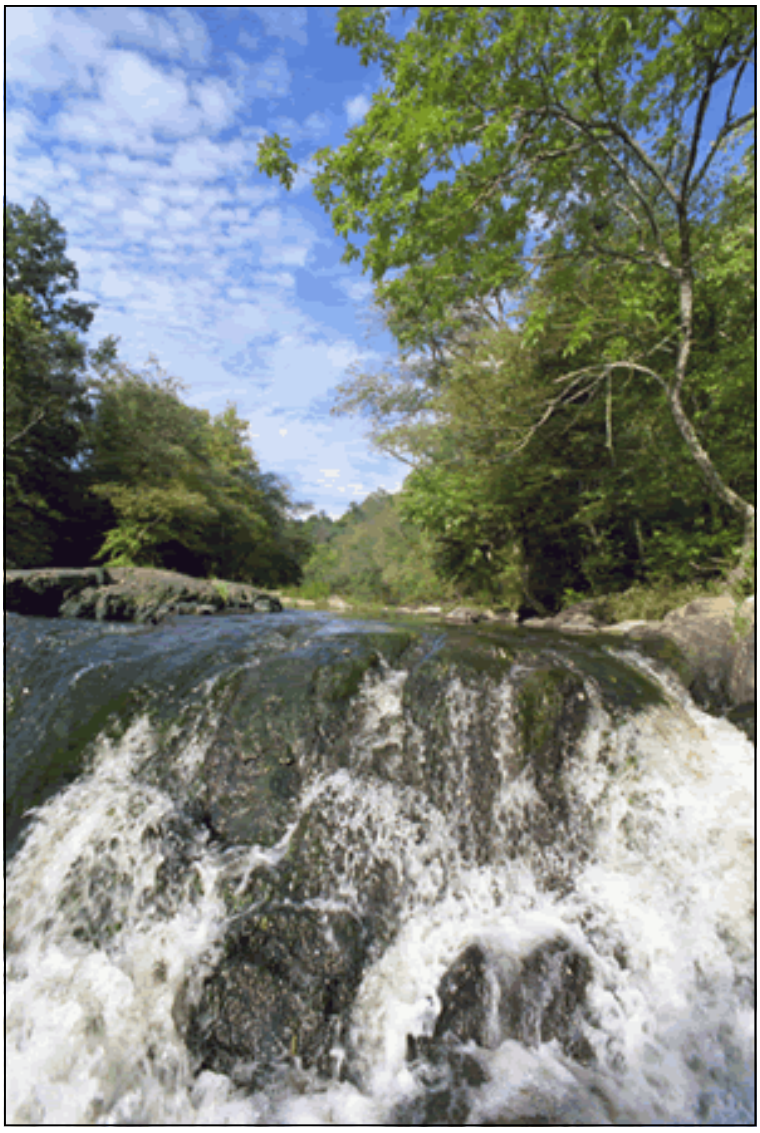
Canoeing on Cane Creek Reservoir



Freshwater mussel shell from New Hope Creek

Looking upriver on the Eno River
(Photo courtesy of the Eno River Association)

WATER RESOURCES

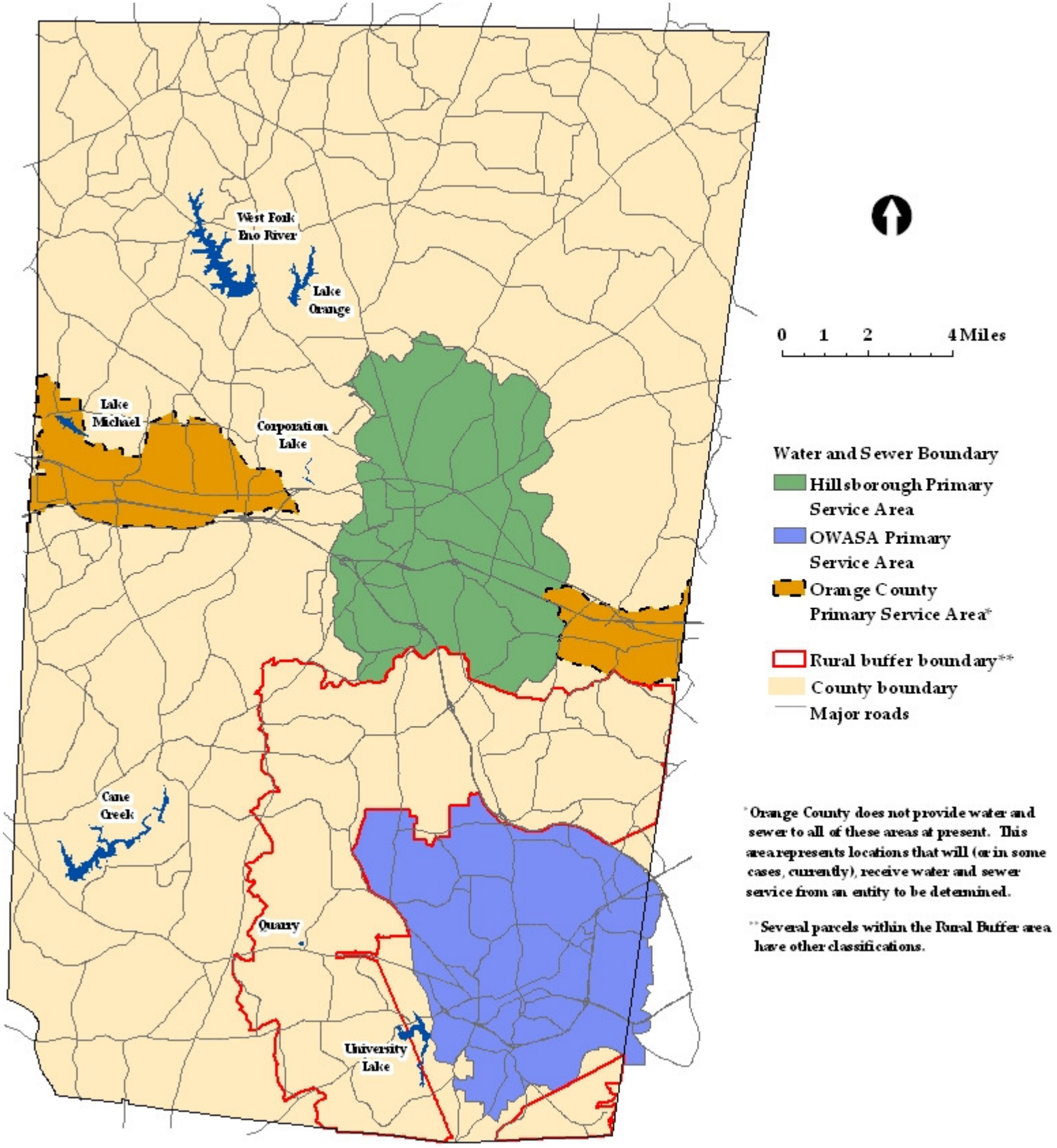
It is essential that the citizens of Orange County have access to an adequate supply of potable water whether it is groundwater or surface water provided by a water supplier. This concept is embraced by the Natural and Cultural Systems Element of the 2008 Orange County Comprehensive Plan, which includes a goal of having a "Sustainable quality and quantity of ground and surface water resources," (Goal 6). Most of the county's populace obtains their water from the Orange Water and Sewer Authority (OWASA), the Orange-Alamance Water System (OAWS), the City of Mebane, the Town of Hillsborough or the City of Durham. OWASA supplies water to the citizens of Chapel Hill, Carrboro and a portion of the county from two reservoirs, University Lake and Cane Creek Reservoir, with a former stone quarry to become available as a future storage facility (see Figure 19). OAWS supplies water to Mebane and surrounding rural areas while the City of Durham supplies water to a limited area of the eastern portion of the county along the I-85 corridor. OAWS obtains their water from the Eno River (via Corporation Lake), four water supply wells and, when needed, purchases water from the Town of Haw River (which purchases their water from the City of Burlington). OAWS also has the capability to purchase water from the City of Mebane, the City of Graham and the Town of Hillsborough via inter-connections. The Town of Hillsborough utilizes the West Fork Eno River Reservoir via Lake Ben Johnson to supply water to the residents of Hillsborough. The City of Mebane obtains their water from the Graham-Mebane Reservoir. Nearly 40 percent of the population of Orange County does not have access to surface water and is instead reliant on groundwater for their water.

