Chapter 26
Population Growth, Land Cover Changes and Water Quality

26.1 Introduction

Human activities can negatively impact surface water quality, even when the activity is far removed from the waterbody. Pollutants that enter waters fall into two general categories: *point sources* and *nonpoint sources*. With increased population comes increased demand for wastewater discharge and conversion of land from lower impact uses to more intensive urban and suburban land uses. In the Cape Fear River basin, there are over 300 miles of Impaired streams that drain urban or urbanizing areas. With proper management of wastes and land use activities, these impacts can be minimized. Every person living in or visiting a watershed impacts water quality. Therefore, each individual should be aware of these contributions and take actions to reduce them. This chapter provides an overview of population growth impacts associated with increased wastewater discharges and conversion of land from agriculture and forestry to urban land uses.

The Cape Fear River basin is one of the fastest developing basins in the state; the effects of development are impacting water quality. Population in the Cape Fear River basin has grown from just under 1.5 million to over 1.8 million people from 1990 to 2000. The overall population of the basin based on 2000 Census data is 1,834,545, with approximately 197 persons/square mile. This growth is expected to continue especially around existing urban areas. The 26 counties with some land area in the Cape Fear River basin are expected to increase population from just under 3 million to over 5 million people (28.9 percent) over the next 20 years (Appendix I). Associated with this growth will be increasing strain on water resources for drinking water, wastewater assimilation and runoff impacts. There will also be loss of natural areas and increases in impervious surfaces associated with construction of new homes and businesses.

26.2 Impacts of Increased Wastewater Discharges

Point sources are typically piped discharges and are controlled through regulatory programs administered by the state. All regulated point source discharges in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state. There has been an increase in wastewater flow discharged to waters in the Cape Fear River basin to meet the demands of the rapidly growing population. Generally, treatment technology has improved to the extent that point sources are no longer the primary source of water quality problems.

Point Sources

Piped discharges from:
- Municipal wastewater treatment plants
- Industrial facilities
- Small package treatment plants
- Large urban and industrial stormwater systems

In the Cape Fear River basin, there are just over 150 Impaired stream miles where point sources are a possible contributor to water quality problems. There are just over 340 miles of streams that may have been adversely impacted by discharges. Most of these streams are located in urban areas where water quality is already degraded. Because of limited assimilative capacity in the basin local governments, industry and the state must carefully plan for wastewater increases on a basinwide scale. Chapter 30 discusses NPDES compliance issues and permitting strategies to be used to accommodate new and expanding discharges in this basin.

26.3 Impacts of Growth and Development

Nonpoint sources are from a broad range of land use activities. Nonpoint source pollutants are typically carried to surface waters by rainfall, runoff or snowmelt. Sediment and nutrients are most often associated with nonpoint source pollution. Other pollutants associated with nonpoint source pollution include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or deposited from the atmosphere into surface waters.

Nonpoint Sources

- Construction activities
- Roads, parking lots and rooftops
- Agriculture
- Failing septic systems and straight pipes
- Timber harvesting
- Hydrologic modifications

Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given these characteristics, it is difficult and resource intensive to quantify nonpoint contributions to water quality degradation in a given watershed. While nonpoint source pollution control often relies on voluntary actions, the state has many programs designed to reduce nonpoint source pollution.

Water quality issues and programs associated with agricultural are discussed in Chapter 28. Water quality issues and programs associated with forestry are discussed in Chapter 29. The remainder of this chapter will discuss water quality issues associated with conversion of land to urban and suburban areas.

Cumulative Effects

While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

Urban land uses have increased from 370,000 acres in 1982 to 627,000 acres in 1997 (70 percent) in the Cape Fear River basin (Appendix III). At this rate of development, well over 1 million acres will be in urban land cover by 2020. Water quality declines dramatically in streams in and around urban centers and along interstate corridors. Most of the Impaired streams in this basin are concentrated in and around existing urban areas. In the Cape Fear River basin, over 300 Impaired stream miles are associated with urban and urbanizing areas. Programs in place to help prevent further degradation to water quality during development are discussed in Chapter 31.

More than any other human activity, urban growth is the greatest threat to aquatic resources. The impacts on rivers, lakes and streams, as development surrounding metropolitan areas consumes neighboring forests and fields, can be significant and permanent if stormwater runoff is not controlled. Greater numbers of homes, stores and businesses require greater quantities of water. Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000).

In addition, as watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways, the ability of the environment to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak streamflows after rainfall. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge urban streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams, leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

Most of the impacts result in habitat degradation (Chapter 27), but urban runoff also carries a potentially toxic cocktail including oil and grease from roads and parking lots, street litter and pollutants from the atmosphere. Cumulative impacts from developing and urban areas can cause severe impairment to urban streams.

Water supply needs have normally been sufficient to meet agriculture, water supply, industrial and power generation needs. The severe drought conditions in 2001 and 2002 stressed water resources to near the limit for these uses. It is during these periods of drought that point to the impending threats to the availability of good quality water. Clean water can likely be provided in sufficient quantity to supply the future needs of the basin, but only with inspired foresight, planning and management. Refer to Chapter 32 for more information on water resources management.