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Ecosystem Management and its Application at the Local Level: APNEP, CAMA and Local Land Use Planning in North Carolina

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A Dissertation

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By

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This dissertation is dedicated to my grandfather

Herbert “Bud” Mattison

June 8, 1916 - December 4, 2008

Without his support, even today, this would not have been possible.
He would be very proud.

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Abstract of the Dissertation

Traditionally, the task of land use planning in the United States rests with local governments. However, a growing number of efforts have attempted to exert more influence over how local governments plan for development. A fundamental purpose of state-mandated growth management has been to infuse regional environmental concerns into local land use planning. Similarly, collaborative ecosystem planning efforts have attempted to encourage local communities to participate in regional planning efforts, and to adopt regional environmental goals and objectives into local land use plans. This paper presents results from a study of state-mandated local planning and collaborative regional planning, addressing in particular local ability to adopt and implement ecosystem planning initiatives for development management. Specifically, this dissertation documents the ecosystem plan quality of 20 communities in North Carolina. This plan quality analysis provides the backdrop for a more in-depth investigation of plan quality and implementation in three case study cities via interviews with planners, elected officials, and environmental advocates, and secondary data analysis.

Results indicate that state mandates are effective at producing plans with higher ecosystem plan quality than those made voluntarily without a mandate. However, while these plans generally acknowledge the need for regional resource protection, they rarely go beyond stating support for State minimum resource protection or beyond jurisdictional boundaries, and rely heavily on state and federal agencies to address regionally significant landscapes. Results from this study also indicate that participation in a regional ecosystem planning effort without adequate capacity or direction will have little effect on local land use policy. Within this context, key factors yielding more environmentally focused planning and implementation included local commitment to ecosystem planning, development pressure, and recent natural hazard impacts. Key factors steering communities away from ecosystem management included poor economic conditions, a desire to maintain local autonomy, and consultant-driven planning processes. Challenges for all communities include the ability to adopt policies that address biodiversity and regionally significant landscapes. This work has broad implications for land use planning and ecosystem management.

Keywords: ecosystem management; collaborative planning; growth management; plan quality; North Carolina

1: Introduction

Changes in urban development patterns, public policy, and technology have shaped and accelerated changes in the natural environment. Significant in recent decades is an emphasis by scientists and public decision-makers to target and coordinate environmental planning and restoration at the regional and ecosystem levels, rather than the traditional species-by-species approach. Ecosystem planning represents a departure from traditional environmental planning and management by addressing all the links between living and nonliving resources (biological, chemical, and socioeconomic), rather than considering single issues in isolation. Ecosystem planning focuses on the multiple activities occurring within specific areas that are defined by ecosystem, rather than political boundaries. Scholars and resource managers have proposed ecosystem management as a more efficient and effective framework for protecting resources and achieving sustainable development practices. Evidence of this can be seen in hundreds of ecosystem-based programs ranging from the Greater Yellowstone Ecosystem and Comprehensive Everglades Restoration Plans to the Chesapeake Bay and National Estuary Programs. To date at least eighteen federal agencies have committed to the principles of ecosystem management, and are implementing projects using this framework.

Academics and practitioners tout ecosystem management as a framework for addressing human uses and abuses of ecosystems. However, there are serious challenges to implementing ecosystem management, not the least of which are disparities between public and private development priorities and the inherent uncertainty within natural systems. While ecosystem management focuses on biotic/abiotic interrelationships, scientists and managers increasingly recognize that implementation must occur at the local level through local land use decisions. Ecosystem management cannot rely only on engineering or structural approaches, but must also encourage the coordination of local plans and development policies across ecosystems (Beatley 1994; 2000: 87; Brody 2003c; Hartig et al. 1998). Therefore, local planning initiatives must be considered when attempting to manage ecological systems. The factors most closely identified with ecosystem decline, such as low-density, dispersed development and habitat fragmentation, occur at the local level and are generated by local land use decisions (Beatley 2000; Platt et al. 1994).