The reliance on local surface water and groundwater has resulted in the County's adoption of a range of strategies and policies to protect these important sources of water. In 1981 critical areas in the Cane Creek, Upper Eno and University Lake watersheds were designated to reduce the threat of development to these surface water reservoirs (Figure 20). The County formed a Water Resources Committee in 1992 to begin to examine groundwater resources in Orange County. Subsequently, Orange County partnered with the United States Geological Survey (USGS) to complete three reports describing the county's hydrogeologic setting. This information is important for understanding the quantity and quality of groundwater available in the county. In 2005 the Water Resources Initiative which detailed several critical water resource issues, along with recommendations to address those issues, was developed by the Commission for the Environment and adopted by the Orange County Board of County Commissioners. Water resource protection measures which have been implemented include the updated well location and construction regulations adopted in 2008 by the Environmental Health Division of the County Health Department. The inspection of new wells, the repair and proper abandonment of existing wells and the minimum requirements for casing, materials and locating wells, are measures which protect the groundwater supply of county residents. Most recently, Orange County hired a Water Resources Coordinator in 2008 to work on surface water and groundwater resource issues affecting the county.

The citizens of Orange County have markedly reduced their consumption of municipal water as a result of the droughts of 2002 and 2007-2008. OWASA reports that per-household residential consumption of their water has decreased by more than 10 percent since 2001. The 2007 demand for OWASA water is less than 20 percent of what was projected in their 2001 Master Plan. This reduction in demand has caused local water utilities to revise their plans and projections for the future. Continued conservation and wise utilization of our precious water resources is important to prevent future water supply shortages.

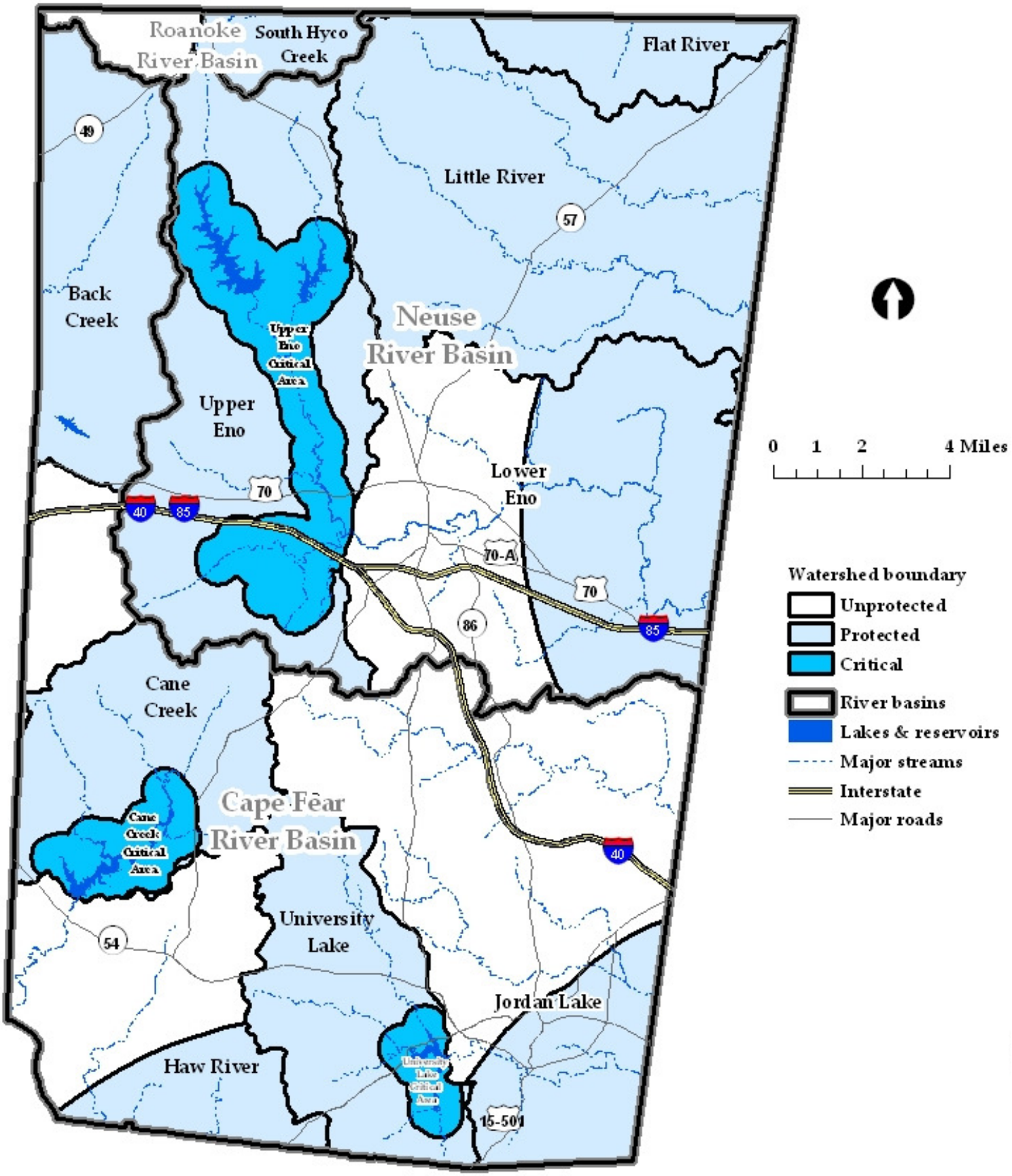
The water resources section of this report includes a number of important indicators to track the status of different aspects of surface water and groundwater usage, quantity, quality and impairment. When combined, these indicators serve as an accurate assessment of the state of water resources in Orange County.

Figure 19: Water and Sewer Primary Service Areas Planning and Boundary Agreement, 2001



Source: Figure 19 —Orange County ERCD, prepared August 5, 2009

Figure 20: Orange County Watersheds



Source: Figure 20—Orange County ERCD, prepared April 15, 2009

WATER RESOURCES

Water Usage

Why the indicator was selected

Clean water is a necessary resource that is renewable but at times is limited. A reliable supply of clean water is vital for public health, agricultural production and economic growth. To continue to provide a healthy environment as well as support sustainable growth in agriculture and industry, the water resources of Orange County must be managed carefully and appropriately.

How the indicator was measured

The self-reported data used in this section were provided by NCDENR - Division of Water Resources (DWR) and the U.S. Geological Survey (USGS). Table 16 shows the amount of water used within the county over a 20-year period as measured in millions of gallons per day (mgd) and demonstrates usage by the source of water: ground or surface. Table 17 tracks the average amount of water used per person from 1985 to 2005, reporting usage in gallons per day per person (g/d/p). For this table, g/d/p is calculated by dividing the total average amount of water used per day by the current population and includes all residential, commercial and industrial uses, which were reported to the USGS and DWR by the individual water providers. Table 16 lists the reported uses of water and the changes in usage over time. It is important to note that approximately 40 percent of the domestic water supply within the county comes from individual (private) water supply wells and is probably not accurately represented in the self-reported information presented herein.

The trend in Orange County

INCREASING

As the urban areas within the county continue to grow, the number of people relying on municipal water supplies increases. Most of this water supply comes from surface water. The available data on per capita water usage reveals that the amount of water used per person increased from 124 g/d/p in 1985 to 145 g/d/p in 2000, a 17 percent increase, but then declined to 128 g/d/p in 2005. The observed increase from 1985 to 2000 would have been higher if Flynt Fabrics, which used 1 mgd, had not closed in 2000. Total water usage, as shown in Table 17, increased by 47 percent from 1985 to 2005, a significant increase. It is likely that this increase is mainly due to population growth during the same interval, which increased by 42 percent. Trends of groundwater usage over time are hard to track, given the lack of comprehensive data. It is expected that the ongoing growth in the number of water supply wells that are present in the county (Table 20) likely mirrors growth in groundwater consumption.

Recommendations

To support a sustainable future, Orange County should:

- Continue to educate local citizens about the importance of conserving groundwater and surface water. Water conservation measures are readily available online on the OWASA and Orange County web sites.
- Create a network of groundwater observation wells to monitor and publicize how groundwater levels are affected by drought or other climactic events and to further characterize the hydrogeologic system. It is important to monitor the status of this resource because a large proportion of county residents rely on groundwater.

