucks has decreased dramatically over a generation due primarily to a shift to lead-free gasoline. Nitrogen oxides (NO_x) are formed when fuels are burned at high temperatures, such as in transportation vehicles and stationary combustion sources like electric utilities and industrial furnaces. They play an important role in the reactions that create ozone and acid rain. Particulate matter (PM) pollutants, usually categorized on the basis of size, include dust, dirt, soot, smoke, and liquid droplets emitted directly into the air by factories, power plants, construction activity, fires and vehicles. Ozone (O₃), the major component of smog, is not usually emitted directly but is formed through chemical reactions in the atmosphere. Precursor compounds like volatile organic compounds (VOC) and oxides of nitrogen (NO_x) react to form O₃ when stimulated by ultraviolet radiation and temperature, so peak O₃ levels typically occur during the warmer times of the day and year. VOCs are chemicals that play a role in forming ozone and are emitted from a variety of sources, including automobiles, chemical and paint manufacturing plants, dry cleaners, and other facilities that use solvents and paint. Sulfur dioxide (SO₂) is released primarily by burning sulfur-containing fuels like coal, oil and diesel fuels, and is emitted from power plants, steel mills, refineries, pulp and paper mills and smelters. Table 6 lists some of the environmental and health effects of the criteria air pollutants (30).

Table 6. Health and Environmental Effects of Criteria Air Pollutants

Pollutant	Effect
CO	Reduces delivery of oxygen to the body's organs and tissues
Pb	Affects nervous, reproductive, digestive, cardiovascular systems and the kidney
NO _x	Effects ecosystems on land and in water; plays a role in the formation of acid rain
PM	Affects breathing, aggravates existing respiratory and cardiovascular disease; damages lung tissue
O ₃	Damaged lung tissues, reduces lung function and sensitizes lungs to other irritants
VOC	Contributes to ozone formation; may cause cancer and have reproductive toxicity
SO ₂	Affects breathing and may aggravate existing respiratory and cardiovascular disease

Source: Environmental Defense, Scorecard. Pollution Locator. Description of Criteria Air Pollutants. Available at: <http://www.scorecard.org/env-releases/cap/pollutant-desc.tcl>. (Accessed January 2007).

Annual CAP Maxima

Annual high levels of criteria air pollutants are not available specifically for Watauga County, but are available for North Carolina as a whole (31). In 2005 North Carolina's annual maxima for 1-hour and 8-hour ozone and large particulate matter were higher than the respective NAAQS standards; all other annual maxima were below the NAAQS standards (Table 7).

Table 7. North Carolina Annual High Levels of Criteria Air Pollutant Emissions, 2005

Pollutant	NAAQS Standard	Highest Recorded Concentration
Carbon monoxide		
1-hour average max	35ppm	10.0ppm
8-hour average max	9ppm	2.8ppm
Ozone		
1-hour average max	0.12ppm	0.146ppm
8-hour average max	0.08ppm	0.111ppm
PM-25		
24-hour average max	65µg/m ³	70µg/m ³
PM-10		
24-hour average max	150ug/m ³	69µg/m ³
Sulfur Dioxide		
3-hour average max	0.5ppm	0.106ppm
24-hour average max	0.14ppm	0.030ppm
Source: Environmental Protection Agency. Air & Radiation. Air Data. http://www.epa.gov/air/data/geosel.html . (Accessed January 2007).		

North Carolina ranks 10th in the nation for CO emissions; 14th for NO_x emissions; 13th for PM-2.5 emissions; 13th for SO₂ emissions; and 8th for volatile organic compound emissions. Although Watauga County does not rank in the top 25 North Carolina counties for tons of emissions of any of the six criteria air pollutants (32); it is listed in the 40th percentile of dirtiest/worst counties in the US for carbon monoxide emissions, sulfur dioxide emissions, and volatile organic compound emissions. Other criteria air pollutants (nitrogen oxides and particulate matter) are in the 40th percentile or less for cleanest/best counties (33).

Air Quality Index

The impact of criteria air pollutants on the environment is described on the basis of exposure, emissions and health risks. One useful measure that combines these parameters is the Air Quality Index (AQI), which was formerly called the Pollutant Standards Index (PSI). The AQI is an information tool to advise the public and it is often presented in the media along with local weather reports. The AQI describes the general health effects associated with different pollution levels, and public AQI alerts include precautionary steps that may be necessary for certain segments of the population when air pollution levels rise into the unhealthy range. The AQI measures concentrations of five of the six criteria air pollutants and converts the measures to a number on a scale of 0-500, with 100 representing the National Ambient Air Quality Standard established under the Clean Air Act. An AQI level in excess of 100 on a given day means that a pollutant is in the unhealthy range that day; an AQI level at or below 100 means a pollutant is in the "satisfactory" range (34). The AQI levels are defined in Table 8.

Table 8. General Health Effects and Cautionary Statements, Air Quality Index

Index Value	Descriptor	General Health Effects	Cautionary Statements
Up to 50	Good	None for the general population.	None required.
50 to 100	Moderate	Few or none for the general population.	None required.
100 to 200	Unhealthy	Mild aggravation of symptoms among susceptible people, with irritation symptoms in the general population.	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity. General population should reduce vigorous outdoor activity.
200 to 300	Very Unhealthy	Significant aggravation of symptoms and decreased exercise tolerance in persons with heart or lung disease; widespread symptoms in the healthy population.	Elderly and persons with existing heart or lung disease should stay indoors and reduce physical activity. General population should avoid vigorous outdoor activity.
Over 300	Hazardous	Early onset of certain diseases in addition to significant aggravation of symptoms and decreased exercise tolerance in health persons. At AQI levels above 400, premature death of ill and elderly persons may result. Health people experience adverse symptoms that affect normal activity.	Elderly persons with existing diseases should stay indoors and avoid physical exertion. At AQI levels above 400, general population should avoid outdoor activity. All people should remain indoors, keeping windows and doors closed, and minimize physical exertion.

Source: NC Department of Environment and Natural Resources, Division of Air Quality, 2000 Ambient Air Quality Report, available at: <http://daq.state.nc.us/monitor/reports/2002-01.pdf> (Accessed January 2007).

According to the EPA, the AQI monitoring site in Watauga County lists the 2007 annual mean for small particulate matter as 9.2 $\mu\text{g}/\text{m}^3$. This is lower than the standard of 15 $\mu\text{g}/\text{m}^3$. Data for other criteria air pollutants are not reported (35). Non-AQI air pollution data for Watauga County are available, however. These data – total categorical CAP emissions – are dated but do offer a picture of the relative importance of each category of pollutant. Table 9 details the total tons of emissions of the six criteria air pollutants for the County, and the amount of each pollutant coming from the typical source categories for 1999.

Table 9. Watauga County Criteria Air Pollutant Emissions, in Tons, 1999

Source Category	CO	NO _x	PM -2.5	PM-10	SO ₂	VOC	TOTAL
Mobile Sources	10,693	1,605	266	905	135	1,227	14,831
Area Sources	4,238	46	689	1,225	187	1,354	7,739
Point Sources	27	39	18	27	64	34	209
All Sources	14,958	1,690	973	2,157	386	2,615	22,779

Source: Environmental Defense. Scorecard. Pollution Locator. Smog and Particulates. Watauga County Report. Available at: http://www.scorecard.org/env-releases/cap/county.tcl?fips_county_code=37187. (Accessed January 2007).

Mobile sources include both on-road vehicles like cars, trucks and busses as well as off-road equipment like airplanes, construction and agricultural equipment. Such sources contribute significantly to air pollution, as nationwide mobile sources are responsible for 75% of carbon monoxide emissions and more nitrogen oxide emissions than either area or point sources (36). Mobile sources in Watauga County produce more carbon monoxide (71%) and nitrogen oxides (95%) than any other source. Nationally, carbon monoxide (77.1%), nitrogen oxides (55.5%), and large particulate matter (40.3%) mostly come from mobile sources. Mobile sources are the primary source of criteria air pollutants in this County (65% of the total tonnage) and in the country (60.2%). County percentages are calculated from Table 9, for example, the 4,238 tons of CO released from area sources makes up 28% of the total 14,958. National percentages can be calculated similarly from information found at <http://www.scorecard.org/env-releases/cap/us.tcl> (, 37).

Area sources are defined as sources that emit less than 10 tons per year of a criterion or hazardous air pollutant or less than 25 tons per year of a combination of pollutants. Such sources include dry cleaners, gas stations and auto body paint shops, and residential and commercial buildings (heating and cooling units, fireplaces). Waste disposal in the form of open burning, landfills and wastewater treatment also are significant area sources (). In Watauga County, area sources account for 34% of all criteria air pollution and produce more small particulate matter (71%), large particulate matter (57%), sulfur dioxides (48%) and volatile organic compounds (52%) than any other sources. Nationally, area sources account for only 21.6% of criteria air pollutants, and are not the source for the majority of any of these pollutants.

Point sources are those facilities that emit 10 tons a year of any of the criteria or hazardous air pollutants or 25 tons per year of a mixture of air toxics. Such sources include major industrial facilities like chemical plants, steel mills, oil refineries, power plants and hazardous waste incinerators. Nationwide point sources contribute the majority (90%) of sulfur dioxide emissions, and account for about 40% of total nitrogen oxide releases (). In Watauga County point sources are not a major contributor to any of the criteria air pollutants (<1% of the total), while nationally point sources account for 18.1% of the total pollutants.

For comparative purposes, in Mecklenburg County, the county in North Carolina with the highest emissions of criteria air pollutants, mobile, area and point sources emitted a total of over 365,000 tons of pollutants, more than sixteen times the tons of air pollutants generated in Watauga County (38).

EPA Air Quality Non-Attainment Areas

As of December 2006, the EPA designated 32 North Carolina counties as “non-attainment” counties regarding ozone standards. The determination was based on air quality monitoring data that shows ozone levels exceed the 8-hour ozone standard in parts of North Carolina during the warmer months (39). The State is required to develop remediation plans for the non-attainment counties that include proposals for curbing ozone by reducing emissions from vehicles, industries and power plants (40). Watauga County is not one of these non-attainment counties.

Additionally, the EPA designated three North Carolina counties as “non-attainment” regarding small particulate matter. The State has successfully worked to improve particle pollution through legislative action via the 2002 Clean Smokestacks Act which targets coal-

fired power plants to reduce particle forming emissions (41). Watauga County is not on the current list of non-attainment counties.

The EPA has not designated any North Carolina counties as “non-attainment” for carbon monoxide, nitrogen dioxide, ozone (1 hour), sulfur dioxide, large particulate matter, or lead ().

Vehicle Emission Inspection Mandates

As of January 1, 2006 48 of the 100 North Carolina counties have mandatory vehicle emission testing; Watauga is not among them. Most of the counties under the mandate are in major population centers or along the major Interstate Highway corridors spanning the State (42).

Vehicle Miles Driven

Since most criteria air pollutants are emitted by mobile sources, it is instructive to examine the patterns and trends in vehicle miles traveled (VMT) per capita (43). Table 10 provides a description of the annual vehicle miles traveled in the United States and in urban and rural areas of North Carolina for 2004. Comparable data for Watauga County is not available.

Table 10. Annual Vehicle Miles Traveled (in millions of miles), 2004

	Rural		Urban		Total per Capita
	Annual VMT	% Trucks	Annual VMT	% Trucks	
North Carolina	47,183	12.6	48,720	9.1	11,222
US Average	20,985	15.6	37,103	7.7	10,077

Source: Federal Highway Administration. Highway Statistics 2004. Selected Measures for Identifying Peer States. Available at www.fhwa.dot.gov/policy/ohim/hs04/htm/ps1.htm. (Accessed January 2007).

According to data from the Energy Center at Appalachian State University, growth in energy consumption for the transportation sector has been outpacing overall energy consumption in the State. One of the primary causes of this growth in energy consumption has been the rapid growth in VMT. VMT figures in North Carolina have grown 3.9% per year over the past 21 years, and VMT per capita have increased 2.2% annually over approximately the same period (44).

Vehicles Powered by Alternative Fuels

One way to overcome air pollution from the combustion of gasoline is to power automobiles by alternative, lower-polluting fuels.

According to date from the US Census Bureau (45), the number of vehicles in the US powered by alternative fuels has increased every year between 2002 and 2004 (Table 11).

Table 11. Number of Vehicles in the US Powered by Alternative Fuels, 2002-2004

Fuel Type	Number of Alternative Fueled Vehicles		
	2002	2003	2004
Liquefied petroleum gasses (LPG)	187,680	190,438	194,389
Compressed natural gas (CNG)	120,839	132,988	143,742
Liquefied natural gas (LNG)	2,708	3,030	3,134
Methanol, 85 percent (M85)	5,873	4,917	4,592
Ethanol, 85 percent (E85)	120,951	133,776	146,195
Electricity*	33,047	45,656	55,852
Total	471,098	510,805	547,9094

Key:* The category "electricity" excludes gasoline-electric hybrids.

Source: US Census Bureau. Publications. Statistical Abstract of the US: 2006. Section 23, Transportation. Table 1079, Alternative Fueled Vehicles in Use by Fuel Type: 2002-2004. Available at <http://www.census.gov>. (Accessed January 2007).

Given the recent influx of hybrid vehicles on the automotive market, it would be expected that future counts of alternative fueled vehicles would be higher.

Mass Transportation

Each year, North Carolina's public transportation systems operate more than 1,900 vehicles and transport more than 40 million passengers. Through cooperative planning, efficient use of resources, new technologies and visionary leadership, public transportation systems in North Carolina are working with intercity passenger rail services, ferries, land-use planners and community leaders to create an intermodal, seamless transportation network linking all areas of the State.

Currently, public transportation operates in all 100 North Carolina counties. Nearly half of these counties are predominantly rural, while others are almost completely urbanized or suburban. Seventeen city transit systems and one metropolitan regional transit system also operate in the State (46).

Watauga County is served by AppalCART which is located in Boone. It is a bus system supported by local, state, and federal governments as well as human service agencies and Appalachian State University. All Boone in-town routes are free; rural roots are zoned for fees (,47).

Hazardous Air Pollutants

Hazardous Air Pollutants (HAPs) refer to over 188 chemicals that can cause adverse effects on human health and the environment. They include substances that can cause cancer, as well as neurological, respiratory and reproductive effects in humans. HAPs are ranked by a method that combines exposure data from the US EPA National Scale Air Toxics Assessment with toxicity data to estimate the health risks posed by chemical pollutants in

ambient air (48). The exposure estimates used in determining risk are based on 1996 emissions data, although they are generally consistent with current air monitoring data. The resulting risk estimates are based on models, and therefore are useful for relative ranking but not for predicting any individual's risk of suffering health effects from exposure (49).