Despite the increasing attention to ecosystem management, there is a limited understanding of how local jurisdictions incorporate the principles of ecosystem management

into their planning and regulatory frameworks. Ecosystem management was derived from federal-level thinking, but effective implementation is achieved at the local level with through land use planning. Long-term success of ecosystem management thus rests on a better understanding of how local plans effectively capture its key principles and practices (Beatley 1994; Beatley 2000; Beatley and Manning 1997; Brody 2003c).

My primary objective in this study is to gain a greater understanding of ecosystem management implementation at the local level. I examine the ability of local comprehensive plans to embody and implement the principles of ecosystem management. While this analysis is focused on the local plans of a particular area, policy implications extend more generally to the ability of local jurisdictions to embrace ecosystem management principles.

Using quantitative and qualitative data, this study will examine the following questions:

- To what extent does participation in a collaborative, voluntary ecosystem-based planning process influence local land use policy?
- To what extent do state mandates for ecosystem-based planning influence local land use policy?
- How important are local factors, relative to ecosystem-based planning participation, in explaining the quality of local plans and implementation of ecosystem directives?
- How can plans, planning processes, and ecosystem management programs be improved to more effectively address the needs of ecosystems?

In order to answer these questions, I selected the state of North Carolina, as it has a combination of institutional, regulatory, geographical, and biological characteristics that make it an ideal setting within which to examine ecosystem planning at the local level. A growing emphasis on ecosystem approaches to management alongside strong support for land use planning, and a regulatory framework that strongly encourages or mandates planning creates an opportunity to implement the principles of ecosystem management. North Carolina also contains ecosystems that have been identified for preservation and restoration, fragile coastal environments, and intense pressure for development statewide that will allow us to test the feasibility of using local planning to advance the concept of ecosystem management.

While much research has been geared toward defining the concept and strategies for instituting the broad principles of ecosystem management, comparatively little research has been done to evaluate specific tools and strategies involved in ecosystem management (Brody 2003c).

Notable exceptions are Brody's work in Florida (2003) and Hartig's work in the Great Lakes region (1998), which focused respectively on developing and measuring ecosystem plan quality and providing a framework for implementation. This thesis will build on both of these works to make a contribution to the ecosystem management and land use planning literature by identifying trends in plan quality for jurisdictions participating in specific ecosystem-based management programs, and gain a greater understanding of the implementation of these policies by local governments. Broadly, this thesis focuses on local implementation of regional environmental programming, and thus has a large audience. This research has the potential to yield empirical information that will be useful to the following: federal agencies (particularly those implementing/assessing National Estuary Programs); state and regional resource managers; local resource and development managers, and; academics and students of the environmental management and planning disciplines.

This thesis is composed of nine chapters. In the next chapter, I provide an overview of the research setting, including its geophysical, demographic, institutional, and regulatory attributes. In Chapter 3, I review the theoretical and empirical literature relevant to this thesis. In Chapter 4 I describe my conceptual framework and study methodology, including propositions regarding the hypotheses, research design, the selection of cases, procedures for data collection and analysis, method of analysis, and limitations of my research. In Chapter 5, I measure the ability of local land use plans to incorporate the principles of ecosystem management. Chapters 6, 7, and 8 are descriptive accounts of the natural, social and planning environments in the cities of Wilmington, New Bern, and Greenville, respectively, and an analysis of each case individually. In Chapter 9, I pull the information from the previous 4 chapters together in a comparative framework, and match the hypothesized expectations to the results observed in both the plan quality analysis and case studies. This chapter also includes a more detailed explanation of the planning and policy implications of my findings and outlines areas for future research.

