HARNETT COUNTY

2010 COMMUNITY HEALTH ASSESSMENT

Volume Two:
Environmental Data

February, 2011

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Introduction

This volume presents an overview of data describing major features of the natural environment of Harnett County. It is intended to complement the Harnett County Community Health Assessment Volume One by describing the environmental context in which the people of Harnett County are living.

The information in this report is based on the Center for Disease Control's 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 Harnett County, using data from the public domain. 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 where known. It describes chemicals and wastes affecting the County's land and soil, and describes municipal waste management and water and wastewater sanitation practices. 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 natural waters. Water is a renewable resource, but clean water is in limited quantity, and as the population continues to grow, the demand for clean water rises every year.

In order to understand water quality issues in North Carolina (NC) it is necessary first to understand the terminology of the 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 Harnett 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.

Watershed - A watershed is a geographic region with elevations and topographical features that cause flowing waters (creeks, streams, and 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***. This state contains a portion of 58 different smaller watersheds that 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. The state of NC conducts its water quality assessment and planning on a watershed-basis, with each of the state's existing 17 watershed basins being monitored once in a five-year rotation.

Groundwater - 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 NC and 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. The term ***aquifer*** describes an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well (1).

Water Resource Agencies in North Carolina

In NC, there are two primary agencies responsible for monitoring and managing the state's natural water resources: the Division of Water Resources (DWR), and the Division of Water Quality (DWQ), both in the NC Department of Environment and Natural Resources (NCDNR). (Data from each of these divisions will be cited later in this report.)

The DWR administers programs for river basin management, water supply assistance, water conservation, and water resources development. It conducts special studies on in-stream flow needs and serves as the state liaison with federal agencies on major water resources related projects. The DWR also administers environmental education outreach programs (2).

The DWQ, with central offices in Raleigh and seven regional offices located across the state, issues pollution control permits, monitors permit compliance, evaluates environmental quality, and carries out enforcement actions for violations of environmental regulations. The regional office serving Harnett County is located in Fayetteville, NC, in Cumberland County (3).

Generally speaking, water bodies in NC and throughout the United States (US) have become cleaner because of pollution controls on industrial discharges and sewage treatment plants, but extensive water quality problems remain. The Federal Clean Water Act requires surface water quality to be high enough to support fish and wildlife populations, protect drinking water sources, and allow for human recreation. According to *Scorecard*, nationwide, 36% of rivers and streams, 39% of lakes and reservoirs, and 38% of estuaries still are not supporting at least one of these uses (4). The following discussion describes surface water quality in Harnett County as assessed by DWQ.

Surface Water

In response to the stipulations of the Clean Water Act, DWQ is charged with submitting a biennial report to the US Environmental Protection Agency (EPA) that assesses water quality in NC 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., for swimming, or water supply) and what might be causes and sources of impairment for those designated uses.

In order to conduct this assessment work, DWQ operates the *Ambient Monitoring System* (AMS), which was established to provide site-specific, long-term water quality information on significant rivers, streams, and estuaries throughout the state. At the time this report was prepared the system operated a total of 323 active AMS stations spread among 95 of the state's 100 counties. The program has been active for over thirty years. Stations are visited at least monthly for the collection of a variety of physical, chemical and bacterial pathogen samples and measurements (5).

The AMS' primary objectives are:

- 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 *Coliform* bacteria).
- To identify long-term temporal or spatial patterns.

The DWQ lists two AMS stations in Harnett County: one on the Cape Fear River at US 401 in Lillington, and the other on the Upper Little River at State Road (SR) 2021 near Lillington. NC AMS data are made available to the public through the US EPA *STORET* data management system, but the detailed nature of that data is beyond the scope of this report. NC AMS data is also summarized by basin on a rotating five-year cycle and reported as part of the Environmental Sciences Section's Basin Assessment Reports (5).

While DWQ's Ambient Monitoring System is the primary source of water quality assessment data, other data sources include the US Geological Survey, local governments and environmental groups, industry,

and municipal and university coalitions. Submitted data is accompanied by a Quality Assurance Project Plan (QAPP) to assure that "external" data were collected in a manner consistent with agency data (6).

River Basins and Watersheds

As noted previously, NC monitors water quality on a river basin basis. Harnett County lies in the Cape Fear River Basin, and includes parts of Subbasin 07 and Subbasin 13 (6).

Subbasin 07 contains the lowermost reach of the Haw River (below Jordan Reservoir and before it joins the Deep River to form the Cape Fear River) and approximately 25 miles of the Cape Fear River from near the confluence of Lick Creek in Lee County to near Buies Creek in Harnett County. While once primarily forested, land in the subbasin has been converted more and more to agricultural or urban uses as Harnett and neighboring counties have grown.

Subbasin 13 includes the entire Upper Little River watershed from its source to the confluence with the Cape Fear River; major tributaries include Juniper and Barbeque Creeks. The headwaters of the Upper Little River lie in Lee County southwest of the City of Sanford. The river flows east where it is joined by Juniper Creek. The river turns southeast near the Harnett County border and is eventually joined by Barbeque Creek.

The City of Sanford is the only urban area in Subbasin 13; the Towns of Lillington and Erwin lie just outside it. Almost two-thirds of the subbasin is forested. There are five National Pollutants Discharge Elimination System (NPDES) permitted dischargers in the Harnett County portion of this subbasin, each of which is a wastewater treatment plant. (NPDES dischargers will be covered more extensively in Chapter 6 of this report.)

The most recent comprehensive assessment of the Cape Fear River Basin is dated 2009 (7). That report is the source for much of the following data.

Following is a summary of two categories of key water quality indicators in the Cape Fear River Basin: Biological Parameters, and Chemical and Physical Parameters.

Biological Parameters of Water Quality

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; and *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 1 summarizes bioclassifications for several monitoring stations in the Cape Fear River Basin in Harnett County, tracked over time.

Table 1. Bioclassification of Subbasin 07 and 13 Sampling Sites Located in Harnett County

Sub-basin	Site	Location	Bioclassification			
			1993	1998	2003	2007-2008
07	Kenneth Creek	SR 1441	Poor	Poor	Poor	Fair
07	Neill's Creek	SR 1441	Good-Fair	Good-Fair	Poor	Good-Fair
07	Parker's Creek	SR 1450	Good	Good	Excellent	Good
13	Barbecue Creek (new)	SR 1285	n/a	n/a	n/a	Not rated
13	Upper Little River	SR 1222	Good-Fair	Good-Fair	Good-Fair	Good-Fair
13	Anderson Creek	SR 2031	Good-Fair	Good-Fair	Good	Good

Source: NC Division of Water Quality, Environmental Sciences Section, Reports and Publications, Basinwide Reports, Cape Fear Basin 2009, Cape Fear Basinwide Biological Assessments, http://www.esb.enr.state.nc.us/documents/CPFBoundTemp_09.pdf

A warning sign present in the most recent samples from several of the sites listed above is an increase in the number of pollution-tolerant species and/or a decrease in the numbers of species dependent on clean, moving waters.

Chemical and Physical Parameters of Water Quality

Table 2 presents a summary of the AMS (and affiliated monitoring coalition) stations located in Harnett County that had at least some measures of assessed parameters of physical characteristics, chemicals, nutrients or coliforms exceeding AMS evaluation levels (standards or action levels) during the period from 2004 through 2008.

Table 2. Stations in Harnett County with Assessments Not Meeting Evaluation Levels (EL) (2004-2008)

Site	Location	Monitoring Agency[1]	Parameter Not Meeting EL
Neill's Creek	US 401 (near Lillington)	MCFRBA	D.O, low pH, turbidity, Fecal Coliforms
Kenneth Creek	SR 1441 (near Angier)	MCFRBA	D.O., low pH, turbidity, Fecal Coliforms
Cape Fear River	US 401 (at Lillington)	MCFRBA	D.O., turbidity, copper, iron, Fecal Coliforms
Cape Fear River	US 401 (at Lillington)	NCAMBNT	Low pH, turbidity, iron, manganese, Fecal Coliforms
Buies Creek	Keith Hills Golf Course	MCFRBA	D.O., turbidity, Fecal Coliforms
Upper Little River	SR 2021 (near Lillington)	MCFRBA	Low pH, Fecal Coliforms
Upper Little River	SR 2021 (near Lillington)	MCFRBA	D.O., low pH, iron, manganese, Fecal Coliforms
Cape Fear River	NC 217 (at Erwin)	NCAMBNT	D.O., turbidity, iron, Fecal Coliforms
Cape Fear River	NC 217 (at Erwin)	MCFRBA	Turbidity, iron, Fecal Coliforms

Source: Source: NC Division of Water Quality, Environmental Sciences Section, Reports and Publications, Basinwide Reports, Cape Fear Basin 2009, Cape Fear Ambient Monitoring Report, http://www.esb.enr.state.nc.us/documents/CapeFearAmbientMonitoring04-08.pdf

[1] MCRBA=Middle Cape Fear River Basin Association; NCAMBNT=NC AMS staff

Although comprehensive river basin reports are developed every five years, the state must report "impaired" waters to the EPA every two years, usually in the form of a "303(d) List". This document, named for the part of the Clean Water Act of 1972 that requires it, is a list of the most impaired waters in the state at the time of the report.

At the present time, the EPA uses a system of five *Integrated Reporting Categories* (IRCs) to describe water body impairment. IRCs represent varying levels of water quality standards attainment, ranging

from Category 1, where all the water's designated uses are met, to Category 5, where a pollutant impairs a water body and a total maximum daily load (TDML) is required. (A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.) Each water body in NC that has been assessed is assigned at least one of the following IRCs:

Category 1: Attaining the water quality standard and no use is threatened. This category consists of those waters or assessment units where all applicable use support categories are rated "Supporting." Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened. This category consists of those waters where at least one of the applicable use support categories is rated "Supporting" and the other use support categories are rated "Not Rated." Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting," the remaining applicable use support categories except Fish Consumption are rated "Not Rated," and the Fish Consumption category is rated "Impaired-Evaluated." Data and information are available to support a determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there is insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information was previously insufficient to make a determination.

Category 3: Insufficient or no data and information to determine if any designated use is attained. This category consists of those waters where all applicable use support categories except Fish Consumption are rated "Not Rated" or "No Data" and the Fish Consumption category is rated "Impaired-Evaluated." Measured data or information to support an attainment determination for any use is not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status.

Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL. This category contains three distinct subcategories:

Category 4a: TMDL has been completed. This category consists of those waters for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered when evaluating Category 4a water bodies for potential delisting, although the TMDL strategy will remain in place.

Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future. This category consists of those waters for which TMDLs will not be attempted because other required regulatory controls (e.g., National Pollutant Discharge Elimination System [NPDES] permit limits, Storm Water Program rules, buyout programs, etc.) are expected to attain water quality standards by the next regularly scheduled listing cycle. Future monitoring will be used to verify that the water quality standard is attained as expected.

Category 4c: Impairment is not caused by a pollutant. This category consists of waters that are impaired by pollution, not by a pollutant. EPA defines *pollution* as "the man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA believes that in situations where the impairment is not caused by a pollutant, a TMDL is generally not the appropriate

solution to the problem. EPA staff has verbally stated that this category is intended to be used for impairments related to water control structures (i.e., dams). Future monitoring will be used to confirm that there continues to be no pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

Category 5: Impaired for one or more designated uses by a pollutant(s), and requires a TMDL. This category consists of those waters that are impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term *pollutant* means "dredged soil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water." In most cases, data are available to support a determination that a water quality standard is not attained. When more than one pollutant is associated with the impairment of a single assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

The state's 303(d) List of Impaired Waters includes only Category 5 impaired waters that require a TDML (6).

Impaired Water Bodies in the Cape Fear River Basin

In ***Subbasin 7***, there were six water bodies in Harnett County that were classified as impaired according to the 2006 NC 303(d) List (8). The 2006 list has no entries for waterbodies in Subbasin 13.

Table 3. Harnett County Water Bodies Classified as Impaired Under the CWA, 2006

Subbasin	Waterbody	Impaired Use	Year Listed	Reason for Listing	Potential Source	Miles
07	East Buies Creek, from a point 0.2 miles downstream of NC HWY 55 to Buies Creek	Aquatic life	2006	Standard violation: Low dissolved oxygen	Unknown	6.2
07	Kenneth Creek, From Wake-Harnett County line to Neills Creek	Aquatic life	1998	Impaired biological integrity	Impervious surface, WWTP NPDES	3.9
07	Neills Creek, from source to a point 0.3 miles upstream of Wake-Harnett County line	Aquatic Life	2006	Impaired biological integrity	Pasture, agriculture, MS4 NPDES, impervious surface	2.6
07	Neills Creek, from a point 0.3 miles upstream of Wake-Harnett County line to SR 1441	Aquatic life	2006	Impaired biological integrity	MS4 NPDES, agriculture, impervious surface, agriculture	2.0
07	Neills Creek, from SR 1441 to Kenneth Creek	Aquatic life	2006	Impaired biological integrity	Pasture, impervious surface, MS4 NPDES, agriculture	1.3
07	Neills Creek, from Kenneth Creek to 0.4 miles upstream of US 401	Aquatic life	2006	Impaired biological integrity		6.7

Source: NC Department of Environment and Natural Resources, Division of Water Quality, Planning, Water Quality Data Assessment, 2006 Final 303(d) List; http://portal.ncdenr.org/c/document_library/get_file?uuid=2648fa39-0975-4b27-8181-b0927ec2a43d&groupId=38364

In the 2010 Final 303(d) List, some of the same water bodies that were cited in Tables 3 still register impairments (9). Table 4 presents the Harnett County waterbodies in the Cape Fear River Basin on the 2010 303(d) List. *Note that in the 2010 List, impaired waters are arranged by watershed instead of by subbasin, and that impairment sources are not listed.*

Table 4. Harnett County Water Bodies Classified as Impaired Under the CWA, 2010

Watershed	Waterbody	Impaired Use	Year Listed	Reason for Listing	Miles
Buies Creek-Cape Fear River Watershed	Cape Fear River, from Lillington water supply intake to Upper Little River	Aquatic life	2008	Standard violation:	9.0
As above	Kenneth Creek, from Wake-Harnett County line to Neills Creek	Aquatic life	1998	"Fair" bioclassification	3.9
As above	Neills Creek, from source to a point 0.3 miles upstream of Wake-Harnett County line	Aquatic Life	2006	"Poor" bioclassification	2.6
As above	Neills Creek, from a point 0.3 miles upstream of Wake-Harnett County line to SR 1441	Aquatic life	2006	"Poor" bioclassification	2.0

Source: NC Department of Environment and Natural Resources, Division of Water Quality, Planning, Water Quality Data Assessment, 2010 Final 303(d) List; http://portal.ncdenr.org/c/document_library/get_file?uuid=8ff0bb29-62c2-4b33-810c-2eee5afa75e9&groupId=38364

Fish Kills

Fish kills and fish disease events in NC often involve a host of factors and underlying causes, so it is important to gather as much information as possible surrounding an event from all involved parties. In 1996 the DWQ staff, in consultation with Wildlife Resources biologists and Division of Marine Fisheries (DMF) personnel, instituted a new fish kill investigation procedure to be used by the DWQ Regional Offices, Response Teams and other agencies to collect and track information on fish kills throughout the state. Fish kill and fish health data are recorded via standardized methods (for example, trained investigators must confirm that at least 25 fish were affected) and sent to the Division for review. Fish kill investigation reports and supplemental information are compiled in a central database where the data can be managed, retrieved, and reported to state officials, scientists, and other concerned parties. Fish kill data is also reviewed as part of the DWQ efforts to monitor water quality trends across the state (10).

There were two fish kill events reported in Harnett County between 2005 and 2010. In August 2009, a fish kill of 2,000 specimens occurred in a private pond on Matthews Millpond Road. Water samples from the pond were positive for a colonial blue green alga known to form blooms in the summer. In October 2010, a fish kill of 200 specimens (mostly redhorse suckers ranging from 0.5 to 2 feet long) occurred in the Upper Little River near Lillington. Investigators suspected a spill or discharge in the area, but could not confirm it (11).

Fish Consumption Advisories

Fish from the vast majority of the state's waters are safe to eat. However certain fish in some NC waters contain high levels of contaminants that may pose a risk to human health. The NC Department of Health and Human Services (DHHS) issues fish consumption advisories for those fish, telling people to either limit consumption or avoid eating those kinds of fish. Unborn children and young children are often more susceptible to developing problems as a result of contact with contaminants; that's why advisories are often more stringent for women of childbearing age and children (12).

The Epidemiology Section of the NC Division of Public Health (DPH) maintains an Internet website listing current fish consumption advice and advisories (13). As of April 2008, the Section listed a statewide advisory against women of childbearing age (15-44 years), pregnant women, nursing mothers, and children under age 15 eating any fish high in mercury; the Section further advised all other persons to consume fish high in mercury no more than one meal 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: albacore (white) tuna (fresh or canned), almaco jack, banded rudderfish, cobia, crevalle jack, greater amberjack, south Atlantic grouper (gag, scamp, red, and snowy), king mackerel, ladyfish, little tunny, marlin, orange roughy, shark, Spanish mackerel, swordfish, tilefish, and tuna (fresh or frozen). There are eight freshwater species on the "avoid" list: blackfish (bowfin), black crappie, catfish (caught wild), jack fish (also called chain pickerel), largemouth bass, walleye from Lake Fontana and Lake Santeetlah, warmouth, and yellow perch. Freshwater fish with the highest mercury levels have been found primarily south and east of Interstate 85. *At the present time here are no fish consumption advisories specific to Harnett County.*

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 are in Harnett County; most were located in the coastal plain of northeastern NC. Advisories were made for consumption of catfish and carp, particularly for children and women of childbearing age; all other persons were advised to eat no more than one meal per month of carp and catfish from these areas. Swimming, boating, and other recreational activities present no known significant health risks.