Risk due to HAPs is estimated by two measures: added lifetime cancer risk for carcinogenic HAPs, and cumulative hazard indices for chemicals with noncancer effects. Added cancer risk is the estimated individual risk of getting cancer due to a lifetime exposure to outdoor hazardous air pollutants. The goal of the Clean Air Act is to reduce lifetime cancer risk from HAPs to 1 in 1,000,000, so added cancer risk is expressed as a multiple of this measure (50).

According to EPA data accessed via Environmental Defense, Mecklenburg County is the North Carolina county with the highest risks (cancer and non-cancer) from hazardous air pollutants. It also has the greatest population living in proximity to such risk. Of the 100 counties in North Carolina, Watauga County ranked 40th in terms of an individual's added cancer risk. The estimated added cancer risk for the Watauga County population is 360, that is, it is 360 times the goal set by the Clean Air Act (51).

The vast majority of the cancer risks (85%) in Watauga County come from mobile sources, primarily diesel emissions from on road vehicles such as cars, buses and trucks, and off-road equipment, such as airplanes and agricultural and construction equipment (52). Diesel emissions are a recognized carcinogen, and *suspected* to be a cardiovascular or blood toxicant, and a respiratory toxicant (53).

Noncancer hazards are measured by the cumulative hazard index (CHI), which is determined by the ratio of a hazardous air pollutant concentration divided by its safe exposure level. Therefore, if a hazard index exceeds 1, the resulting exposure level may pose noncancer risks such as neurological, respiratory, reproductive, developmental or other adverse health effects. The goal of the Clean Air Act is to attain an "ample margin of safety to protect public health", or an index of less than one ().

According to data from Environmental Defense, Watauga County is ranked 27th for cumulative hazard index out of all North Carolina counties with a score of 1.7, which is above the Clean Air Act goal of 1.0. Mecklenburg County, which is ranked as the county with the highest risks of any kind, has a cumulative hazard index of 3.5 ().

The sources of the pollutants that contribute to non-cancer health risks are not as easy to pinpoint as those leading to cancer risks, and they vary much more from county to county. However the most significant non-cancer hazardous air pollutant in Watauga County is acrolein (). This chemical, ranked among the worst 10% of compounds hazardous to ecosystems and human health, is produced in high volume in consumer products, building materials or furnishings, and pesticide products, and contributes to indoor air pollution. Acrolein is *suspected* of being a carcinogen, a cardiovascular or blood toxicant, a developmental toxicant, a gastrointestinal or liver toxicant, a neurotoxicant, a respiratory toxicant, and a skin or sense organ toxicant (54). In Watauga County, area sources contribute 63% to the cumulative hazard index while mobile sources contribute 36% to the CHI ().

Indoor Ambient Air

The quality of the air inside buildings has received greater attention in recent years. Indoor ambient air pollutants may cause both short-term and long-term health effects. Immediate effects may show up after a single exposure or after repeated exposures. Health effects from indoor air pollutants include irritation of the eyes, nose, and throat, headaches, dizziness, and fatigue. Such immediate effects are usually short-term and treatable. Sometimes the treatment is simply eliminating the person's exposure to the source of the pollution, if it can be identified. Symptoms of some diseases, including asthma, hypersensitivity pneumonitis, and humidifier fever, may also show up soon after exposure to some indoor air pollutants.

Other health effects may show up either years after exposure has occurred or only after long or repeated periods of exposure. These effects, which include some respiratory diseases, heart disease, and cancer, can be severely debilitating or fatal. It is prudent to try to improve the indoor air quality in homes and other structures even if symptoms are not noticeable.

The primary cause of indoor air quality problems in homes is sources that release gases or particles into the air, including sources of combustion (oil, gas, kerosene, coal and wood as well as tobacco products), wet, damp or deteriorated insulation or carpet, cabinetry and furniture made of certain pressed wood products, chemical products for cleaning, personal care, or hobbies, and central heating and cooling systems and humidification devices. Also of concern are gasses from the outside such as radon, pesticides and outdoor air pollution that seep into homes. Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the home (55).

Carbon Monoxide

Carbon monoxide (CO) is called the silent killer because it cannot be seen, smelled or tasted, and it does not irritate the skin, eyes or lungs. Most accidental carbon monoxide poisonings occur from CO released by heaters or cars. People exposed to the gas are unaware they are breathing in the CO until they get sick. About 600 accidental deaths due to CO poisoning occur each year in the United States (56).

Carbon Monoxide Poisoning Deaths

In North Carolina in 2004, there were 10 deaths due to *accidental* exposure to non-organic gases and vapors (including carbon monoxide) and an additional 30 deaths due to *intentional* self-poisoning; one death was due to an assault with gases and vapors. In 2005 there were 20 accidental deaths and 34 intentional deaths statewide attributable to these causes (57).

According to the NC State Center for Health Statistics, in 2005 there were 49 deaths statewide due to CO poisoning, 14 of which were unintentional. No deaths due to CO poisoning occurred in Watauga County in 2005 (58).

Radon

Radon is a naturally occurring, invisible, odorless gas that comes from soil, rock and water. It is a radioactive decay product of radium, which is in turn a decay product of uranium; both radium and uranium are common elements in soil. Radon usually is harmlessly dispersed in outdoor air, but when trapped in buildings it can be harmful. Most indoor radon enters a home from the soil or rock beneath it, in the same way air and other soil gases enter: through cracks in the foundation, floors or walls, hollow-block walls, and openings around floor drains, heating and cooling ductwork, pipes, and sump pumps (59).

Radon may also be dissolved in water as it flows over radium rich rock formations. Dissolved radon can be a significant health hazard, although to a lesser extent than radon in indoor air. Homes supplied with drinking water from private wells or from community water systems that use wells as water sources generally have a greater risk of exposure to radon in water than homes receiving drinking water from municipal water treatment systems. This is because well water comes from ground water, which has much higher levels of radon than surface waters. Municipal water tends to come from surface water sources which are naturally lower in radon, and the municipal water treatment process itself tends to reduce radon levels even further (60).

Trace amounts of uranium are sometimes incorporated into construction materials such as concrete, brick, granite and drywall. Although these materials have the potential to produce radon, they are rarely the main cause of elevated radon levels in buildings ().

Elevated levels of radon have been found in many counties in North Carolina, but the highest levels have been detected primarily in the upper Piedmont and mountain areas of the State where the soils contain the types of rock (gneiss, schist and granite) that have naturally higher concentrations of uranium and radium. Eight counties in North Carolina appear to have the highest levels of radon, exceeding, on average, 4 pCi/L (pico curies per liter). These counties are Alleghany, Buncombe, Cherokee, Henderson, Mitchell, Rockingham, Transylvania and Watauga (61).

Watauga County is among the 8 North Carolina Counties with predicted average indoor radon levels in the highest-range, greater than 4 pCi/L (62). According to county-level data provided by the NC Radon Program, the average radon level among 144 Watauga County air samples reported in 2004 was 8.06 pCi/L (63).

Health Risks of Radon

The primary risk of exposure to radon gas is an increased risk of lung cancer. Smokers are at higher risk of developing radon-induced lung cancer than non-smokers. There is no evidence that other respiratory diseases, such as asthma, are caused by radon exposure, nor is there evidence that children are at any greater risk of radon-induced lung cancer than are adults (64).

In recent years, the US EPA has worked with the National Academy of Sciences to update the estimates of lung cancer risks from indoor radon. The EPA's updated best national estimate of annual lung cancer deaths from radon is about 21,000 (65). Table 12 shows the

lifetime risk of lung cancer death per person from radon exposures of certain levels in homes.

Table 12. Lifetime Risk of Lung Cancer Death (per person) from Radon Exposure in the Home

Radon Level (pCi/L)	Never Smokers	Current Smokers	General Population
20	36 out of 1,000	260 out of 1,000	110 out of 1,000
10	18 out of 1,000	150 out of 1,000	56 out of 1,000
8	15 out of 1,000	120 out of 1,000	45 out of 1,000
4	73 out of 10,000	620 out of 10,000	230 out of 10,000
2	37 out of 10,000	320 out of 10,000	120 out of 10,000
1.25	23 out of 10,000	200 out of 10,000	73 out of 10,000
0.4	73 out of 100,000	640 out of 100,000	230 out of 100,000

NB: Assumes constant lifetime exposure in homes at these levels

Source: US EPA. Air. Indoor Air Quality. Radon. Assessment of Risks from Radon in the Home. Available at http://www.epa.gov/radon/risk_assessment.html. (Accessed February 2007).

Environmental Tobacco Smoke

In 1992, the EPA completed its risk assessment on *The Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders* and concluded that the widespread exposure to environmental tobacco smoke (ETS) in the United States presents a serious and substantial public health impact. Children are particularly susceptible to the effects of passive smoking. Their bronchial tubes are smaller and their immune systems are less developed, making them more likely to develop respiratory and ear infections when exposed to environmental tobacco smoke. Because they have smaller airways, children breathe faster than adults and consequently breathe in more harmful chemicals per pound of their weight than an adult would in the same amount of time (66).

A review by the World Health Organization concluded that passive smoking is a cause of bronchitis, pneumonia, coughing and wheezing, asthma attacks, middle ear infection, cot death, and possibly cardiovascular and neurobiological impairment in children (67). Asthma is the most common chronic disease of childhood. There is now compelling evidence that passive smoking is a risk factor for the induction of new cases of asthma as well as for increasing the severity of disease among children with established asthma. Infants of mothers who smoke have almost five times the risk of dying from Sudden Infant Death Syndrome compared to those whose mothers do not smoke. Parental smoking is also responsible for a 20%-40% increased risk of middle ear disease in children ().

A University of North Carolina at Chapel Hill survey showed that childhood smoking and exposure to environmental tobacco smoke were responsible for about 15 percent of asthma cases in the youngsters surveyed and resulted in an estimated \$1.34 million in excess medical costs. Statewide, there are an estimated 2,659 cases of asthma attributable to environmental tobacco smoke and 198 cases attributable to current childhood cigarette use

in this survey. Since the annual cost of treating a single active asthma case in North Carolina in that age group is \$471 (in 2001 dollars), parents and others spend \$1.34 million a year to provide care for the excess asthma cases resulting from tobacco exposures (68).

According to CDC data (69), in 1996 25.7% of adults responding to the North Carolina BRFSS self-identified as “current smokers”. In that same year, 10.1% of North Carolina households had an adult smoker and children living in the home. According to CDC estimates, 23.1% of all children under 18 in the United States were exposed to ETS in the home; in North Carolina the comparable exposure figure was 26.1% (Table 13).

Table 13. Prevalence of Cigarette Smoking Among Adults, and Children’s Exposure to Environmental Tobacco Smoke, North Carolina and United States, Percent of Households except as noted, 1996

	Current Smoker % of Adults ≥ 18	Current Smoker and Children in the Home	Smoking Allowed in All or Some Areas of the Home	Children Exposed to ETS in the Home No. Children	% Children
North Carolina	25.7%	10.1%	87.5%	416,544	26.1%
United States	23.6%	9.8%	87.5%	229,446	23.1%

Source: Centers for Disease Control and Prevention. (November 7, 1997). State-Specific Prevalence of Cigarette Smoking among Adults, and Children’s and Adolescents’ Exposure to Environmental Tobacco Smoke – United States, 1996. *MMWR. Weekly Report*, 46(44), 1038.

According to the 2006 Behavioral Risk Factor Surveillance System Survey, 22.1% respondents statewide self-identify as “current smokers”. No comparable county-specific BRFSS data exist for Watauga County, but according to *regional* BRFSS data (which includes respondents from Alleghany, Ashe, Avery, Watauga, and Wilkes counties), 19.6% of respondents self-identified as “current smokers” in 2006 (70).

As noted in 13 above, in 1996, 87.5% of households in North Carolina and the United States allowed smoking in all or some areas of the home. According to 2004 BRFSS data, the percent of North Carolina households allowing smoking in all or some areas of the home, or having no rules about smoking, had decreased dramatically to 27.7%; the percent dropped even further by 2006, to 24.8% (71). The percentage of households allowing smoking in the BRFSS region including Ashe County was 34% in 2004 and 26.6% in 2006 (Table 14).

Table 14. BRFSS Results: Household Smoking Policies, Percent of Responses, 2004 and 2006

	Not Allowed Anywhere		Allowed in Some Places		Allowed Anywhere		No Rules About Smoking	
	2004	2006	2004	2006	2004	2006	2004	2006
Watauga Region	66.0	73.3	9.7	6.1	8.6	3.3	15.7	17.2
North Carolina	72.3	75.2	8.1	8.2	7.0	4.2	12.6	12.4

Source: NC State Center for Health Statistics. 2004 & 2006 BRFSS Survey Results: North Carolina. Second Hand Smoke Policy. NC Statewide; Alleghany, Ashe, Avery, Watauga, and Wilkes counties. Available at <http://www.schs.state.nc.us/SCHS/aaw/2006/index.html>. (Accessed January 2007).

Indoor Air Quality Regulations and Policies

Smoke-Free Workplaces

North Carolina does not have a complete inventory of smoke free workplaces. However, WorkingSmokeFree.com is a website where workplaces may voluntarily register their smoke free status. There is one workplace in Watauga County on record as being officially smoke free: IRC, Inc. (72). Similarly, StepUp NC provides a voluntary registry of smoke free restaurants available at <http://stepupnc.com/do/smokefreedining.htm> (73).

Data summarized by the American Lung Association (74) indicates that as of August 3, 2006 North Carolina had no overarching state laws regulating clean indoor air in public places or in private workplaces. Legislation passed in 2006, however, effectively regulates the use of tobacco products in government buildings. NC General Statute §§ 143-595 et seq. (2006) stipulates:

The following areas may be designated as non-smoking areas in buildings owned, leased, or occupied by the state government. A library or museum open to the public; an area established as a non-smoking area, as long as at least 20 percent of the interior area, of equal quality, is required to be designated as a smoking area; any indoor space in an auditorium or arena except a designated smoking area shall be established in the lobby; any educational buildings primarily involved in health care instruction, and certain buildings/areas in University of North Carolina schools. Existing physical barriers and ventilation systems shall be used for non-smoking areas. All areas of any buildings occupied by the General Assembly are also smokefree. Exempt from this law are primary or secondary schools or day care centers -- except for a teacher's lounge, enclosed elevators, public school buses, hospitals, nursing homes and other rest homes, local health departments and the grounds of local health departments, local departments of social services and the grounds of local departments of social services, tobacco manufacturing, processing or administrative facilities, indoor arenas with a seating capacity greater than 23,000 people, state correctional facilities operated by the Department of Correction, community colleges and nonprofit organizations whose primary purpose is to discourage the use of tobacco products by the general public. Individuals who continue to smoke in a non-smoking area, despite notice by the person in charge, will be guilty of an infraction and be fined no more than \$25. This law does not supersede any local law, rule, or ordinance enacted prior to October 1, 1993. After this date, local laws, rules, or ordinances shall not be amended or enacted to contain restrictions regulating smoking, which exceed those in this law.