Table 16: Reported Water Usage (mgd), 1985-2005

	1985			1990			1995			2000			2005			
Type of Use	G	S	ST	G	S	ST	G	S	ST	G	S	ST	G	S	ST	% of Total
Municipal and Community	0.00	7.52	7.52	0.00	9.49	9.49	0.25	10.50	10.75	0.52	12.44	12.96	0.32	11.51	11.83	78%
Industry	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%
Crop Irrigation	0.00	0.80	0.80	0.08	0.74	0.82	0.76	2.28	3.04	0.52	1.47	0.81	0.22	0.59	0.81	5%
Domestic use from wells	1.20	0.00	1.20	0.71	0.00	0.71	1.72	0.00	1.72	1.94	0.00	1.94	1.42	0.00	1.42	9%
Livestock Use	0.35	0.06	0.41	0.36	0.06	0.42	0.35	0.13	0.48	0.24	0.06	0.30	0.16	0.05	0.21	1%
Other*	0.15	0.24	0.39	0.12	0.30	0.42	0.03	0.00	0.03	0.30	0.88	1.18	0.20	0.67	0.87	6%
Total Use	**1.71**	**8.62**	**10.3**	**1.27**	**10.6**	**11.9**	**3.11**	**12.9**	**16**	**3.52**	**14.9**	**17.2**	**2.32**	**12.8**	**15.1**	**100%**

G—Groundwater S—Surface Water ST—Sub Total mgd– Millions Gallons per Day

* Other consists of water used for mining, commercial, golf course irrigation and aquaculture purposes.

Table 17: Percent Change in Water Usage (g/d/p), 1985-2005

	1985	1990	1995	2000[10, 11]	2005	% Change 1985-1990	% Change 1990-1995	% Change 1995-2000	% Change 2000-2005	% Change 1985-2005
Usage, mgd	10.3	11.9	16.0	17.2	15.1	14.8%	35.1%	7.3%	-12.0%	47.0%
Population	83,581	93,851	107,352	115,531	118,386	12.3%	14.4%	10.1%	2.5%	41.6%
g/d/p	124	127	149	149	128	2.2%	18.1%	-2.6%	-14.3%	2.9%

g/d/p— gallons per day per person

[10] The decrease in usage compared to 2000 is mainly attributed to the closing of Flynt Fabrics in 2000, which used 1 mgd. If Flynt Fabrics had remained open and continued to use the same amount of water as previously, the g/d/p would be 150 and the overall upward trend would have continued.

[11] Orange County's 2000 population figure was amended by the U.S. Census.

Source: Tables 16 and 17 — United States Geological Survey

WATER RESOURCES

Public Water System Safe Yields

Why the indicator was selected

The U.S. Environmental Protection Agency (EPA) defines a safe yield as "the annual amount of water that can be taken from a source of supply over a period of years without depleting the source beyond its abilities to be replenished naturally in 'wet' years." This statistic is a useful gauge for determining the resource storage capacity that is available within a water system.

How the indicator was measured

This indicator includes only the three largest water suppliers in Orange County (Orange Water and Sewer Authority (OWASA), Orange-Alamance Water System (OAWS) and the Town of Hillsborough because smaller community-based water providers are not required to identify or report their safe yields. The Division of Water Resources (DWR) and the Triangle J Council of Governments (TJCOG) compiled these data from Local Water Supply Plans which were submitted to DWR by the providers for 1992 and 1997. TJCOG and the largest water providers also contributed data for 2001 and 2003. The remaining data was provided by local water providers, as shown in Table 18. One-half of OAWS' customers are within Orange County, an increase since the one-third reported in the *2004 State of the Environment* report. Thus the numbers reported for the OAWS system were adjusted by 50% to estimate the demand trends within Orange County. It should be noted that the Town of Hillsborough and OAWS bought finished water from Durham and Graham-Mebane respectively during extended periods over the past several years. These supplemental supply sources are not factored into the safe yield calculations because the purchase arrangements are not permanent in nature and may be discontinued. Table 19 reveals the average and maximum daily demands on each water system for the years listed.

The trend in Orange County

STEADY

Since 1992, the safe yield for OAWS has remained fixed. Their demand typically exceeds their safe yield, as shown in Tables 18 and 19. This system remains dependent on purchasing water during drought conditions or to meet increased demand. Hillsborough increased their safe yield by developing the West Fork Eno River Reservoir. OWASA has a significantly larger water supply than Hillsborough or OAWS and additional storage is anticipated by using an operating stone quarry that will become available to OWASA in approximately 20 years. OWASA's safe yield was adjusted downward in 2003 using more conservative modeling than was previously used. OWASA is also developing a water reuse system in which reclaimed water will be used in selected chiller plants at UNC-CH. This system is expected to decrease the demand for OWASA potable water by more than six percent.

Recommendations

To support a sustainable future, Orange County should:

- Support wastewater reclamation/reuse projects such as the one involving OWASA and UNC-Chapel Hill. A similar reuse system is being studied for the planned Carolina North project in Chapel Hill.
- Continue to educate citizens about the benefits and need for water conservation and pursue conservation at County facilities.

Table 18: Public Water Supply Safe Yields, 1992-2008

Water Provider	1992	1997	2001	2003	2008
Orange Water and Sewer Authority	13.50	13.50	15.10	12.50 [12]	12.50
Hillsborough	0.76	0.76	2.56	2.56 [13]	2.56
Orange-Alamance Water System (Orange County portion)	0.12	0.12	0.12	0.12	0.12

All figures in mgd - million gallons per day.

[12] Decrease due to change in OWASA's modeling using a more conservative estimate of 30-year drought condition safe yield.
[13] Equals 1.8 mgd for West Fork Eno River Reservoir plus 0.68 mgd for Lake Ben Johnson plus 0.08 mgd for Lake Orange.

Table 19: Average and Maximum Daily Demand Per Year, 1992-2008

	Orange Water and Sewer Authority		Hillsborough		Orange-Alamance Water System [14]	
Year	Average Daily Demand	Maximum Daily Demand	Average Daily Demand	Maximum Daily Demand	Average Daily Demand	Maximum Daily Demand
1992	7.14	12.00	1.46	2.04	0.24	0.34
1996	7.91	11.25	1.47	2.29	-	-
1997	8.38	12.29	1.80	2.65	0.36	0.44
1998	8.45	13.45	1.72	2.37	-	-
1999	8.56	14.11	1.52	2.53	-	-
2000	9.17	12.93	1.38	2.58	-	-
2001	9.46	12.76	1.23	1.87 [15]	0.29	0.39
2002	9.01	14.07	1.05	1.78	-	-
2003	8.06	12.45	1.14	2.00	0.30	0.40
2004	8.47	11.87	1.27	1.89	0.39	0.42
2005	8.58	11.99	1.20	2.29	0.36	0.39
2006	8.55	11.54	1.21	1.77	0.33	0.39
2007	8.57	13.35	1.22	1.75	0.31	0.37
2008	7.67	10.82	1.14	1.86	0.32	0.38

All figures in mgd– millions gallons per day.

[14] Portion of total demanded estimated for service area within Orange County.
[15] The large decrease in the Hillsborough demanded in 2001 was due to the closing of the Flynt Fabrics Facility.

Sources: Tables 18 and 19—Individual Water Providers

WATER RESOURCES

Groundwater Quantity

Why the indicator was selected

Groundwater is a very important source of domestic, agricultural and industrial water within Orange County. Many new wells are installed in the county each year. Usage of groundwater is largely unrecorded and thus total demand is unknown. Two recent relatively long-term droughts raised concerns for many about the supply of groundwater. While it is likely that the long-term supply of groundwater was only minimally impacted by recent drought events, accurate local information concerning the availability of groundwater is needed to safely utilize this resource. Observation wells monitor the impact of variations in climatic conditions and bedrock lithology (physical characteristics of a rock) on groundwater levels. Regolith observation wells monitor the quantity of groundwater contained in the unconsolidated material (regolith) present above bedrock, while bedrock observation wells monitor groundwater levels within bedrock. Groundwater present in the regolith represents the water stored for eventual use via supply wells which access water present in fractured bedrock.

How the indicator was measured

Currently, there are only two observation wells in Orange County. The Caldwell bedrock well is operated by the DWR and is located in the northeastern corner of the county. A second well, NC-126, is a shallow regolith well on the campus of UNC-Chapel Hill (operated by the USGS). Both wells have groundwater level records which began in 1969 and 1943 respectively, although both records contain data gaps.