Groundwater

Much less is known generally about groundwater than surface waters, despite the facts that over 95% of all freshwater is groundwater, and that half the population in NC relies on groundwater as its primary source of drinking water.

In NC, DWR is responsible for monitoring and managing the state's groundwater resources. The agency maintains a library of databases on various groundwater topics that was the source of the information in this section (14).

Aquifers

As noted previously, aquifers are hydraulically connected materials (sands, limestone, and fractured rock) that provide water through a properly constructed well opening. The aquifers in NC are highly varied in their character and water producing capabilities. Several of them can be traced over large geographic areas and form *principal aquifers*, which are significant sources of groundwater for drinking

water supplies, agriculture, and industries. Other aquifers provide less significant amounts of water and cover smaller areas of the state (15).

There are eight *principal aquifers* in NC: the Lower Cape Fear, Upper Cape Fear, Castle Hayne, Yorktown, Surficial, Black Creek, Peedee, and Bedrock aquifers. The three *minor aquifers* in the state include the Lower Cretaceous, Beaufort, and Pungo River aquifers. The Upper and Lower Cape Fear, Black Creek, Peedee, and Castle Hayne aquifers are *regional aquifers*, with substrates so well connected that withdrawals from one site can cause pressure reductions many miles from the pumping center (15).

Five aquifers serve Harnett County (15):

Upper Cape Fear Aquifer

This aquifer is present in the western portions of the coastal plain at elevations of 295 to -2401 feet, averaging -388 feet. The Upper Cape Fear aquifer ranges from 3 to 3892 feet thick and averages 185 feet thick. The aquifer is composed of very fine to coarse sands and occasional gravels. Wells typically yield 200-400 gallons per minute. The southeastern part of Harnett County may use water from this aquifer.

Black Creek Aquifer

This aquifer is present in the central and southwestern portions of the coastal plain at elevations of 318 to -1483 feet, averaging -173 feet. The Black Creek aquifer ranges from 14 to 448 feet thick and averages 160 feet thick. The aquifer is composed of very fine to fine "salt and pepper" sands. Wells typically yield 200-400 gallons per minute. The eastern half of Harnett County may use water from this aquifer.

Surficial Aquifer

The Surficial (or “unconfined”) aquifer is widely used *throughout* NC for individual home wells. It overlies *all* the aquifers in the Coastal Plain. It is the shallowest aquifer, and most susceptible to contamination from septic tank systems and other pollution sources. The Surficial aquifer is also very sensitive to variations in rainfall amounts, and wells tapping this aquifer are the first to dry-up in a drought. On the Outer Banks, shallow wells from this aquifer are subject to rainfall amounts, saltwater intrusion, poor quality water, and ocean overwash. Commonly, large diameter wells (up to 3 feet in diameter) are drilled up to 60 feet deep to store large quantities of water in the well casing. Wells tapping this aquifer typically yield 25-200 gallons per minute.

Fractured Bedrock Aquifer

This aquifer is widely used for home water supply in the western coastal plain, Piedmont, and Blue Ridge Provinces. Usually six inch wells are drilled to intercept water bearing fractures which are more common in valleys or draws. Thick sequences of regolith (surficial aquifer) above fractured bedrock can improve yields to 200 gallons per minute or more. Industries and county or municipal well fields look for these higher yielding bedrock wells. Wells typically yield 5-35 gallons per minute.

Drinking water – from both private wells and public water systems – in Harnett County is covered in Chapter Seven of this report.

Groundwater Incidents

The DWQ Incident Management Office keeps track of leaks and spills of chemicals that present risks to health. While the Incident Management System database previously was accessible to the public, DWQ has changed its policy and restricted access to only approved users. Consequently, recent groundwater incident data cannot be included in this report. Instead, the report repeats below (Table 5) the groundwater incident summary for 2004-2006 that appeared in the 2006 Harnett County Community Health Assessment, Volume II (16).

Underground storage tanks leaking gasoline and surface spills accounted for the largest proportion of groundwater incidents for the period cited.

Table 5. Harnett County Groundwater Contamination Incidents, 2004-2006

Incident Location/ Name	Address	City/Town	Source	Type	Submitted
BP And Mini Mart	201 S 13th St	Erwin	Underground Storage Tank	Gasoline	4/6/2005
Motoguzz1	455 W Depot St	Angier	Underground Storage Tank	Gasoline	5/24/2005
G&M CITGO	1208 Denim Dr	Erwin	Underground Storage Tank	Gasoline	11/5/2004
Kidde Fire Fighting	141 Junny Rd	Angier	Nonpoint Source	Other	2/2/2006
Energy Conversion Systems	1 Morganite Dr	Dunn	Surface Spill	Metals	5/5/2005
Armtec	608 E McNeil St	Lillington	AST System	Other	6/2/2004
Southeastern Transformer Co	405 E Edgerton St	Dunn	Surface Spill	Other	3/8/2005
Erwin Mills/Burlington Ind.	S Burlington St.	Erwin	Pit, Pond, Lagoon	Sludge	4/27/2005

Source (subsequently unavailable): 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).

Chapter Two: Air Quality

Outdoor Ambient Air

The central piedmont region of North Carolina, where Harnett County is located, can have significant air quality problems, due to emissions from polluting industries and Interstate highway traffic. In order to understand Harnett County air quality issues it is first helpful to understand some of the underlying air science. Nationally, air quality is the responsibility of the Environmental Protection Agency (EPA); most of the following information and data originate with that agency. In NC, the agency responsible for monitoring air quality is the Division of Air Quality (DAQ) in DENR.

The 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 CAP, above which human health may suffer adverse effects (17). Table 6 (following page) lists the current NAAQS.

Following are descriptions of the sources of the six CAPs (18).

Carbon Monoxide (CO) - Nationwide, 77% of carbon monoxide emissions are from transportation sources, primarily highway motor vehicles, but other sources include wood-burning stoves, incinerators and industrial outputs.

Lead (Pb) – Lead 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 dioxides (NO_x) – Nitrogen oxides 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) – Particulate matter is usually categorized on the basis of size, and includes dust, dirt, soot, smoke, and liquid droplets emitted directly into the air by factories, power plants, construction activity, fires and vehicles.

Ozone (O_3) – Ozone, the major component of smog, is not usually emitted directly but rather formed through chemical reactions in the atmosphere. Precursor compounds like volatile organic compounds (VOC) and oxides of nitrogen (NO_x) react to form O_3 when stimulated by ultraviolet radiation and temperature, so peak O_3 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 (SO_2) - This pollutant 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. Primary National Ambient Air Quality Standards (2010)

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	0.15 µg/m^3	Rolling 3-month average	n/a
	1.5 µg/m^3	Quarterly average	n/a
Nitrogen dioxide	53 ppb	Annual (arithmetic average)	The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard
	100 ppb	1-hour	To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb
Particulate matter (PM_{10})	150 µg/m^3	24-hour	Not to be exceeded > 1/year on average over 3 years
Particulate matter ($PM_{2.5}$)	15.0 µg/m^3	Annual (arithmetic average)	To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3
	35 µg/m^3	24-hour	To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3
Ozone (O_3)	0.075 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 0.075 ppm
Sulfur Dioxide	0.03 ppm	Annual (arithmetic average)	
	0.14 ppm	24-hour	Not to be exceeded > 1/year
	75 ppb	1-hour	Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb

Source: Environmental Protection Agency. Air and Radiation. National Ambient Air Quality Standards (NAAQS). http://www.epa.gov/air/criteria.html.

Table 7 lists some of the environmental and health effects of CAPS and their precursors.

Table 7. 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: Scorecard. Pollution Locator. Description of Criteria Air Pollutants. Available at: http://www.scorecard.org/env-releases/cap/pollutant-desc.tcl

Annual CAP Maxima

Harnett County is in the Fayetteville Region of the NC DAQ Monitoring and Emissions Data System, along with 10 other counties (Anson, Bladen, Cumberland, Hoke, Montgomery, Moore, Richmond, Robeson, Sampson and Scotland Counties). Measurements of criteria air pollutants are not available for Harnett County because there is no air quality monitoring station in the county. The monitoring stations in the Fayetteville Region are located in Cumberland, Montgomery, Robeson and Sampson counties. Other nearby monitoring stations are located in Wake County (19).

The EPA produces an Annual Report of Criteria Air Pollutants for each state that shows the CAP maxima data for each county that has one or more monitoring stations. Table 8 presents 2008 NC annual maxima for each CAP and identifies the county in which it was measured. Concentrations noted in **bold** type exceed the NAAQS standard.

Table 8. North Carolina Annual High Levels of Criteria Air Pollutant Emissions, 2008

Pollutant	NAAQS Standard	Highest Recorded Concentration	County
Carbon monoxide			
1-hour average max	35 ppm	3.1 ppm	Wake
8-hour average max	9 ppm	2.2 ppm	Forsyth
Nitrogen dioxide			
Annual mean	53 ppb	0.0011 ppb	Forsyth, Mecklenburg
PM-10			
24-hour average max	150 µg/m^3	45 µg/m^3	Mecklenburg
PM-2.5			
Annual mean	15 µg/m^3	**41.6 µg/m^3**	New Hanover
Ozone			
1-hour average max	0.12 ppm	0.115 ppm	Lincoln
8-hour average max	0.075 ppm	**0.093ppm**	Mecklenburg[1]
Sulfur Dioxide			
24-hour average max	0.14 ppm	0.028 ppm	New Hanover
Annual mean	0.03 ppm	0.006ppm	Forsyth, New Hanover

Source: US EPA. Air and Radiation. AirData Criteria Air Pollutants, County Air Quality Report, North Carolina; http://www.epa.gov/air/data/geosel.html.

[1] Other counties where 8-hr O_3 exceeded NAAQS: Alexander, Caswell, Durham, Forsyth, Franklin, Graham, Granville, Guilford, Haywood, Pitt, Rockingham, Rowan, Union, Wake, and Yancey counties.

Historically, NC has fared poorly in national rankings of states based on emissions of CAPs. According to pre-2004 data from *Scorecard,* the state ranked among the 20% of states with the highest emissions of carbon monoxide and volatile organic compounds, and among the 30% of states with the highest emissions of nitrogen oxides, sulfur dioxide, and small particulate matter (PM 2.5). It also ranked among the 30% of states with the most person days in exceedance of the 8-hour NAAQS standard for ozone (20). From the data presented in Table 8, it is clear that NC still experiences exceedances for particulate matter and ozone, especially in the populous metropolitan areas and along Interstate Highway corridors.

Air Quality Index

The impact of CAPs in the environment is described on the basis of emissions, exposure, and health risks. A 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. The AQI describes the general health effects associated with different pollution levels, and public AQI alerts (often heard as part of local weather reports) 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 NAAQS standard. 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 (21). Table 9 defines the AQI levels.

Table 9. General Health Effects and Cautionary Statements, Air Quality Index

Index Value	Descriptor	Color Code	Meaning
Up to 50	Good	Green	Air quality is satisfactory, and air pollution poses little or no risk.
51 to 100	Moderate	Yellow	Air quality is acceptable; however, for some pollutants there may be a moderate heath concern for a very small number of people who are unusually sensitive to air pollution.
101 to 150	Unhealthy for sensitive groups	Orange	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200	Unhealthy	Red	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201-300	Very unhealthy	Purple	Health alert: everyone may experience more serious health effects.
301-500	Hazardous	Maroon	Health warnings of emergency conditions. The entire population is more likely to be affected.

Source: AIRNow, Air Quality Index (AQI) – A Guide to Air Quality and Your Health; http://airnow.gov/index.cfm?action=aqibasics.aqi

Statewide, there were only a few counties that experienced days with "unhealthy" AQI measurements in 2008: Mecklenburg County (3 days), and Chatham, Durham, Guilford, Lincoln, Martin, New Hanover, Pitt and Wake Counties (1 day each) (22).

Because there is no AQI monitoring site in Harnett County, county-specific AQI data are not available. For perspective, a 2008 annual AQI summary for neighboring Cumberland and Wake counties is presented in Table 10. Again it is clear that the lingering air pollution problems in NC are ozone and particulate matter.

Table 10. Annual Air Quality Index Report, Cumberland and Wake Counties, 2008

AQI Parameter	County	
	Cumberland	**Wake**
No. Days with AQI	333	336
No. Days when Air Quality was:		
Good	225	222
Moderate	105	105
Unhealthy for Sensitive Groups	3	8
Unhealthy	0	1
AQI Statistics		
Maximum	119	170
Median	44	43
No. Days when AQI Pollutant was:		
CO	0	2
NO_2		
O_3	146	179
SO_2		0
PM 2.5	186	155
PM 10	1	0

Source: US EPA, Air & Radiation, AirData, Reports and Maps, Air Quality Index Report, North Carolina, 2008; http://www.epa.gov/oar/data/monaqi.html?st~NC~North%20Carolina

Sources of Criteria Air Pollutants

The sources of criteria and other air pollutants are categorized as *mobile*, *area*, or *point* sources, each of which is described below.

Mobile sources include on-road vehicles like cars, trucks and busses as well as off-road equipment like airplanes, construction and agricultural equipment. Mobile sources are the primary source of criteria air pollutants in the US (60.2% of the total tonnage). Nationally, carbon monoxide (77.1%), nitrogen oxides (55.5%), and large particulate matter (40.3%) mostly come from mobile sources (23).

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 heating and cooling units in residential and commercial buildings. Waste disposal in the form of open burning, landfills and wastewater treatment also are significant area 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 (23).

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 (23).

EPA Air Quality Non-Attainment Areas

As of January 17, 2010, the EPA had designated seven NC counties (Cabarrus, Gaston, Iredell, Lincoln, Mecklenburg, Rowan and Union) as "moderate/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 NC (especially during the warmer months). Additionally, the EPA designated three NC counties (Catawba, Davidson, and Guilford) as "non-attainment" regarding small particulate matter (PM 2.5) (24). 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 (25).

The EPA has not designated any NC counties as "non-attainment" for carbon monoxide, nitrogen dioxide, ozone (1 hour), sulfur dioxide, large particulate matter, or lead (24).

Harnett County is *not* on any CAP non-attainment list, nor is it adjacent to any counties that are.

Vehicle Emission Inspection Mandates

North Carolina is fighting an on-going battle against ozone-forming emissions from gasoline-operated cars and light duty trucks. Since 2002, licensed inspection stations have been required to conduct inspections using a vehicle's on-board diagnostic (OBD) system, computerized equipment installed on all new vehicles since 1996. Though they are still required to obtain a safety inspection, diesel-operated vehicles are exempt from the annual emissions inspection (26).

Safety/OBD inspections currently are required in 48 counties: Alamance, Brunswick, Buncombe, Burke, Cabarrus, Caldwell, Carteret, Catawba, Chatham, Cleveland, Craven, Cumberland, Davidson, Durham, Edgecombe, Forsyth, Franklin, Gaston, Granville, Guilford, Harnett, Haywood, Henderson, Iredell, Johnston, Lee, Lenoir, Lincoln, Mecklenburg, Moore, Nash, New Hanover, Onslow, Orange, Pitt, Randolph, Robeson, Rockingham, Rowan, Rutherford, Stanly, Stokes, Surry, Wake, Wayne, Wilkes, Wilson and Union (26). Note that Harnett County *is* on this list; most of these counties are in major population centers or along the major Interstate highway corridors crossing the state.

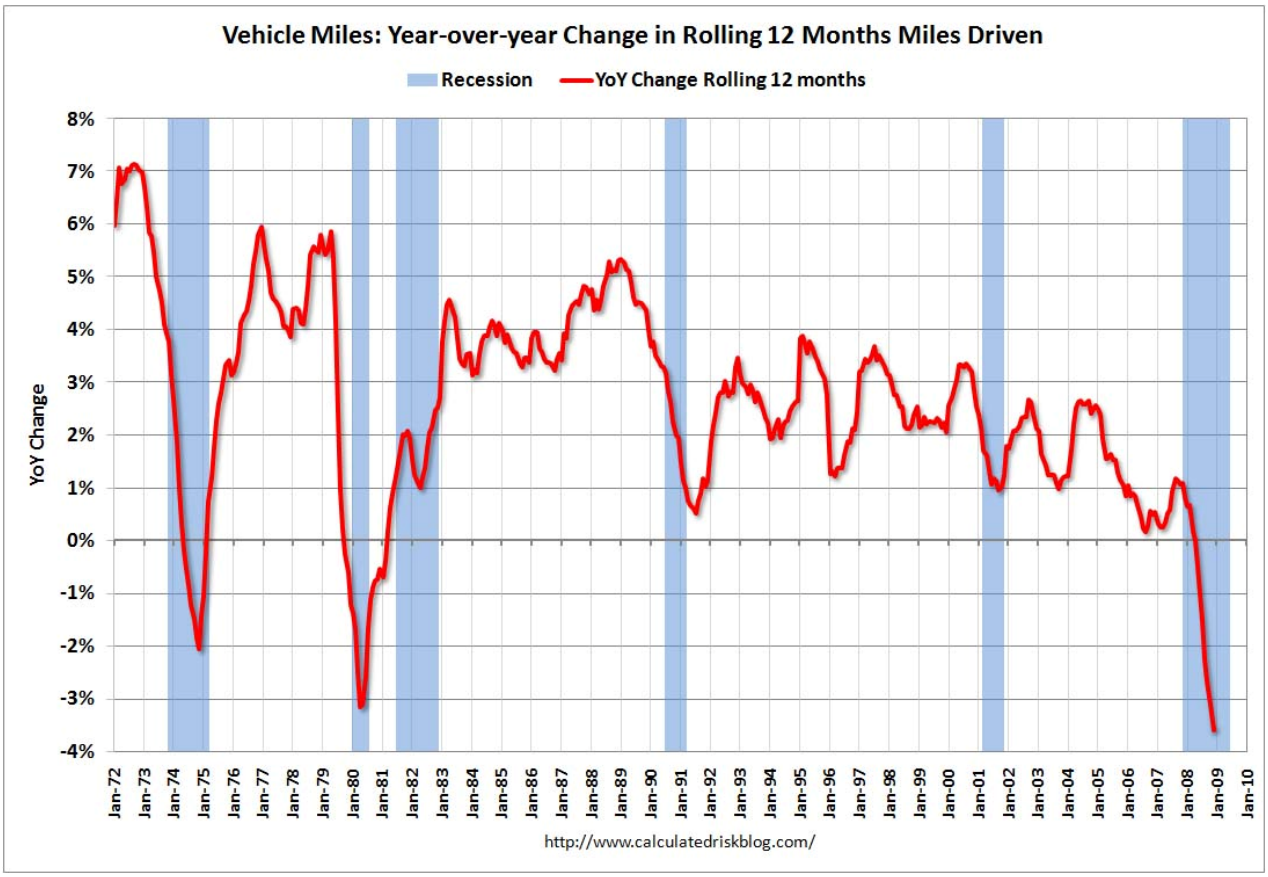
Vehicle Miles Driven

Since most CAPs are emitted by mobile sources, it is instructive to examine the patterns and trends in vehicle miles driven (VMD). While state and local data are difficult to obtain, a recent national study by the US Department of Transportation reveals some interesting information about a continuing *decline* in VMD.