In addition, according to NC General Statute § 148-23.1 (2006):

No person may use tobacco products inside of a state correctional facility, except for authorized religious purposes. Inmates in violation of this section are subject to disciplinary measures to be determined by the department, including the potential loss of sentence credits earned prior to that violation. Employees in violation are subject to disciplinary action by the department.

Visitors in violation are subject to removal from the facility and loss of visitation privileges.

The State has had enabling legislation on the books since 2003 (NC General Statute §§ 115C-407) permitting local boards of education to adopt and enforce policies prohibiting the use of all tobacco products in public school buildings, in school facilities, on school campuses, or at school-related or school-sponsored events, and in or on other school property.

School-Focused Policies

An issue of growing importance these days is the air quality in our nation's schools. A study published by the US Government Accounting Office and the Department of Health and Human Services estimates that 8.4 million students attend schools with poor indoor air quality. Poor air quality can affect children's desire and ability to learn and can cause them to miss valuable days of school (75). According to the National Association of State Boards of Education, the State of North Carolina does not have any statutes specifically addressing indoor air quality in schools; however, North Carolina general Statute §130A-236 (1998) requires the Commission for Health Services to adopt rules establishing sanitation requirements, which include cleanliness, adequate lighting, ventilation, and waste disposal, for public, private, and religious schools, and requires the Department of Environmental and Natural Resources to conduct an annual inspection of schools (76).

Tobacco-Free Schools

One factor greatly affecting indoor air quality in schools is the school district's or Board of Education's school tobacco policies. Having a tobacco-free school environment is important in achieving physical, mental, and social health goals for students, staff, the school and the district. On July 18, 2007, Governor Easley signed Senate Bill 1086 which requires all North Carolina public schools to be 100% tobacco-free by August 2008 (77). As of September 2007, 86 of North Carolina's 115 School districts had adopted 100% Tobacco-Free policies, Watauga County Schools were among them (78).

The Northwest Tobacco Prevention Coalition

In addition to the governmental regulations and policies cited above, the Northwest Tobacco Prevention Coalition serves Alleghany, Ashe, Caldwell, Watauga, and Wilkes counties to help eliminate exposure to secondhand smoke, promote tobacco cessation, prevent youth initiation of tobacco use, and identify and eliminate tobacco-related disparities in specific populations. Using funding from the Centers for Disease Control and Prevention as administered by the Tobacco Prevention and Control Branch within the NC Department of Health and Human Services, the coalition partners with local health departments to generate several projects and initiatives towards its stated goals (79).

One such project is the Indoor Air Quality Monitoring Report which measures the levels of particulate air pollution in restaurants in order to help understand the serious health risks of secondhand smoke. In 2007, a comparison of Watauga County restaurants showed that air

quality was 4.5 times worse in mixed restaurants (with separate smoking and nonsmoking sections) than in smokefree restaurants. Restaurants allowing smoking throughout had 11 times worse air quality than smokefree restaurants (). See the Appendix section for a complete powerpoint presentation of the Air Quality Monitoring Project results in Watauga County, as reported to the Appalachian District Board of Health and the community.

The coalition also conducts campaigns to increase the number of smokefree restaurants and businesses. As of July 2007, over 70% of Watauga County restaurants are smokefree. Appendix A lists the smokefree dining options in Watauga County. The coalition also took part in the design and distribution of a smoking cessation toolkit which contains information regarding cessation and secondhand smoke dangers. The toolkit included a "prescription pad" to provide a concise and effective way to communicate facts ().

Lastly, the coalition works with the Families in Smokefree Homes (FISH) Project which is a cessation counseling program for pregnant women. Evaluation of the FISH project has demonstrated success in reducing tobacco use in participants, lowering incidence of premature birth, and increasing the number of higher birthweights for participants who reduce or quit smoking ().

Health Effects of Air Pollution

Air pollution poses many health risks and different pollutants can lead to respiratory problems, exacerbated allergies, asthma, and increased incidence of cardiovascular disease. This is especially true for vulnerable populations such as children, the elderly, pregnant women, those with heart or lung disease, and people with weakened immune systems.

Sick Building Syndrome/Building Related Illness

According to the US EPA (80), the term "sick building syndrome" (SBS) is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but for which no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be widespread throughout the building. In contrast, the term "building related illness" (BRI) is used when symptoms of diagnosable illness are identified and can be attributed directly to airborne building contaminants.

A 1984 World Health Organization Committee report suggested that up to 30 percent of new and remodeled buildings worldwide may be the subject of excessive complaints related to indoor air quality (IAQ). Often this condition is temporary, but some buildings have long-term problems. Frequently, problems result when a building is operated or maintained in a manner that is inconsistent with its original design or prescribed operating procedures. Sometimes indoor air problems are a result of poor building design or occupant activities.

Indicators of SBS include:

- Building occupants complain of symptoms associated with acute discomfort, e.g., headache; eye, nose, or throat irritation; dry cough; dry or itchy skin; dizziness and nausea; difficulty in concentrating; fatigue; and sensitivity to odors.
- The cause of the symptoms is not known.
- Most of the complainants report relief soon after leaving the building.

Indicators of BRI include:

- Building occupants complain of symptoms such as cough; chest tightness; fever, chills; and muscle aches.
- The symptoms can be clinically defined and have clearly identifiable causes.
- Complainants may require prolonged recovery times after leaving the building.

It is important to note that complaints may result from other causes. These may include an illness contracted outside the building, acute sensitivity (e.g., allergies), job related stress or dissatisfaction, and other psychosocial factors. Nevertheless, studies show that symptoms may be caused or exacerbated by indoor air quality problems ().

A number of factors have been cited as causing or contributing to SBS, among them:

- Inadequate ventilation.
- Chemical contaminants from indoor sources (adhesives, carpeting, upholstery, manufactured wood products, copy machines, pesticides, and cleaning agents, especially those emitting volatile organic compounds; environmental tobacco smoke; respirable particulate matter; and combustion products such as carbon monoxide and nitrogen dioxide from unvented kerosene and gas space heaters, woodstoves, fireplaces and gas stoves).
- Chemical contaminants from outdoor sources (pollutants from motor vehicle exhausts; plumbing vents, and building exhausts that enter buildings through poorly located air intake vents, windows, and other openings or garages).
- Biological contaminants (bacteria, molds, pollen, and viruses that may breed in stagnant water in ducts, humidifiers and drain pans, or where water has collected on ceiling tiles, carpeting, or insulation; also in insect or bird droppings).

In order to establish a cause and effect relationship between the symptoms of an illness and a contaminant of an indoor environment it is necessary to conduct an investigation that demonstrates both (a) the presence of a contaminant in the environment and, and (b) that the physical or mental complaint is actually caused or exacerbated by that contaminant. Proving such relationships is exceedingly difficult.

An Industrial Hygiene Consultant in the Occupational and Environmental Epidemiology unit in the Epidemiology Section of the NC Division of Public Health maintains a database of city and county level data on indoor air quality complaints received during intake calls, including the type of facility, the type of complaint, and the complainant. However, it is important to note that this database requires the initiative of complainants and therefore may be subject to fluctuations of public awareness about indoor air quality hazards. In 2005 and 2006, there were two indoor air quality complaints in Watauga County, one for mold and one for radon (81).

Asthma

Asthma is a chronic respiratory disease characterized by episodes or attacks of inflammation and narrowing of small airways in response to asthma “triggers.” Asthma attacks can vary from mild to life-threatening and involve shortness of breath, cough, wheezing, chest pain or tightness, or a combination of these symptoms.

Sources of indoor and outdoor air pollution can trigger asthma attacks. Some of the most common indoor asthma triggers include secondhand smoke, dust mites, mold, cockroaches and other pests, and combustion byproducts (82). Outdoor triggers include high levels of ozone and particulate pollution, which have been associated with 10-20% of all respiratory hospital visits and admissions (83).

Asthma Mortality

According to data from the CDC (84), in 2002, 4,261 people died from asthma in the United States. Among children, asthma deaths are rare. Nationwide, 187 children aged 0-17 years died from asthma in 2002. That indicates a mortality rate of 0.3 deaths per 100,000 children, compared to 1.9 deaths per 100,000 adults aged 18 and over. Non-Hispanic blacks were the most likely to die from asthma, and had an asthma death rate over 200% higher than non-Hispanic whites and 160% higher than Hispanics. National estimates for Hispanic subgroups, such as Puerto Ricans and Mexicans, are not available. Females had an asthma death rate about 40% higher than males.

In 2005, there were 7,617 respiratory disease deaths statewide, 107 of which were attributed to asthma. In Watauga County in 2005 there were thirty-six deaths due to respiratory diseases, none of which were attributed specifically to asthma (85).

Asthma Morbidity

Prevalence. The prevalence of asthma in the US increased by more than 73% between 1980 and 1999, during which interval children and certain racial groups, especially African Americans, experienced relatively greater increases in asthma prevalence (86).

According to CDC data based on the national BRFSS Survey, in 2002, 12.9% of the adult respondents in North Carolina reported having been diagnosed with asthma at some point in their lifetime, compared to a national average of 10.1% (87). According to the 2006 BRFSS Survey, in the five county region that includes Watauga County the lifetime prevalence of asthma was 9.6%; statewide, the comparable figure for lifetime asthma prevalence was 10.9% (88).

According to the National Survey of Children’s Health, in 2003 9.0% of North Carolina children currently suffered from asthma, compared to 8.9% of children nationwide (89). In School Year 1999-2000 the North Carolina School Asthma Survey was conducted statewide in North Carolina by a group of researchers from the School of Public Health at the University of North Carolina in Chapel Hill. The purpose of the survey was to assess the prevalence of asthmatic symptoms and risk factors in children in the seventh and eighth grades. According to the results of that survey, the prevalence of asthma among school-aged children in Watauga County was 8.9%, while the prevalence of undiagnosed wheezing was 14.1%.

Based on these findings, Watauga County ranked 26th of all NC counties for prevalence of diagnosed asthma, and 9th for undiagnosed wheezing (90).

The burden of asthma in a community can also be assessed by reviewing rates of hospitalizations and emergency department admissions and discharges for acute asthma events. In 2005, there were 65 asthma-related hospital discharges among the total population in Watauga County, equaling a hospitalization rate of 151.4 per 100,000, compared to a rate of 128.5 per 100,000 for the State as a whole. Among children aged 0-14, the 2005 Watauga County hospitalization rate was 210.2 per 100,000, compared to a statewide hospitalization rate of 164.6 per 100,000 (91).

Cardiovascular and Respiratory Events

During the last decade, epidemiological studies conducted worldwide have shown a consistent, increased risk for cardiovascular events, including heart and stroke deaths, in relation to short- and long-term exposure to outdoor air pollution, especially particulate matter. Elderly patients, people with underlying heart or lung disease, lower socioeconomic populations and diabetics may be at particularly increased risk. Investigations of adverse effects of particulate air pollution have found a 1% increase in total mortality for each 10 mg/m³ increase in particulate matter, with respiratory mortality increasing 3.4% and cardiovascular mortality increasing 1.4% (92).

Rates of cardiovascular and respiratory disease in Watauga County are discussed thoroughly in Volume 1 (Demographic, Socioeconomic and Health Data) of the Watauga County Community Health Assessment. At the present time there is no simple mechanism for linking cardiovascular or respiratory events to air pollution at the county level.

Chapter Three: Toxic Chemical Releases

Toxic Release Inventory

Over 6.5 billion pounds of toxic chemicals are released into the nation's environment each year. The US Toxic Releases Inventory (TRI), created in 1986 as part of the Emergency Planning and Community Right to Know Act, is the tool the US EPA uses to track these releases. Certain industrial facilities are required to report estimates of their environmental releases and waste generation annually to the TRI. Their reports estimate the facilities' releases of any of approximately 650 toxic chemicals to air, water, and land, as well as the quantities of chemicals they recycle, treat, burn or dispose of in any way on-site or off-site. These reports do not cover all toxic chemicals, and they omit pollution from motor vehicles and small businesses. Because TRI facilities in North Carolina and most other states are not required to report the quantities of toxic chemicals actually *used* (inputs), and report only *estimates* of emissions rather than actual outputs, TRI data may not be entirely realistic (93).

In 2002, North Carolina ranked among the 20% dirtiest states in the US in terms of total major chemical releases to the environment, ranking 12th out of 56 US states and territories (94). Of the 80 North Carolina counties ranked in 2002, Watauga is listed as 70th and it ranks among 20% of cleanest counties in the nation. Davie County was considered the best county in the State in terms of total environmental releases while Person County was considered the worst (95). Table 15 compares the releases among these three counties. Total Watauga County Releases decreased 98% between 1988 and 2002.

Table 15. Comparison of TRI Pollution, 2002

County	Ranking in NC (out of 80)	Pounds Released	Top Pollutant Released	Pounds of Top Pollutant Released	Primary Method of Release
Person	1	19,125,859	Hydrochloric Acid	14,802,518	Air/Land
Watauga	70	7,000	N-Methyl-2-Pyrrolidone	7,000	Air
Davie	80	1	Lead Compounds	1	Air

Source: Scorecard, Pollution Locator, Toxic Chemical Releases. Available at: http://www.scorecard.org/ranking/rank-counties.tcl?fips_state_code=37&type=mass&category=total_env&modifier=na&how_many=100 (Accessed January 2007).

North Carolina ranks fourth out of 56 US states, territories and protectorates which release chemicals to the air, seventh out of 54 for chemical releases to water, and 18th out of 55 with regards to chemical releases to land. Eighty-one percent of the State's total emissions were air releases, which include all TRI chemicals emitted by a plant from its smoke stacks and from "fugitive sources" such as leaking valves, spills and evaporative losses (). All TRIs in Watauga County are released into the air (96). Water releases, which include discharges to streams, rivers, lakes, oceans and other bodies of surface water, account for approximately 7% of the total in North Carolina (), but 0% of the total in Watauga County (). Land releases, which include all the chemicals disposed on land in landfills, via farming, in surface impoundments, and via accidental spills or leaks, comprise the second most important category of releases in North Carolina (11%) (), and make up 0% of releases in Watauga County (). The following section identifies the primary point sources and health risks associated with the most abundant pollutants emitted in Watauga County.

In 2002 the Watauga County facility releasing the most TRI chemicals was International Resistive Co. in Boone (7,000 pounds of N-Methyl-2-Pyrrolidone) (97). It should be noted that the TRI chemical release was reduced by 97% between 1988 and 2002 ().

Watauga County ranks 62nd in the State (out of 81 ranked counties) in terms of production related waste – 172,301 pounds compared to the worst county, New Hanover with almost 174 million pounds of total production-related waste (). Total production-related waste is the sum of all non-accidental chemical waste generated at a facility, and includes on-site environmental releases, on-site waste management (recycling, treatment and combustion for energy recovery) and off-site transfer for any purpose). The Watauga County facility generating the most production-related waste is the same cited above, International Resistive Co. with 172,301 pounds of primarily N-Methyl-2-Pyrrolidone (). Production-related waste at this facility decreased 33% from 1991-2002 ().