2: Natural and Social Environment in North Carolina

2.1: Introduction

Coastal ecosystems are important natural resources. In addition to supporting a wide range of wildlife, fish and complementary resources, they contribute in very important ways to the economy of coastal regions and beyond. Coastal ecosystems are dynamic areas, which are undergoing tremendous changes in population, economic structure and land use. Many of these changes are positive. Growth brings jobs, improves infrastructure and creates economic prosperity in historically depressed areas. However, many of these changes have also caused damage to the natural features that attracted people to the coast. While enhancing opportunity, population pressures in coastal ecosystems also increase solid waste production and volumes of urban non-point runoff, result in loss of green space and wildlife habitat, reduce water quality, and increase demand for potable water and energy supplies. The challenges of assimilating increasing numbers of people within a small area of land, while minimizing the potential environmental degradation from development, are considerable. Equally important are the government policies at the local, state and federal level that influence the patterns and types of economic activities taking place in any region. These policies can range from local taxes and zoning ordinances to state mandated land use controls and federal coastal zone management efforts.

North Carolina has a combination of institutional, regulatory, geographical, and biological characteristics that make it an ideal setting within which to examine ecosystem planning at the local level. A growing emphasis on ecosystem approaches to management alongside strong support for land use planning, and a regulatory framework that strongly encourages or mandates planning creates an atmosphere of high commitment and opportunity to implement the principles of ecosystem management. North Carolina also contains ecosystems that have been identified for preservation and restoration, fragile coastal environments, and intense pressure for development statewide that will allow us to test the feasibility of using local planning to advance the concept of ecosystem management. The following provides an overview of the physical, regulatory and planning environments in the State of North Carolina.

2.2: Existing Biodiversity and Critical Habitats

Generally, because of its climate and topography, North Carolina has high natural biodiversity. From the Appalachians to the Atlantic, North Carolina is home to a wealth of plants, animals and unique natural areas, some of which can be found nowhere else on Earth. North Carolina is home to approximately 5,700 species of plants, 990 species of vertebrates and more than 10,000 species of invertebrates (North Carolina Natural Heritage Program 2010). A classification of North Carolina natural communities was developed that describes more than 100 natural community types ranging from the grassy balds in the mountains to the maritime forests of the barrier islands. The North Carolina Natural Heritage Program (NCNHP), a division of the North Carolina Department of Environmental and Natural Resources, documents the best examples of these natural communities throughout the state. More than 1,500 natural areas of national, state and regional significance have been identified in both regional and county natural inventories. The NCNHP has also identified more than 2,000 Significant Natural Heritage Areas (SNHA) across the state. A Significant Natural Heritage Area is an area of land or water identified by the NCNHP as being important for conservation of the State's biodiversity. SNHA's contain one or more Natural Heritage elements - high-quality or rare natural communities, rare species, and special animal habitats.

Within the State of North Carolina there are three major geographic regions: the Appalachian Mountains, the Piedmont and the Coastal Plain (Figure 2.1). North Carolina's western landscape features the Blue Ridge Mountains and the Great Smoky Mountains, which help make up the Appalachian Mountain range. The tallest peaks of the Appalachian Mountains are found in North Carolina, including Mount Mitchell, which is the highest point in the U.S. east of the Mississippi River. The mountains lie within the Appalachian-Blue Ridge ecoregion and are heavily forested. They often feature thick underbrush, except a few which have prairies on the summits, called balds. The Piedmont, which literally means 'foot of the mountain' is the middle region of the State, located between the Coastal Plain and the Appalachian Mountain regions (Orr and Stuart 2000). This area has low rolling hills, shallow streams and red clay soil, which generally drain east to the Coastal Plain. This area is home to a diverse mixture of natural areas, as well as substantial agricultural, urban, government, manufacturing, and research & technology development. The six largest cities in the State of North Carolina, and eight of the

top ten, are in this region of the State. The exceptions to this are Wilmington in the Coastal Plain and Asheville in the Appalachian Mountains.