Figure 1 shows the annual change in the rolling 12-month average of VMD in the US for the period from January 1972 through January 2008. (The researchers used the rolling average statistical technique to

remove data noise and seasonality.) According to this graph, vehicle miles driven were off 3.6% Year-over-Year (YoY) between 2007 and 2008. This decline in miles driven is larger than declines during the early '70s and the 1979-1980 oil crisis (as denoted by the overall length of the respective line segments into negative values) (27). This trend, along with improved auto emissions and an increase in the number of hybrid- and electric vehicles on the road, as well as recent spikes in the cost of gasoline may be affecting mobile CAPs nationally.

Figure 1. Vehicle Miles Driven in the US as Year-over-Year Change (1972-2008)



Source: Calculated Risk, Finance and Economics, Thursday, February 19, 2009, US Vehicle Miles Driven Off 3.6% in 2008; http://www.calculatedriskblog.com/2009/02/us-vehicle-miles-driven-off-36-in-2008.html

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 data from the US Census Bureau presented in Table 11, the total number of vehicles in the US powered by alternative fuels increased every year from 2004 through 2007 (28).

It must be noted, however, that the data in this table *excludes* perhaps the fastest-growing segment of alternatively-fueled vehicles: gasoline-electric (or diesel-electric) hybrids. Up until now the US Census Bureau has excluded vehicles in this category because the input fuel in these vehicles is gasoline or diesel rather than a totally alternative transportation fuel.

Given the recent influx of hybrid vehicles on the automotive market, it may be necessary to provide an accounting of these types in future Census counts of alternative fueled vehicles. For example, according to one source, there were 308,001 hybrid cars sold in the US in 2008, and 290,272 sold in 2009. In 2009 the total number of hybrid cars registered in the US was estimated at 1.6 million (29).

Table 11. Number of Vehicles in the US Powered by Alternative Fuels, 2004-2007

Fuel Type	Number of Alternative Fueled Vehicles			
	2004	2005	2006	2007
Compressed Natural Gas (CNG)	118,532	117,699	116,131	114,391
Electric (all electric)	49,536	51,398	53,526	55,730
Ethanol, 85 percent (E85)	211,800	246,363	297,099	364,384
Hydrogen	43	119	159	223
Liquefied Natural Gas (LNG)	2,717	2,748	2,798	2,781
Liquefied Petroleum Gas (LPG)	182,864	173,795	164,846	158,254
Other fuels	--	3	3	3
TOTAL	565,492	592,125	634,562	695,766

Source: US Census Bureau. The 2010 Statistical Abstract. Transportation: Motor Vehicle Registrations, Alternative Fuel Vehicles. Table 1061. Alternative Fueled Vehicles and Estimated Consumption of Vehicle Fuels by Fuel Type: 2004 to 2007; http://www.census.gov/compendia/statab/2010/tables/10s1061.pdf

Mass Transportation

The Public Transportation Division (PTD) of the NC Department of Transportation (DOT) was created in 1974 by the NC General Assembly to foster the development of intercity, urban and rural (now referred to as "community") public transportation in the state. This agency administers federal and state transportation grant programs, provides safety and training opportunities for transit professionals; and makes planning and technical assistance available. According to PTD, community, regional community, urban, and regional urban transportation systems in NC serve more than 62 million passengers each year via intercity bus, rail, air and ferry services (30).

Harnett County is served by Harnett Area Rural Transportation System (HARTS), a curb-to-curb paratransit and ride sharing public transportation system, providing subscription routes, Dial-a-Ride, and Demand-Response services. Transportation is provided for medical, personal, human service, employment and education purposes. HARTS operates Monday through Friday, between the hours of 4:00 a.m. and 6:00 p.m. The system does not operate on weekends or on holidays (31).

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, neurological, respiratory, and reproductive effects in humans. HAPs are ranked by a method that combines exposure data from the EPA National-Scale Air Toxics Assessment (NATA) with toxicity data to estimate the ***health risks*** posed by chemical pollutants in ambient air. The exposure estimates used in determining risk are

based on 1996 emissions data. (It is necessary to rely on exposure *estimates* rather than actual monitoring because there are fewer than 50 monitoring stations measuring outdoor levels of HAPs in the entire country. NATA currently provides the only data available for assessing the extent of exposures to hazardous air pollutants across the entire US) *Scorecard*, the source of much of the following data, uses conventional risk assessment methods to produce a screening-level health risk assessment, which offers valuable information about the magnitude and sources of hazardous air pollution problems (32). Although it is useful and interesting to identify problem-level HAPs in the local environment, the use of this "applied" statistical data comes with some important cautions.

Caveats in Using HAP Assessment Data

Effect of Using 1996 Exposure Estimates. EPA cautions against "using the results of the National-Scale Air Toxics Assessment modeling exercise alone to draw real-world conclusions about current local conditions" because of the limitations involved in modeling exposures using 1996 emissions data. There clearly have been changes in emissions since 1996 in pollution sources and quantities that may affect the reliability of EPA's exposure estimates. For example, some pollution sources have come under substantial regulatory controls since 1996, and others have grown in importance. Nevertheless, EPA comparisons among 1996 monitoring data, NATA estimates and current monitoring data found that modeled estimates are generally consistent with current concentrations (33).

Effect of Focusing of Small Geographic Areas or Individual Sources. Uncertainties in the accuracy of exposure data and source apportionment increase as the scale of geographic analysis decreases to the census tract or source-specific level. EPA recommends the county level of resolution because emissions inventory data for some pollutants and sources are only available at the county level and there are large uncertainties regarding exposure modeling parameters at the tract level (33).

Effect of Uncertainty on Health Risk Assessment. *Scorecard* applies conventional health risk assessment methods to characterize potential cancer and noncancer risk. Note that risk estimates are calculations based on *models*; hence they are useful for ranking purposes but are not necessarily predictive of any actual individual's risk of getting cancer or other diseases. Risk assessment methods rely on the use of assumptions to address gaps in scientific understanding and data. Some assumptions err on the side of health protection (e.g., presuming animal carcinogens are potential human carcinogens) and may result in overestimation of health risk. Other assumptions may result in underestimated health risk (e.g., presuming all people have equal susceptibility to toxicants) (33).

Note that NATA includes only chronic health effects from inhalation exposure to outdoor sources of air toxics. Effects from less-than-lifetime exposures (e.g., accidental chemical releases) and total exposure to air toxics (e.g., including indoor air pollution sources) require further evaluation. In addition, because EPA's methodology only considers inhalation, exposures to HAPs which are persistent or bioaccumulative may be significantly *underestimated* by NATA. For example, ingestion of contaminated food, water or soil is likely to result in substantially greater human exposures than inhalation for lead, mercury, cadmium, polychlorinated biphenyls, dioxin, hexachlorobenzene, polycyclic aromatic hydrocarbons, and polycyclic organic matter. Other HAPs exposures that may be significantly *underestimated* by NATA for various technical reasons include formaldehyde, acetaldehyde, acrolein, and lead (33).

Effects of Limitations in Emissions Inventories. Limitations in available emissions inventories for mobile sources may impact the accuracy of NATA results. In its assessment of on-road emissions, EPA uses population data as a surrogate to project vehicle miles traveled. This method results in underestimation of on-road emissions in more suburban counties, while largely overestimating on-road

emissions in urban counties. In its assessment of off-road emissions, EPA uses economic measures of construction activity as a surrogate to project emissions from off-road engines. This method distorts the relative contribution of off-road diesel sources in urban counties where housing and commercial building prices are extremely high (33).

Cancer and Non-Cancer HAP Risks

Risk due to HAPs is estimated by two measures: added lifetime cancer risk for carcinogenic HAPs, and cumulative hazard indices for chemicals with non-cancer effects.

Added Cancer Risk. Added cancer risk is the estimated individual risk of getting cancer due to a lifetime exposure to outdoor HAPs. 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. For example, an added risk of 550 per 1,000,000 is 550 times higher than the Clean Air Act goal (34).

According to EPA data accessed via *Scorecard*, Mecklenburg County is the NC county with the highest added cancer risk from hazardous air pollutants; its added cancer risk score is 800 (35). It also has the greatest population living in proximity to such risk (36). The primary offending HAP in Mecklenburg County is diesel emissions (37). Of the 100 counties in NC, Harnett County ranked 39th in terms of an individual's added cancer risk. The estimated added cancer risk for the Harnett County population is 360; i.e., it is 360 times the goal set by the Clean Air Act (35). The primary HAP contributing to the added cancer risk is diesel emissions (38).

The vast majority of the cancer risk from diesel emissions (82%) in Harnett County come from mobile sources, primarily diesel emissions from on road vehicles such as cars, buses and trucks, and off-road equipment, such as boats and agricultural and construction equipment (38).

Health Effects of Diesel Emissions. The microscopic particles in diesel exhaust are small enough to penetrate deep into the lungs, where they contribute to a range of health problems. Diesel exhaust and many individual substances contained in it (including arsenic, benzene, formaldehyde and nickel) have the potential to contribute to mutations in cells that can lead to cancer. In fact, long-term exposure to diesel exhaust particles poses the highest cancer risk of any toxic air contaminant evaluated by the California Office of Environmental Health Hazard Assessment (OEHHA). In its comprehensive assessment of diesel exhaust, OEHHA analyzed more than 30 studies of people who worked around diesel equipment, including truck drivers, railroad workers and equipment operators. The studies showed these workers were more likely to develop lung cancer than workers who were not exposed to diesel emissions. These studies provide strong evidence that long-term occupational exposure to diesel exhaust increases the risk of lung cancer (39).

While cancer resulting from long-term exposure to diesel emission can take years to develop, short-term exposure can have immediate health effects. Diesel exhaust can irritate the eyes, nose, throat and lungs, and it can cause coughs, headaches, lightheadedness and nausea. In studies with human volunteers, diesel exhaust particles made people with allergies more susceptible to the materials to which they are allergic, such as dust and pollen. Exposure to diesel exhaust also causes inflammation in the lungs, which may aggravate chronic respiratory symptoms and increase the frequency or intensity of asthma attacks (39).

Cumulative Hazard Index. Non-cancer hazard from HAPs is measured by the cumulative hazard index (CHI), which is calculated as the concentration of a HAP divided by its safe exposure level.

Therefore, if a hazard index exceeds 1, the resulting exposure level may pose non-cancer 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 1. A cumulative hazard index of 55, for example, is 55 times higher than the Clean Air Act goal (34).

According to data from *Scorecard*, Harnett County ranks 37th out of all NC counties for non-cancer cumulative hazard index with a score of 1.5, 50% 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 (40).

The sources of the pollutants that contribute to non-cancer health risks are not as easy to pinpoint as those leading to higher cancer risks, and they vary much more from county to county. However the most significant non-cancer hazardous air pollutant in both Mecklenburg and Harnett Counties is acrolein (41, 42). This chemical is ranked among the worst 10% of compounds hazardous to ecosystems and human health, and is on at least 10 federal regulatory lists. Acrolein is produced in high volume (exceeding 1 million pounds annually in the US); it is found 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 (43). In Harnett County, area sources contribute 36% to the cumulative hazard index while mobile sources contribute 59% to the CHI (44).

Indoor Ambient Air

The quality of the air inside buildings has received greater attention in recent years. Indoor ambient air pollutants can have 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, may also show up soon after exposure to some indoor air pollutants (45).

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 (45).

The primary cause of indoor air quality problems in homes is the release of gases or particles into the air, from sources including: 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 (45).

Carbon Monoxide

Carbon monoxide (CO) is an odorless, colorless and toxic gas. It is impossible to see, taste or smell the toxic fumes of CO, and it does not irritate the skin, eyes, or lungs. Called the "silent killer", CO can cause death before the exposed person becomes aware of its presence. The effects of CO exposure can vary greatly from person to person depending on age, overall health and the concentration and length of exposure (46).

At low concentrations, health effects of CO exposure include fatigue in healthy people and chest pain in people with heart disease. At higher concentrations, exposure effects include impaired vision and coordination, headaches, dizziness, confusion, and nausea. Moderate exposures can cause angina, impaired vision, and reduced brain function, but can also result in flu-like symptoms that may clear up after leaving the vicinity of the source. At very high concentrations, death can occur due to the formation of carboxyhemoglobin in the blood, which inhibits oxygen intake (46).

The sources of CO include: unvented kerosene and gas space heaters; leaking chimneys and furnaces; back-drafting from furnaces, gas water heaters, wood stoves, and fireplaces; worn or poorly maintained gas stoves; generators and other gasoline powered equipment; automobile exhaust in attached garages; and tobacco smoke. Auto, truck, or bus exhaust from attached garages, nearby roads, or parking areas can also be a source (47).

Carbon Monoxide Poisoning Deaths

CO may be the cause of more than one-half of the fatal poisonings reported in many countries. Because fatal cases are believed to be grossly under-reported or misdiagnosed by medical professionals, the precise number of individuals who have suffered from CO intoxication probably is not known (47).

According to data compiled by the CDC, unintentional CO exposure accounts for an estimated 15,000 emergency department visits and 500 unintentional deaths in the US each year. During the period 1999-2004, an average of 439 persons died annually from unintentional, non-fire-related CO poisoning, and the national average annual death rate was 1.5 per 1 million persons. However, rates varied by demographic subgroup, month of the year, and state. Rates were highest among adults aged >65 years, men, non-Hispanic whites, and non-Hispanic blacks. The average number of deaths was highest during January (48).

In 2009 in NC, there were 15 deaths attributable to *accidental* exposure to non-organic gases and vapors including carbon monoxide (ICD 10 Code X47) and an additional 33 deaths due to *intentional* self-poisoning (ICD 10 Code X67) (49). There were no deaths in these categories in Harnett County in 2009 (50).

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, hollow-block

walls, and openings around floor drains, heating and cooling ductwork, pipes, and sump pumps. The average outdoor level of radon in the air is normally so low that it is not a problem (51).

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 (51).

Radon may also be dissolved in water as it flows over radium-rich rock formations. Dissolved radon can be a 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 (52).

Elevated levels of radon have been found in many counties in NC, 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 (53). Eight counties in NC 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 (54).

There are an additional 53 counties in the central and western Piedmont area of the state with radon levels in the 2-4 pCi/L range. Harnett County is among the 61 NC counties with predicted average indoor radon levels in the lowest-range, less than 2 pCi/L (54).

According to county-level data provided by the NC Radon Program, the average radon level among 19 Harnett County air samples reported in 2004 was 0.62 pCi/L (55).

Health Risks of Radon

There are no immediate symptoms to indicate exposure to radon. The primary risk of exposure to radon gas is an increased risk of lung cancer (after an estimated 5-25 years of exposure). 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 (56).

In 2003, the EPA worked with the National Academy of Science (NAS) 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 (57). 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[1]

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

Source: US Environmental Protection Agency, Air, Indoor Air Quality, Radon, Health Risks, Report: Assessment of Risks from Radon in Homes; http://www.epa.gov/radon/risk_assessment.html
[1] Assumes constant lifetime exposure in homes at these levels.

Environmental Tobacco Smoke

Tobacco smoking has long been recognized as a major cause of death and disease, responsible for hundreds of thousands of deaths each year in the US. Smoking is known to cause lung cancer in humans, and is a major risk factor for heart disease. However, it is not only active smokers who suffer the effects of tobacco smoke. In 1993, the EPA published a risk assessment on *passive smoking* and concluded that the widespread exposure to environmental tobacco smoke (ETS) in the US presented a serious and substantial public health impact (58).

ETS is a mixture of two forms of smoke that come from burning tobacco: sidestream smoke (smoke that comes from the end of a lighted cigarette, pipe, or cigar) and mainstream smoke (smoke that is exhaled by a smoker). When non-smokers are exposed to secondhand smoke it is called involuntary smoking or passive smoking. Non-smokers who breathe in secondhand smoke take in nicotine and other toxic chemicals just like smokers do. The more secondhand smoke that is inhaled, the higher the level of these harmful chemicals will be in the body (59).

Secondhand smoke causes harm in many ways (59). In the US alone, each year it is responsible for:

- An estimated 46,000 deaths from heart disease in non-smokers who live with smokers;
- About 3,400 lung cancer deaths in non-smoking adults;
- Other breathing problems in non-smokers, including coughing, mucus, chest discomfort, and reduced lung function;
- 50,000 to 300,000 lung infections (such as pneumonia and bronchitis) in children younger than 18 months of age, which result in 7,500 to 15,000 hospitalizations annually;
- Increases in the number and severity of asthma attacks in about 200,000 to 1 million children who have asthma;
- More than 750,000 middle ear infections in children; and
- Pregnant women exposed to secondhand smoke are also at increased risk of having low birth-weight babies.