For purposes of relating chemical releases to the health of the public, TRI chemicals are categorized as having “cancer risks” or “noncancer risks”. The ranking system, based on pounds of releases, uses a weighting factor so chemical releases can be compared on a common scale that takes into account both exposure and toxicity. The weighted result, referred to as a Toxic Equivalency Potential (TEP), is a relative measure of human health risk associated with a release of one pound of subject chemical compared to the risk posed by the release of one pound of a reference chemical. All releases of carcinogens are converted to pounds of benzene equivalents; all releases of chemicals that cause noncancer health effects are converted to pounds of toluene equivalents. Each chemical’s TEP is multiplied by its release quantity (in pounds) to determine the chemical’s local risk score (98).

Watauga County did not rank out of the 66 counties in North Carolina ranked for overall cancer risk score (99) and did not rank out of the 78 counties ranked for overall non-cancer risk score (100).

Land Contamination

Superfund Sites

Watauga County currently does not have any sites on EPA’s National Priorities List (NPL), commonly known as the Federal “Superfund” Program List. Superfund sites are some of the nation’s worst toxic waste sites, made eligible by law for long-term remediation. North Carolina currently has 31 superfund sites, just above the national average for all states. The 31 North Carolina Superfund Sites are scattered statewide in 20 counties and of those, none are in the same region as Watauga County (101).

Brownfields

The US EPA began the Brownfields Initiative in 1995 to encourage the clean-up and reuse of abandoned contaminated properties. A Brownfields site is any real property that is abandoned, idle or underutilized where environmental contamination, perceived or real, hinders redevelopment. Loans are very difficult to obtain when property comes with potential environmental cleanup liability; the NC Brownfields program aims to alleviate that liability for

possible developers. As of May 10, 2007, 97 Brownfields Agreements had been negotiated in North Carolina; there were 119 active eligible projects and 26 more pending. At that time one active eligible project was located in Watauga County: the State Farm Road site located at 660 State Farm Road in Boone (102).

Inactive Hazardous Sites

In 1987 the North Carolina General Assembly enacted the North Carolina Inactive Hazardous Sites Response Act, establishing a program to protect the public and the environment from uncontrolled and unregulated hazardous waste sites that are not addressed by other environmental programs. The Inactive Hazardous Site Branch (IHSB) of DENR can deal with any site where hazardous substance or waste contamination exists that isn't already under the jurisdiction of another program. IHSB assesses sites, maintains the list of current sites and oversees the remediation process. There are three such sites in Watauga County: the Moses Cone Memorial Park located off of Blue Ridge Parkway in Blowing Rock, Old John's River Road Dump at Mile Marker 296.1 off the Blue Ridge Parkway in Blowing Rock, and Vermont American off State Farm Road in Boone (103).

Hazardous Substances Emergency Events

Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has maintained an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system to describe the public health consequences associated with the release of hazardous substances. The North Carolina Division of Public Health has participated in the system since 1991, collecting information on acute hazardous substances emergency events.

Through this program, public health professionals study and describe the public health effects associated with releases of hazardous substances such as ammonia, chlorine, acids, pesticides, paints, and dyes, but *not* petroleum products (104).

Although the data presented below is dated, it is included here as a baseline for comparison with data in future assessments.

HSEES Events in North Carolina

A total of 1,087 statewide hazardous substances emergency events were reported to the HSEES system between 1998 and 2001 by the N.C. Division of Public Health, Occupational and Environmental Epidemiology Branch. Approximately 2% of these events were threatened releases. Thirty-four percent of the events occurred at fixed facilities, and 66% were transportation-related events.

Fixed-facility events occur in various areas of the facilities; approximately 27% occurred in above-ground storage areas, 22% in piping, 13% in material handling, and 10% in process vessels. In transportation-related events, 92% occurred during ground transport (for example, truck, van, or tractor), and 7% involved transport by rail. The remaining

transportation-related events involved water, air, or pipeline transport. Human error was a contributing factor in 41% of the events, 23% involved equipment failure, 16% involved improper filling or loading, and the remaining events were attributable to other factors. (Information on factors contributing to transportation events was not collected until 2000.) The most commonly reported hazardous substances released were in the category "Other" (24%); 19% of the events involved volatile organic compounds, 9% involved acids, and 13% involved other inorganic compounds. During this reporting period 106 events resulted in a total of 417 victims, four of whom died. The most common adverse health effects experienced among the survivors were respiratory irritation (264 victims), eye irritation (100 victims), gastrointestinal problems (68 victims) and trauma (42 victims). One-hundred thirty-eight, or almost 13% of the 1087 events required evacuation (105).

HSEES Events in Watauga County

There were two such events for Watauga County reported between 1998 and 2001, one fixed facility and one transportation related (.). No injury data are available for these events.

Chapter Four: Lead Hazards

Lead is a highly toxic metal that was used for many years in products found in and around the home. Elevated exposure to lead can cause serious health effects, particularly by disrupting normal neurological development in young children. Lead exposure typically occurs in and around the house as a result of deteriorating lead-based paint, lead-contaminated dust, and lead-contaminated soil. Recent news coverage has directed attention to lead levels in children's toys.

Housing Units at Risk

One way to estimate the potential burden of lead hazards is to examine local housing and demographic indicators to identify areas with housing at high risk of lead hazards. Studies have demonstrated that housing built prior to 1950 and households with income below the poverty threshold have an elevated risk of lead contamination. The 2000 US Census provides data for both of these risk factors to help estimate potential lead hazards in housing (106). When Watauga County is compared to other North Carolina counties, it ranks 50th of the 50 counties ranked for percent of housing units at high risk for lead hazards; it ranks 47th out of 50 for number of housing units with low income; it ranks 21st out of 50 for percent of housing units with low income (107). Watauga County is not ranked for the other risk factors as shown in Table 16. However, data for all risk factors are still available.

Table 16. Watauga County Lead Hazard Indicators, 1999

Housing Units at High Risk for Lead Hazards		Housing Units Built Before 1950		Housing Units with Low Income		Children < 5 Living Below Poverty Level	
No.	%	No.	%	No.	%	No.	%
250	2	1,900	n/a	3,100	19	360	21

Source: Scorecard, Pollution Rankings. Lead Hazards. County Report. Available at http://scorecard.org/env-releases/lead/county.tcl?fips_county_code=37189. (Accessed February 2007).

Childhood Blood Lead Levels

According to statistics provided by the State, the percentage of Watauga County children screened for lead has been above the State average for children aged one and two years for all of the four most recent reporting periods (Table 17). Of those children screened during this period, an equal or lower percentage of children in the County tested positive for elevated lead levels than in the State as a whole in all of the four years cited. Table 18 presents the screening results for children ages six months to six years. The percentages of children with high blood lead levels (10-19 µg/dL) in Watauga County were lower than North Carolina in all but one of the four most recent reporting periods. Blood lead levels >20 µg/dL were lower in Watauga County than in North Carolina in all of the reporting periods (108).

Table 17. Watauga County Childhood Lead Screening Results, Ages 1 and 2 years

Year	Location	Target Population	No. Screened	% Screened	% Screened among Medicaid	No. >10 µg/dL	% >10 µg/dL
2005	Watauga	701	346	49.4	66.6	2	0.6
	NC	238,065	96,623	40.6	56.1	873	0.9
2004	Watauga	692	373	53.9	-	4	1.1
	NC	235,599	92,057	39.1	-	1,167	1.3
2003	Watauga	677	356	52.6	58.2	7	2.0
	NC	235,419	87,993	37.4	55.9	1,716	2.0
2002	Watauga	701	328	46.8	56.1	3	0.9
	NC	238,359	86,212	36.2	54.5	1,614	1.9

NB: Dashes indicate data are not available.

Source: NC Division of Environmental Health. Children's Environmental Health Branch. Available at http://www.deh.enr.state.nc.us/ehs/Children_Health/Lead/Surveillance_Data_Tables/surveillance_data_tables.html. (Accessed January 2007).

Table 18. Watauga County Childhood Lead Screening Results, Ages 6 Months to 6 years

Year	Location	No. Screened	No. Confirmed 10-19 µg/dL	% Confirmed 10-19 µg/dL	No. Confirmed >20 µg/dL	% Confirmed > 20 µg/dL
2005	Watauga	433	0	0	0	0
	NC	128,249	299	0.23	53	0.04
2004	Watauga	451	2	0.44	0	0
	NC	124,486	349	0.28	52	0.04
2003	Watauga	454	1	0.22	0	0
	NC	121,697	467	0.38	38	0.03
2002	Watauga	456	0	0	0	0
	NC	120,966	461	0.38	68	0.06

Source: NC Division of Environmental Health. Children's Environmental Health Branch. Available at http://www.deh.enr.state.nc.us/ehs/Children_Health/Lead/Surveillance_Data_Tables/surveillance_data_tables.html. (Accessed January 2007).

Chapter Five: Agricultural Pollution

Growing crops successfully involves the application of a variety of chemicals, some of which have environmental effects beyond their intended use. Unfortunately, most of these effects are deleterious. Livestock production also requires chemicals, mostly in the form of food additives and antibiotics, but at the present time the major environmental issue connected with livestock production is the generation of animal waste. In order to understand the effect of a county's agricultural production on the environment, it is first necessary to understand the nature of the crops being grown and livestock being raised.

Watauga County Agricultural Census

In 2002 Watauga County was home to 731 farms, totaling 51,758 acres, 8,822 of which is harvested cropland. The average farm size in Watauga County is 71 acres. Crops in Watauga County include tobacco and hay. (Note: grapes and Christmas trees are not considered crops *per se* and will be covered separately.) Livestock raised in the County includes cattle and beef cows. Crops account for the majority of cash receipts, bringing in \$17 million in 2004 and ranking 57th in the State (109). A summary of agricultural crop production in Watauga County for 2006 is shown in Table 19; livestock production for 2002 is summarized in Table 20. Cash receipts for 2004 are shown in Table 21.

Table 19. Crops Grown in Watauga County, 2006

Crop	Acres Planted	Acres Harvested	Yield per Acre	Production	State Rank
Tobacco, lbs.	Not Available	100	1,650	165,000	65
Cotton, 480 lb. bales	-	-	-	-	-
Soybeans, bu.	-	-	-	-	-
Corn, bu.	-	-	-	-	-
Corn for silage, tons	-	-	-	-	-
Peanuts, lbs.	-	-	-	-	-
Wheat, bu.	-	-	-	-	-
Barley, bu.	-	-	-	-	-
Oats, bu.	-	-	-	-	-
Sweet potatoes, Cwt.	-	-	-	-	-
Irish potatoes, Cwt.	-	-	-	-	-
All hay, tons	Not available	5,900	2.75	16,200	47
Sorghum, bu.	-	-	-	-	-

NB: Harvests of less than 15 acres tobacco, 100 acres peanuts, and 200 acres other crops are not shown in table.

Source: NC Department of Agriculture and Consumer Services. Agricultural Statistics Division. County Estimates. County Estimates by Commodities. Available at http://www.agr.state.nc.us/stats/cnty_est/cnty_est.htm. (Accessed January 2007).

Table 20. Livestock Raised in Watauga County, 2002

Stock		Number of animals
Cattle		9,832
Hogs and pigs		32
Broilers and other meat type chickens		NA
Poultry	Layers	256
	Turkeys	0
Sheep and lambs		456
Total		10,544

NB: NA = Data are not available in order to avoid disclosing information on individual farms.

Source: United States Department of Agriculture. National Agricultural Statistics Service. 2002 Census of Agriculture – Volume 1 Geographic Area Series Census, State – County Data. Watauga County: Tables 11, 12, 13, 16. Available at: http://www.nass.usda.gov/Census/Create_Census_US_CNTY.jsp . (Accessed February 2007).

Table 21. Cash Receipts in Watauga County, 2004

Cash Receipts	Dollars	State Rank
Livestock, Dairy, and Poultry	5,020,000	76
Crops	17,416,000	57
Government Payments	30,000	95
Total	22,466,000	77

Source: NC Department of Agriculture and Consumer Services. Agricultural Statistics Division. County Estimates. County Estimates by Commodities. Available at http://www.agr.state.nc.us/stats/cnty_est/cnty_est.htm. (Accessed January 2007).

Pesticides

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant (110).

By their very nature, most pesticides create some risk of harm to humans, animals, or the environment because they are designed to kill or otherwise adversely affect living organisms.

Pesticide Usage on Crops

The NC Department of Agriculture and Consumer Services does not list agricultural chemicals applied to tobacco and hay, therefore information on pesticide application was not available for Watauga County (111).

Health Effects of Pesticides

The health effects of pesticides depend on the type of pesticide. Some, such as the organophosphates and carbamates, affect the nervous system. Others may irritate the skin or eyes. Some pesticides may be carcinogens. Others may affect the hormone or endocrine systems in the body (112). The EPA's assessment of the health risks and health effects of the herbicides, insecticides, and fungicides are listed in the agency pesticide re-registration database (113). Information is not available for Watauga County however because data regarding chemical usage is not available.

Pesticide Residues in/on Food

According to an employee of the NC Department of Agriculture's Product Testing unit (114) in 2005 four food samples tested were in violation of regulations for pesticide residues for safe consumption. According to the contact, these positive samples represented less than 1% of all samples tested.

Pesticide-Related Poisonings

There was one accidental death due to pesticide poisoning in North Carolina in 2005, however it was not in Watauga County. None occurred statewide between 2000 and 2004, but one occurred in 2000. This poisoning was also not in Watauga County (115).

Viticulture

North Carolina ranks 10th in the United States for wine and grape production and has a total of 61 wineries in 34 counties. The State had 1,300 bearing acres of grapes in 2006, with a production rate of 3.52 indicating total production at 4,580 tons. This is a marked increase from ten years earlier where there were 480 bearing acres, a production rate of 2.50, and a production of 1,200 tons (116).