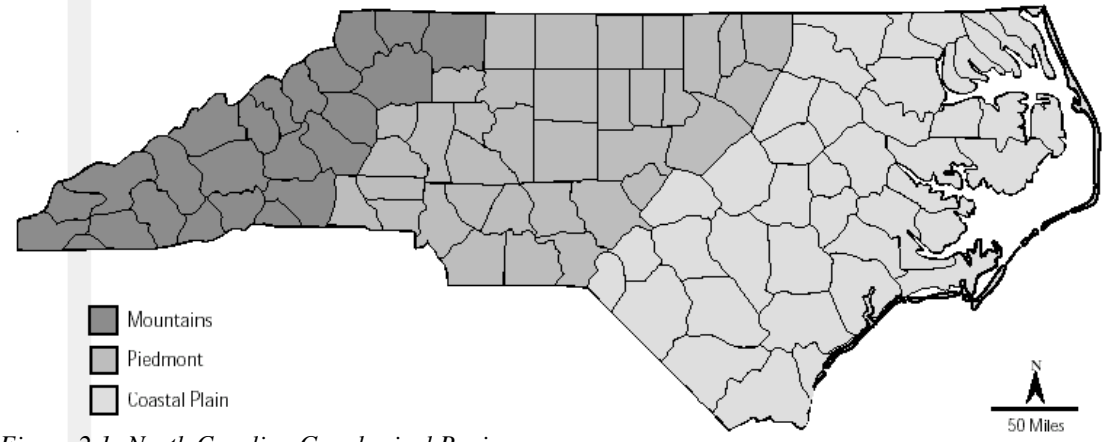

Figure 2.1: North Carolina Geophysical Region
Source: Department of Geography and Earth Sciences, UNC

North Carolina's Coastal Plain is the largest geographic area of the State, and is low, flat land that runs parallel to the Atlantic Ocean. It is often divided into two parts: the Outer Coastal Plain and the Inner Coastal Plain. The Outer Coastal Plain is made up of the Outer Banks and the Tidewater region. The Outer Banks are a string of barrier Islands separated from the mainland by sounds or inlets. The largest islands in the Outer Banks are Bodie, Cape Hatteras, Ocracoke, Portsmouth and the Core Banks. The Tidewater is the area along the coast close to sea level, primarily where major streams and rivers empty into the sounds or the ocean. The rivers of the coastal plain are much wider, deeper and slow moving than those in other areas of the State. The Coastal Plain encompasses two large landlocked sounds (i.e. salt-water inlets separated from the ocean by a series of sand bars and islands): Albemarle Sound in the north and the Pamlico Sound in the south. In total there are seven sounds in the North Carolina Tidewater region: Pamlico, Albemarle, Currituck, Croatan, Roanoke, Core and Bogue Sounds. The Inner Coastal Plain is a higher, drier area to the west of the Tidewater, which contains some of the State's best pine/evergreen forest and farmland.

The coastal region of North Carolina contains a wealth of resources. The shoreline is a mosaic of drowned river mouth estuaries, large and small barrier island sounds, and oceanfront beaches. The oceanfront coastline extends roughly 320 miles in length, the estuarine shoreline extends over 4,000 miles, and the total coastal zone is approximately 9,363 square miles (Price

and Miller 2007). Although there are differences in morphology along the North Carolina coastal estuaries, most provide similar ecosystem services (i.e. primary production, nursery habitat, buffer from storms, stormwater sinks), as well as a basis for the local economy. Included in this ecoregion are eight watersheds that drain the lower Appalachian Mountains, Piedmont and Coastal Plains; and the Albemarle-Pamlico Estuarine System, one of the largest and most productive estuarine systems in North America. The Albemarle-Pamlico system presents North Carolina's key resource base for commercial fishing and tourism. In fact, the estuaries of North Carolina are responsible for 90% of all of the commercial seafood landed in the State (Wilson, 2000). Flanked by nine counties and fed by five major rivers, the Albemarle Sound's water is mostly fresh, while the Pamlico is brackish to saline. The Pamlico Sound, with more than 2,000 square miles of surface water, is the largest individual body of water in the Albemarle-Pamlico system. The sound runs for nearly 100 miles and is more than 25 miles wide in many places. Despite its size, the sound is generally shallow, with a mean depth of approximately 15 feet (Price and Miller 2007). Myriad shoals are constantly being built and moved about in the sound by winds and tides. The Outer Banks - a 160-mile-long ridge - is what makes the Pamlico Sound the largest embayed (or lagoonal) estuary in the nation (Figure 2.1). From an ecosystem perspective, this thin fringe of estuaries is dynamic, varying constantly with tidal fluctuations and levels of surface runoff, and serves as important habitat for invertebrates, fish, reptiles, waterfowl, mammals and a diverse array of plants. These estuaries also act as a filter to remove pollutants and trap sediments from upland regions.