The trend in Orange County

STEADY

Large fluctuations in the groundwater table have occurred since 2002 due to the impact of drought. Water levels in the Caldwell bedrock well have been measured since 1969 except for a gap from late 1991 to the middle of 2006. Since 2007, the groundwater level in this well has been significantly lower than its historical trend and in late 2007, after the water level fell consistently during the second half of 2007, was near the lowest level ever measured in the well. Additional water level data would be necessary to draw conclusions regarding groundwater levels in the county.

Recommendations

To support a sustainable future, Orange County should:

- Implement a groundwater observation well network to facilitate monitoring of this important source of water. This network should utilize regolith wells and bedrock wells to permit measurement of groundwater levels in the regolith and bedrock lithologies found in the county;
- Publish information obtained from the observation well network to increase awareness of the trend of groundwater quantity in the county; and
- Use the observation well network to monitor groundwater base flow to streams, especially streams which feed surface water reservoirs.

Figure 21: NC-126 Regolith Observation Well Groundwater Level, 1943-2008

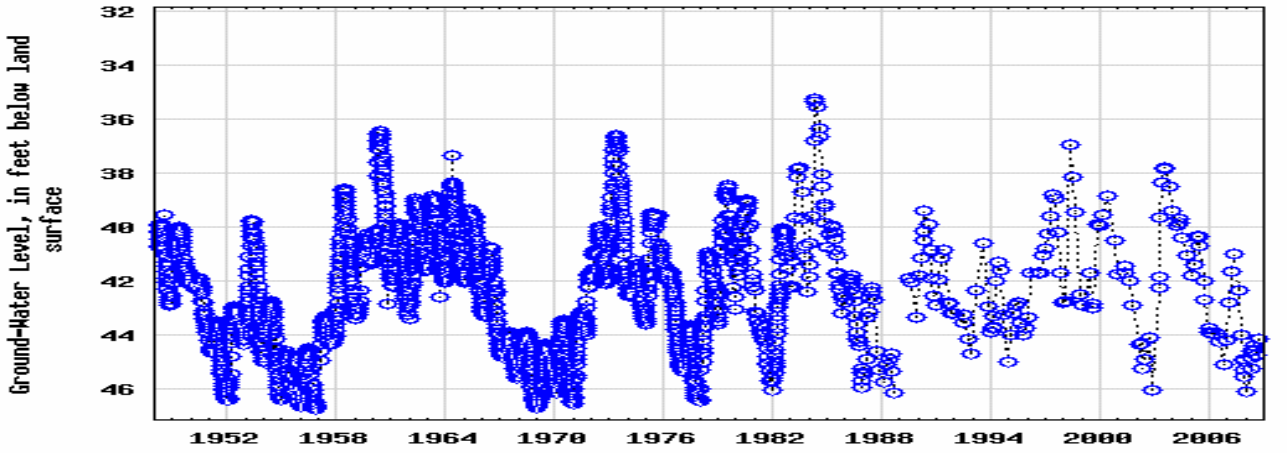


Figure 22: Caldwell Bedrock Observation Well Groundwater Level, 1970-2008

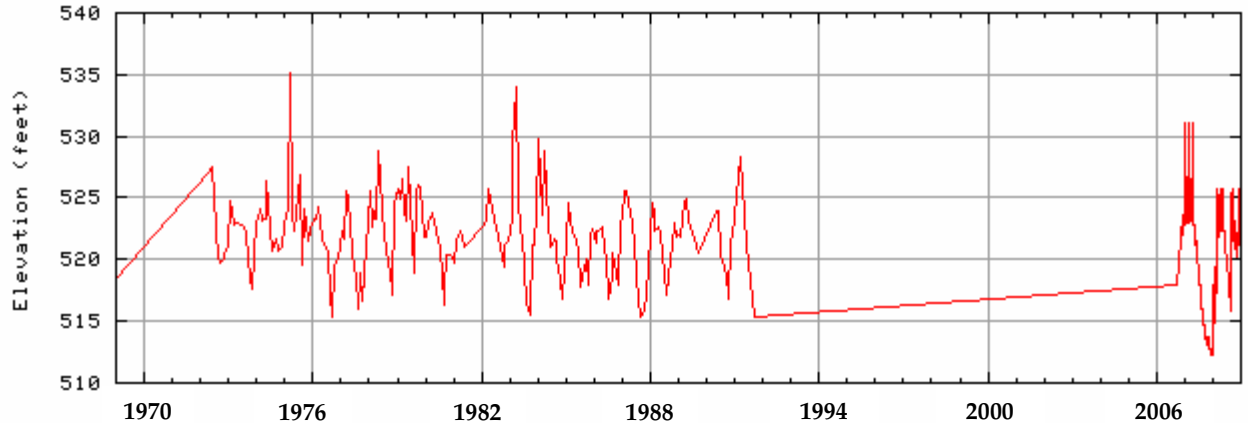


Figure 23: Groundwater Level in Caldwell Well During 2006-2008 Drought

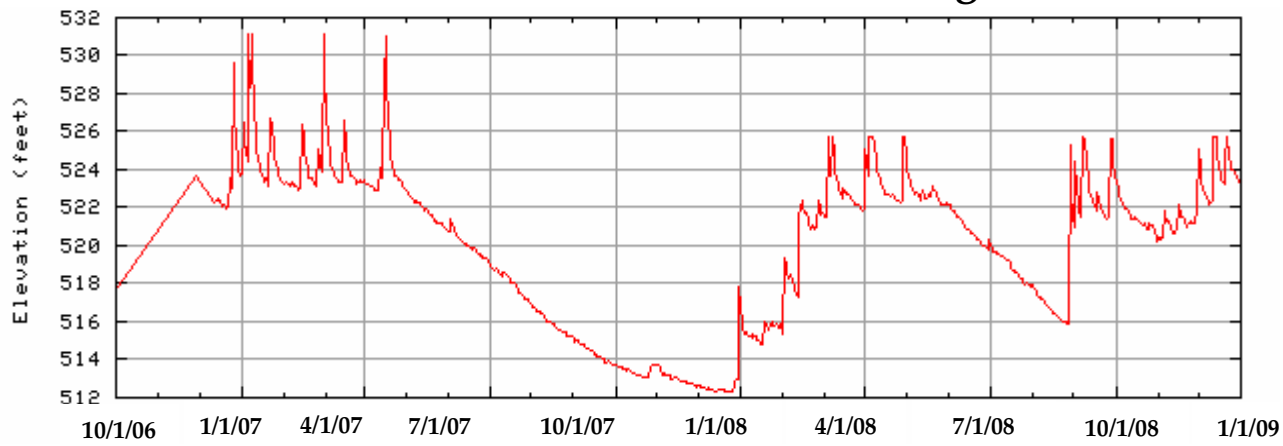


Table 20: Groundwater Wells Installed, 1991-2007

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Drinking Water Wells	305	535	426	413	400	497	481	490	514	376	398	372	257	308	294	301	277
Non-Drinking Water Wells	-	-	-	-	-	-	-	-	-	-	-	5	15	7	10	12	31
Community Supply Wells	-	-	-	-	-	-	-	-	-	-	-	2	1	2	1	1	0

Sources: Figure 21 —USGS web site. (USGS information may be approved or provisional data.) Figures 22 and 23—DWR web site. Table 20 —Orange County Environmental Health Dept.

WATER RESOURCES

Groundwater Quality

Why the indicator was selected

Current information regarding groundwater quality in the County is limited. Cunningham and Daniel (2001) documented the quality of groundwater by sampling 51 wells across the county. In general, "few drinking water concerns" were identified through their research. However, uncontrolled releases of numerous commonly available materials such as petroleum products, chemicals, waste materials, fertilizers and pesticides can result in groundwater and soil contamination. The number of groundwater contamination incidents is an indicator that demonstrates how our daily activities may impact the natural environment. In order to protect groundwater quality, it is necessary to minimize activities that are capable of negatively impacting groundwater resources.

How the indicator was measured

The Division of Waste Management (DWM) and Division of Water Quality (DWQ) within NCDENR manage release incidents that pose a risk to groundwater quality in the State. Such incidents include releases from underground storage tanks (USTs) and aboveground tanks (ASTs), surficial spills of hazardous materials, releases at dry cleaning sites, Superfund and Resource Conservation and Recovery Act (RCRA) sites and other sites which have potentially hazardous materials present on them. DWM and DWQ manage databases which detail the sites which represent a potential threat to groundwater in Orange County.