The NC Department of Agriculture and Consumer Services does not collect county-level data on grape production, nor does it provide information on pesticide application to grape crops. However, North Carolina State University provides data on commonly used pesticides as shown in Table 22 (117)

Table 22. Commonly Used Grape Pesticides

Application Time	Name	Type of Pesticide	Level of Toxicity
Dormancy – Shatter	Mancozeb	Fungicide	Slightly toxic; less than one pint can kill an adult
	Nova	Fungicide	Moderately toxic; less than two tablespoons can kill an adult
	Abound	Fungicide	Slightly toxic; less than one pint can kill an adult
	Vanguard	Fungicide	Slightly toxic; less than one pint can kill an adult
	Sevin	Insecticide	Moderately toxic; less than two tablespoons can kill an adult
	Princep	Herbicide	Slightly toxic; less than one pint can kill an adult
	Surflan	Herbicide	Slightly toxic; less than one pint can kill an adult
	Gramoxone Max	Herbicide	Highly toxic; less than one teaspoon can kill an adult
First Cover – Harvest	Roundup Ultramax	Herbicide	Slightly toxic; less than one pint can kill an adult
	Nova	Fungicide	Moderately toxic; less than two tablespoons can kill an adult
	Elevate	Fungicide	Slightly toxic; less than one pint can kill an adult
	Vanguard	Fungicide	Slightly toxic; less than one pint can kill an adult
	Captan	Fungicide	Highly toxic; less than one teaspoon can kill an adult
	Sevin	Insecticide	Moderately toxic; less than two tablespoons can kill an adult
	Imidan	Insecticide	Moderately toxic; less than two tablespoons can kill an adult
	Lorsban	Insecticide	Moderately toxic; less than two tablespoons can kill an adult
Post Harvest	Pyramite	Insecticide	Moderately toxic; less than two tablespoons can kill an adult
	Gramoxone Max	Herbicide	Highly toxic; less than one teaspoon can kill an adult
	Mancozeb	Fungicide	Slightly toxic; less than one pint can kill an adult
	Kerb	Herbicide	Slightly toxic; less than one pint can kill an adult
	Select	Herbicide	Moderately toxic; less than two tablespoons can kill an adult

Source: North Carolina State University. Department of Environmental and Molecular Toxicology. Extension. Links of Interest. Publications. Pesticides and human health: grapes. Names and Application Times of the Most Common Grape Pesticides. Available at <http://www.tox.ncsu.edu/extension/pdfs/Grape-English.pdf>. (Accessed August 2007).

Horticulture

North Carolina ranks 2nd in the United States for Christmas tree production which provided \$57.6 million in revenue in 2002. Information regarding the total acreage of Christmas tree production in the State was not available at press time. Watauga County is ranked 5th in North Carolina and 37th in the United States for Christmas tree production. Christmas trees are one of the County's top agricultural items. In 2002, Watauga County produced 1,789 acres of cut Christmas trees, bringing in \$2.2 million (118).

Similar to viticulture, the NC Department of Agriculture and Consumer Services does not provide information on pesticide application in horticulture. However, North Carolina State University and the NC Cooperative Extension provide data on commonly used pesticides. On average, 0.5 ounces of pesticides are used over the life of a Christmas tree. Based on two surveys distributed to members of the Christmas tree industry (representing in total over 600 growers and 21,000 acres), Table 23 lists pesticides and associated health effects that are used on at least 3% of Christmas tree acreage (119).

Table 23. Commonly Used Christmas Tree Pesticides

Chemical Name	Toxicology Information
Insecticide	
Di-Syston 15 G	Highly toxic via ingestion, inhalation, and dermally in humans. No chronic effects were noted, however rats showed reproductive effects and at high levels, teratogenic effects. Mutagenic effects were noted on bacteria. There is no evidence of a carcinogenic effect.
Lindane	Moderately toxic via ingestion, inhalation, and dermal exposure in humans. No observable chronic effects in mice, rats, or dogs. Rats showed reproductive and teratogenic effects. No mutagenic or carcinogenic effects were found in mice.
Dimethoate	Moderately toxic via ingestion, inhalation, and dermally in humans. No chronic effects were noted, however, in mice there were both reproductive and mutagenic effects. Rats showed teratogenic and carcinogenic effects.
Asana	Moderately toxic orally, slightly toxic dermally, non-toxic via inhalation in humans. No chronic, reproductive, teratogenic, mutagenic, or carcinogenic effects were shown in laboratory animals.
Lorsban	Moderately toxic ingestion and inhalation, and in a limited capacity dermally, in humans. Chronic toxicity resulted in the same effects as acute exposure. No reproductive, teratogenic, mutagenic, or carcinogenic effects were found in laboratory animals.
Savey	Not available
Morestan	Not available
Herbicides	
Roundup	Nontoxic via ingestion and dermal exposure. Moderately toxic via inhalation in humans. No chronic, reproductive, teratogenic, mutagenic, or carcinogenic toxic effects were noted in laboratory animals.
Simazine	Slightly toxic via ingestion, inhalation, and dermal exposure in humans. No reproductive, teratogenic, mutagenic, or carcinogenic effects were shown in laboratory animals.
Goal	

Chemical Name	Toxicology Information
Vantage	Slightly toxic via ingestion. Nontoxic via ingestion and inhalation in humans. Reproductive effects were shown in laboratory animals, although teratogenic, mutagenic, and carcinogenic effects were not.
Stinger	Not available
Garlon	Not available
Crossbow	Not available

Sources: NC State University. North Carolina Cooperative Extension. Mountain Horticultural Crops Research and Extension Center. Programs. Christmas Trees. Christmas Tree Production in North Carolina. Christmas Tree Production and the Environment. Available at: <http://www.ces.ncsu.edu/fletcher/programs/xmas/environment/pesticides.html>. (Accessed August 2007).

Agricultural Animal Waste

In 1997 North Carolina had the dubious distinction of being among the 20% of states with the highest levels of animal waste, with especially high rates of waste production from hogs and poultry and comparably high amounts of nitrogen and phosphorus released to the environment. Of the 98 North Carolina counties ranked for animal waste generation, Watauga County is ranked 73rd with an output of 63,000 tons (120). Animal waste generation of between 1.5 and 4.5 *million* tons occurs in the North Carolina counties at the top of the ranking: Duplin, Sampson, Bladen and Wayne. Table 24 and Table 25 detail the animal waste production in the County. The data for these tables comes from the National Agricultural Statistics Services (NASS). NASS publishes an agricultural census every five years; the most current census report available is from 2002. Although other assessments are conducted annually, methods vary from year to year, therefore the NASS dataset offers the most comprehensive and consistent data available.

Table 24. Inventory of Livestock Animal Head and Waste Production for Watauga County, 1997 and 2002

	Number of Animals		Waste Production (tons/year)		Waste Rate (tons/year/head)	
	1997	2002	1997	2002		
Cattle	12,791	9,832	106,165	81,606	8.3*	
Hogs and pigs	32	NA	61	NA	1.9	
Poultry	Broilers and other meat type chickens	NA	NA	NA	0.024	
	Layers	374	256	18	12	0.047
	Turkeys	NA	0	NA	0	0.112
Sheep and lambs	238	456	95	182	0.4	
Total	13,435	10,544	106,339	81,800	-	

NB: NA = Data are not available in order to prevent disclosing information on individual farms.

NB: Because the category of cattle is not subdivided into meat and dairy, the waste rate for beef cattle was used so that the total waste production would be an underestimate. The waste rate for dairy cattle (22.3) is almost three times the rate for beef cattle.

NB: Waste Production is equal to the number of animals times the waste rate.

Source: United States Department of Agriculture. National Agricultural Statistics Service. 2002 Census of Agriculture – Volume 1 Geographic Area Series Census, State – County Data. Watauga County: Tables 11, 12, 13, 16. Available at: http://www.nass.usda.gov/Census/Create_Census_US_CNTY.jsp. (Accessed February 2007).

Source: NC State University. 2005 North Carolina Agricultural Chemicals Manual. Livestock Manure Production Rates and Nutrient Content. Available at: <http://www.lib.clemson.edu/agric/pdfs/LIVESTOCKMANUREPRODUCTIONRATESANDNUTRIENTCONTEN T.pdf>. (Accessed February 2007).

Table 25. Percent of Total Livestock Number and Waste Production for Watauga County, 1997 and 2002

	Percent of Animal Head		Percent of Waste Production		
	1997	2002	1997	2002	
Cattle	95.2%	93.2%	99.8%	99.8%	
Hogs and pigs	0.2%	NA	0.1%	NA	
Poultry	Broilers and other meat type chickens	NA	NA	NA	
	Layers	2.8%	2.4%	0.0%	0.0%
	Turkeys	NA	0.0%	NA	0.0%
Sheep and lambs	1.8%	4.3%	0.1%	0.2%	

NB: Percentages calculated from Table 24.

Source: United States Department of Agriculture. National Agricultural Statistics Service. 2002 Census of Agriculture – Volume 1 Geographic Area Series Census, State – County Data. Watauga County: Tables 11, 12, 13, 16. Available at:

http://www.nass.usda.gov/Census/Create_Census_US_CNTY.jsp . (Accessed February 2007).

Source: NC State University. 2005 North Carolina Agricultural Chemicals Manual. Livestock Manure Production Rates and Nutrient Content. Available at:

<http://www.lib.clemson.edu/agnic/pdfs/LIVESTOCKMANUREPRODUCTIONRATESANDNUTRIENTCONTENT.pdf>. (Accessed February 2007).

As of 2002, 93.2% of livestock in Watauga County were cattle, making up 99.8% of the waste production (121, 122). Waste from animals whose digestive system more closely resembles the human digestive system is considered more of a threat to human health. Cattle are herbivores and so their digestive system is dramatically different from a human's. Likewise with chickens, whose digestive system is slightly more like a human's than a cow's. Hogs, like humans, are omnivores, and so their digestive system is more like that of a human; therefore hog waste is considered more dangerous to humans than either cattle or poultry waste.

Between 1997 and 2002, livestock farming in Watauga County did not change appreciably, and as a result neither has animal waste production (Table 24). Cattle production decreased from 12,791 to 9,832 head and layer production decreased from 374 to 246 head. Sheep and lamb production increased from 238 to 456 head. Trend data was not available for hog, broiler, and turkey production.

It is important to note that concerns about the potential for contaminated air, groundwater, and drinking water from lagoon and sprayfield waste management systems in rural counties have led to a moratorium on hog farms. Since August of 1997, legislation has placed a temporary ban on the construction or expansion of hog farms that employ the use of lagoons and sprayfields. The moratorium was intended to allow counties to establish zoning ordinances that would regulate the siting of hog farms. Over the past ten years, the moratorium has been extended four times. In 2000, researchers began to explore technologies that more effectively treat and distribute agricultural waste (123, 124).

Chapter Six: Waste Management

Solid Waste Management

In FY 2004-2005, Watauga County managed 65,132 tons of solid waste for a rate of 1.52 tons *per capita*. This figure represented an *increase* of 54% from the comparable *per capita* rate for 1991-1992. It is significant to note that during this same period the overall state *per capita* solid waste management rate increased approximately 21% from 1991-1992 to 2003-2004 (125).

Landfills, Waste Drop-Off, and Recycling

Appalachian State University operates a compost facility at 265 Dale Street in Boone. Watauga County operates a both Landclearing and Solid Waste Transfer facilities at 336 Landfill Road in Boone. This same location is home to a now closed construction and demolition landfill. The Watauga County Municipal and Solid Waste Landfill at US 421 in Boone is also closed. (126,127).

The Watauga County waste transfer station allows residents to drop off solid waste. Each household is permitted 2,000 pounds of waste per year. If they exceed this amount, they are charged \$45 per ton of solid waste and \$35 per ton of brush. A hazardous household waste recycling day is held twice per year. Additionally, Watauga County has ten recycling/convenience sites. More information on solid waste management in the County is available at <http://www.wataugacounty.org/sanitation/index.html> (128).

Wastewater Management

According to 1990 Census data (data not available for the 2000 Census), 7,260 Watauga County housing units (37.2%) were on a year-round public sewer system and 11,582 residences (59.2%) had septic tanks or cesspools. An additional 696 housing units (3.6%) had some other form of sewage disposal, including individual sewer pipes into creeks, rivers and streams (straight pipes) or outhouses (129).

Although there are no county wastewater treatment plants, the Towns of Boone, Beech Mountain, and Blowing Rock have municipal plants. The Boone wastewater treatment plant has a capacity of 4.82 million gallons per day (mgd), with an average flow of 2.4 mgd. Effluent is discharged into the South Fork of the New River. Beech Mountain has two treatment plants: Pond Creek and Buckeye Creek. The former has a capacity of 400,000 gallons per day (gpd), an average flow of 80,000 gpd, and discharges into Pond Creek. The latter has a capacity of 147,000 gpd, an average of 36,000 gpd, and discharges into Buckeye Creek. The Blowing Rock wastewater treatment plant discharges into the South Fork of the New River. Additional information on this wastewater treatment plants was not available by press time (130).

On-Site Wastewater Management

According to 1990 Census data cited above, approximately 37% of the County's residences were connected to year-round public sewer, meaning 63% had septic tanks or cesspools or some other mechanism of sewage disposal. Some commercial and government facilities outside of the sanitary sewer district must depend on on-site wastewater treatment systems, or "package plants" for wastewater treatment.

The Surface Water Protection Section of NC DENR levies civil penalties for discharges from wastewater treatment plants (WWTPs), including package plants, which exceed limits for particular chemical or biological parameters. From January – May 2007, two package WWTPs in Watauga County received fines. Two fines were levied for Hebron Colony Ministries Inc – Hebron Colon and Grace Home WWTP and one fine for Appalachian State University – Camp Broadstone WWTP(131).

Local health departments are charged with inspecting and permitting on-site wastewater facilities. During FY 03-04, the Environmental Health Division of the Watauga County Health Department made a reported 3,384 site visits, and issued 1 citation for violations; no permits were revoked or suspended, but 48 inspections resulted in denied construction or improvement permits (132). Additionally, information provided by the Appalachian District Health Department indicates that between May 2003 and August 2005, surveyors from the Wastewater Discharge Elimination (WaDE) program visited 1,548 sites, completed 754 survey forms through homeowner interviews, and identified and reported 86 violations of septic tank rules. WaDE records currently show 75 of these violations remain unrepaired. An estimated \$23,169 is available to complete the permitting process for repairs for these known non-compliant septic systems. \$56,492 is available as financial assistance to qualified homeowners for repairs through WAMY Community Action, Inc (133).

Chapter Seven: Drinking Water

According to the 1990 Census (data not available for the 2000 Census), 8,534 Watauga County year-round housing units (43.7%) were on a water source supplied by a city or county water department, a water district, a private water company, or a well serving six or more housing units. Another 7,640 units (39.1%) had an individual well as the primary source of water. A smaller number of units – 3,364, or 17.2% – obtained water from some other source, such as springs, creeks, rivers, lakes, ponds or cisterns (134).

Water Usage

Table 26 details the annual average rate of water usage in Watauga County based on data from the 2000 US Census. Domestic water usage includes withdrawal of fresh water from individual wells for domestic uses. Municipal/community water usage is defined as the withdrawal of fresh water from surface and ground water sources by public water supply systems for municipal and commercial uses. Industrial usage is the withdrawal of fresh water from surface and ground water sources or purchases from a water supplier for industrial uses. Irrigation usage refers to water withdrawn from surface and ground sources for agricultural and golf course irrigation, and livestock usage refers to use of surface and groundwater for watering livestock. The total water use is the average annual rate of withdrawal of fresh water from surface and ground water sources for all uses. All figures are reported in millions of gallons per day.