Within this ecosystem there are numerous issues such as overharvesting, wetlands loss, and water quality degradation that threaten species living within the system. Many of the commercial species - including blue crabs, oysters, shrimp, and a variety of finfish – that inhabit the estuary have different adaptations that allow each to utilize different parts of the estuary. Blue crab, one of the sound's most important species, can be found anywhere from the ocean to areas that are mostly fresh water, but struggles with

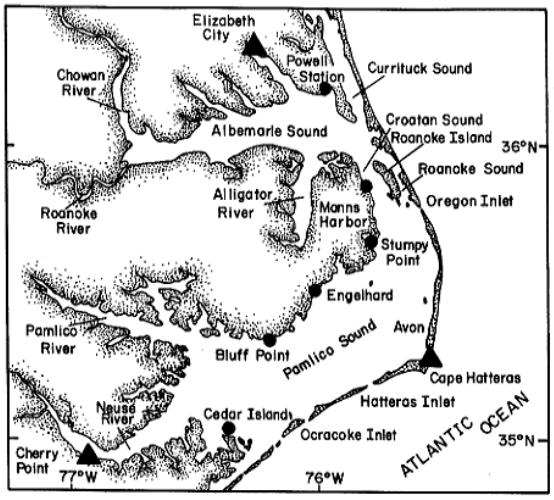

Figure 2.2: Albemarle-Pamlico Estuary
Source: North Carolina State University

overharvesting and loss of habitat due to poor water quality. Some fish and shellfish are ocean-going as adults, but rely on the marshes of the estuary to protect their eggs and young, many of which are being lost to erosion and poor development practices. Oysters, clams and other mollusks need stable salty sound water and habitat to grow and thrive, but suffer from reef degradation due to hypoxia. Many other species of plants and fish use the estuary as well, and many of these species feed larger ocean fish such as marlin and dolphin. Through this lens it is easier to see how things such as overharvesting, destruction of marshes and wetlands, and water quality degradation within the estuary have far-reaching effects on the larger marine ecosystem. Unfortunately, these ecosystems have faced tremendous stress and the destruction of habitats for many years because of excessive nutrient inputs from human waste, industrial sources, runoff from farms and cities, dredging, sedimentation, and poor developmental planning. Accelerating nutrient inputs lead to overproduction of microalgae in the form of nuisance algal blooms, which promote low oxygen conditions (hypoxia), fish kills, and a reduction in fish habitats and yields. Never was this more apparent than it was in the wake of the fall 1999 hurricanes, which struck Eastern North Carolina. The massive flooding that followed Hurricane Floyd inundated an already stressed system with sediment and nutrient enriched water, seriously impacting water quality and fisheries habitat. Predictions of elevated tropical storm activity in the future further raise concerns that many of these issues need to be addressed before damage to the system proves irreversible.

2.3: Population Growth

2.3.1: Estimating Coastal Population

Physical boundaries and natural characteristics of coastal ecosystems provide meaningful geographic areas to evaluate the environmental consequences of a growing population. However, community-level decisions and legislation are usually made within the frame of political boundaries. It is necessary to examine political units regionally to understand population growth and development pressure within ecosystems. The U.S. Census Bureau compiles population data using several different geographic units, including states, counties, municipalities and census tracts/blocks. However, analyzing data and information on an area such as the coast is difficult because one must first define the "coast." Crowell *et al*. (2010) note in their review of coastal-oriented literature that there are a variety of methods and defining criteria that can be used to define coastal areas. This can result in a wide variety of coastal-population estimates that range

from less than 10% to greater than 50% of the total U.S. population. While this wide disparity does not mean that some estimates are more accurate than others, it does mean that the defining criteria used to determine coastal populations must properly correspond to the physical process or issue being considered.