In 2006 the US Surgeon General issued a report with a number of significant conclusions:

- Secondhand smoke causes premature death and disease in children and in adults who do not smoke;
- Children exposed to secondhand smoke are at an increased risk of sudden infant death syndrome (SIDS), acute respiratory infections, ear problems, and more severe asthma. Smoking by parents causes breathing (respiratory) symptoms and slows lung growth in their children;
- Secondhand smoke immediately affects the heart and blood circulation in a harmful way. Over a longer time it also causes heart disease and lung cancer;
- The scientific evidence shows that there is no safe level of exposure to secondhand smoke
- Many millions of Americans, both children and adults, are still exposed to secondhand smoke in their homes and workplaces despite a great deal of progress in tobacco control; and
- The only way to fully protect non-smokers from exposure to secondhand smoke indoors is to prevent all smoking in that indoor space or building. Separating smokers from non-smokers, cleaning the air, and ventilating buildings cannot keep non-smokers from being exposed to secondhand smoke (60).

There are four places where exposure to second-hand smoke is prevalent: at work, in public places, at home, and in the car. Through the relatively recent intervention of federal, state and local governments, as well as some health-conscious businesses, smoking is increasingly prohibited in workplaces and restaurants, and in schools and government properties of all kinds, by policy or by law. In NC, entire school campuses and government offices are now smoke-free, as are most restaurants and bars. Nevertheless, smoking is still popular among state residents, and exposure to second-hand smoke remains a problem.

According to the 2009 NC Behavioral Risk Factor Surveillance System (BRFSS) Survey results, 20.3% of respondents statewide self-identified as “current smokers” (61). This figure was down from a comparable figure of 22.6% in 2005 (62). No comparable county-specific BRFSS data exist for Harnett County, and smoking habit questions were not part of the 2006 or 2010 Harnett County Community Health Surveys. However there is some evidence that smoking is a health issue among at least pregnant women in Harnett County, where the percentage of births occurring to mothers who smoke is 13.1%, a figure 19% higher than the comparable percentage (11.0) for NC as a whole (see Harnett County Community Health Assessment, Volume I, Health Statistics, Pregnancy).

A recent UNC poll revealed that smoke-free policies are supported by large majority of NC citizens (63). On January 2, 2010, NC became the first tobacco-producing state in the nation to ban smoking in restaurants and bars. The poll, conducted after the law went into effect, shows that the ban is supported by 72.2% of adults in the state. The poll also found 25.8% of the population opposed the ban, and 2.1% were undecided. Proponents were more likely to be nonsmokers (85.5% vs. smokers 30.7%), women (80.3% vs. men 63.5%), and more highly educated (82.1% vs. lower education 60.2%).

In addition, a large majority–72.1%–said they would support a law that requires *all* indoor workplaces and public places to be smoke-free, while 25.8% opposed such a measure and 2.1% were undecided.

Concern was voiced during the debate on the legislation that it would have a deep, negative economic impact on restaurants and bars. However, the new poll suggests the opposite may be true. Despite the challenging economic times, 38.8% of adults said they dine out more since the ban took effect, 50.4% said it has made no difference, and only 10.6% said they go out less often.

Other Health Effects of Air Pollution

Air pollutants besides radon and tobacco smoke pose health risks that include 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 EPA, 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 (64).

Indicators of SBS include:

- Building occupants complain of symptoms associated with acute discomfort, such as 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; and
- 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; and
- 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 (64).

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); and
- 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) (64).

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. There are no public statistics in NC cataloging SBS or BRI.

Asthma

Asthma is a chronic respiratory disease that inflames and narrows the airways of the lungs, causing recurring periods of wheezing, chest tightness, shortness of breath, and coughing. The coughing often occurs at night or early in the morning. Asthma attacks can vary from mild to life-threatening. Asthma affects people of all ages, but it most often starts in childhood. In the US, more than 22 million people are known to have asthma; nearly 6 million of these people are children (65).

The exact cause of asthma isn't known. Researchers think a combination of factors (family genes and certain environmental exposures) interact to cause asthma to develop, most often early in life. These factors include: an inherited tendency to develop allergies (called *atopy)*; parents who have asthma; certain respiratory infections during childhood; and contact with some airborne allergens or exposure to some viral infections in infancy or in early childhood when the immune system is developing (65).

Air Pollution Asthma Triggers. 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, pet dander, and combustion byproducts. In addition, even low levels of exposure to nitrogen dioxide (as a byproduct of fuel-burning appliances such as gas stoves, gas or oil furnaces, fireplaces, wood stoves and unvented kerosene or gas space heaters) may cause increased bronchial reactivity in people with asthma, and make young children more susceptible to respiratory infections. Long-term exposure to high levels of NO_2 can lead to chronic bronchitis (66).

Outdoor asthma triggers include high levels of ozone and particulate pollution, which have been associated with 10-20% of all respiratory hospital visits and admissions (67).

Asthma Prevalence among Adults. According to CDC data based on the national BRFSS Survey, in 2008, 13.3% of the adult respondents in the US and 11.7% of the respondents in NC reported having been diagnosed with asthma at some point in their lifetime (*lifetime prevalence*). These percentages extrapolate to approximately 30.9 million lifetime asthma diagnoses nationally and 803,000 diagnoses in NC (68).

As noted in Volume One of this report, the NC BRFSS regional population sample that includes Harnett County is too diverse to yield county-specific data.

Estimates of *current prevalence* of asthma among US adults are somewhat lower than estimates of lifetime prevalence. According to data from the National Center for Health Statistics (69), 7.3% of non-institutionalized adults in the US (a total of 16.4 million) currently have asthma.

Asthma Prevalence among Children. With regard to childhood asthma, CDC data from the 2008 National BRFSS survey indicates that 13.3% of children referenced in the survey sample had been diagnosed with asthma; this *lifetime prevalence* rate translates to approximately 7.6 million lifetime diagnoses of childhood asthma (70). The 2008 and 2009 NC BRFSS surveys did not implement the childhood asthma question module, so no comparable state data are available.

According to recent (2009) data from the National Center for Health Statistics, the *current prevalence* rate of childhood asthma in the US is 9.4% (7.0 million children) (69).

Asthma Mortality. According to preliminary national data for 2008, there were 3,395 deaths in the US attributable to asthma, yielding a corresponding age-adjusted death rate of 1.0 per 100,000 population (71). Asthma deaths among children are relatively rare; in 2006, 131 of the 3,613 asthma deaths nationally (4%) were among children under the age of 15 (72). (Comparable NC data for 2008 is not yet available.)

In 2009, there were 94 deaths statewide in NC attributed to asthma; two of these deaths occurred in children under the age of 15 (73). In Harnett County in 2009, only one death (a middle-aged adult) was attributed to asthma (74).

Cardiovascular 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.

In 2004, the American Heart Association (AHA) issued a scientific statement on "Air Pollution and Cardiovascular Disease," concluding that exposure to particulate matter (PM) air pollution contributes to cardiovascular morbidity and mortality. Since then, numerous studies expanded understanding of this association and further elucidated the physiological and molecular mechanisms involved. In 2010, the AHA updated its original statement, citing the following findings regarding exposure to small particulate matter in air (75):

- Exposure to small particulate matter (PM2.5) over a few hours to weeks can trigger cardiovascular disease–related mortality and nonfatal events;
- Longer-term exposure (e.g., a few years) to PM increases the risk for cardiovascular mortality to an even greater extent than exposures over a few days and reduces life expectancy within more highly exposed segments of the population by several months to a few years;
- Overall evidence is consistent with a causal relationship between PM2.5 exposure and cardiovascular morbidity and mortality;
- Reductions in PM levels are associated with decreases in cardiovascular mortality within a time frame as short as a few years;

And concluding the following: PM2.5 exposure is deemed a *modifiable* factor that contributes to cardiovascular morbidity and mortality (75).

A 2009 study that examined hospital records for 9.3 million Medicare enrollees and air pollution levels gathered between 1999 and 2005 in 126 urban counties around the US found that levels of ambient carbon monoxide (CO) in the air *well below* accepted environmental standards are associated with an increased risk of hospital admissions for "heart problems" among the elderly. Specifically, a 1 part per million (ppm) increase in daily one-hour exposure was associated with a 0.96 percent increase in the risk of hospitalization for cardiovascular disease (CVD) outcomes (including ischemic heart disease, heart rhythm disturbances and heart failure, as well as cerebrovascular disease and total CVD) among people over the age of 65. According the study's authors, the increased risk persisted at extremely low

CO levels of less than 1 ppm, suggesting that the detrimental effects of even short exposure to low levels of CO or other traffic- related pollutants pose an under-recognized health risk to seniors (76).

Admittedly, a person's relative cardiovascular risk due to air pollution is small compared with the impact of established cardiovascular risk factors such as smoking, obesity, or high blood pressure. However, it is fair to conclude that cardiovascular risk from air pollution is a serious public health problem because an enormous number of people are exposed over an entire lifetime.

At the present time there is no simple mechanism for linking cardiovascular events to air pollution at the county level.

Chapter Three: Toxic Chemical Releases

Toxic Release Inventory

Over 4 billion pounds of toxic chemicals are released into the nation's environment each year. The US Toxic Releases Inventory (TRI) program, created in 1986 as part of the Emergency Planning and Community Right to Know Act, is the tool the EPA uses to track these releases. Approximately 20,000 industrial facilities are required to report estimates of their environmental releases and waste generation annually to the TRI program office. 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. Note that because TRI facilities in NC and most other states are not required to report the quantities of toxic chemicals actually *used* (inputs), but rather to report only *estimates* of emissions, TRI data may not be entirely realistic (77).

The EPA makes TRI data available through downloadable files and data access tools in order to provide communities with information about toxic chemical releases and waste management activities and to support informed decision making at all levels by industry, government, non-governmental organizations, and the public (78).

TRI release data is available for 85 NC counties for 2009. In 2009, New Hanover County was the NC county on the list with the largest quantity of TRI releases (total of on- and off-site disposal or other release): 4,872,665 pounds; Davie County had the smallest quantity of releases: 27 pounds. Several of the 85 NC counties listed (Caswell, Clay, Greene, Pasquotank and Warren) had zero TRI releases. Facilities in Harnett County released 20,765 pounds of TRI chemicals in 2009, placing it 64th on the list of 85 NC counties (79). Table 13 presents details on the major 2009 Harnett County releases (80).

Table 13. TRI Chemical Releases in Harnett County, 2009

Site	Total Pounds Disposed On-Off-Site/ Released	Primary Pollutant Released	Pounds of Primary Pollutant Released
Capital Marble Creations Inc., Lillington	1,681	Styrene	1,671
Kidde Firefighting Inc., Angier	13,536	Di(2-ethylhexyl) phthalate	11,498
Warren Oil Co, Dunn	5,548	Methanol	5,242

Source: US Environmental Protection Agency, Toxic Release Inventory (TRI) Program, TRI Explorer, Reports, Facility Report, 2009, Select a State, North Carolina, Select from a List of Counties, Harnett, http://www.epa.gov/triexplorer/facility.htm

For purposes of relating chemical releases to the health of the public, *Scorecard* categorizes TRI chemicals 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 (81).

The most recent data available from the TRI risk hazards section of *Scorecard* describes 2002 TRI releases. At that time, Harnett ranked 71st among 80 NC counties listed for total environmental releases (6,200 pounds) (82). In 2002 the overall cancer risk and non-cancer risk scores were related primarily to releases of lead compounds and copper (83). Neither of these was a primary release chemical in 2009, so scores for them are no longer relevant. General health effects of the primary TRI release chemicals in Harnett County (listed in Table 13) are described below.

Di (2-ethylhexyl) phthalate (DEHP) – This specific chemical belongs to the larger category of *phthalates*. Phthalates are used in hundreds of consumer products, including cosmetics and personal care products such as perfume, hair spray, soap, shampoo, nail polish, and skin moisturizers. They are used in flexible plastic and vinyl toys, shower curtains, wallpaper, vinyl miniblinds, food packaging, and plastic wrap and in wood finishes, detergents, adhesives, plastic plumbing pipes, lubricants, medical tubing and fluid bags, solvents, insecticides, medical devices, building materials, and vinyl flooring. Phthalates had been used to make pacifiers, soft rattles, and teethers, but at the request of the U.S. Consumer Product Safety Commission, U.S. manufacturers have not used phthalates in those products since 1999. People can be exposed to low levels of phthalates through air, water, or food, or if they use cosmetics, personal care products, cleaning products, or other plastic and vinyl products that contain them.

The human health effects of phthalates are not yet fully known, but are being studied by several government agencies, including the Food and Drug Administration, the National Institute of Environmental Health Sciences, and the National Toxicology Program's Center for the Evaluation of Risks to Human Reproduction. *Di (2-ethylhexyl) phthalate* is listed as a substance "reasonably anticipated to be a human carcinogen" in the Eleventh Report on Carcinogens, published by the National Toxicology Program. High levels of exposure to di (2-ethylhexyl) phthalate through the use of medical tubing and other plastic devices for feeding, medicating, and assisting the breathing of newborn infants, may affect the development of the male reproductive system, according to the National Institute of Environmental Health Sciences (84).

Methanol - Methanol is a highly toxic colorless liquid that may explode when exposed to flames. Other common names for methanol are methyl alcohol and wood alcohol. Methanol occurs naturally in wood and volcanic gases, and is a product of decaying organic material such as vegetation. It is also emitted from gasoline and diesel engines, and from burning trash and plastics. Methanol is used in antifreeze products and as a solvent, and is an ingredient of gasoline, and some paint strippers. It is used in wall and spray paints, paint thinner, shellac, varnish, carburetor cleaners, inks, resins, adhesives, dyes, plastics, car windshield washer compounds, some insulation products, copy machine fluids, and some pesticides. In some vehicles, it is used as an alternative fuel, and is used as a fuel for picnic stoves. It is also used in semi-conductor manufacturing; antibacterial substances used on mortuary instruments, cadavers, and biological specimens; oil recovery injection; and in the production of some

pharmaceuticals, such as vitamins and hormones. It has been used in the treatment against Dutch elm disease and fungi on timbers, wood fence posts and poles, and lumber.

People can be exposed to methanol by using consumer products such as wall and spray paints, paint strippers, adhesives, cleaners, insulation products, pesticides, and car windshield washer fluid or antifreeze. Exposure can occur from breathing air that contains methanol from natural sources or vehicle exhaust, and from drinking or eating contaminated water or food.

Swallowing, breathing, or absorbing large quantities of methanol through the skin, as in an industrial setting, can cause death. Exposure to methanol can cause visual problems and lead to blindness. It can cause convulsions, coma, loss of consciousness, kidney failure, liver damage, low blood pressure, respiratory arrest, and damage to the central nervous system. Chronic exposure to methanol can result in methanol poisoning, which may cause inflammation of the eye, recurrent headaches, insomnia, stomach problems, visual failure, and dermatitis. Short-term exposure to methanol can cause difficulty breathing, lack of coordination, blurred vision, dermatitis, headache, dizziness, insomnia, confusion, nausea, vomiting, diarrhea, inflammation of the pancreas, conjunctivitis, stomach problems and pain, weakness, leg cramps, and excessive sweating. Persons may be at an increased risk when exposed to methanol if they have an existing skin, kidney, liver, or eye disorder (85).

Styrene - Styrene is primarily used in the production of polystyrene plastics and resins. Acute (short-term) exposure to styrene in humans results in mucous membrane and eye irritation, and gastrointestinal effects. Chronic (long-term) exposure to styrene in humans results in effects on the central nervous system (CNS), such as headache, fatigue, weakness, and depression, CSN dysfunction, hearing loss, and peripheral neuropathy. Human studies are inconclusive on the reproductive and developmental effects of styrene; several studies did not report an increase in developmental effects in women who worked in the plastics industry, while an increased frequency of spontaneous abortions and decreased frequency of births were reported in another study. Several epidemiologic studies suggest there may be an association between styrene exposure and an increased risk of leukemia and lymphoma, but the evidence is inconclusive. EPA has *not* given a formal carcinogen classification to styrene (86).

Land Contamination

Superfund Sites

As of February 2, 2011, Harnett County currently did 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. Nationally, there are 1,277 Superfund sites; NC currently has 35 Superfund sites scattered statewide in 20 counties. The nearest NPL sites to Harnett County are in Fayetteville (Cumberland County) (87).

Brownfields

The 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.

The North Carolina Brownfields Program, authorized by the state statute known as the Brownfields Property Reuse Act, provides a mechanism to treat prospective developers of brownfield sites differently than the parties responsible for contaminating them. Prospective developers negotiate a brownfields agreement with the program that defines activities needed to make the site suitable for reuse, rather than cleaning up the site to regulatory standards (which responsible parties are required to do) (88).

As of March 31, 2010, 160 Brownfields Agreements had been negotiated in NC; there were 113 active eligible projects and 23 more pending. No negotiated, active eligible, or pending Brownfields projects were listed in Harnett County at that time (89).

Inactive Hazardous Sites

In 1987 the NC General Assembly enacted The NC 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 was created to deal with any site where hazardous substance or waste contamination existed that wasn't already under the jurisdiction of another program. An organizational change within DENR in 2007 consolidated oversight of contaminated site remediation into the Division of Waste Management (DWM).

The Inactive Hazardous Sites Branch, within the Superfund Section of the DWM, is responsible for oversight and approval of the assessment and remediation of all historical and any recent accidental releases of hazardous substances and pollutants (with a number of specific exceptions). The Branch oversees remedial actions, conducts any necessary enforcement of assessment and remediation at sites deemed to be a priority, and conducts the work itself at orphaned sites when state resources are available (90).