As illustrated in Table 26, total water usage in Watauga County decreased 10% between 1995 and 2000. While domestic usage increased during this time period, municipal/community usage, irrigation usage, and livestock usage all decreased. Industrial usage remained the same with a usage rate below a million gallons of water per day.

Table 26. Average Annual Rate of Water Usage, Watauga County, 1995 and 2000 (Millions of gallons per day)

	Domestic Usage	Municipal and Community Usage	Industrial Usage	Irrigation Usage	Livestock Usage	Total Usage
2000	0.86	3.41	0.00	1.20	0.15	5.62
1995	0.49	4.01	0.00	1.47	0.28	6.25

Source: Log Into North Carolina (LINC) Database Search. Topic Group: Environment, Recreation and Resources. Mineral, Water Resources. V1307, V1308, V1309, V1310, V1312, and V1313. Watauga County. Available at http://data.osbm.state.nc.us/pls/linc/dyn_linc_main.show. (Accessed April 2007).

Drinking Water Systems

Currently, the EPA lists 103 water systems in Watauga County (135). Twenty-eight are *community water systems* that together serve 36,547 people (Table 27). A community water system is one that serves at least 15 service connections used by year-round residents or regularly serves 25 year-round residents. This category includes municipalities, subdivisions

and mobile home parks. Four community systems use surface water; however watershed data are not available for three of these systems. The Town of Boone uses surface water that comes from the Upper Yadkin watershed.

Table 27. Watauga County Community Water Systems (April, 2007)

Water System Name	Number Served	Primary Water Source Type
Appalachian State Univ WTP	11,150	Surface Water
Town of Beech Mountain	2,418	Surface Water
Bloomfield Apartments	31	Groundwater
Town of Blowing Rock	1,637	Surface Water
Blue Ridge Estates	32	Groundwater
Town of Boone	16,406	Surface Water
Bradford Park	380	Groundwater
Chapel Hill S/D	245	Groundwater
Crestview Estates S/D	80	Groundwater
Crystal Mountain	76	Groundwater
Echota S/D	200	Groundwater
Green Briar Apartments	36	Groundwater
Green Valley Townhomes	25	Groundwater
Hampton MHP	45	Groundwater
Heavenly Mtn Resort – Village	30	Groundwater
Highland Hall Retirement Ctr	30	Groundwater
Hound Ears Water System	976	Groundwater
Mill Ridge POA	250	Groundwater
Mountain Care Facilities	75	Groundwater
Mountain Ridge Estates	168	Groundwater
Pebble Creek Apartments	30	Groundwater
Powder Horn Mountain	485	Groundwater
Town of Seven Devils	725	Groundwater
Ski Mountain S/D	475	Groundwater
Smoketree Lodge	110	Groundwater
Spiritual Center of America – E	150	Groundwater
Spiritual Center of America – W	250	Groundwater
Valley View S/D	32	Groundwater

Source: Environmental Protection Agency. Envirofacts. Safe Drinking Water Information System (SDWIS). Safe Drinking Water Query. County Search. Available at <http://www.epa.gov/safewater/dwinfo/nc.htm> (Accessed January 2007).

Drinking Water Standards Violations

The US EPA records violations of drinking water standards reported to it by states in its Safe Drinking Water Information System (SDWIS). It records violations as either *health-based* (contaminants exceeding safety standards or water not properly treated) or *monitoring- or reporting-based* (system failed to complete all samples or sample in a timely manner, or had

another non-health related violation) (). There were twelve reported health-based violations for eight water systems in the period from 2000 through September of 2006 (Table 28).

Table 28. Watauga County Public Drinking Water Systems Reporting Health-Based Violations, 2000-2006

System Name	Dates	Type of Violation	Contaminant	Population Served
Town of Beech Mountain	Apr-Jun 2005	MCL, Average	Total Haloacetic Acids	2,418
Town of Blowing Rock	Apr-Jun 2005	MCL, Average	Total Haloacetic Acids	1,637
Chapel Hill S/D	Sep 2004	MCL, Monthly	Coliform (TCR)	245
Hampton MHP	Jul 1994 – Dec 2025	OCCT Study Rec	Lead & Copper Rule	45
Mill Ridge POA	Jul 2003 – Feb 2005	OCCT Study Rec	Lead & Copper Rule	250
Mill Ridge POA	Jan 2001 – Jul 2002	Public Education	Lead & Copper Rule	250
Town of Seven Devils	Jul 2003 – Nov 2004	Public Education	Lead & Copper Rule	725
Town of Seven Devils	Jul 2003 – Feb 2005	OCCT Study Rec	Lead & Copper Rule	725
Town of Seven Devils	Jan 2000 – Jul 2001	Public Education	Lead & Copper Rule	725
Town of Seven Devils	Jan 2000 – Aug 2002	OCCT Study Rec	Lead & Copper Rule	725
Smoketree Lodge	May 2003	MCL, Monthly	Coliform (TCR)	110
Valley View S/D	Jul 2001 – Jun 2005	Public Education	Lead & Copper Rule	32

Source: Environmental Protection Agency. Envirofacts. Safe Drinking Water Information System (SDWIS). Safe Drinking Water Query, County Search. Available at <http://www.epa.gov/safewater/dwinfo/nc.htm>. (Accessed January 2007).

NB: To access violation information, you must click on each individual system name.

There are fourteen *non-transient, non-community water systems*, which are systems that serve the same people, but not on a year-round basis in Watauga County. They serve as estimated 2,757 people ().

Transient non-community water systems do not consistently serve the same people, and include sites like rest stops, churches, hotels, restaurants, campgrounds and gas stations. There are 61 such systems in place in Watauga County, serving an estimated 4,932 people ().

Chapter Eight: Food-, Water-, and Vector- Borne Diseases

A number of human diseases and syndromes are caused or exacerbated by contamination of the natural environment with microbes or chemicals, or by animal vectors. Several of these conditions are among the illnesses that must be reported to health authorities. A number of food-, water-, and vector- borne diseases are of increasing importance because they are either rare but becoming more prevalent, or spreading in geographic range, or becoming more difficult to treat. Among these diseases are Shiga toxin producing *E.coli*, salmonellosis, Lyme disease, West Nile virus infection, Eastern equine encephalitis, and rabies. Table 29 lists the number of cases of major reportable food-, water- and vector-borne diseases reported in Watauga County from 2002 to 2005. Comparable data for North Carolina are provided for 2005 only. From 2002-2005, there were seventeen cases of Campylobacter, fifteen cases of Salmonellosis, four cases of Shiga toxin-producing *E. coli*, four cases of Lyme disease, two cases of Listeriosis, and one case of *E. coli* O157 in Watauga County.

Table 29. Watauga County Reported Cases of Food-, Water-, and Vector- Borne Diseases in Humans, 2002-2005

	2002	2003	2004	2005	NC (2005)
Campylobacter	5	2	6	4	672
Cryptosporidiosis	0	0	0	0	92
<i>E. coli</i> O157	1	0	0	0	--
<i>E. coli</i> (Shiga toxin-producing)	0	2	2	0	64
Encephalitis, California group	0	0	0	0	23
Encephalitis, Eastern equine	0	0	0	0	1
Encephalitis, West Nile Virus	0	0	0	0	2
Ehrlichiosis (monocytic)	0	0	0	0	29
Hepatitis A	0	0	0	0	84
Listeriosis	0	1	0	1	34
Lyme disease	1	2	1	0	49
Rocky Mountain spotted fever	0	0	0	0	625
Salmonellosis	3	1	7	4	1,701
Shigellosis	0	0	0	0	202

NB: The table is limited to the primary food-, water-, and vector borne diseases found in North Carolina and is not the comprehensive list of diseases found from the following source.

Source: NC Division of Public Health, Epidemiology Section, General Communicable Disease Branch. Communicable Disease Control. Statistics. County Tables: Reported Cases, North Carolina, 2002-2005, County of Residence by Diseases and Year of Report. Available at <http://www.epi.state.nc.us/epi/gcdc.html>. (Accessed February 2007).

Arboviral Diseases

Arboviral diseases are viral diseases transmitted from an animal host to humans (and sometimes other animals) by the bite of an arthropod, usually a tick or biting fly such as a

mosquito. Mosquito-borne diseases are of particular significance in communities where there is a lot of water, since that is the environment in which they breed.

Historically, mosquito-transmitted diseases, most notably Eastern Equine Encephalitis (EEE) and LaCrosse Encephalitis (LAC) are endemic in North Carolina. West Nile Virus (WNV), however, is relatively new. It first appeared in the US in 1999, but by 2001 it had spread to 28 states. The first North Carolina appearance of WNV was in 2000 in Chatham County, where it was detected in a dead crow. The virus is believed to be carried by migrating flocks of birds and transmitted to other vertebrates and humans via mosquito bites.

The NC Division of Environmental Health's Public Health Pest Management Section manages the State's WNV surveillance program, which is focused on mosquitoes, wild birds and other animals. Because the reservoir for WNV appears to be avian, "sentinel" flocks of birds, primarily chickens, are used as a kind of early warning system. The public also plays a role in surveillance by submitting dead birds for testing.

According to the NC Public Health Pest Management Section, North Carolina reported one positive human case of WNV in 2006, five cases in 2005, 2 cases in 2004, and 23 cases in 2003, none of which occurred in Watauga County. However, in 2003, there was one wild bird case (136).

Eastern Equine Encephalitis is a disease of the central nervous system that affects horses and humans. It is transmitted by a species of mosquito that lives in marshes and swamps and feeds on birds in which the virus multiplies. The presence of the disease is monitored by the sentinel flock method. In 2006 there were no positive human cases in North Carolina; there were none in 2005, one in 2004, and one in 2003. No human or non human cases occurred in Watauga County from 2002-2006 ().

Both WNV and EEE are considered emerging infectious diseases because their incidence is growing dramatically in the US. There are vaccines for both for horses, but not for humans.

La Crosse Encephalitis is the most common arbovirus affecting North Carolinians (DHHS). Transmission occurs most frequently after being bitten from an infected mosquito. LAC is a disease of the central nervous system with complications ranging from headaches and fever, to tremors and coma. From 2002-2006, there were 104 positive cases of LAC reported in North Carolina. No positive cases of LAC were found in Watauga County from 2002-2006 (,137).

In March 2007, the Appalachian District Health Department applied for and subsequently was awarded state aid in mosquito control to serve the 84,910 permanent residents and 3.3 million temporary residents in the 977 square miles that cover Alleghany, Ashe, and Watauga Counties. In 2006, 50 requests/complaints were made for mosquito control assistance. The Health Department requested almost \$1.5 million in state funds to pay for a mosquito control program to:

- Educate the public to the health hazard mosquitoes pose
- Educate the public in ways to reduce and eliminate sources for mosquito breeding
- Receive and respond to public complaints and concerns
- Practice surveillance through seasonal maintenance of light trapping sites in varying environments

- Develop and maintain up to date data on species breeding, location, and population trends
- Identify problem mosquito species and implement efficient control strategies
- Maintain regular control over potential high density breeding sites
- Practice viral surveillance through pooling samples and submitting them to the state for testing, as well as other methods in the future (138).

Rabies

The Communicable Disease Control Branch reports cases of rabies (139). Table 30 lists the number of cases of rabies in animals in Watauga County from 2001 through 2006. Selected animal hosts, including all those with reported cases, are shown. From 2001-2006, there were twenty-four reported cases of rabies in Watauga County, fifteen, four in cats, three in skunks, one in a dog, and one in a fox ().

Table 30. Watauga County Cases of Rabies in Animals, 2001-2006

	Bat	Cat	Cow	Dog	Fox	Skunk	Raccoon
2006	0	2	0	0	0	0	2
2005	0	1	0	0	0	0	4
2004	0	0	0	0	1	0	2
2003	0	1	0	0	0	1	3
2002	0	0	0	0	0	1	1
2001	0	0	0	1	0	1	3

Source: NC Department of Public Health. Epidemiology. Communicable Disease Control. Rabies. Available at <http://www.epi.state.nc.us/epi/rabies/state.html>. (Accessed January 2007).

Additionally, the Appalachian District Health Department provided information for rabies investigations and treatments for humans in Watauga County from 2004-June 2007. In 2004, there were 15 investigations, 3 treatments, and 5 referrals. In 2005, there were 16 investigations, 19 treatments, and 3 referrals, and in 2006, 19 investigations, 0 treatments, and 4 referrals. Lastly in 2007, there were 8 investigations, 1 treatment, and 0 referrals (140).

References

1 NC Department of Environment and Natural Resources. Division of Water Quality. Ambient Monitoring System (AMS). Available at <http://h2o.enr.state.nc.us/esb/ams.html>. (Accessed January 2007).

2 NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Reports. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed January 2007).

3 Environmental Defense. Scorecard. Pollution Locator. Water. Clean Water Act Status, Watauga County. Available at http://www.scorecard.org/env-releases/water/cwa-county.tcl?fips_county_code=37189. (Accessed February 2007).

4 Environmental Defense. Scorecard. Pollution Locator. Water. Watershed Indicators Report - Content Descriptions. Available at <http://www.scorecard.org/env-releases/water/iwi-report-descriptions.tcl#summary>. (Accessed January 2007).

5 Environmental Defense. Scorecard. Pollution Locator. Pollutants or Environmental Stressors Impairing Water Quality. Available at http://www.scorecard.org/env-releases/def/cwa_cause_class_def.html. (Accessed January 2007).

6 Environmental Defense. Scorecard. Pollution Locator. Leading Sources of Water Quality Impairment. Available at http://www.scorecard.org/env-releases/def/cwa_source_class_def.html. (Accessed January 2007).

7 North Carolina Division of Water Quality. Basinwide Planning. Which Basin Are You In? Available at <http://h2o.enr.state.nc.us/basinwide/whichbasin.htm>. (Accessed January 2007).

8 NC Department of Environment and Natural Resources. Division of Water Quality. North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report). Public Review Draft. 06 IR County Summary. Available at http://h2o.enr.state.nc.us/tmdl/General_303d.htm. (Accessed January 2007).

9 NC Department of Environment and Natural Resources. Division of Water. North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report). Public Review Draft. 303d List Draft. Available at http://h2o.enr.state.nc.us/tmdl/General_303d.htm. (Accessed January 2007).

10 Environmental Defense. Scorecard. Pollution Locator. Water. State Watershed Indicators Report. Available at http://scorecard.org/env-releases/water/iwi-state.tcl?fips_state_code=37. (Accessed January 2007).

11 Environmental Defense. Scorecard. Pollution Locator. EPA Watershed Evaluation Categories. Available at http://scorecard.org/env-releases/def/iwi_def.html. (Accessed January 2007).