Numerous estimates of the U.S. coastal population have been published over the past several years:

- Culliton *et al*. (1990) estimated that 45% of the U.S. population lived in the 451 counties identified as coastal counties, including counties bordering the Great Lakes.
- Culliton *et al*. (1998) and Crosset *et al*. (2004) estimated that there are 673 coastal counties in the U.S. with a total of 53% of the population. These counties were defined as a county with at least 15% of its total land area within a coastal watershed, which means that land-locked counties could be considered coastal.
- NOAA classifies 674 coastal counties, defined by 1) at least 15% of the county's total land area is located within a coastal watershed; or 2) a portion of the entire county accounts for at least 15% of the coastal cataloging unit (i.e. an individual drainage basin) (Wiley 2003). This definition does not require a county to contain or to be within a certain distance of a coastline.
- Wilson and Fischetti (2010), using 2000 Census data, note that the coastline accounts for 254 of the nation's 3,142 counties yet contains 29% of the total population. These figures do not include counties along the Great Lakes, though it does include counties adjacent to bays, estuaries, gulfs, sounds, oceans or seas.
- The United States Census Bureau notes that 48.9% of the U.S. population lives within 50 miles of the coastline. The Census Bureau clarifies these figures by saying that coastline is any land that borders the ocean and any of its saltwater tributaries, as well as the Great Lakes (U.S. Census Bureau 2010).
- Crowell *et al. (2010)* estimate that 24,662,000 people, or 8.6% of the U.S. population live in the coastal zone based on direct coastal census block groups and FEMA National Flood Hazard Layer (NFHL) data.

Recognizing that the majority of peer-reviewed published data on coastal demographics are limited and usually represent the upper bounds of a wide range of possible coastal-population

statistics, it is important to determine which set of demographics are most appropriate for analyzing coastal ecosystem impacts.

According to Crowell *et al*. (2010), the Culliton *et al*. (1998) and U.S. Census Bureau (2010) data sets are by far the most common coastal demographics cited by academic papers, books, professional reports and press articles dealing with various aspects of coastal population. The Culliton *et al*. (1998) data set is based on county geopolitical units and coastal, watershed-based geophysical indicators as outlined by NOAA. The inland boundaries of this data set are defined by coastal watershed, and the commonly cited 673 counties and 53% of the population includes the Great Lakes region and its population tallies. In the case of coastal watersheds, these areas include the entire geographical area drained by a river and its tributaries that drains into coastal waters. With this in mind, it should be noted that this data set includes population from numerous landlocked counties, including Sussex County, New Jersey; San Bernadino County, CA; Pitt County, NC, and Appomattox County, Virginia. However, Crowell *et al*. (2010) note that the Culliton data is the most appropriate for situations or research where coastal ecosystems or water quality is of major concern. As such, this work will rely primarily on the Culliton data, and by extension the NOAA data sets, for national trends and data extrapolated from these sources for the 37 coastal counties in the State of North Carolina. However, some of the specific data pertaining to North Carolina will also be drawn from various State government sources, which defines the coastal area in the State's Coastal Area Management Act of 1974 (CAMA), Chapter 113A-103(2) as "the counties that (in whole or in part) are adjacent to, adjoining, intersected by or bounded by the Atlantic Ocean (extending

Figure 2.3: North Carolina Coastal Counties Map
Source: NC Department of Coastal Management

offshore to the limits of State jurisdiction, as may be defined by rule of the Commission for purposes of this article, but in no event less than three geographical miles offshore) or any coastal sound." These 20 counties roughly coincide with the Tidewater region of the Coastal Plain (Figure 2.3). For the purposes of this study, each data source will be clearly delineated to avoid confusion.