As of January 6, 2011 there were 1,886 inactive hazardous sites across NC listed by DWM. Seven of these sites were in Harnett County: Energy Conservation Systems (Dunn), Erwin Mills/Burlington Industries (Erwin), Lancaster Plating (Lillington), NC DOT Asphalt Site #32/Johnson Brothers (Lillington), Peterbilt of Dunn "A" Parcel (Dunn), Peterbilt of Dunn "B" Parcel (Dunn), and Pope Property (Dunn) (91).

Hazardous Substances Emergency Events

In 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) established an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system to describe the public health effects associated with releases of hazardous substances such as ammonia, chlorine, acids, pesticides, paints, and dyes (but not petroleum products). The NCDPH joined the federally funded project in 1991, but that iteration of the project ended in 2009. Data are available from 1993–2005 (92).

A total of 3,549 hazardous substances emergency events throughout NC were reported to the HSEES system between 1993 and 2005. Over this same period, there were 16 HSEES events in Harnett

County, three in the 1993-1997 period, five in the period from 1998-2001, six in 2002-2003, and two in 2004-2005 (93).

In 2009, NCDPH was awarded a new grant from ATSDR that builds on the surveillance data collected in the HSEES program. The new program name is the *National Toxic Substance Incidents Program (NTSIP)*. Currently the NTSIP program is funded in seven states: Louisiana, New York, North Carolina, Oregon, Tennessee, Utah and Wisconsin. The goal of the program is to reduce illnesses and deaths from acute toxic substance incidents. In order to meet this goal the program objectives include: (1) maximizing coordination among federal, state, and local agencies involved in toxic substance activities, (2) incorporating multiple levels of surveillance and outreach, (3) conducting public health investigations of highly significant incidents, (4) generating maps to identify chemical vulnerabilities in communities, and (5) promoting green chemistry. To achieve these objectives program staff will interact with stakeholders including, but not limited to, government officials, responders, and industry personnel who are working to achieve a safer environment for the people of NC (94). Subsequent HSEES event reports should emanate from this new program.

Chapter Four: Lead Hazards

Lead is a highly toxic natural metal found in the environment in soil, dust, air, and water. Historically it was used for many years in common household products such as paint, batteries, makeup, and ceramics, as an additive to gasoline, and as an ingredient in pesticides. Currently, it is used in lead-acid batteries, fishing weights, marine paint, lead shot, bullets, and in the manufacture of some plastics. Recently, the electronics industry is using more lead in magnetic imaging equipment, transistors, night vision equipment, and energy generation (95).

People can get lead in their body if they put their hands or other objects covered with lead dust in their mouths, ingest paint chips, soil, or water that contains lead, or breathe in lead dust, especially during renovations that disturb painted surfaces.

Where Lead is Found

Paint

Lead-based paint is the most common source of lead poisoning (especially for children) because it was widely used in most oil-based paints prior to 1950. Children are exposed to lead when they eat paint chips or chew painted surfaces. Lead-containing paint is most dangerous when it is peeling, chipping, chalking, or cracking, or is located on a surface that is subject to damage from repeated impacts such as door frames. Improper renovation of homes with-lead based paint can generate lead in the air, dust, and soil (96).

Soil and Dust

Soil and dust can be major sources of lead-contamination around the home as a result of peeling and chipping paint and remodeling activities, such as sanding and scraping of paint. Industries such as lead ore mining, milling, or smelting, municipal solid waste incinerators, and lead-acid battery recycling facilities can contaminate soil with lead. Lead-contaminated soil is a potential source of exposure, directly through hand-to-mouth activity, and indirectly as a contributor to indoor floor dust when tracked into the home (96).

Air

Sources of airborne lead include emissions from gasoline combustion, smelters, and battery manufacturers, among others. Due to the federal Clean Air Act, there is less lead in motor fuels and tighter emission controls on industrial activities. This has driven air emissions of lead down nearly 90 percent during the last 20 years (96).

Water

Industrial facilities, urban runoff and atmospheric deposition are sources of lead in the aquatic environment. Lead solder can contaminate drinking water (96).

Health Effects of Lead Exposure

Childhood lead poisoning remains a major environmental health problem in the US, but adults also can be affected by exposure to lead.

Adults exposed to lead can suffer from reproductive problems (in both men and women), high blood pressure and hypertension, nerve disorders, memory and concentration problems, and muscle and joint pain (96). In adults, a "normal" blood lead level is less than 20 µg/dL (micrograms per deciliter). Adults who have been exposed to lead should have blood lead levels below 40 µg/dL. Treatment is recommended if there are symptoms of lead poisoning, or if the blood lead level is greater than 60 µg/dL (97).

Lead is more dangerous to children than adults because babies and young children often put their hands and other objects in their mouths, children's growing bodies absorb more lead, and children's brains and nervous systems are more sensitive to the damaging effects of lead. If not detected early, children with high levels of lead in their bodies can suffer from damage to the brain and nervous system, behavior and learning problems (such as hyperactivity), slowed growth, hearing problems, and headaches (96). Among children, a "normal blood lead level is less than 10 µg/dL. A blood lead level greater than this threshold requires further testing and monitoring, and the source of lead must be found and removed. A blood lead level greater than 45 µg/dL in a child's blood usually indicates the need for treatment (97).

Assessing Lead Risks

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. *Scorecard*, via 2000 US Census data, ranks counties by overall lead hazard risk in housing to help estimate potential lead hazards in housing. Harnett County ranked 26th out of 50 NC counties listed in terms of the number of housing units (650) with a high risk of lead hazards (98). Details of that risk are shown below in Table 14.

Table 14. Harnett County Lead Hazard Indicators, 2000 US Census

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.**	**%**
650	2	4,100	n/a	5,300	16	2,000	29

Source: Scorecard, Pollution Rankings. Lead Hazards. County Report. Harnett County; http://scorecard.goodguide.com/env-releases/lead/county.tcl?fips_county_code=37085

The figures in Table 14 are relatively low compared to figures for largely urban areas of NC that were developed earlier and more densely than the communities in Harnett County. For example, Mecklenburg County and Guilford County lead the state in terms of housing units built before 1950; in each there are an estimated 22,000 homes built prior to 1950 (98). Note that data from the soon-to-be-released 2010 Census is unlikely to change these figures since they describe past events.

Childhood Blood Lead Levels

The Children's Environmental Health Branch of DENR, via its Lead Poisoning Prevention Program, catalogues data on the results of blood lead level screenings and testing among children (99). Results for the period from 2005 through 2009 are presented in Tables 15 and 16.

Table 15 presents results of routine *screening* data for children ages 1 and 2. (These are the ages for which universal blood lead screening is recommended.) Note that statewide, the number and percentage of children in this age group testing positive for blood lead levels ≥ 10µg/dL declined every year during the period cited, even as the number tested was rising. The pattern in Harnett County is not as clear, although the percentage testing positive at a level ≥ 10µg/dL in 2009 was lower than the comparable percentage in 2005.

Table 15. County Childhood Lead Screening Results, Ages 1 and 2 years

Year	Location	Target Population[1]	No. Tested[2]	% Tested	No. ≥10 µg/dL	% ≥10 µg/dL
2009 (Draft)	Harnett County	3,258	1,353	41.5	10	0.7
	Onslow County	7,365	2,333	31.7	6	0.3
	State of NC	261,644	129,267	49.4	581	0.4
2008	Harnett County	3,190	1,428	44.8	7	0.5
	Onslow County	7,228	2,397	33.2	5	0.2
	State of NC	258,532	121,023	46.8	654	0.5
2007	Harnett County	3,056	1,400	45.8	8	0.6
	Onslow County	6,720	1,857	27.6	9	0.5
	State of NC	250,686	112,556	44.9	706	0.6
2006	Harnett County	2,937	1,194	40.7	14	1.2
	Onslow County	6,559	1,671	25.5	9	0.5
	State of NC	242,813	103,899	42.8	867	0.8
2005	Harnett County	2,865	1,107	38.6	11	1.0
	Onslow County	6,548	1,428	21.8	12	0.8
	State of NC	238,065	96,623	40.6	873	0.9

Source: NC Department of Environment and Natural Resources, Children's Environmental Health Branch, Lead Poisoning Prevention Program, Surveillance Data Tables (2009 [Draft], 2008, 2007, 2006, 2005 Lead Surveillance Data);
http://www.deh.enr.state.nc.us/ehs/Children_Health/Lead/Surveillance_Data_Tables/surveillance_data_tables.html
1 "Target Population" is based on the number of live births in preceding years.
2 "Number Tested" is an unduplicated count of children tested for lead poisoning within the calendar year.
Note: Children are counted as being tested for lead poisoning in successive years until they are confirmed to have a lead level ≥ 10µg/dL. Confirmation is based on a child receiving two consecutive blood lead test results ≥ 10µg/dL within a six-month period. "Confirmed" lead levels are based on the confirmation data and are classified according to the highest level confirmed during the calendar year.

Table 16 presents *testing* results for children ages six months to six years for the same period. These children were tested because a lead poisoning hazard had been identified in their residential housing

unit or their child-occupied facility (e.g., daycare facility). The numbers of children with high blood lead levels (10-19 µg/dL) in Harnett County and Onslow County are so low they are probably unstable and should not be compared. Statewide, the number of children with confirmed blood lead levels in the 10-19 µg/dL range decreased every year even as the number tested increased. The number of children statewide with blood lead levels greater than or equal to 20µg/dL remained approximately constant (36-38) from year to year over the last four years of the period cited.

Table 16. County Childhood Lead Testing Results, Ages 6 Months to 6 years

Year	Location	No. Tested	No. Confirmed 10-19 µg/dL	No. Confirmed ≥20 µg/dL
2009 (Draft)	Harnett County	1,909	3	0
	Onslow County	2,833	0	1
	State of NC	160,563	143	38
2008	Harnett County	2,097	0	1
	Onslow County	3,096	0	0
	State of NC	152,222	181	36
2007	Harnett County	2,050	1	1
	Onslow County	2,085	0	0
	State of NC	143,972	232	38
2006	Harnett County	1,823	1	0
	Onslow County	1,821	0	0
	State of NC	135,595	255	38
2005	Harnett County	1,707	5	1
	Onslow County	1,712	2	1
	State of NC	128,249	299	53

Source: NC Department of Environment and Natural Resources, Children's Environmental Health Branch, Lead Poisoning Prevention Program, Surveillance Data Tables (2009 [Draft], 2008, 2007, 2006, 2005 Lead Surveillance Data);
http://www.deh.enr.state.nc.us/ehs/Children_Health/Lead/Surveillance_Data_Tables/surveillance_data_tables.html
Note: "Confirmed 10-19" and "Confirmed ≥ 20" are mutually exclusive.

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. Another 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. One aid in this task is the US Census of Agriculture, which is conducted every five years by the US Department of Agriculture. The most recent Census of Agriculture was completed in 2007; the data were released in February, 2009 and updated in December 2009. The following section presents Harnett County data from the 2007 US Census of Agriculture, and compares some of it to data from the 2002 census.

Harnett County Agricultural Census

From the 2007 US Census of Agriculture (100):

In 2007, Harnett County was home to 727 farms (down from 730 in 2002), involving a total of 111,770 acres, 64.5% of which (72,092 acres) was in harvested cropland. The average size of a farm in Harnett County in 2007 was 154 acres, down 2% from the average size in 2002.

In terms of the *total* market value of agricultural products sold, Harnett County ranked 12th out of 100 counties statewide in 2007. The *per-farm* market value of products sold was $243,760 in 2007, up 69% from a comparable vale of $143,881 in 2002. The average government payment received by each Harnett County farm in a government program in 2007 was $10,732, up 33% from the comparable figure in 2002. With average per farm production expenses of $195,947 in 2007, average per farm net cash farm income of operation was only $57,590.

Only about half of the Harnett County farm operators (354) listed farming as their primary occupation in 2007. The average age of the principal operators of Harnett County farms (10% of whom were female) in 2007 was 57.1 years.

The NC Department of Agriculture's Agricultural Statistics Division catalogues annual estimates on the production of crops and livestock throughout the state on a county basis. However, the Division imposes numeric thresholds for the data it releases. For instance, information regarding livestock raised is not reported for counties with fewer than 1,000 hogs or 500 total cattle, 200 beef or milk cows, 500,000 broilers or turkeys, or 50,000 other chickens.

Table 17 summarizes Harnett County crop data for 2009; Table 18 summarizes livestock data. The crop data will be used subsequently to calculate the volumes of selected chemicals (pesticides and herbicides) used in the county, and the livestock data will be used to calculate animal waste production estimates.

Soybeans are the crop in Harnett County with the most acres harvested, but flue-cured tobacco is the leader in terms of the monetary value of production (Table 17). The primary livestock raised in Harnett County is broiler chickens; the county ranks 9th in NC in the production of this commodity (Table 18).

Table 17. Harnett County Crop Data, 2009

Crop	Acres Harvested	Yield per Acre	Production	State Rank
Corn for Grain (Bu.)	n/a	n/a	n/a	n/a
Cotton (Lbs); Production in 480 Lb. Bales	10,500	777	17,000	18
Hay, Other (Tons)	6,600	2.4	16,000	39
Peanuts (Lbs.)	n/a	n/a	n/a	n/a
Soybeans (Bu.)	28,500	30.0	853,800	27
Sweet Potatoes (Cwt.)	1,200	200	240,000	11
Tobacco, Burley (Lbs.)	n/a	n/a	n/a	n/a
Tobacco, Flue-Cured (Lbs.)	7,280	2,430	17,704,000	8
Wheat (Bu.)	4,800	45.0	216,000	41
Nursery, Greenhouse, Floriculture, Christmas Trees (Dollars)			4,720,000	32

Source: NC Department of Agriculture and Consumer Services, Agricultural Statistics Division, 2010 Annual Statistics Book, County Summary: Harnett; http://www.ncagr.gov/stats/2010AgStat/index.htm
Note: "n/a" signifies a value below the threshold for reporting.

Table 18. Harnett County Livestock Data, 2009

Livestock	Number	State Rank
Broilers Produced (2009)	26,000,000	9
Cattle, All (Jan. 1, 2010)	7,700	40
Beef Cows (Jan. 1, 2010)	4,300	37
Milk Cows (Jan 1, 2010)	n/a	n/a
Chickens, Excluding Broilers (Dec. 1, 2009)	n/a	n/a
Hogs and Pigs (Dec. 1, 2009)	58,000	23
Turkeys Raised (2009)	n/a	n/a

Source: NC Department of Agriculture and Consumer Services, Agricultural Statistics Division, 2010 Annual Statistics Book, County Summary: Harnett; http://www.ncagr.gov/stats/2010AgStat/index.htm
Note: "n/a" signifies a value below the threshold for reporting.

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 US law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant (101).

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.

Pesticides Used on Crops

Tables 19, 20 and 21 list the agricultural chemicals *commonly applied* to the three major kinds of crops grown in Harnett County in 2009: soybeans, cotton, and winter wheat. The lists of chemicals are based on NC Department of Agriculture and Consumer Services data gathered from statewide surveys. It is not possible to calculate the precise volume of each chemical applied because although there are *recommended* application rates, it is the individual farm operator's choice on which plants, how much and how often to apply crop chemicals. The lists as presented here denote only what *might* be being applied to crops in Harnett County. Note that although tobacco is planted on the third highest number of acres in Harnett County (Table 17), the Department does not list agricultural chemicals applied to tobacco.

Table 19. Agricultural Chemicals Commonly Applied to Soybeans

Chemical	Number of Applications	Application Rate (pounds/acre)
Herbicides		
Cloransulam-methyl (e.g., FirstRate Herbicide)	1	0.012
Flumiclorac-pentyl (e.g., Resource Herbicide)	2	0.014
Glyphosate isopropylamine salt (e.g., Roundup)	2	0.816
Insecticides		
Lambda-cyhalohrin (e.g., Demand, Warrior insecticides)	1	0.022

Source: NC Department of Agriculture and Consumer Services, Agricultural Statistics Division, Environmental Statistics, 2006 Agricultural Chemical Use Estimates, Soybeans – Agricultural Chemical Applications, 2006; http://www.ncagr.gov/stats/release/ChemUse2006.pdf

Table 20. Agricultural Chemicals Commonly Applied to Cotton

Chemical	Number of Applications	Application Rate (pounds/acre)
Herbicides		
2,4-D,2-ethylhexyl ester (e.g., Weedone)	1	0.226
2,4-D, dimethl salt (e.g., Barrage)	1	0.606
Carfentrazone-ethyl (e.g., Aim)	1	0.015
DCMU (e.g., Diuron)	1	0.521
Flumiclorac-pentyl (e.g., Resource)	1	0.038
Flumioxazin (e.g., Chateau Herbicide SW)	1	0.044
Fluometuron	1	0.758
Glyphosate (e.g., Roundup)	2	0.766
Linuron (e.g., Afalon)	1	0.481
MSMA (e.g., Trimec)	1	1.410
Pendimethalin (e.g., Prowl)	1	0.624
Prometryn (e.g., Prometrex)	1	0.843
Pyraflufen-ethyl (e.g., ET Herbicide)	1	0.003
Pyrithiobac-sodium (e.g., Staple Herbicide)	1	0.064
S-Metolachlor (e.g., Kixor Herbicide)	1	0.890
Trifloxysulfuron-sodium (e.g., Evoke, Monument)	1	0.006

Table 20. Agricultural Chemicals Commonly Applied to Cotton (continued)

Chemical	Number of Applications	Application Rate (pounds/acre)
Insecticides		
Acephate (e.g., Orthene)	1	0.481
Aldicarb (e.g., Temik)		0.756
Cyfluthrin (e.g., Tempo)	1	0.033
Cypermethrin (e.g., Ammo, Barricade)	1	0.108
Lambda-cyhalothrin (e.g., Demand, Warrior)	1	0.028
Zeta-cypermethrin (e.g., Mustang)	1	0.022
Fungicides		
PCNB (e.g., Avacol, Teraclor)	1	1.094
Other		
Bacillus cereus	1	
Cyclanilide (e.g., FINISH)	1	0.133
Ethephon (e.g., Arvest)	1	1.194
Kinetin	1	<0.0005
Mepiquat chloride (e.g., Pix, Stance)	1	0.029
Mepiquat pentaborate (e.g., Pentia)	1	0.069
Monocarbamide dehydrate (First Pick)	1	2.913
Paraquat (e.g., Dextrone, Sweep)	1	0.451
Thidiazuron (e.g., Dropp)	1	0.069
Tribufos (e.g., Def)	1	0.530

Source: NC Department of Agriculture and Consumer Services, Agricultural Statistics Division, Environmental Statistics, 2007 Agricultural Chemical Use Estimates, Upland Cotton Agricultural Chemical Applications, 2007; http://www.ncagr.gov/stats/release/ChemUse2007.pdf

Noteworthy from Table 20 is the *extensive* range of chemicals used on cotton.