-
- 12 Environmental Protection Agency. Wetlands, Oceans, & Watersheds. Watauga County, NC. Available at http://cfpub.epa.gov/surf/county.cfm?fips_code=37189. (Accessed January 2007).
- 13 Environmental Defense. Scorecard. Pollution Locator. Water. County Watershed Indicators Report: Watauga County. Available at http://scorecard.org/env-releases/water/iwi-county.tcl?fips_county_code=37189. (Accessed January 2007).
- 14 Environmental Defense. Scorecard. Pollution Locator. Watershed Vulnerability Indicators. Available at http://scorecard.org/env-releases/def/iwi_wvi.html. (Accessed January 2007).
- 15 NC Department of Environment and Natural Resources. Division of Water. North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report). 2006 Public Review Draft. Available at http://h2o.enr.state.nc.us/tmdl/General_303d.htm. (Accessed May 2007).
- 16 NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report Watauga River Basin, April 2005. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).
- 17 NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Planning Program. Executive Summaries. Watauga, January 2007. Available at http://wire.enr.state.nc.us/basinwide/documents/ExecutiveSummary_026.pdf. (Accessed July 2007).
- 18 NC Department of Environment and Natural Resources. Division of Water. North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report). 2006 Public Review Draft. Available at http://h2o.enr.state.nc.us/tmdl/General_303d.htm. (Accessed May 2007).
- 19 NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report New River Basin, August 2004. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).
- 20 Virginia Department of Water Quality. Final 2006 305(b)/303(d) Water Quality Assessment Integrated Report. Chapter 3.2 Individual River Basin Assessment Summary - New River Basin. Available at http://www.deq.state.va.us/wqa/pdf/2006ir/2006irdoc/ir06_Pt3_Ch3.2_Basin_Summary.pdf. (Accessed May 2007).
- 21 NC Department of Environment and Natural Resources. Division of Water. North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report). 2006 Public Review Draft. Available at http://h2o.enr.state.nc.us/tmdl/General_303d.htm. (Accessed May 2007).
- 22 NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report Yadkin-Pee Dee River Basin, 2007. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed July 2007)

23 NC Department of Environment and Natural Resources. Division of Water. North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report). 2006 Public Review Draft. Available at http://h2o.enr.state.nc.us/tmdl/General_303d.htm. (Accessed May 2007).

24 NC Department of Environment and Natural Resources. Division of Water Quality. Basinwide Assessment Report Catawba River Basin, 2003. Available at <http://www.esb.enr.state.nc.us/bar.html>. (Accessed May 2007).

25 NC Department of Environment and Natural Resources. Division of Water Quality. Environmental Sciences Section. Fish Kill Event Update. Historic Events. Available at <http://h2o.enr.state.nc.us/esb/Fishkill/fishkillmain.htm> (Accessed January 2007).

26 NC Division of Public Health. Epidemiology Section. Fish Consumption Advisories. Available at <http://www.epi.state.nc.us/epi/fish/current.html>. (Accessed January 2007).

27 NC State Laboratory of Public Health. Environmental Sciences. Microbiology. Sample Test Results. Available at <http://slph.state.nc.us/EnvironmentalSciences/Microbiology/frmMainSearch.aspx>. (Accessed January 2007).

28 NC Department of Environment and Natural Resources. Groundwater Section. Database Download Website. Query Incident Management Database. Available at <http://its.enr.state.nc.us/gwi/>. (Accessed January 2007).

29 Environmental Protection Agency. Air & Radiation. National Ambient Air Quality Standards (NAAQS). Available at <http://www.epa.gov/air/criteria.html>. (Accessed January 2007).

30 Environmental Defense. Scorecard. Pollution Locator. Smog and Particulates. Criteria Air Pollutant Descriptions. Available at <http://www.scorecard.org/env-releases/cap/pollutant-desc.tcl>. (Accessed January 2007).

31 Environmental Protection Agency. Air & Radiation. Air Data. Available at <http://www.epa.gov/air/data/geosel.html>. (Accessed January 2007).

32 Environmental Defense. Scorecard. Pollution Locator. Smog and Particulates. Rank States by Emissions. Emissions of Criteria Air Pollutants. Available at <http://www.scorecard.org/env-releases/cap/rank-states-emissions.tcl>. (Accessed January 2007).

33 Environmental Defense. Scorecard. Pollution Locator. Smog and Particulates. Watauga County Report. Available at http://www.scorecard.org/env-releases/cap/county.tcl?fips_county_code=37189. (Accessed January 2007).

34 NC Department of Environment and Natural Resources. Division of Air Quality. Ambient Monitoring Section. 2000 Ambient Air Quality Report, December 2002. Available at <http://daq.state.nc.us/monitor/reports/2002-01.pdf>. (Accessed January 2007).

-
- 35 Environmental Protection Agency. Air & Radiation. Air Data. Reports and Maps. Air Quality Index Report. Available at <http://www.epa.gov/air/data/repst.html?st~NC~North%20Carolina>. (Accessed April 2007).
- 36 Environmental Defense. Scorecard. Pollution Locator. Definitions of Air Pollution Source Categories. Available at http://www.scorecard.org/env-releases/def/air_source.html. (Accessed January 2007).
- 37 Environmental Defense. Scorecard. Pollution Locator. Smog and Particulates. National Report. Available at <http://www.scorecard.org/env-releases/cap/us.tcl>. (Accessed January 2007).
- 38 Environmental Defense. Scorecard. Pollution Locator. Smog and Particulates. State Report, North Carolina. Available at http://www.scorecard.org/env-releases/cap/state.tcl?fips_state_code=37. (Accessed January 2007).
- 39 Environmental Protection Agency. Air Data. Nonattainment Area Map - Criteria Air Pollutants. Available at <http://www.epa.gov/air/data/repst.html>. (Accessed January 2007).
- 40 NC Department of Environment and Natural Resources. Division of Air Quality. News and Public Outreach. Press Releases 2003. Areas Recommended for Ozone Non-Attainment Designation. Available at http://daq.state.nc.us/news/pr/2003/nonattain_0715.shtml. (Accessed January 2007).
- 41 NC Department of Environment and Natural Resources. Division of Air Quality. News and Public Outreach. Press Releases 2004. North Carolina Air Quality Chief Comments on EPA Particulate Matter Designation. Available at http://daq.state.nc.us/news/pr/2004/pm_12172004.shtml. (Accessed January 2007).
- 42 NC Department of Transportation. Division of Motor Vehicles. Driver Services. Vehicle Services. Emission Inspection Requirements. Available at http://www.ncdot.org/dmv/vehicle_services/emissioninspection/requirements.html. (Accessed May 2007).
- 43 Federal Highway Administration. Highway Statistics 2004. Selected Measures for Identifying Peer States. Available at <http://www.fhwa.dot.gov/policy/ohim/hs04/index.htm>. (Accessed January 2007).
- 44 Appalachian State University. Energy Center. Energy Use in the Transportation Sector. Available at <http://www.energy.appstate.edu/sep/ch11.php>. (Accessed January 2007).
- 45 US Census Bureau. Publications. Statistical Abstract of the US: 2006. Section 23, Transportation. Table 1079, Alternative Fueled Vehicles in Use by Fuel Type: 2002-2004. Available at <http://www.census.gov>. (Accessed January 2007).
- 46 NC Department of Transportation. Transit. Gazetteer of Intermodal Transportation in North Carolina. Available at <http://www.ncdot.org/transit/transitnet/PublicInfo/Gazetteer.html>. (Accessed January 2007).

-
- 47 AppalCART. Rider Information. Available at http://www.appalcart.appstate.edu/EN/US/?page=41&Rider_Info. (Accessed July 2007).
- 48 Environmental Defense. Scorecard. Pollution Locator. Descriptions of Hazardous Air Pollution. Available at <http://www.scorecard.org/env-releases/hap/report-descriptions.tcl#risk>. (Accessed January 2007).
- 49 Environmental Defense. Scorecard. Pollution Locator. Caveats on Hazardous Air Pollution Data. Available at http://www.scorecard.org/env-releases/def/hap_caveats.html. (Accessed January 2007).
- 50 Environmental Defense. Scorecard. Pollution Locator. Assessing Cancer and Noncancer Risks. Available at http://www.scorecard.org/env-releases/def/hap_qra.html. (Accessed January 2007).
- 51 Environmental Defense. Scorecard. Pollution Locator. Hazardous Air Pollution. State Report, North Carolina. Available at http://www.scorecard.org/env-releases/hap/rank-counties.tcl?fips_state_code=37&how_many=100. (Accessed January 2007).
- 52 Environmental Defense. Scorecard. Pollution Locator. Hazardous Air Pollution. County Report, Watauga County. Available at http://www.scorecard.org/env-releases/hap/county.tcl?fips_county_code=37189. (Accessed January 2007).
- 53 Environmental Defense. Pollution Locator. Recent Air Toxics Studies Confirm Diesel Emissions Pose a Significant Public Health Threat. Available at http://www.scorecard.org/env-releases/def/hap_diesel.html. (Accessed January 2007).
- 54 Environmental Defense. Scorecard. Chemical Profiles. Acrolein. Available at http://www.scorecard.org/chemical-profiles/summary.tcl?edf_substance_id=107-02-8. (Accessed January 2007).
- 55 Environmental Protection Agency. Indoor Air Quality. An Introduction to Indoor Air Quality. Available at <http://www.epa.gov/iaq/ia-intro.html>. (Accessed January 2007).
- 56 UNC Healthcare. Good Medicine. Prevention is key in avoiding carbon monoxide poisoning. Available at http://www.unchealthcare.org/site/healthpatientcare/goodmedicine/carbon_monoxide_poisoning.htm. (Accessed January 2007).
- 57 NC State Center for Health Statistics. County Level Data. Detailed Mortality Statistics Report. North Carolina; Watauga County: ICD 10 Codes X47, X67. Available at <http://www.schs.state.nc.us/SCHS/deaths/dms/2005/>. (Accessed January 2007).
- 58 NC State Center for Health Statistics. Personal communication to Elizabeth Nelson from Kathleen Jones-Vessey, Vital Statistics Team Leader (Kathleen.Jones-Vessey@ncmail.net).
- 59 NC Department of Environment and Natural Resources. NC Radon Program. Facts about Radon. Available at <http://www.ncradon.org/Facts.htm>. (Accessed February 2007).

-
- 60 NC Department of Environment and Natural Resources. NC Radon Program. Radon in Water. Available at <http://www.ncradon.org/water.htm>. (Accessed February 2007).
- 61 NC Department of Environment and Natural Resources. NC Radon Program. Radon and Geology. Available at <http://www.ncradon.org/Geology.htm>. (Accessed February 2007).
- 62 NC Department of Environment and Natural Resources. NC Radon Program. EPA Radon Zone Map of NC. Available at <http://www.ncradon.org/zone.htm>. (Accessed February 2007).
- 63 NC Department of Environment and Natural Resources. NC Radon Program. County Information Regarding Radon Levels. Available at http://www.ncradon.org/countydata/weballcounty_1.html. (Accessed February 2007).
- 64 NC Department of Environment and Natural Resources. NC Radon Program. Health Risks of Radon. Available at <http://www.ncradon.org/Health.htm>. (Accessed February 2007).
- 65 Environmental Protection Agency. Air. Indoor Air Quality. Radon. Assessment of Risks from Radon in Homes. Available at http://www.epa.gov/radon/risk_assessment.html. (Accessed February 2007).
- 66 Action on Smoking and Health. Passive Smoking: The impact on children. Available at <http://www.ash.org.uk/html/passive/html/kidsbrief.html>. (Accessed January 2007).
- 67 World Health Organization. Tobacco Free Initiative. Tobacco and the Rights of the Child. Available at http://www.who.int/tobacco/resources/publications/rights_child/en/. (Accessed January 2007).
- 68 UNC Healthcare. News Release: Survey: active, passive smoking in NC middle school children boosts asthma cases 15 percent. Available at http://www.unchealthcare.org/site/newsroom/news/2004/Feb/passive_smoking (Accessed January 2007).
- 69 Centers for Disease Control and Prevention. (November 7, 1997). State-Specific Prevalence of Cigarette Smoking Among Adults, and Children's and Adolescents' Exposure to Environmental Tobacco Smoke - United States, 1996. *MMWR. Weekly Report*, 46(44), 1038.
- 70 NC State Center for Health Statistics. 2006 BRFSS Survey Results: North Carolina. Tobacco Use. Current Smoker. NC Statewide; Alleghany, Ashe, Avery, Watauga, and Wilkes counties. Available at http://www.schs.state.nc.us/SCHS/brfss/2006/aaw/_rfsmok3.html. (Accessed October 2007)
- 71 NC State Center for Health Statistics. 2006 BRFSS Survey Results: North Carolina. Second-hand Smoke Policy. NC Statewide; Alleghany, Ashe, Avery, Watauga and Wilkes counties. Available at <http://www.schs.state.nc.us/SCHS/brfss/2006/aaw/housesmk.html>. (Accessed January 2007).
- 72 NC Department of Health and Human Services. Tobacco Prevention and Control Branch. WorkingSmokeFree. North Carolina Smoke-Free Workplace Directory. Available at <http://www.workingsmokefree.com>. (Accessed January 2007).

73 NC Department of Health and Human Services. Tobacco Prevention and Control Branch. StepUp NC. North Carolina Smoke-Free Dining. Available at <http://stepupnc.com/do/smokefreedining.htm>. (Accessed February 2007).

74 American Lung Association. Tobacco Control. State Legislated Actions on Tobacco Issues [SLATI]. SLATI State Information: North Carolina. Available at <http://slati.lungusa.org/state-templ.asp?id=33>. (Accessed January 2007).

75 National Safety Council. Environmental Health Center. Indoor Air Quality and Schools. Available at <http://www.nsc.org/EHC/indoor/schools.htm>. (Accessed January 2007).

76 National Association of State Boards of Education. Healthy Schools. State-level School Health Policies. North Carolina. Available at <http://www.nasbe.org/HealthySchools/States/Topics.asp?Category=C&Topic=6>. (Accessed January 2007).

77 (2007, August 2). Ashe County Applauds General Assembly: All NC Schools Are Now 100% Tobacco-Free. *Ashe Mountain Times*, p. 6.

78 NC Department of Health and Human Services. Tobacco Prevention and Control Branch. Map and Graphs: NC school districts that are 100% tobacco-free. Available at <http://www.nctobaccofreeschools.com/why/index.shtm>. (Accessed January 2007).

79 Appalachian District Health Department. (July 5, 2007). Personal communication from Jennifer Bryan to Sheila Pfaender.

80 Environmental Protection Agency. Indoor Air Quality. Publications. Indoor Air Facts No. 4 (revised): Sick Building Syndrome (SBS). Available at <http://www.epa.gov/iaq/pubs/sbs.html#Biological%20contaminants>. (Accessed January 2007).

81 NC Division of Public Health. Occupational and Environmental Epidemiology. (March 3, 2007). Personal communication from David Lipton to Molly Cannon.

82 Centers for Disease Control and Prevention. Environmental Hazards and Health Effects. Asthma. Available at <http://www.cdc.gov/asthma/faqs.htm>. (Accessed January 2007).