The trend in Orange County

INDETERMINATE

As Figure 24 indicates, the number of UST incidents in Orange County has increased steadily over the past twenty two years, reaching a total of nearly 450 incidents in 2008. While the number of reported incidents that have been investigated and "closed out" has grown each year, the increase does not appear to have kept pace with the number of incidents reported. Currently, 71% of UST incidents have been "closed out", meaning that these sites have been determined to no longer be a threat. Table 21 summarizes 20 categories describing nearly 850 sites (including UST sites) that pose a potential threat to groundwater. It should be noted that not all of these sites have released hazardous materials into the environment but they may merely represent a potential threat to do so.

Recommendations

To support a sustainable future, Orange County should:

- Alert residents to be vigilant of potential contamination of groundwater, as a result of their own activities and the activities of others;
- Compile information regarding groundwater contamination incidents in the county and make this information available to the public;
- Encourage the use of alternatives to hazardous materials where possible;
- When appropriate, pursue cleanup of incidents where action has stalled;
- Encourage residents to properly abandon out-of-service wells as required by NCDENR and Orange County regulations; and
- Continue to educate citizens regarding the appropriate disposal of potentially hazardous materials at Orange County Solid Waste facilities.

Figure 24: Underground Storage Tank Incidents, 1986-2008

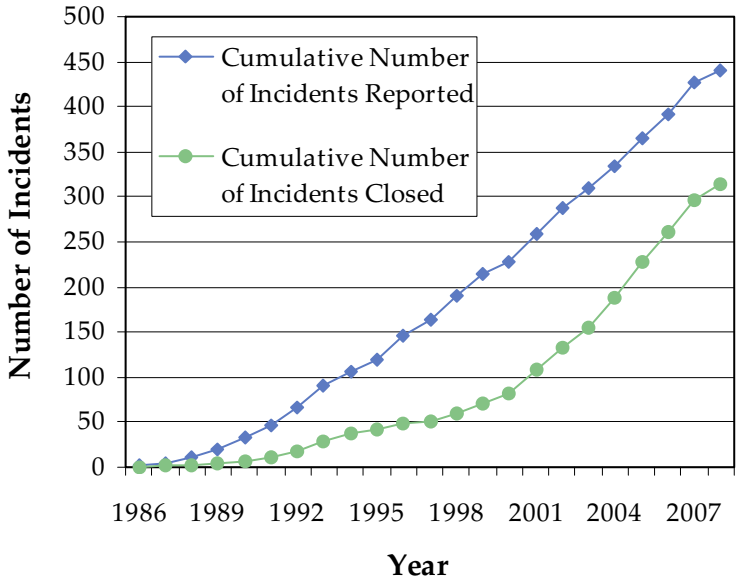


Table 21: Potential Threats to Groundwater Quality

Type of Site	Number Present in Orange County
Reported UST and AST Sites or Surface Spills of Misc. Hazardous Materials	439 [17]
UST Permits (Registered USTs, Typically Present at Gas Stations)	76[16]
Animal Operation Sites (with Certified Animal Waste Management Plans)	21[16]
NC State Superfund Program sites	14 [19]
NPL (National Priority List) Sites ("Superfund" Sites)	0[16]
Non-Discharge Permits (Ind./Municipal Facilities that Treat Various Wastes)	42[16]
National Pollutant Discharge Elimination System (NPDES) Permits	96[16]/153 [18]
Old Landfill Sites (Non-Permitted Municipal Landfills or Dump Sites)	4 [19]
Polychlorinated Biphenyl (PCB) Sites	1[16]
RCRA Hazardous Waste Large/Small Quantity Generators/Transporters	1/19 [18]
RCRA Hazardous Waste Transport, Storage, Disposal (TSD) Sites	4/19 [18]
Septage Disposal Sites (Permitted Sites for Land Application of Septage)	0[16]
Permitted Biosolids Application Sites (3,112 acres active/1,403 acres inactive)	4,515 acres[16]
Soil Remediation Sites (Bioremediation of Petroleum Contaminated Soil)	0[16]
Solid Waste Facilities (Includes Garbage, Construction Debris, Sludge, etc.)	2[16]
Dry-Cleaning Solvent Clean-up Act (DSCA) Program Sites	6 [20]
Tier II Facilities (Storing Hazardous Materials under SARA[21])	34[16]
Brownfields Sites	4 [22]
Underground Injection Control (UIC) Sites (Wells Not For Waste Injection)	11[16]
Pesticide Release Sites	0 [23]

[16] NCDENR– DEH Source Water Assessment Program Sept. 2006 [17] Summer 2008 UST Section Database [18] August 4, 2008 EPA EnviroFacts Warehouse Web Site [19] Corroborated by July 11, 2008 NCDENR database [20] July 24, 2008 DSCA Web Site [21] Superfund Amendments and Reauthorization Act [22] September 30, 2007 NC Brownfields Web Site [23] NCDACS Pesticides Division

Sources: Figure 24 and Table 21 —NCDENR—Division of Waste Management and Division of Water Quality databases.

WATER RESOURCES

Wastewater Treatment and Disposal

Why the indicator was selected

Centralized wastewater treatment is an essential service for urban centers and cities. The quality of that service can be evaluated in part by tracking the number and volume of wastewater spills, which can contribute nutrients and pollutants to surface waters. Spills occur as a result of blockages in pipes, commonly caused by the buildup of fats, greases and other materials inappropriately added to the waste disposal system.

Septic systems also represent a significant method of wastewater treatment and disposal in the county. Approximately 9,000 septic systems have been installed in the county since 1985. Maintenance of septic systems is necessary to ensure proper operation. Improperly functioning or failing septic systems can contaminate surface water and groundwater resources and could result in health hazards. According to *The North Carolina Septage Study* by Grayson, Olive and Steinbeck (1982), 10.9 percent of the 1,333 septic systems in Orange County that were checked in their study had experienced malfunctions or failures during the previous year.

How the indicator was measured

The OWASA and Hillsborough wastewater treatment plants, the DWQ and the Environmental Health Division of the Orange County Health Department provided the data for this indicator. Figure 25 and Table 22 report the total amount of wastewater released annually, the volume of wastewater that reached surface waters each year and the total amount of monetary penalties levied for these violations. Figure 26 shows the number of septic systems that have been installed and repaired in the county since 1991.

The trend in Orange County

IMPROVING

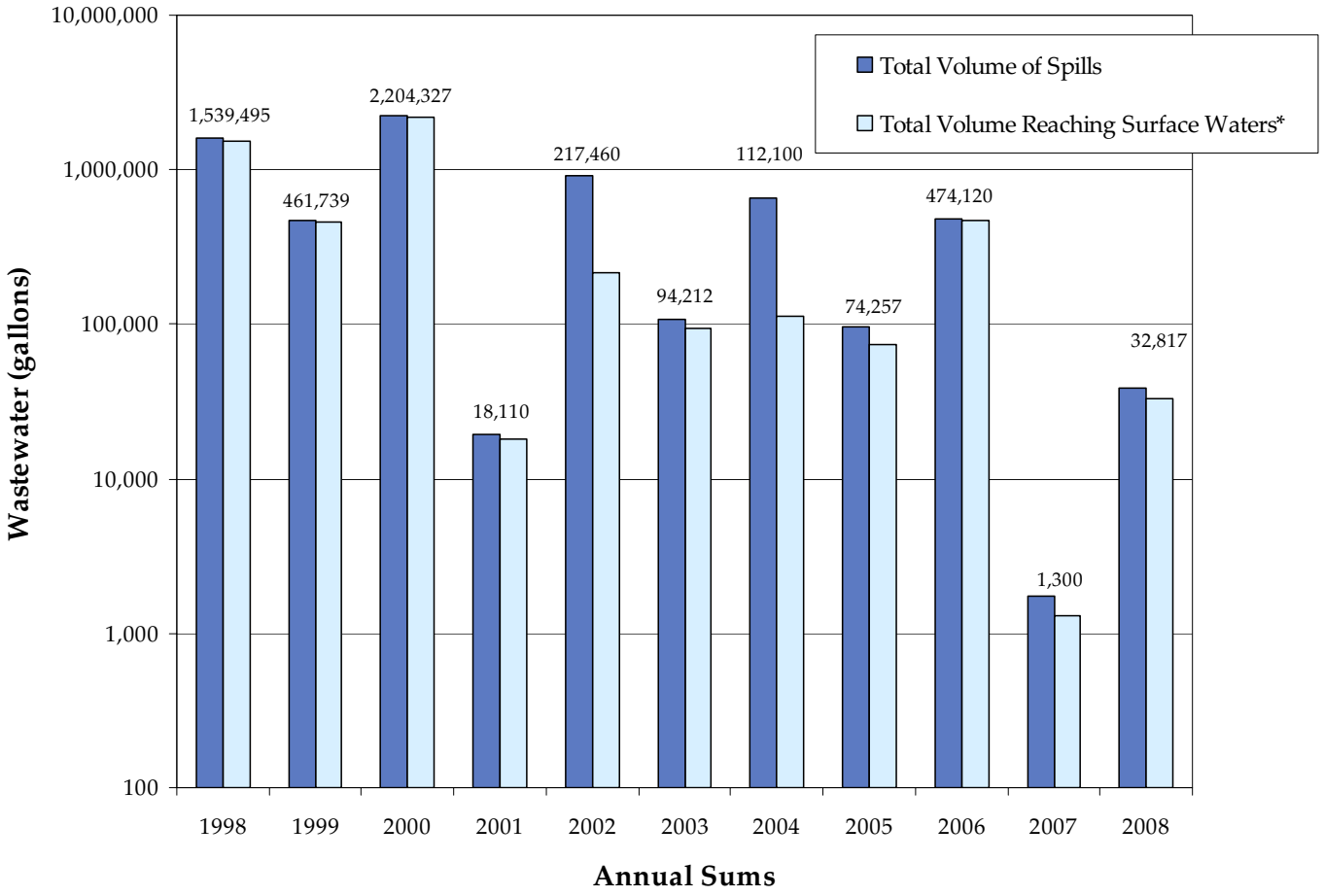
As shown in Table 22, the number of wastewater releases that occur varies from year to year but since 1998 a total of 284 spills of wastewater have occurred, with more than 5 million gallons reaching surface waters. Table 22 also indicates that the annual number of wastewater spills decreased in the past few years. Figure 25 illustrates that the volume of wastewater reaching surface waters also fell in the last two years. Figure 26 demonstrates that nearly 7,000 septic systems have been installed since 1991 and more than 1,200 failing systems have been repaired since then.