Table 21. Agricultural Chemicals Commonly Applied to Winter Wheat

Chemical	Number of Applications	Application Rate (pounds/acre)
Herbicides		
2,4-D (e.g., Barrage)		0.66
Diclofop-methyl (e.g., Hoelon, One Shot)		0.58
Thifensulfuron (e.g., Pinnacle)		0.02
Tribenuron-methyl (e.g., Accurate, Express, Harmony)		0.01

Source: NC Department of Agriculture and Consumer Services, Agricultural Statistics Division, Environmental Statistics, 2005 Agricultural Chemical Applications – Winter Wheat. (No longer available; originally accessed January, 2007. See 2006 Harnett County Community Health Assessment, Volume II, Environmental Data, for original reference.)

Health Risks of Pesticides

The effects of pesticides on human health depend on the type of pesticide, the concentration, and the length of exposure. Some types of pesticides, 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 (102).

Human exposures to agricultural chemicals can occur through air, water, and direct contact. Sprayed pesticides can be carried in droplets into the air, and it is possible for pesticides and their degradation products to run off into surface waters and leach into groundwater. The greatest effects of agricultural chemicals may be borne by the people who mix and apply pesticides, thus possibly coming into direct, repeated contact with them. The NC State Center for Health Statistics reports a total of five pesticide poisoning deaths in the period from 2004 through 2009, none of which occurred in Harnett County (103). Data on illness due to pesticide exposure is far more elusive. Although state- and county-level is available listing hospital discharges due to poisoning and other accidental injury, this data does not separate poisonings by source.

Table 22 presents data from the Pesticide Action Network of North America (104) on some of the environmental and health risks and health effects of the herbicides, insecticides, fungicides and other chemicals that may be applied on Harnett County crops (from Tables 19, 20 and 21).

Table 22. Health and Environmental Risks of Chemicals Used on Crops in Harnett County

Chemical	Acute Toxicity	Carcino-genicity	Cholin-esterase Inhibitor[1]	Ground Water Contaminant	Developmental or Reproductive. Toxicity[2]	Endocrine Disruptor[3]
Herbicides						
2,4-D, 2-ethylhexyl ester	Slight	Possible	No	Potential	High	Suspected
2,4-D, dimethyaminel salt	High	Possible	No	Potential	Unknown	Suspected
Carfentrazone-ethyl	No	Not likely	No	Unknown	Unknown	Unknown
Cloransulam-methyl	Slight	Not likely	No	Unknown	Unknown	Unknown
DCMU (Diuron)	Slight	High	No	High	High	Suspected
Diclofop-methyl	Moderate	High	No	Unknown	High	Unknown
Flumiclorac-pentyl	Slight	Not likely	No	Unknown	Unknown	Unknown
Flumioxazin	Unknown	Not likely	No	Unknown	Unknown	Unknown
Fluometuron	Slight	Possible	No	Potential	Unknown	Unknown
Glyphosate	Slight	Not likely	No	Potential	Unknown	Unknown
Glyphosate isopropylamine salt	Unknown	Unknown	No	Potential	Unknown	Unknown
Linuron	Slight	Possible	No	Potential	High	Suspected
MSMA	Slight	High	No	Potential	Unknown	Unknown
Pendimethalin	Slight	Possible	No	Unknown	Unknown	Suspected
Prometryn	Slight	Not likely	No	Potential	High	Suspected
Pyraflufen-ethyl	Unknown	High	No	Unknown	Unknown	Unknown
Pyrithiobac-sodium	Moderate	Possible	No	Potential	Unknown	Unknown
S-Metolachlor	Slight	Possible	No	High	Unknown	Suspected
Thifensulfuron	Unknown	Unknown	No	Unknown	Unknown	Unknown
Tribenuron-methyl	Slight	Possible	No	Unknown	Unknown	Unknown
Trifloxysulfuron-sodium	Unknown	Not likely	No	Potential	Unknown	Unknown
Insecticides						
Acephate	Slight	Possible	Yes	Potential	Unknown	Suspected
Aldicarb	High	Unclassifiable	Yes	High	Unknown	Suspected
Cyfluthrin	Moderatee	Not likely	No	Unknown	Unknown	Unknown
Cypermethrin	Unknown	Possible	No	Unknown	Unknown	Suspected
Lambda-cyhalothrin	Unknown	Unknown	No	Unknown	Unknown	Unknown

Chemical	Acute Toxicity	Carcino-genicity	Cholin-esterase Inhibitor[1]	Ground Water Contaminant	Developmental or Reproductive. Toxicity[2]	Endocrine Disruptor[3]
Zeta-cypermethrin	High	Possible	No	Unknown	Unknown	Suspected
Fungicides						
PCNB	Slight	Possible	No	Unknown	Unknown	Suspected
Other						
Bacillus cereus	Unknown	Unknown	No	Unknown	Unknown	Unknown
Cyclanilide	Moderate	Not likely	No	Unknown	Unknown	Unknown
Ethephon	Not acute	Unclassifiable	Yes	Unknown	Unknown	Unknown
Mepiquat chloride	Moderate	Not likely	No	Potential	Unknown	Unknown
Mepiquat pentaborate	Unknown	Unknown	No	Unknown	Unknown	Unknown
Monocarbamide dehydrate (urea dihydrogen sulfate)	Unknown	Unknown	No	Unknown	Unknown	Unknown
Paraquat	High	Not likely	No	Potential	Unknown	Suspected
Thidazauron	Not acute	Unknown	No	Unknown	Unknown	Unknown
Tribufos	Moderate	High	Yes	Unknown	Unknown	Unknown

Source: Pesticide Action Network North America (PANNA), Pesticide Action Network (PAN) Pesticide Database, Search Alphabetized Chemical List, Alphabetical List of All Chemicals in the PAN Database; http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp

[1] Proper functioning of the nervous system requires an enzyme called cholinesterase (ChE), which facilitates the transmission of nerve impulses. ChE-inhibiting pesticides disable this enzyme, resulting in symptoms of neurotoxicity: tremors, nausea, and weakness at low doses; paralysis and death at higher doses. Most of these pesticides are insecticides with a similar mechanism of action in both insects and humans. Exposure to cholinesterase-inhibiting pesticides has been linked to impaired neurological development in the fetus and in infants, chronic fatigue syndrome, and Parkinson's disease.

[2] Causing birth defects, infertility, sterility and impairment of normal growth and development.

[3] Substance that interferes with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body that are responsible for the maintenance of normal cell metabolism, reproduction, development, and/or behavior.

What is noteworthy from Table 22 is how much is *not* know about the environmental and health effects of the agricultural chemicals being used on crops.

Agricultural Animal Waste

Animal waste from livestock sometimes finds its way into surface and/or groundwater, with the amounts depending on the waste collection and treatment practices being implemented by individual farmers – or “corporate” farms.

At farms where animals are allowed to graze on pasture, much—if not all—of their manure is excreted directly onto the land, serving as a fertilizer and recycling nutrients back into the soil.

On industrial livestock farms, however, animals drop their manure in the houses where they live. From there, the manure must be cleaned out, transported, and stored, each step of which can negatively affect the environment. Manure is usually stored for many months, often in giant outdoor pits known as lagoons. As it decomposes, the manure emits harmful gases such as ammonia and hydrogen sulfide. Meanwhile, these lagoons can leak or rupture, polluting the surrounding soil and water systems. Even without leaks, manure lagoons are so fragile that major storms often result in overflows. Perhaps most famously, in 1999, the majority of NC’s manure lagoons spilled over into waterways during Hurricane Floyd, leading to widespread water contamination (105).

Since manure is produced on factory farms in excess of what can safely be absorbed by the farm's soil, it is often shipped to neighboring farms for use as fertilizer. Once the manure arrives at its destination, it is sprayed onto farm fields as fertilizer. Under the current system of animal production, however, there is always more manure available than can possibly be absorbed by the soil as fertilizer. This practice is not only harmful to the soil, but can also result in contamination of human drinking water and lead to serious public health problems (105).

Factory livestock facilities pollute the air and release over 400 separate gases, mostly due to the large amounts of manure they produce. The principal gases released are hydrogen sulfide, methane, ammonia, and carbon dioxide. Gases can be dangerous air pollutants that threaten both the environment and human health (105).

The risks of lagoon leakage, overflows, and illegal discharge of waste also pose a direct microbial threat to the quality of soil and water systems. Manure from leaky lagoons or saturated farm fields has been known to enter public water sources and infect humans (105).

Among the many nutrients usually present in high concentrations in animal waste are phosphorous and nitrogen, which are beneficial to the soils when the manure is added in small concentrations. However, the volume of manure usually found in lagoons and storage systems, and subsequent very high concentrations of nutrients, can cause a range of ecological problems like fish kills or a loss in biodiversity when released into the environment and can affect human health when leached into drinking water (105).

Table 23 shows the extent of livestock farming among the 727 farms in Harnett County farms in 2007. Beef cattle ranching/farming composes the largest proportion of livestock operations in Harnett County (128 farms). Note that no cattle raising operations in the county classify as “feedlot” operations.

Table 23. Harnett County Farms by North American Industry Classification System, 2007

Type of Livestock Farming	Number of Farms
Beef cattle ranching and farming	128
Cattle feedlots	0
Dairy cattle and milk production	0
Hog and pig farming	8
Poultry and egg production	91
Sheep and goat farming	46
Animal aquaculture and other animal production	87

Source: US Department of Agriculture, National Agricultural Statistics Service, 2007 Census of Agriculture, Volume I, Chapter 2, County Level Data, North Carolina, Table 45. Farms by North American Industry Classification: 2007; http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/North_Carolina/st37_2_045_045.pdf

Table 24 offers a profile of animal waste production in 2009, using as its base the livestock production data from Table 18. The waste computation uses per-head waste production estimates, by animal source, that were developed by NC State University researchers and personnel from the NC Department of Agriculture and Consumer Services in 2002 (106). According to these calculations, an estimated 798,110 tons of animal waste were produced by Harnett County livestock in 2009.

Table 24. Estimated Livestock Waste Production in Harnett County, 2009

Livestock Category	Number of Head	Feces and Urine Production (tons/year/head)	Total Feces and Urine Produced (tons/year)
Poultry			
Broilers	26,000,000	0.024	624,000
Cattle			
All cattle	7,700	8.3[1]	63,910
Swine			
Hogs and Pigs	58,000	1.9	110,200

Source: NC State University, 2002 North Carolina Agricultural Chemicals Manual, Livestock Manure Production Rates and Nutrient Content; http://agrienvarchive.ca/bioenergy/download/barker_ncsu_manure_02.pdf

[1] Because the livestock category "cattle" is not subdivided into beef and dairy, the waste rate for beef cattle was applied. Note that the annual per head waste produced by dairy cattle is 22.3 tons/year, or almost three times the rate for beef cattle; therefore, the total waste production estimate for cattle in the table is likely low, since the actual cattle census contains both beef and dairy cattle.

Chapter Six: Waste Management

Solid Waste Management

Table 25 presents figures summarizing tonnage of solid waste disposed in Harnett County, Onslow County and NC for the period FY2005-06 through FY2008-09. In FY2008-09, Harnett County managed 84,342 tons of municipal solid waste (MSW) for a rate of 0.77 tons *per capita*. This tonnage represented a *decrease* of 24% from the *per capita* rate for FY1991-92 (the period customarily used for the base rate). During the same 2008-09 period the overall state *per capita* solid waste management rate was the same as the FY1991-92 base *per capita* rate. According to the NC Division of Waste Management (DWM), the tonnage disposed statewide in FY2008-09 was an all-time low, due primarily to the national recession, a resulting decline in construction waste, and increased costs for disposal (107).

Table 25. Solid Waste Disposal, FY2005-06 through FY2008-09

Location	MSW Tons Managed	MSW Tons Disposed				Base Year Per Capita	Per Capita Rate	% Change Base Year to
	1991-1992	2005-06	2006-07	2007-08	2008-09	(1991-1992)	2008-2009	Current
Harnett County	69,073	90,784	91,232	92,540	84,342	1.01	0.77	-24%
Onslow County	158,344	200,180	190,664	178,092	184,852	1.04	1.05	+1%
State of NC	7,257,428	11,765,855	11,837,104	11,284,712	9,910,031	1.07	1.07	0%

Source: NC Department of Environment and Natural Resources, Division of Waste Management, Solid Waste Program, NC Solid Waste Management Annual Report, Fiscal Year 2008-2009; http://wastenot.enr.state.nc.us/swhome/AR08_09/AR08_09.pdf

County-Level Solid Waste Collection

Harnett County Solid Waste is responsible for the management and day-to-day operation of two combination landfill/transfer stations. One is the Dunn-Erwin center located on NC State Road 1724 in Dunn, and the other is the Anderson Creek center located on NC State Road 1164 in Spring Lake. The county operates four Convenience/Recycling centers that accept household trash only; they are located in Cameron, Bunnlevel, Lillington, and Fuquay-Varina (108).

Town-Level Solid Waste Collection

Town of Angier. The Town of Angier provides once-a-week household trash pickup for residential customers who must put their refuse in a town-provided trash cart. The trash carts are billed with water bills at $8.50 each per month. Commercial customers are allowed two trash carts at $12.00 each. Other pick-ups may include short lengths of plant prunings, leaves (by vacuum truck), as well as tires without rims, empty paint cans, white goods and small appliances, but not carpet or construction debris (109).

Town of Coats. The Town of Coats does not provide waste collection services, but residents are eligible to use county-sponsored landfills.

City of Dunn. The City of Dunn contracts with Republic Waste Service to provide pickup of normal household waste (e.g., boxes, packaging materials, food scraps, etc.). The City provides one 90 gallon trash can, which is emptied one time each week. Collected trash is delivered to a county-operated transfer station. In addition, the City Public Works Department offers pick up of large items such as furniture and white goods one day a week; residents must call the Public Works office to schedule such pickups (110).

Town of Erwin. The Town of Erwin provides its residents one 90-gallon trash can, which is emptied once a week. Republic Waste is the vendor for this service. In addition to the trash cans, the vendor also will pick up bulky items (e.g., furniture, stoves) if they is place curbside. Residents can also expect seasonal collection of leaves and year-round pick up of small limbs and shrub trimmings (111).

Town of Lillington. The Town of Lillington provides a 96-gallon container household trash. The Town has contracted with Waste Industries for once-a-week curbside trash pickup. Yard debris and other items must be placed at the curb to be picked up. Limbs can be no longer than 6' in length and no larger than 6" in diameter in order to qualify for pick up (112).

County-Level Recycling

As noted in the previous section, the county operates four Convenience/Recycling centers that accept household trash only; they are located in Cameron, Bunnlevel, Lillington, and Fuquay-Varina. There is an additional facility in Buies Creek (at Campbell University) that accepts recycling only (108).

All the centers accept co-mingled white paper; green, brown and clear glass; paperboard such as cereal boxes; plastic bottles #1 through #5; aseptic juice boxes; gabled-top paper carton (e.g., milk cartons); metal food cans; aluminum beverage cans; aluminum foil, six-pack plastic rings; and junk mail catalogues. In addition, the two Landfill/Transfer Station/Recycling Centers also accept lead acid batteries, scrap metal/white goods, non-construction wooden pallets, used vehicle oil filters, and scrap tires (113). The county also maintains 14 dedicated newspaper and/or magazine recycling sites located throughout the county (114).

Town-Level Recycling

Town of Angier. The Town of Angier Board of Commissioners voted unanimously to initiate a Mandatory Curbside Recycling Program beginning July 1, 2010. As of February 4, 2011, rates for this service had not yet been posted on the Town website. Waste Industries is the town's recycling vendor, providing pick-up once every two weeks. The vendor accepts: glass, aluminum, steel and tin cans; newspaper, magazines, catalogs and white paper; plastic bottles (#1-5) and soft plastic rings; gable-top containers and aseptic boxes; paperboard, chipboard, SBS board and paper tubes; and flattened corrugated cardboard (115).

Town of Coats. The Town of Coats does not provide waste collection services, but residents are eligible to use county-sponsored recycling centers.

City of Dunn. Residential curbside recycling is a relatively new (May 2010) service provided by the City of Dunn. The City has contracted with Republic Services to conduct the program (116).

Town of Erwin. The Town of Erwin has contracted with Republic Services to provide single stream curbside recycling (only one container for all recyclables). Recycling is serviced once every other week on days other than regular household trash pickup. Acceptable materials include newspapers and inserts; junk mail and magazines; catalogs and envelopes; corrugated cardboard; white paper and phone books; paperboard gable top paper cartons; paper bags; aluminum cans and clean foil; metal food cans; glass jars and bottles; aseptic juice boxes; and plastics #1 and #2 (117).

Town of Lillington. The Town of Lillington also provides a 60 gallon recycling container, which is picked up every other week by the Town's trash vendor, Waste Industries (112).