83 Environmental Protection Agency. Indoor Air. Asthma and Indoor Environments. Outdoor Air Pollution. Available at <http://www.epa.gov/asthma/outdoorair.html>. (Accessed January 2007).

84 Centers for Disease Control and Prevention. National Center for Health Statistics. Health and Stats. Asthma Prevalence, Health Care Use and Mortality, 2002. Available at <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm>. (Accessed January 2007).

85 NC State Center for Health Statistics. County Level Data. Detailed Mortality Statistics Report. North Carolina; Watauga County: ICD 10 Codes J00-J99;J45. Available at <http://www.schs.state.nc.us/SCHS/deaths/dms/2005/>. (Accessed January 2007).

86 Centers for Disease Control and Prevention. (March 29, 2002). Surveillance for Asthma - United States, 1980-1999. MMWR. Surveillance Summaries, 51(SS01), 1-13.

87 Centers for Disease Control and Prevention. (February 27, 2004). Asthma Prevalence and Control Characteristics by Race/Ethnicity - United States, 2002. MMWR Weekly Report, 53(7), 145-148.

88 NC State Center for Health Statistics. 2006 BRFSS Survey Results: North Carolina. Asthma. Lifetime Prevalence. NC Statewide; Alleghany, Ashe, Avery, Watauga, and Wilkes, counties. Available at <http://www.schs.state.nc.us/SCHS/brfss/2005/aaw/topics.html>. (Accessed January 2007).

89 Child and Adolescent Health Measurement Initiative. National Survey of Children's Health. Data Resource Center. [Query for: Healthy People 2010; HP 2010 Focus Area #24: Respiratory Diseases; How many children/youth currently have asthma? US and NC]. Available at <http://nschdata.org/DataQuery/SurveyAreas.aspx> (Accessed January 2007).

90 NC Division of Public Health. Women's and Children's Section. Children and Youth Branch. Asthma Program Office. North Carolina School Asthma Survey, 1999-2000. Prevalence of Asthma and Undiagnosed Wheezing. Available at <http://wch.dhhs.state.nc.us/Asthma/pdf/Asthma%20Prevalence%20by%20County%20Table1.pdf>. (Accessed January 2007).

91 NC State Center for Health Statistics. Health Data. County-level Data. County Health Data Book, 2007. Asthma Hospital Discharges (Total and Ages 0-14) per 100,000 Population, 2005. Available at <http://www.schs.state.nc.us/SCHS/data/databook/>. (Accessed January 2007).

92 American Heart Association. Air Pollution, Heart Disease and Stroke. Available at <http://www.americanheart.org/presenter.jhtml?identifier=4419>. (Accessed January 2007).

93 Environmental Defense. Scorecard. Pollution Locator. Toxic Chemical Releases. Environmental Releases Report. Available at http://www.scorecard.org/env-releases/er-report-descriptions.tcl#major_chemical_releases. (Accessed January 2007).

94 Environmental Defense. Scorecard. Pollution Rankings. Toxic Chemical Releases. By State. States with Reported Releases of TRI Chemicals to the Environment. Available at http://www.scorecard.org/ranking/rank-states.tcl?type=mass&category=total_env&modifier=na&how_many=100. (Accessed January 2007).

95 Environmental Defense. Scorecard. Pollution Rankings. Toxic Chemical Releases. By County. Counties with Reported Releases of TRI Chemicals to the Environment. Available at http://www.scorecard.org/ranking/rank-counties.tcl?fips_state_code=37&type=mass&category=total_env&modifier=na&how_many=100. (Accessed January 2007).

96 Environmental Defense. Scorecard. Pollution Locator. Toxic Chemical Releases. Reports. Environmental Release Report. Watauga County NC. Available at http://www.scorecard.org/env-releases/county.tcl?fips_county_code=37189. (Accessed April 2007).

97 Environmental Defense. Scorecard. Pollution Rankings. Toxic Chemical Releases by Counties in North Carolina. Facilities releasing TRI Chemicals to the Environment. State Report, North Carolina. Watauga County. Available at http://www.scorecard.org/ranking/rank-facilities-in-county.tcl?how_many=100&drop_down_name=Total+environmental+releases&fips_state_code=37&fips_county_code=37189&sic_2=All+reporting+sectors. (Accessed April 2007).

98 Environmental Defense. Scorecard. Pollution Locator. Risk Scoring System. Available at http://www.scorecard.org/env-releases/def/tep_gen.html. (Accessed January 2007).

99 Environmental Defense. Scorecard. Pollution Ranking. Toxic Chemical Releases. By County. Counties with Cancer Hazards from Manufacturing Facilities. Available at http://www.scorecard.org/ranking/rank-counties.tcl?how_many=100&drop_down_name=Cancer+risk+score&fips_state_code=37. (Accessed January 2007).

100 Environmental Defense. Scorecard. Pollution Ranking. Toxic Chemical Releases. By County. Counties with Non-Cancer Hazards from Manufacturing Facilities. Available at http://www.scorecard.org/ranking/rank-counties.tcl?how_many=100&drop_down_name=Noncancer+risk+score&fips_state_code=37. (Accessed January 2007).

101 Environmental Protection Agency. Superfund. Site. National Priority List Sites. Available at <http://www.epa.gov/superfund/sites/npl/locate.htm>. (Accessed January 2007).

102 NC Department of Environment and Natural Resources. Division of Waste Management. North Carolina Brownfields Project. Program Inventory as of 3/31/07. Available at http://www.ncbrownfields.org/project_inventory.asp. (Accessed April 2007).

103 NC Department of Environment and Natural Resources. Division of Waste Management. Superfund Section. Inactive Hazardous Sites Branch. Available at <http://www.wastenotnc.org/sfhome/ihsbrnch.htm>. (Accessed January 2007).

104 NC Division of Public Health. Epidemiology. Occupational and Environmental Epidemiology Branch. Occupational Illnesses and Injuries. Hazardous Substances Emergency Events Surveillance Program (HSEES). Available at <http://www.epi.state.nc.us/epi/oii/hsees.html>. (Accessed January 2007).

105 NC Division of Public Health. Epidemiology. Occupational and Environmental Epidemiology Branch. Occupational Illnesses and Injuries. Hazardous Substances Emergency Events Surveillance Program (HSEES). Program Publications. HSEES Reports. Surveillance of Hazardous Substances Emergency Events in North Carolina, Cumulative Report, 1998-2001. Available at <http://www.epi.state.nc.us/epi/oii/pdf/HSEES1998-2001.pdf> (Accessed January 2007).

-
- 106 Environmental Defense. Scorecard. Lead Hazard Indicators. Available at http://scorecard.org/env-releases/def/lead_hazard_measures.html. (Accessed February 2007).
- 107 Environmental Defense. Scorecard. Pollution Rankings. Lead Hazards by County. Available at http://scorecard.org/env-releases/lead/rank-counties.tcl?fips_state_code=37. (Accessed February 2007).
- 108 NC Division of Environmental Health. Children's Environmental Health Branch. Available at http://www.deh.enr.state.nc.us/ehs/Children_Health/Lead/Surveillance_Data_Tables/surveillan_data_tables.html. (Accessed February 2007).
- 109 NC Department of Agriculture and Consumer Services. Agricultural Statistics Division. County Estimates. County Estimates by Commodities. Available at http://www.agr.state.nc.us/stats/cnty_est/cnty_est.htm. (Accessed February 2007).
- 110 Environmental Protection Agency. Pesticides. About Pesticides. Available at <http://www.epa.gov/pesticides/about/index.htm#not>. (Accessed February 2007).
- 111 NC Department of Agriculture and Consumer Services. Agricultural Statistics Division. Environmental Statistics. Agricultural Chemical Applications. Available at <http://www.agr.state.nc.us/stats/otherept.htm#county>. (Accessed February 2007).
- 112 Environmental Protection Agency. Pesticides. Health and Safety. Human Health Issues. Available at <http://www.epa.gov/pesticides/health/human.htm>. (Accessed February 2007).
- 113 Environmental Protection Agency. Pesticides. Regulating Pesticides. Re-registration. Re-registration Status. Available at <http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>. (Accessed February 2007).
- 114 NC Department of Agriculture and Consumer Services. Food and Drug Protection Division. Food Branch. Product Testing. Personal communication from Michael Woody to Christina Rowland.
- 115 NC State Center for Health Statistics. County Level Data. Detailed Mortality Statistics Report. North Carolina Resident Deaths, 2000-2005. North Carolina; Watauga County: ICD 10 Code X48. Available at <http://www.schs.state.nc.us/SCHS/data/county.cfm>. (Accessed February 2007).
- 116 NC Wine.Org. News & Stats. Statistics. NC Grape Harvest Statistics. Available at: <http://www.ncwine.org/news/statisticsChart.html>. (Accessed August 2007).
- 117 North Carolina State University. Department of Environmental and Molecular Toxicology. Extension. Links of Interest. Publications. Pesticides and human health: grapes. Names and Application Times of the Most Common Grape Pesticides. Available at <http://www.tox.ncsu.edu/extension/pdfs/Grape-English.pdf>. (Accessed August 2007).

118 United States Department of Agriculture. National Agricultural Statistics Service. 2002 Census of Agriculture State and County Profiles. North Carolina. Watauga County. Available at: <http://www.nass.usda.gov/census/census02/profiles/nc/cp37189.PDF>. (Accessed August 2007).

119 NC State University. North Carolina Cooperative Extension. Mountain Horticultural Crops Research and Extension Center. Programs. Christmas Trees. Christmas Tree Production in North Carolina. Christmas Tree Production and the Environment. Available at: <http://www.ces.ncsu.edu/fletcher/programs/xmas/environment/pesticides.html>. (Accessed August 2007).

120 Environmental Defense. Scorecard. Pollution Locator. Agricultural Animal Waste. State Report, North Carolina. Available at http://www.scorecard.org/env-releases/aw/rank-counties.tcl?animal_type_code=total&waste_type_code=tons&fips_state_code=37 (Accessed July 2007).

121 United States Department of Agriculture. National Agricultural Statistics Service. 2002 Census of Agriculture -- Volume 1 Geographic Area Series Census, State -- County Data. Watauga County; Tables 11, 12, 13, 16. Available at http://www.nass.usda.gov/Census/Create_Census_US_CNTY.jsp. (Accessed February 2007).

122 NC State University. 2005 North Carolina Agricultural Chemicals Manual. Livestock Manure Production Rates and Nutrient Content. Available at <http://www.lib.clemson.edu/agnic/pdfs/LIVESTOCKMANUREPRODUCTIONRATESANDNUTRIENTCONTENT.pdf>. (Accessed February 2007).

123 North Carolina General Assembly. House Bill 515/S.L. 1997-458. 1997-1998 Session. Clean Water Responsibility Act. Available at <http://www.ncga.state.nc.us/gascripts/BillLookUp/BillLookUp.pl?Session=1997&BillID=H515>. (Accessed May 2007).

124 North Carolina State University. Waste Management Programs. Development of Environmentally Superior Technologies for Swine Waste Management per Agreements Between the Attorney General of North Carolina, Smithfield Foods, Premium Standard Farms, and Frontline Farmers. The Agreement. Available at http://www.cals.ncsu.edu/waste_mgt/smithfield_projects/smithfieldsite.htm. (Accessed May 2007).

125 NC Department of Environment and Natural Resources. Division of Waste Management, NC Solid Waste Management Annual Report, 2004-2005. Appendix B. County Population Waste Disposal, Per Capita Rate and Percent Reduction, FY 2004-2005. Available at http://www.wastenotnc.org/swhome/sw04-05_AR.htm. (Accessed March 2007).

126 NC Department of Environment and Natural Resources. Division of Waste Management. Solid Waste Section. Facility Lists. Permitted Solid Waste Facilities by County. Available at <http://www.wastenotnc.org/swhome/>. (Accessed April 2007).

127 NC Department of Environment and Natural Resources. Division of Waste Management. Solid Waste Section. Data, Statistics, and Reports. Municipal Solid Waste Landfill Capacity ('04-'05). Available at <http://www.wastenotnc.org/swhome/>. (Accessed March 2007).

128 Watauga County. Departments. Solid Waste and Recycling. Available at: <http://www.wataugacounty.org/sanitation/index.html>. (Accessed August 2007).

129 Log into North Carolina (LINC) Database Search. Topic Group: Environment, Recreation, and Resources. Wastes, Pollutants. V6218, V6219, and V6220. Watauga County. Available at http://data.osbm.state.nc.us/pls/linc/dyn_linc_main.show. (Accessed April 2007).

130 Appalachian District Health Department. Personal communication to Elizabeth Nelson from Andrew Blethen, Environmental Health Supervisor (andrew.blethen@apphealth.com).

131 NC Department of Environment and Natural Resources. Enforcement. Water Quality Enforcement Actions. Environmental Fines - Water Quality. Available at http://www.enr.state.nc.us/html/environmental_fines_--_water_q.html. (Accessed April 2007).

132 NC Department of Environment and Natural Resources. Division of Environmental Health. On-site Wastewater Section. County Monthly Reports. On-site Activity Report FY 03-04. Available at http://www.deh.enr.state.nc.us/osww_new/new1//progimprovteam.htm. (Accessed April 2007).

133 Appalachian District Health Department. Personal communication from Jennifer Bryan to Sheila Pfaender.

134 Log into North Carolina (LINC) Database Search. Topic Group: Environment, Recreation, and Resources. Wastes, Pollutants. V6218, V6219, and V6220. Watauga County. Available at http://data.osbm.state.nc.us/pls/linc/dyn_linc_main.show. (Accessed April 2007).

135 Environmental Protection Agency. Envirofacts. Safe Drinking Water Information System. North Carolina Drinking Water. Envirofacts Data on North Carolina. County Search: Watauga. Available at <http://www.epa.gov/safewater/dwinfo/nc.htm>. (Accessed April 2007).

136 NC Department of Environment and Natural Resources. Division of Environmental Health. Public Health Pest Management. Arboviral Incidence in North Carolina. Mosquito borne. Various years. Available at <http://www.deh.enr.state.nc.us/phpm/html/data-maps.html>. (Accessed February 2007).

137 NC Department of Health and Human Services. Epidemiology in North Carolina. Arboviruses. La Crosse Encephalitis. Available at <http://www.epi.state.nc.us/epi/arbovirus/lac.html>. (Accessed May 2007).

138 Appalachian District Health Department. Personal communication from Tyler McKeithan to Sheila Pfaender.

139 NC Division of Public Health. Epidemiology. Rabies in North Carolina. Rabies Around the State. Available at <http://www.epi.state.nc.us/epi/rabies/state.html>. (Accessed February 2007).

140 Appalachian District Health Department. (July 12, 2007). Personal communication from Jennifer Bryan to Sheila Pfaender.

Appendix A Smokefree Dining In Watauga County & Indoor Air Quality Monitoring Project Results-Watauga County