Recommendations

Since the County does not operate a wastewater treatment plant, to support a sustainable future, Orange County should:

- Continue to track the number and volume of wastewater spills;
- Educate citizens regarding appropriate septic system maintenance and upkeep, as well as what materials to avoid disposing of in septic systems; and
- Support citizen education regarding the appropriate disposal of waste materials including using household hazardous materials disposal facilities operated by the Orange County Solid Waste Management Department.

Figure 25: Total Volume of Wastewater Spills, 1998-2008

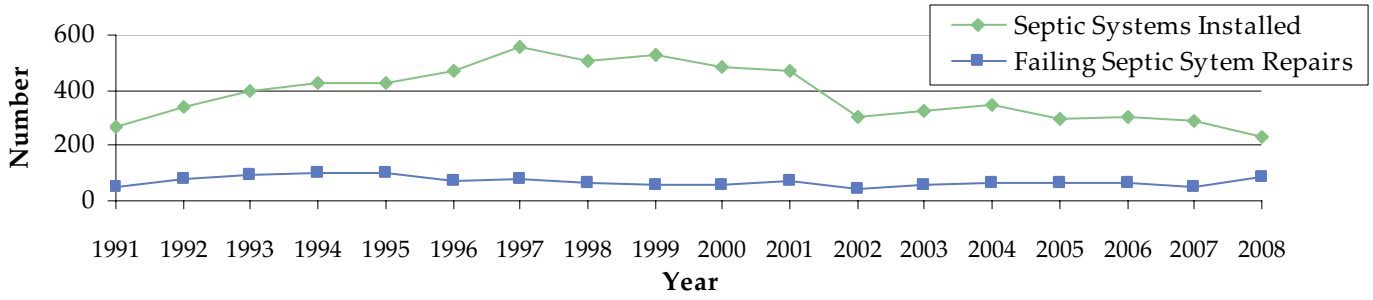


* Numbers shown represent the total volume of wastewater reaching surface waters for each year.

Table 22: Wastewater Spills and Associated Permit Violations, 1998-2008

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Number of Spills	62	55	26	10	31	33	16	19	14	4	14	284
Total Monetary Penalties Assessed, in Dollars	$5,425	$10,425	$24,836	$3,500	$0	$0	$0	$0	$0	$0	$0	$44,186

Figure 26: Septic System Installations and Repairs to Failing Systems



Sources: Figure 25 and Table 22 — NCDENR - Division of Water Quality, OWASA, Town of Hillsborough
Figure 26 —Environmental Health Division of the Orange County Health Department

WATER RESOURCES

Surface Water Quality

Why the indicator was selected

Dissolved oxygen (DO) and total nitrogen (TN) content were selected as indicators because taken together they provide a fairly good measure of surface water quality. DO content of a stream can be considered the single most important indicator of habitat quality. If the concentration of DO in a stream is less than 5 mg/L, fish and other organisms can become stressed. The TN content is the sum of nitrate, nitrite, organic nitrogen and ammonia concentrations present in a water sample. These compounds are potentially present in surface water as a result of the over-application of fertilizer, from wastewater treatment plant effluent, in groundwater impacted by septic systems and as a result of stormwater runoff from agricultural fields, animal lots and urban areas.

How the indicator was measured

Online DO and TN data was obtained from the United States Geological Survey. Sampling locations within Orange County (and one in Durham County) were utilized which had analytical results available over at least the period from 1988 to 2008. Single locations on the Eno River, Morgan Creek and Cane Creek were used to determine trends in water quality over the twenty year time interval. A single location on the Little River within Durham County was also used to track the water quality trend for the Little River, as no information was available for the stretch of this stream in Orange County.

The trend in Orange County

MIXED

The trends of the data for the sampling locations listed indicates that dissolved oxygen levels have decreased in all four streams over the last twenty years (Figure 27). This trend is of concern as it appears to be consistent at all of the stream sampling locations included herein. Total nitrogen concentrations decreased over the same interval for three of the streams, increasing over time at only the Little River sampling location in Durham County (Figure 28). The decrease in the total nitrogen trends over time is encouraging.

Recommendations

To support a sustainable future, Orange County should:

- Continue to work with other local governments and organizations to improve water quality and stream integrity. The Jordan Lake and Falls Lake Nutrient Management Strategies that are being developed have brought together many different parties to work on improving water quality in the Jordan Lake and Falls Lake watersheds;
- Investigate options available for reducing non-point sources of nutrients and other pollutants that make their way into the county's water bodies;
- Enforce and update regulations to protect surface water quality;
- Continue to educate citizens regarding threats to surface water quality; and
- Support existing efforts to improve surface water quality.