2.3.2: Population Growth in the Coastal Zone

Conventional wisdom says that concentrations of people in coastal areas threaten coastal ecosystems. Today, it is estimated that approximately 158 million people (53% of the U.S. population) live in the nation's 673 coastal counties (Culliton 1998), which is an increase of 49.6 million people since 1970 (National Oceanographic and Atmospheric Association 2010). While these growth rates are comparable to the growth rate of the nation, the growth is occurring in a much smaller area (approximately 17% of the total land area). Further, Culliton (1998) notes that this population is increasing by an average of 3,600 people per day, a rate of growth that is far faster than the nation as a whole. However, the concentration of people in coastal areas is not a new phenomenon. As long as humans have fished, traded and traveled the coast has been prime real estate. In fact, Beach (2002: 1) notes that "throughout most of the history of the United States, the coast has contained half or more of the country's residents." This begs the question: *why does there appear to be a greater concern over population increases in the coastal zone?*

While population percentages have remained fairly constant in coastal areas for the last 50 years, it is the rate of conversion and increased densities that define the challenges facing coastal areas. Today the coast is by far the most densely settled part of the country. Population density is the measurement of the number of people in an area, frequently expressed as the number of people per square mile (Wilson and Fischetti 2010). As noted by Culliton (1998: 1) "In 1960, an average of 187 people were living on each square mile of coastal land (excluding Alaska). This population density increased to 273 persons per square mile by 1994, and is expected to reach 327 by 2015." The current coastal county estimated average of 300 persons per square mile is much higher than the national average of 98 persons per square mile (Crossett et al. 2004). Within this area, the most crowded portion of the coastal area is generally that part bordering an ocean or estuary. These locations are primary areas for residential and commercial development, and are estimated to have an average of 480 people living within every square mile

of land – figures that far exceed the average density in the rest of the coastal area (Wilson and Fischetti 2010).

Beyond the permanent population figures, coastal areas are also subject to dramatic population influxes during peak seasonal periods. U.S. Census data, which is used to estimate the physical infrastructure and service needs of coastal communities based on permanent population counts, generally does not capture seasonal populations. However, seasonal populations (i.e. population present for less than six months of the year) often have a tremendous impact on the environment, growth and development, and demand for infrastructure and other governmental services. A prime example of this is Ocracoke Island, NC. Ocracoke is an 8.71 square mile (5,575 acre) barrier island located approximately 25 miles off the mainland of Hyde County, NC. While seasonal population is notoriously difficult to estimate, Ocracoke is an island accessible only by boat, and the vast majority of visitors arrive by ferry service operated by the North Carolina Department of Transportation. Based on the recorded number of people taking the ferry to the island, as well as other factors such as utility consumption and emergency management calls, it is possible for officials to gain a fairly accurate picture of the number of people visiting and staying on the island during peak seasonal periods. Based on 2000 Census data, Ocracoke Island had a total population of 769 people and 844 housing units, or 96.9 housing units per square mile. However, these figures are misleading, since all residential development on the island is in the Ocracoke Village community, which comprises the 775 acres (1.21 square miles) not included in the Cape Hatteras National Seashore, or is otherwise undevelopable. This means that Ocracoke Island, which has maintained a steady permanent population of roughly 769 since the year 2000, has a housing density of 697.5 housing units per square mile. According to the *Hyde County CAMA Core Land Use Plan* (2007b), these units, along with substantial commercial, hotel and recreational construction, house a peak seasonal population of approximately 10,000 people, an increase of over 13 times that of the permanent population. A similar example is Nantucket Island, MA, which supports a permanent population of approximately 8,520 people. In the summer the population grows to approximately 40,000 people and represents the third fastest growing community in Massachusetts (Massachusetts Office of Energy and Environmental Affairs 2011).