Landfill Capacity

As noted previously, municipal solid waste in Harnett County is collected at two transfer stations (the Harnett County Transfer Station in Spring Lake, and the Harnett County-Dunn/Erwin Transfer Station in Dunn) and transported out of county for landfill disposal. The primary destinations for Harnett County municipal solid waste are the Waste Industries – Sampson County Disposal Inc. facility in Roseboro, NC and the Uwharrie Environmental Regional Landfill in Mount Gilead (Montgomery County) NC (118). Table 26 shows the 2008-09 summary of household/municipal waste collection and ultimate landfill destination.

Table 26. Harnett County Municipal Waste Collection and Transfers, 2008-09

Facility	Tons Collected	Tons Received via Transfer
Harnett County-Dunn/Erwin Transfer Station	34,187	
Harnett County Transfer Station	16,306	
Waste Management Lee County Transfer Station	778	
Uwharrie Environmental Regional Landfill		74
Waste Industries – Sampson County Disposal Inc.		57,602

Source: NC Division of Waste Management, Sections and Programs, Solid Waste Section, Annual Reporting; Solid Waste Data, Plans, Statistics and Reports; Statistics, Solid Waste County Disposal 2008-09, Harnett County; http://www.wastenotnc.org/swhome/AR08_09/County%20Waste%20Disposal%20Report_2008-2009.pdf

The projected life of landfills is of regional and local concern. The Waste Industries – Sampson County Disposal, Inc. facility in Roseboro was opened in 1995; in 2009 it was estimated to have a remaining capacity of 37.9 million tons and a projected lifetime of between 36 and 49 years at current disposal rates. The Uwharrie Environmental Regional Landfill was constructed in 1995; in 2009 it was estimated to have a remaining capacity of 15.8 million tons and a projected lifetime of between 20 and 27 years (119).

While Harnett County transfers municipal waste out of county, it collects and landfills construction and demolition debris locally, primarily (but not exclusively) at two facilities: the Harnett County Anderson Creek Construction and Demolition Landfill in Lillington (9,313 tons collected in 2008-09), and the Harnett County Construction and Demolition Landfill in Dunn (16,566 tons collected in 2008-09) (118). The Anderson Creek facility was opened in 1996; in 2009 it had an estimated remaining capacity of 3,600 tons, and a projected lifetime of less than one year. The construction and demolition facility in Lillington was opened in 1998, and in 2008 had an estimated remaining capacity of 7,270 tons, also

with a projected lifetime of less than one year (119). More recent data is not yet available from NC DWM, but it would appear that if it has not yet done so, Harnett County soon will have to find a new solution for the disposal of construction and demolition debris.

Wastewater Management

According to 1990 Census data (data are not available for the 2000 Census, and 2010 Census data had not yet been released by the time of this report), 10,706 Harnett County housing units (38.4%) were on a year-round public sewer system and 16,649 (59.7%) residences had septic tanks. An additional 541 housing units (1.9%) had some other form of sewage disposal, including individual sewer pipes into creeks, rivers and streams (straight pipes) or outhouses (120).

County-Level Wastewater Management

The Harnett County Department of Public Utilities currently operates four wastewater treatment plants that serve approximately 22,000 county residents. Harnett County is also under contract to provide wastewater treatment services to Fort Bragg by 2012 (121).

County residents or businesses that are not part of a municipal wastewater treatment system likely have either an individual septic system or participate in a community wastewater treatment system.

Permits for installing new septic fields must be obtained from the Environmental Health Division of the Harnett County Department of Public Health. It is this local agency's responsibility to oversee the installation and use of septic systems throughout the county. The Health Department uses standards adopted by DENR's Division of Environmental Health that cover the design and location of septic tanks and drain fields.

Town-Level Wastewater Management

Town of Angier. The Town of Angier operates a 3.5 MGD wastewater treatment plant (122).

Town of Coats. The Town of Coats does not operate a wastewater treatment facility. The Harnett County Department of Public Utilities provides wastewater treatment services for some of the residents of Coats.

City of Dunn. Wastewater for the City of Dunn is handled by the city's Black River Waste Water Treatment Plant, which is capacity rated at 3.75 million gallons per day (MGD). Current treated flow is 2.5 MGD. After a preliminary mechanical pretreatment, wastewater is secondarily treated through a biological process called extended aeration which utilizes activated sludge to breakdown organics found in wastewater. The treated wastewater is clarified, chlorinated for disinfection, and de-chlorinated to prevent toxicity issues before discharge in the Cape Fear River. Excess sludge is thickened and stabilized before land application as biosolids to permitted farm sites (123, 124).

The facility had one compliance violation in 2010: the average daily flow in February, 2010 exceeded the plant's capacity of 3.75 MGD (124)

The City is in the process of a collection system upgrade utilizing a Clean Water Management Trust Fund grant and State Revolving Fund loan to help resolve major inflow and infiltration issues which should result in lower flows to the Wastewater Treatment Facility. This work is scheduled to be completed in 2011 (124).

The sewer department for the City of Dunn is responsible for the operation and general maintenance of the City's wastewater collection system, including making sewer taps for new homes and businesses, renewing sewer taps that have become unusable, making repairs on sewer services and sewer mains, and responding to customer complaints concerning sewer blockages. The department also has a combination jet vacuum truck for cleaning the more than seventy-five miles of sewer lines (and seven lift stations) that lie underneath Dunn city streets. Another very important duty performed by this crew is sewer line inspection. This is done primarily by inspection cameras. The city has two cameras it uses to perform visual sewer line inspections, a main line camera and a service camera (125).

In FY2010 the city reported nine sanitary sewer overflows (126).

Town of Erwin. The Town of Erwin Public Works Department is responsible for repairing and maintaining the town's storm drains. The Town does not operate a municipal sewage treatment plant (127).

Town of Lillington. The Town of Lillington maintains a sewage collection system of gravity lines and pump stations which feed directly to the Harnett County Regional Wastewater Treatment Facility. There it undergoes extensive filtration, sedimentation, sludge removal, and disinfection before being discharged into the Cape Fear River.

The town's Sanitary Sewage Collection Department is responsible for the maintenance and repair of lines and pumps, installation of taps, and general observation of the system. In FY2010 the department reported a total of six sanitary sewer overflows with a total release of 551,054 gallons of untreated waste (128).

On-Site Wastewater Management

According to the 1990 Census data sited above, only approximately 38% Harnett County residences were connected to year-round public sewer, meaning 68% had septic tanks or some other mechanism of sewage disposal. In addition, the lack of an extensive public sewer system means that some residential communities and commercial and government facilities outside of the sanitary sewer districts must depend on on-site wastewater treatment systems, or "package plants" for wastewater treatment.

Package treatment plants are usually constructed and maintained by developers to service residential subdivisions and commercial projects. These systems carry some community risk: unless a package treatment plant is properly maintained and continuously monitored, it can break down, inconvenience the property owners who depend on it, and threaten public health. As a result, local governments usually seek financially and legally binding assurances from developers and homeowners associations that package treatment plants will be properly managed and maintained so they do not become a public burden.

As of February 8, 2011, the On-Site Water Protection Section of DENR listed 24 "large wastewater systems" (package plants) in Harnett County (129). Represented among them are numerous types of systems, many combining a number of wastewater treatment modalities. Communities served by these

systems include a school, car washes, rest homes, truck stops, manufacturing plants, a state park, and a variety of other primarily commercial users.

The focus of the On-Site Water Protection Section of DENR is not on the operations of large wastewater systems (which are the responsibility of the Environmental Health Division of the local health department) but rather on protecting surface and groundwater from degradation. The Section's work includes: evaluating and documenting appropriate innovative and alternative systems from both public health and water quality perspective; documenting potential effects of on-site wastewater systems and community wastewater systems on coastal water quality; evaluating and documenting the extent of water quality impacts from high-density on-site wastewater systems and by designing measures to mitigate water quality impacts; evaluating potential programs (rules) for improved life cycle management of on-site wastewater systems, advanced wastewater treatment and disposal systems; coordinating and facilitating educators and technology transfer to government agencies and to the public; and encouraging local governments, interstate or intrastate agencies, public and private nonprofit organizations and institutions to participate in this program through federal, state and/or local funding. Grants that support the Section's work are allocated by the EPA (130).

As noted previously, local health departments are charged with permitting and inspecting on-site wastewater facilities. Table 27 presents a summary of selected Harnett County Department of Public Health (HCDPH) On-Site Wastewater activities for 2007-2010. The decrease in permits noted over the period cited may be a reflection of the recent economic downturn and its effect on local development.

Table 27. HCDPH Environmental Health Section On-Site Wastewater Activity Summary 2007-2010

Activity	2007[1]	2008	2009	2010[2]
Site Visits (all activities)	2,885	2,887	2,434	2,208
Site Evaluations	426	571	603	546
Permits Issued				
New/Revised	925	760	528	465
Expansion	0	10	10	1
Repair/Replacement	56	44	55	52
Sewage Complaint Investigations	41	75	52	47

Source: Harnett County Department of Public Health, Environmental Health Section, Monthly Environmental Health Reports, On-Site Wastewater Activities, 2007-2010; personal communication from Susan G. Stewart (Environmental Health Section, Harnett County Department of Public Health) to Debra Hawkins (Health Education Supervisor, Harnett County Department of Public Health) December 17, 2010.

[1] 2007 data excludes April

[2] 2010 data includes January through November only

Permitted Wastewater Discharges

The US Clean Water Act of 1972 initiated strict control of wastewater discharges with the responsibility of enforcement given to the EPA. The EPA then created the National Pollutant Discharge Elimination System (NPDES) to track and control point sources of pollution in surface waters. The primary method of control is the issuance of permits to dischargers with limitations on wastewater flow and constituents. The EPA delegated permitting authority to the State of NC in 1975 (131).

In NC, the NPDES Unit in DENR's DWQ is responsible for issuing wastewater discharge permits. This process includes determining the quality and quantity of treated wastewater that the receiving stream can assimilate, incorporating input from stream modeling, collaborating with Regional Office staff, and evaluating the discharger's location. In addition to administering the NPDES program throughout the state, the NC NPDES unit is also responsible for enforcing discharge limitations. The penalty for discharging without a permit is a fine of up to $25,000 per day (131).

Table 28 lists the Harnett County facilities permitted to discharge wastewater to surface waters as of February 2, 2011.

Table 28. Harnett County NPDES-Permitted Wastewater Discharges (February, 2011)

Owner	Facility	Discharge Destination	Permitted Flow (Gal/Day)
Harnett County Public Utilities	South Harnett County Regional WWTP	Little River	5,000,000
Harnett County Public Utilities	North Harnett County Regional WWTP	Cape Fear River	5,600,000
AA Holdindgs - Fuquay-Varina LLC	Senters Rest Home	Kenneth Creek	4,800
Harnett County Public Utilities	Harnett County WTP	Cape Fear River	Not Limited
City of Dunn	Dunn WWTP	Cape Fear River	3,000,000
Harnett County Public Utilities	Erwin WWTP	Cape Fear River	1,200,000
Harnett County Public Utilities	Erwin WWTP, #2	Cape Fear River	80,000
City of Dunn	A.B. Uzzle WTP	Juniper Creek	2,000,000

Source: NC Department of Environment and Natural Resources, Division of Water Quality, Surface Water. NPDES Wastewater Permitting and Compliance Program, Permit Info, List of Active Individual Permits as of 2/11/11; http://portal.ncdenr.org/web/wq/swp/ps/npdes/

[1] WWTP = Wastewater Treatment Plant

[2] WTP = Water Treatment Plant

Chapter Seven: Drinking Water

According to the 1990 Census (data is not available for the 2000 Census and not yet available for the 2010 Census), 15,126 year-round housing units in Harnett County (54.2%) 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 12,627 units (45.3%) had an individual well as the primary source of water. A smaller number of units – 143 – obtained water from some other source, such as springs, creeks, rivers, lakes, ponds or cisterns (132).

Water Usage

Table 28 details the annual average rate of water usage in Harnett County for 1990, 2000 and 2005. For the purposes of this table, *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 (MGD) (133).

As illustrated in Table 28, total water usage in Harnett County increased by 95% from 1990 to 2000, but decreased by 30% from 2000 to 2005, due mainly to a decrease in municipal and community usage.

Table 28. Average Annual Rate of Water Usage, Harnett County, 1990, 2000 and 2005 (Millions of gallons per day)

Year	Domestic Usage	Municipal and Community Usage	Industrial Usage	Irrigation Usage	Livestock Usage	Total Usage
1990	0.34	5.73	0.07	2.77	0.28	9.19
2000	0.28	10.00	1.07	4.08	2.52	17.95
2005	1.73	4.35	0.00	3.79	2.76	12.64

Source: Log Into North Carolina (LINC) Database Search. Topic Group: Environment, Recreation and Resources. Data Items 1307, 1308, 1309, 1310, 1311, 1312, 1313; http://data.osbm.state.nc.us/pls/linc/dyn_linc_main.show (accessed February, 2011).

Drinking Water Systems

Community Drinking Water Systems

Groundwater and aquifers have been discussed in Chapter One of this report. Although private wells draw from groundwater, most of the community drinking water systems in Harnett County source surface water.

As of January 14, 2011, the EPA Safe Drinking Water Information System (SDWIS) lists eight active water systems in Harnett County (134). Seven are *community water systems* that together serve 102,579 people (Table 29). Based on this figure and the estimated 2010 population of 116,118, 88% of county residents receive drinking water from community water systems. 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.

Table 29. Harnett County Active Community Water Systems (January, 2011)

Water System Name	Number Served	Primary Water Source Type
Angier, Town of	4,972	Purchased Surface Water
Bragg Communities/NTA	402	Purchased Surface Water
Coats, Town of	2,246	Purchased Surface Water
Dunn, City of	11,747	Surface Water
Harnett County Department of Public Utilities	79,058	Surface Water
Lillington Water System	3,747	Purchased Surface Water
Shady Grove Mobile Home Park	407	Groundwater
TOTAL	102,579	

Source: US Environmental Protection Agency, Envirofacts Warehouse, Safe Drinking Water Information System (SDWIS). Query: North Carolina, Harnett County, All Populations, Active; http://www.epa.gov/enviro/html/sdwis/sdwis_query.html#geography

Community Drinking Water System SDWIS Violations

The EPA records violations of drinking water standards reported to it by states in its 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). Table 30 cites only the *health-based* violations for SDWIS Community Water Systems in Harnett County for the period from January 2005 through December 2010. There was only one health-based violation during the period cited, at the Harnett County Department of Public Utilities facility, and compliance for the violation was achieved in 2010. There were numerous citations for monitoring and/or reporting violations at all seven community water systems listed in Table 29 during the period cited.

Table 30. Harnett County Community Drinking Water Systems SDWIS Health-Based Violations, 2005-2010

System Name	Dates	Type of Violation	Contaminant
Harnett County Department of Public Utilities	June 2005	MCL, Average	Chlorite

Source: US Environmental Protection Agency, Envirofacts Warehouse, Safe Drinking Water Information System (SDWIS). Query: North Carolina, Harnett County, All Populations, Active (click on water system name for violations list); http://www.epa.gov/enviro/html/sdwis/sdwis_query.html#geography

In addition to the Community Water Systems described in the section above, there is one *transient, non-community water systems* in Harnett County: Camp Agape. Transient, non-community water systems are those that do not consistently serve the same people (e.g., rest stops, campgrounds, gas stations, etc.). The drinking water system at Camp Agape, which uses groundwater, serves an estimated 150 people. Camp Agape has not been cited for health violations in the past ten years, but has been cited several times for monitoring and/or compliance violations (134).

A third category of water systems, *non-transient, non-community water systems,* are those that serve the same people, but not year-round (e.g., schools that have their own water system). There were no water systems of this type listed for Harnett County as of January 14, 2011 (134).

County-Level Drinking Water System

According to Harnett County government, approximately 98% of all county residents have access to public water. The Harnett County Department of Public Utilities is a regional water utility that provides service to approximately 75,000 county residents. The Harnett County Regional Water Treatment Plant, which draws its source water from the Cape Fear River, is located in Lillington. The county water utility supplies water to the county municipalities of Angier, Coats and Lillington, as well as to various water purveyors within the five contiguous counties of Cumberland, Johnston, Lee, Moore and Wake. For example, the county recently completed a major joint construction initiative with the Fayetteville Public Works Commission to supply water to Fort Bragg (121).

Harnett County's water system consists of nine different rural water and sewer districts. These districts have a total of over 1,800 miles of water mains and currently have over 35,000 active connections within their boundaries. The county water treatment system has been recognized nationally for providing its customers drinking water with quality exceeding required federal standards (121).

The county currently is expanding the Water Treatment Plant. Work includes upgrading the existing water treatment plant from a capacity of 15 MGD to 24 MGD including improvements to the raw water pump station, new mixing station, new flash mix, new SuperPulsator, new conventional filters, retrofit of existing filter to GAC, new UV disinfection, new finish water pump station, new contact chamber and all piping, electrical, and controls for a complete facility (135).

Town-Level Drinking Water Systems

Town of Angier. As noted above, the Town of Angier purchases its water from Harnett County.

Town of Coats. As noted above, the Town of Coats purchases its water from Harnett County.

City of Dunn. The City of Dunn's A.B. Uzzle Water Treatment Facility is located near the Cape Fear River in Erwin, NC. This facility was originally constructed in 1968 as a 4 MGD water treatment plant. It underwent a major upgrade in 1990 to increase the treatment capability to 8 MGD. The facility has since received several smaller improvements, including the addition of a three million gallon storage facility, addition of ability to feed chloramines for disinfection, replacement of chlorine gas feed system with a much safer sodium hypochlorite feed system, and addition of a standby generator at the plant and the raw water pump station to ensure a constant power supply during periods of power outage (136).