Figure 27: Dissolved Oxygen Level Trends, 1988-2008

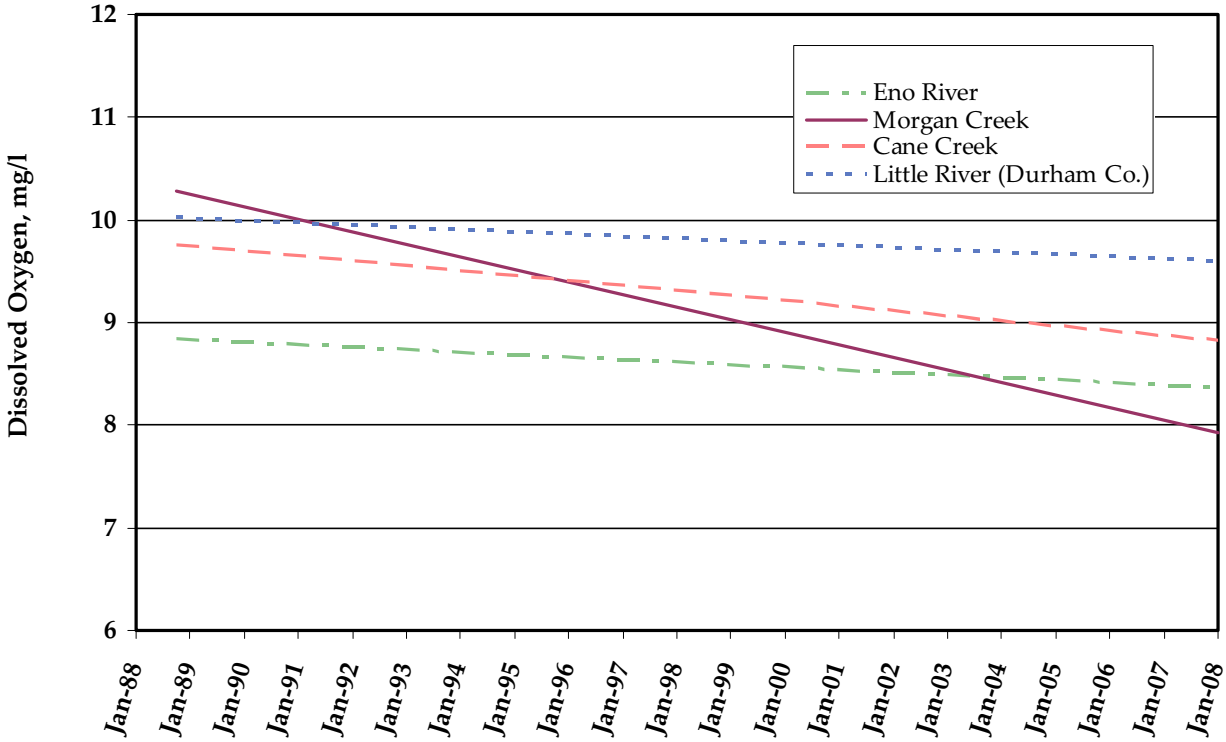
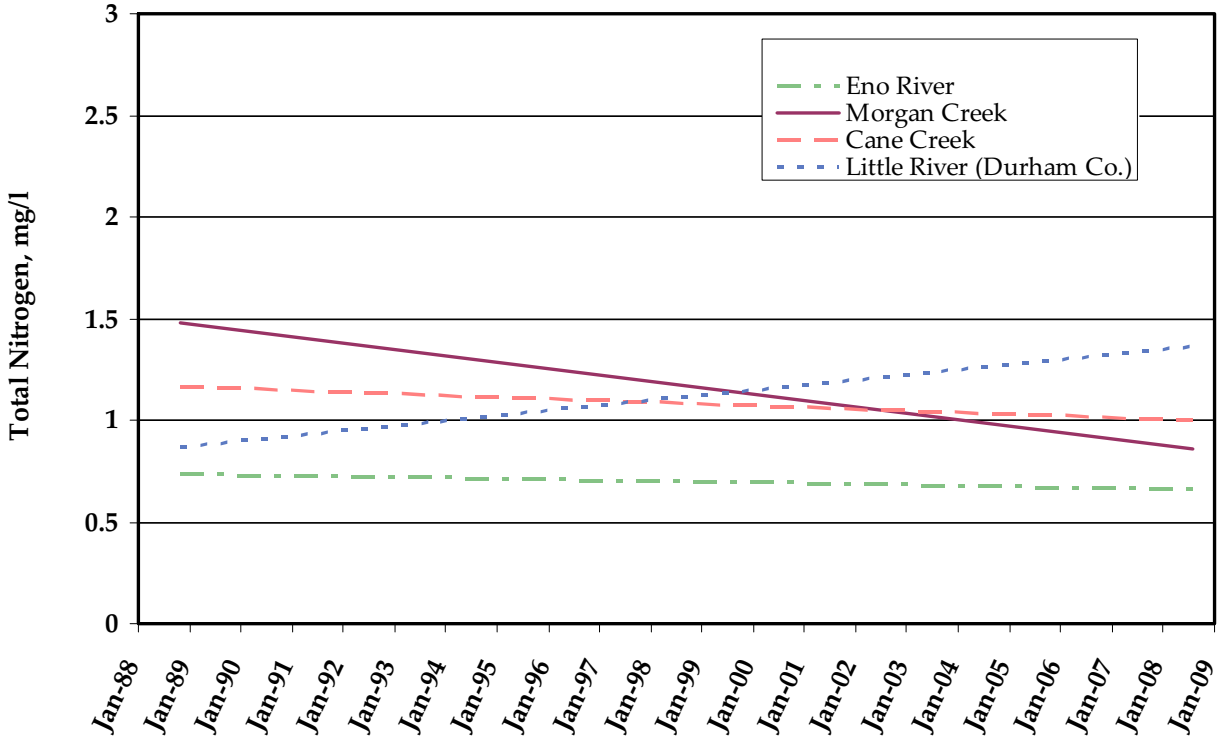


Figure 28: Total Nitrogen Level Trends, 1988-2008



Source: Figure 27 and 28 —USGS NWISWeb database, includes final and provisional data that may not have received Director's approval and may be subject to revision.

WATER RESOURCES

Stream Ratings

Why the indicator was selected

The Division of Water Quality classifies waters in North Carolina according to their best intended uses and periodically evaluates how capable water bodies are at supporting their designated use. DWQ assesses streams using different types of biological data including benthic macroinvertebrate bioclassification, fish community structure (NCIBI), phytoplankton and algal bloom measurements and physical and chemical parameter measurements. Streams that are determined to be either **Partially Supporting** or **Not Supporting** their designated use are considered **Impaired**. Streams that are found to be meeting their intended use are termed **Fully Supporting**. The use of macroinvertebrate and fish population data has proven to be a reliable water quality monitoring tool, as benthic macroinvertebrate and fish communities can be sensitive to subtle changes in water quality.

How the indicator was measured

Fish population and benthos evaluations are used to monitor river and stream water quality. Benthic macroinvertebrates, or benthos, are organisms that live on the bottom of rivers and streams. In freshwater, many of these organisms consist of aquatic insect larvae. DWQ assigns each benthic sample a bio-classification ranging from Poor to Excellent which reflects water quality at that location. The table below illustrates how the results of the NCIBI fish population surveys and bioclassification analyses correlate with stream ratings:

Stream Rating	Bioclassification	NCIBI
Fully Supporting **(FS)**	Excellent	Excellent
Fully Supporting **(FS)**	Good	Good
Fully Supporting **(FS)**	Good-Fair	Good-Fair
Partially Supporting **(PS)**	Fair	Fair
Not Supporting **(NS)**	Poor	Poor

The trend in Orange County

STEADY

In general, Orange County appears to be maintaining the quality of streams in rural areas (Table 23). Among the streams that have been checked by DWQ since 1996, all streams outside of Chapel Hill and Carrboro, except Collins Creek (Figure 29), were found to be **Fully Supporting** of their intended use during their most recent analysis. **Partially Supporting** or **Not-Supporting** streams appear to be limited to the urban areas of the county, indicating that runoff from development and sewage treatment plant effluent are likely impacting water quality. It is not certain why Collins Creek is not meeting its' intended use, although agricultural fields, biosolids application sites, private wastewater treatment plants with permitted discharges and areas undergoing development are present in the Collins Creek watershed.

Recommendations

To support a sustainable future, Orange County should:

- Continue acquiring property and conservation easements to protect streams;
- Enforce and maintain streamside buffers to protect water quality; and
- Support efforts to improve and restore water quality, especially those measures that concern streams in urban areas of the County.

Table 23: Water Quality Summary, 1984-2005

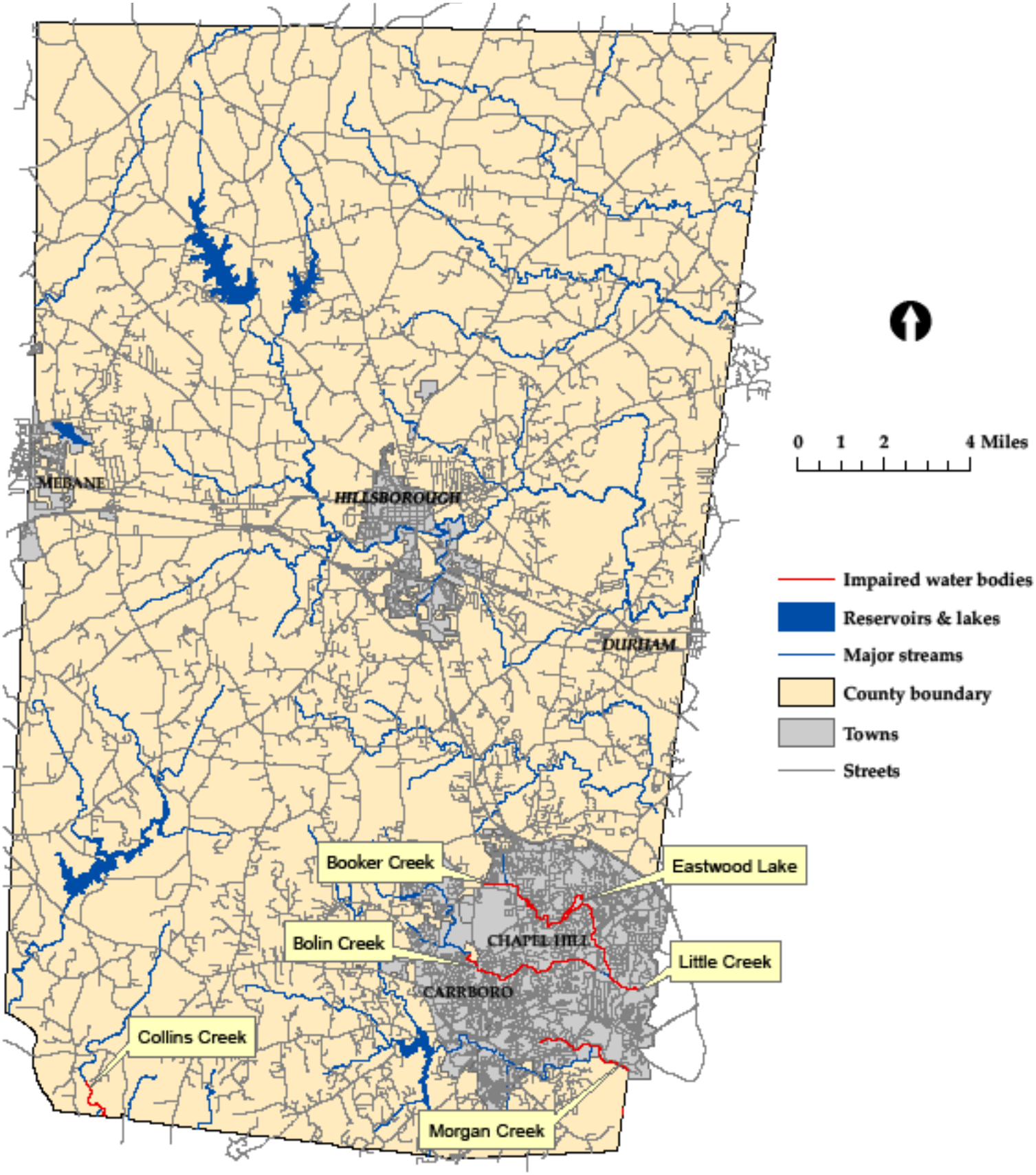
Cape Fear River Basin								
Water Body and Sample Location	**Year**							
	1984	**1985**	**1987**	**1990**	**1993**	**1996**	**1998**	**2003**
Cane Creek SR 1114					FS (w) FS (s)		FS (w) FS (s)	FS (s)
New Hope Creek SR 1734					FS			
Morgan Creek NC 54		FS			FS (w) FS (s)		FS (w)	FS
Morgan Creek SR 1726	PS (s)	NS	PS (s)	PS (s)	PS (s)		PS (s)	
Morgan Creek SR 1900						PS	NS	PS
Bolin Creek Off SR 1750						PS	NS	

Neuse River Basin								
Water Body and Sample Location	**Year**							
	1988-1989	**1991**	**1994**	**1995**	**1996**	**1998**	**2000**	**2005**
Seven Mile Creek SR 1120		FS		FS			FS	FS
Eno River SR 1336		FS		FS			FS	FS
Eno River SR 1336							FS	FS
Eno River NC 70 BYP.	FS							
Eno River 2nd NC 70 BYP.	FS							
Eno River NC86, above WWTP			FS					
Eno River NC86, below WWTP			PS					
Eno River SR 1569	FS	FS		FS	FS	FS	FS	FS
S. Fork Little River SR 1538				FS			FS	FS
N. Fork Little River SR 1519				PS			FS	
N. Fork Little River SR 1538				FS			FS	FS

WWTP - wastewater treatment plant w– Winter sampling s– Summer sampling FS– Fully Supporting PS– Partially Supporting NS– Non-Supporting. All Cape Fear basin samples were benthic macroinvertebrate samples except Morgan Creek-SR 1900 and Bolin Creek samples which were fish community (NCIBI) samples. The 2003 Morgan Creek-SR 1900 sample was also a benthic macroinvertebrate sample. All Neuse River basin samples were benthic macroinvertebrate samples except the Eno River-1336 samples which were NCIBI samples. The 1998 Eno River-SR 1569 sample was also a NCIBI sample.

Source: Table 23 —NC Division of Water Quality—Biological Assessment Unit

Figure 29: Impaired Water Bodies as of 2008



Source: Figure 29— Orange County ERCD, prepared April 17, 2009

WATER RESOURCES

Ongoing Concern: Radon and Arsenic in Groundwater

Between 1993 and 2001 the U.S. Geological Survey (USGS), in collaboration with Orange County, completed three investigations of the groundwater in Orange County. These projects were referenced in the *Water Resources Initiative (2005)*[24], an initiative to document critical needs for advancing the characterization and protection of groundwater resources in the county. The USGS report by Cunningham and Daniel (2001) stated that "the groundwater [in the county] was found to be of good quality," identifying only three naturally occurring elements present in groundwater in excess of State drinking water standards - iron, manganese and zinc[25]. These are essential elements to plants and animals but according to the 2001 USGS report, ingestion of large amounts of iron can cause staining and affect taste.

Of perhaps greater import is the finding, as described in both the 2001 USGS report, as well as in recent work conducted by the N.C. Geological Survey, that radon and arsenic are additional naturally occurring elements that could be of concern to groundwater users in the county.

Radon is a gas formed during the decay of uranium 238 and is mainly found in association with granitic rocks. In Orange County, radon has been detected in the groundwater, particularly in the southern portion of the county where a large body of granitic rock is present in the subsurface. Radon is primarily a concern because the inhalation of radon gas particles has been linked to an increased potential for the development of lung cancer. Sixty-seven percent of the groundwater samples collected in Orange County during the 2001 USGS study contained radon in concentrations in excess of the proposed EPA's Maximum Contaminant Level (MCL) of 300 pCi/L (picocuries per liter[26]) and one sample exceeded the proposed Alternative MCL (AMCL) of 4,000 pCi/L. It should be noted, however, that debate still exists concerning the risk posed by elevated radon concentrations, and the proposed MCL for radon has not been finalized. Orange County's *Water Resources Initiative* (2005) stated "Additional research and follow-up on these [radon] findings are of immediate and critical importance to citizens who live in the parts of the county most affected and this action should not be delayed any longer."

Arsenic is another naturally occurring element that can be present in the groundwater of Orange County. The N.C. Division of Water Quality has studied arsenic in groundwater and concluded "the volcanic and volcaniclastic rocks of the Carolina Slate Belt (which underlies most of Orange County and is now known as the Virgilina sequence of the Carolina terrane) are the most probable host materials for arsenic bearing groundwater." The N.C. Geological Survey analyzed N.C. Department of Health and Human Services data from nearly 500 wells in Orange County. This work found that, in general, groundwater from wells located in areas where the bedrock is made up of "welded tuffs proximal to a pluton[27]" appear to contain the highest concentrations of arsenic in the county. The allowable concentration of arsenic in groundwater is 50 ug/L, whereas the N.C. drinking water standard for arsenic is 10 ug/L. The N.C. Department of Public Health recommendation for arsenic in drinking water is even lower, 0.02 ug/L.

To address this concern, Orange County should:

- Support groundwater sampling for radon and arsenic and other potential contaminants (naturally occurring and artificially generated) as needed;
- Investigate further study of radon in groundwater in areas of the county underlain by granitic rock, perhaps in conjunction with the USGS and adjoining counties;
- Proceed with plans to establish the Orange County Observation Well Network to research groundwater quantity and quality concerns across the county; and
- As described in the *Water Resources Initiative*, the County "should develop an inventory of ground-water contamination incidents based on county/state/federal reports…" This inventory should be made available to the public in an easily understandable format.

[24] The Water Resources Initiative was prepared by the CFE and approved by the Board of County Commissioners in 2005.

[25] Zinc may be present as a result of the use of galvanized well construction materials.

[26] A curie is a unit of radioactivity, defined is 0.037 decays/second, which is roughly the radioactivity of one gram of radium; a picocurie is 10^{-12} curies, and measures the amount of radioactivity in a liter of liquid substance.

[27] A pluton is an intrusive igneous rock and tuff is a rock formed from the consolidation of volcanic ash ejected from a volcano.