The city's Water Department (part of Public Works) is responsible for the safe, uninterrupted distribution of treated water to the more than 4,600 water customers of the City of Dunn. Water Department staff is responsible for the operation and maintenance of the more than 200 miles of water line throughout the city. They also make water taps for new homes and businesses and replaces water service taps that have become unusable. They are involved in the installation and repair of water meters and troubleshooting water meter problems. The water department is responsible for the repair of water main breaks and is tasked to do so in such a manner as to minimize periods of service interruption (137).

Town of Erwin. The official Town of Erwin government website does not discuss how town residents access drinking water.

Town of Lillington. As noted above, the Town of Lillington purchases its water from Harnett County.

Private Wells

Unlike public water systems in NC, which are required to undergo mandatory periodic sampling and quality assessment, the water in private wells usually is sampled only at the request of the owner. The county health department is responsible for permitting all new wells, which undergo initial testing when they are installed. After that, any requested water quality tests are conducted by the NC State Laboratory for Public Health, through a process that must be facilitated by Environmental Health personnel from the local health department.

The Environmental Microbiology Unit of the NC State Laboratory for Public Health performs bacteriological analyses on water samples from both public and private water systems. Samples are examined for the presence of the *Coliform* group of bacteria, which are indicators of fecal contamination. Water is not examined specifically for pathogenic bacteria, as the prospect of isolating them from water is very remote. The State Laboratory also analyzes water samples, both public and private, for the presence of certain inorganic and organic chemicals (138).

Samples from existing private wells will be analyzed for *Coliform* bacteria only if the sample is submitted through a local health department. In most counties, an Environmental Health Specialist from the local health department goes to the property and personally draws the water to be analyzed. (There are two reasons for health department involvement: one is to ensure that the sample is collected and stored properly, and the other is that the well should be inspected at the time the sample is collected, and well inspections are the responsibility of the local health department.) For new private well water analysis, collection kits may be purchased by the public from the State Laboratory.

According to State Laboratory rules, no sample for sanitary analysis should be submitted from an open well, an unprotected spring, or from any source where there is visible evidence of contamination. Such supplies are unsafe for drinking purposes, regardless of laboratory findings. The State Laboratory will analyze samples of non-drinking water, such as those from lakes, streams, rivers, and ponds for total and fecal *Coliform* bacteria providing they are submitted by a local health department (138).

Table 31 summarizes HCDPH, Environmental Health Section activities related to wells and well testing for 2007 through 2010. Comparing Table 31 with Table 30 it is obvious that there are far fewer well activities than on-site wastewater activities. This is a reflection of the extensive public water system throughout the county compared with a fairly limited public sewage system: fewer people depend on wells for drinking water and more people depend on septic systems for wastewater disposal.

Table 31. HCDPH Environmental Health Section Well Activity Summary, 2007-2010

Activity	2007[1]	2008	2009	2010[2]
Site Evaluations	8	20	29	9
Well Site Consultative Visits	18	47	39	51
Well Permits				
New	0	5	26	11
Repairs	0	0	0	1
Water Samples Collected				
Bacterial	39	47	46	49
Chemical	20	36	35	23

Source: Harnett County Department of Public Health, Environmental Health Section, Monthly Environmental Health Reports, Well Activities, 2007-2010; personal communication from Susan G. Stewart (Environmental Health Section, Harnett County Department of Public Health) to Debra Hawkins (Health Education Supervisor, Harnett County Department of Public Health) December 17, 2010.

[1] 2007 data excludes April

[2] 2010 data includes January through November only

Table 32 presents data from the NC State Laboratory of Public Health on private well water samples assayed during the period from January 1 1998 through February 15, 2009 (after which the state changed its reporting scheme). The State Laboratory processed 1,088 water samples from Harnett County for microbiological analysis during the period cited. Of those, 217 (19.9%) showed the presence of bacteria according to analysis for "total coliforms". Each sample returning a positive result for total coliforms was also tested for the presence of *E. coli*, a specific fecal contaminant. Fecal contamination was confirmed in 18 of the 217 coliform-positive samples (8.3%).

The 18 *E. coli* positives were distributed throughout the county. (Some of the town names are not in Harnett County; the address for the responsible party may be different county than the well location):

- Angier – 3
- Benson – 1
- Broadway – 1
- Bunnlevel – 2
- Cameron – 1
- Coats – 1
- Dunn – 4
- Fuquay-Varina – 1
- Lillington – 2
- Lumberton – 1
- Unlisted address – 1

Table 32. Harnett County Private Well Test Results, 1998-2009

Year	No. Samples	No. Positive Total Coliforms	% Positive Total Coliforms	No. Coliforms as *E. coli*	% Coliforms As *E. coli*
1998	111	31	28	4	14
1999	151	26	17	1	6
2000	168	36	21	1	5
2001	90	12	13	1	8
2002	103	23	22	0	0
2003	64	10	16	2	13
2004	85	16	19	4	21
2005	76	15	20	1	5
2006	70	11	16	0	0
2007	69	12	17	0	0
2008	78	21	27	4	15
2009[1]	23	4	17	0	0
Total	1,088	217	---	18	---

Source: NC Division of Public Health, State Laboratory of Public Health, Environmental Microbiology, Relevant Links, Water Sample Test Results;
http://slphreporting.ncpublichealth.com/EnvironmentalSciences/Micro/Default.aspx

[1] 2009 data includes January 1 through February 15 only

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

A number of human diseases and syndromes are caused or exacerbated by microbial contaminants or by animal vectors in the natural environment. 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 33 lists the number of cases of major reportable food-, water- and vector-borne diseased reported among Harnett County residents from 2002 to 2005. Comparable data for NC are provided for 2005 only.

Table 33. Reported Cases of Food-, Water-, and Vector- Borne Diseases, 2002-2005

Disease	Harnett County				NC
	2002	2003	2004	2005	2005
Campylobacter	6	3	4	5	672
Cryptosporidiosis	1	0	0	0	92
E. coli O157	1	0	0	0	--
E. coli (Shiga toxin-producing)	0	0	1	0	64
Ehrlichiosis (monocytic)	0	0	0	0	29
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
Hepatitis A	1	1	4	1	84
Listeriosis	1	0	0	0	34
Lyme disease	2	0	2	0	49
Rocky Mountain spotted fever	7	6	7	12	625
Salmonellosis	7	14	30	31	1,701
Shigellosis	1	11	1	2	202

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.
Note: The table is limited to the primary food-, water-, and vector borne diseases found in NC and is not the comprehensive list of diseases catalogued by the source cited above.

The Harnett County Department of Public Health has provided updated local data for the period 2005-2009 on the occurrence of some of these diseases (139). The list shows the total Harnett County reports for the period cited; the comparable total for NC as a whole (140) is shown in parentheses. (The 2009 data for NC included in the state total represents reports from January-September only.)

- Campylobacter – 24 (3,100)
- Rocky Mountain Spotted Fever – 1 (2,905)
- Salmonellosis – 127 (7,648)
- Shigellosis – 5 (1,008)

At both the county and state level, salmonella and campylobacter infections are among the most common of all reported diseases.

Food-Borne Diseases

The disease causing the largest number of reports cited in Table 33 (and the following data update) in Harnett County and NC was salmonellosis. Salmonellosis, or salmonella infection, is one of the most common food-borne diseases. Salmonella may occur in small, contained outbreaks in the general population or in large outbreaks in hospitals, restaurants, or institutions housing children or the elderly. Every year, the CDC receives reports of 40,000 cases of salmonellosis in the US. Children are the most likely to get salmonellosis. The elderly, infants, and those with compromised immune systems and especially people with AIDS are more likely to have severe and/or recurring illness (141).

Salmonella bacteria can be found in food products such as raw poultry, eggs, and beef, and sometimes on unwashed fruit. Food prepared on surfaces that previously were in contact with raw meat or meat products can, in turn, become contaminated with the bacteria (*cross-contamination*). In recent years, the CDC has received reports of several cases of salmonella from eating raw alfalfa sprouts grown in contaminated soil. It is also possible to get salmonella after handling pets, particularly reptiles like snakes, turtles, and lizards. The disease can be spread from infected persons to other people through poor sanitary practices (such as a lack of hand washing before preparing food) (141).

The HCDPH, as all health departments throughout NC, plays a major role in preventing outbreaks of food-borne illnesses, and in investigating any that do occur.

On the *prevention* side of the equation, the health department is responsible for inspecting food and lodging establishments to enforce state and local government regulations designed to protect the health of the public. The establishments under this purview include: restaurants, food stands, push carts, school lunchrooms, limited food stands, lodging, summer camps, bed and breakfast homes, bed and breakfast inns, meat markets, nursing homes, child day care facilities, school buildings, local confinements, elderly nutrition sites, residential facilities, swimming pools, and tattoo parlors. Table 34 summarizes data on HCDPH food, lodging and institutional sanitation activities for 2007-2010.

Table 34. HCDPH Food, Lodging and Institutional Sanitation Activities Summary, 2007-2010

Activity	2007[1]	2008	2009	2010[2]
Inspections	1,112	990	959	907
Permits				
Issued	127	122	146	n/a
Suspended/Revoked	4	19	7	n/a
Investigations				
Complaint	53	74	63	n/a
Foodborne Illness	0	1	0	n/a
Lead	0	1	1	n/a

Source: Harnett County Department of Public Health, Environmental Health Section, Monthly Environmental Health Reports, Well Activities, 2007-2010; personal communication from Susan G. Stewart (Environmental Health Section, Harnett County Department of Public Health) to Debra Hawkins (Health Education Supervisor, Harnett County Department of Public Health) December 17, 2010.

[1] 2007 data excludes April

[2] 2010 data includes January through November reports for investigations only

On the *investigation* side of the equation, the health department conducts routine surveillance of food-borne and other diseases as they are diagnosed by health professionals in the community and reported, as required, to the health department. When the surveillance staff of the HCDPH detects a suspicious pattern or unexpected recurring incidence of a disease, they muster medical, nursing and environmental health staff to conduct an *outbreak investigation* in order to pinpoint the cause and identify the population at risk. The HCDPH conducted one comprehensive food-borne outbreak investigation during the period cited in Table 34, in 2008.

Water-Borne Diseases

Water can be the primary source of transmission of a number of the diseases listed in Table 33. Cryptosporidiosis (caused by a protozoan), camplyobacteriosis, E. coli infections, and Legionellosis (all caused by bacteria) are examples. Outbreaks of water-borne diseases would be noted and investigated by the HCDPH.

Vector-Borne Diseases

Vectors are the transmitters of disease-causing organisms that carry the pathogens from one host to another. While most vectors are invertebrate animals, especially arthropods (notably insects and ticks), vertebrates can also act as vectors, as for examples foxes, raccoons, and skunks that can all transmit the rabies virus to humans via a bite. The most significant mode of vector-borne disease transmission is by biological transmission by blood-feeding arthropods. The pathogen multiplies within the arthropod vector, and the pathogen is transmitted when the arthropod takes a blood meal. Mechanical transmission of disease agents may also occur when arthropods physically carry pathogens from one place or host to another, usually on body parts.

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 a 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, several mosquito-transmitted diseases, most notably Eastern Equine Encephalitis and LaCrosse Encephalitis are endemic in NC. West Nile Virus is a relatively new arboviral disease.

West Nile Virus

West Nile virus (WNV) is a disease normally found in Africa, West Asia and the Middle East. It first appeared in the US in 1999, and by 2001 it had spread to 28 states. The first NC 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.

Symptoms of WNV occur five to 15 days after infection and may include fever, headache and body aches, which may be accompanied by skin rashes and swollen lymph glands. In more severe cases, disorientation, coma, tremors and paralysis can occur. This disease is rarely fatal; the elderly are most at risk. There is no vaccine for West Nile Virus (142).

The NC Division of Environmental Health's Public Health Pest Management (PHPM) 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. (When the virus first appeared in the US, NC was among many states that were able to get valuable information from the collection and testing of dead, wild birds. Now that the virus has become established within the wild bird population, testing dead birds is no longer necessary) (142).

According to PHPM data, there were only four positives among sentinel flock chickens for the period from 2006-2009; none were in Harnett County. State veterinary surveillance resulted in the identification of eight positives between 2004 and 2007; none were in Harnett County, but one case (in 2004) was in adjacent Johnston County. NC reported four "positive" (i.e. confirmed, probable or suspect) human cases of WNV in 2005, one case in 2006, four cases in 2007, and three cases in 2008. One of the human cases during this period (in 2005) was from Harnett County (142).

Eastern Equine Encephalitis

Eastern equine encephalitis (EEE) is a rare disease that can affect both humans and horses. The virus normally occurs in birds, but when mosquito populations grow very large, the virus is more likely to spread to non-avian species. This state averages about one human case each year. Approximately half of human EEE cases are fatal, with young children and the elderly most at risk. In NC, this disease is more likely to occur in coastal or eastern Piedmont areas, usually late in the summer or in early fall (143).

Symptoms develop a few days to two weeks after being bitten by an infected mosquito and include rapid onset of fever and headache. The symptoms of EEE resemble flu symptoms, but survivors of EEE infections may suffer from long-term effects to the nervous system. Therapy is limited to treating the symptoms of the disease; there is no specific cure. There is a vaccine for EEE in horses but not for humans (143).

The presence of EEE is monitored by the sentinel flock method. There were 35 positive sentinel flock cases in NC in 2006, 21 in 2007, 23 in 2008, and 53 in 2009; none of the sentinel cases were in Harnett County. Veterinary surveillance statewide over the same period discovered 5 cases in 2006, 0 cases in 2007, 13 cases in 2008 (two of them in Harnett County), and 23 cases in 2009 (2 of them in Harnett County). In 2005 there were no positive human cases statewide; there was one in 2006, none in 2007, and one in 2008. None of the positive human cases was in Harnett County (143).

LaCrosse Encephalitis

La Crosse Encephalitis (LAC) is the most common arboviral disease affecting NC, where it appears mainly in the western part of the state. LaCrosse encephalitis (LAC) is associated with small mammals like squirrels and chipmunks. Transmission occurs most frequently after being bitten by an infected mosquito (144). There is no sentinel surveillance program for LAC in NC.

Symptoms occur a few days to two weeks after the mosquito bite. They include fever, headache, nausea and vomiting. In more severe cases, convulsions, tremors and coma can occur, but the disease is rarely fatal in humans. Young children and the elderly are the most susceptible to the disease (144).

From 2005-2008, there were 70 positive cases of LAC reported in NC (32 in 2005, 18 in 2006, 11 in 2007 and 9 in 2008), all in the western-most region of the state. No positive cases of LAC occurred in Harnett County (144).

Other Arthropod-Transmitted Diseases

Rocky Mountain Spotted Fever

Rocky Mountain Spotted Fever (RMSF) is a seasonal disease that occurs throughout the US, primarily from April through September. Over half of the cases occur in the south-Atlantic region of the country (Delaware, Maryland, Washington D.C., Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida). The highest incidence rates have been found in NC and OK. Although this disease was first discovered and recognized in the Rocky Mountain area, relatively few cases are reported from that area today. RMSF is caused by a species of bacteria, *Rickettsia rickettsii*, which is spread to humans through tick bites (145). The disease can be very difficult to diagnose, and so likely is under-reported.

RMSF generally requires an incubation period of about five to 10 days after the tick bite. The early clinical presentation of the disease is often nonspecific and may resemble many other infectious and non-infectious diseases. Initially, patients may report fever, nausea, vomiting, severe headache, muscle pain and/or a lack of appetite. Later symptoms may include rash, abdominal pain, joint pain or diarrhea. RMSF can be a severe illness, and the majority of patients are hospitalized (145).

As noted in Table 33 and the subsequent update cited previously, there were 20 cases of RMSF in Harnett County over the period from 2002 through 2004, and one case between 2005 and 2009.

Lyme Disease

Lyme Disease, an infection caused by the bacterium *Borrelia burgdorferi*, is on the rise in NC, after first becoming endemic in the northeastern region of the US. In the Northeast, the bacterium normally occurs in mice, squirrels and other small animals, and can be transmitted to humans through the bite of a black-legged tick. The ticks that transmit Lyme disease can occasionally transmit other tick-borne diseases as well. In the southeastern US, the transmission cycle is not as clearly defined or understood (146).

Typical symptoms of Lyme Disease include fever, headache, fatigue, and a characteristic, circular skin rash called *erythema migrans*. If left untreated, infection can spread to joints, the heart, and the nervous system. Lyme disease is diagnosed based on symptoms, physical findings (e.g., rash), and the possibility of exposure to infected ticks; laboratory testing is helpful in the later stages of disease. Most cases of Lyme disease can be treated successfully with a few weeks of antibiotics. The ticks that transmit Lyme disease can occasionally transmit other tick-borne diseases as well (147).

As noted in Table 33, cited previously, there were four cases of Lyme Disease in Harnett County over the period from 2002-2005.

Rabies

Rabies is a deadly viral disease that attacks the central nervous system of warm-blooded animals, particularly mammals. In NC, the most common type of rabies is raccoon-variant rabies. It is found commonly in raccoons, skunks, red and grey foxes, coyotes, wolves, groundhogs and beavers. Bats can also transmit rabies but have their own bat-variant rabies virus. Any mammal can become infected with rabies. The virus can infect domestic pets, agricultural animals such as cows and horses, and people when they are exposed to rabid wildlife (148).

In NC, rabies law requires that all owned dogs, cats and ferrets must be vaccinated against rabies by four months of age (NCGS 130A-185). One shot is not enough; rabies vaccinations must be kept current. In 2009, the NC General Assembly updated the state's rabies laws to conform to recommendations of the Centers for Disease Control and Prevention and the National Association of Public Health Veterinarian's Compendium of Animal Rabies Prevention and Control, 2008 (148).

Rabies is not commonly reported in Harnett County. For the entire period from 2006 through 2010, there were 10 positive rabies test results; two positives were from foxes, and eight were from raccoons (149).

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