As in many of America's coastal areas, rapid population increases in the North Carolina coastal zone have degraded the quality of its coastal resources. Over this time period, the

American Southeast region, which includes North Carolina, South Carolina, Georgia and Florida, has experienced the largest rate of population increase of any coastal area (Crossett et al. 2004; Environmental Protection Agency 2008). As outlined by Crossett *et al*., the Southeast region exhibited a 58% increase for the period from 1980 to 2003. This region has increasingly become a leading destination for retirees and job seekers. Between the years 1995 and 2000, the U.S. Census Bureau reported that the highest levels of migration were to states that fall within the Southeast region, particularly to Florida, Georgia and North Carolina (Franklin 2003). As noted in the Environmental Protection Agency's *National Coastal Condition Report III* (2008: 107) "Given the influx of people and businesses to southeastern coastal states and the ensuing pressures on the coastal zones of this region, there is increased need for effective management of the region's resources."

According to 2005 U.S. Census estimates, net migration into the State of North Carolina is the fifth highest rate in the nation, and the State's overall growth rate is the sixth highest in the nation. While the majority of the population still resides in the center of the State (particularly in the Charlotte and Raleigh/Durham regions) the coastal area has experienced a dramatic increase in permanent population. While growth rates vary from county to county as well as regionally, the North Carolina counties closest to the coast have experienced growth rates in permanent population up to six times higher than the state-wide rate (Brower et al. 1989). Further, the steady growth of the Charlotte and Raleigh/Durham regions has a direct relationship to the seasonal/temporary coastal populations, as either of these metropolitan areas is only a few hours from the coast.

Within the North Carolina coastal zone, Brunswick County provides an interesting microcosm of the development pressures facing the entire coastal zone. Brunswick County is the southeastern-most county in the State, and is situated between the rapidly growing metropolitan areas of Wilmington, NC and Myrtle Beach, SC (it is part of the Wilmington Metropolitan Statistical Area). Representative of many North Carolina coastal areas, the County is very low in elevation, contains a great deal of fresh and saltwater wetlands, and has been an initial landfall for numerous tropical storms. Historically the county was sparsely populated and natural resource production drove the economic and social structure. In 1970, the county had a population of approximately 24,223. U.S. Census numbers released in 2010 set the permanent population at 107,431, which made Brunswick County the 37th fastest growing county in the

nation – a position it had maintained for four straight years. However, these statistics generally do not capture seasonal and temporary populations. The 2006 Brunswick County *State of the County's Health* Report estimated that the population of the county increases to approximately 180,000 with permanent residents and peak season tourists, though these numbers aren't reflected in Census statistics. In 2007, the Brunswick County Economic Development Commission (2007a) estimated the peak seasonal population as 190,480, with the majority of this population staying in the barrier island beach communities and the numerous golf course developments.

2.3.3: Impacts of Coastal Population

While population statistics are commonly used to measure the magnitude of impact to the environment, scholars note that environmental impact is actually a product of population, affluence and technology (I=PAT). The I=PAT equation, though phrased mathematically, is a simple conceptual expression of the factors that create environmental impact. In words, this formula describes how the human impact (I) on the environment equals the product of population (P), affluence (A) and technology (T). This equation was developed in the 1970's during the course of a debate between Barry Commoner, Paul R. Ehrlich and John Holdren. In his seminal work *The Environmental Cost of Economic Growth* (1972), Commoner argued that environmental impacts in the United States were caused primarily by changes in its production technology following World War II. In contrast, Ehrlich and Holdren (1971) argued that all three of these factors were equally important, and emphasized the role of population growth in particular. Passing over more complex models, I=PAT has been chosen by many scholars in both the natural and social sciences as a starting point for investigating interaction of population, economic growth and technological change.

By most accounts, impacts to coastal ecosystems have occurred at rates far exceeding population growth. For example, measures of land consumption indicate rates that are more than twice the rate of population growth (Beach 2002). As coastal areas become more crowded, the development in these areas becomes more spread out and "suburban" in nature. Per capita, coastal residents consume more land, drive more, boat more and generally use more resources than their inland counterparts (Culliton 1998). Although increased consumption of resources has been documented nationally, it is exaggerated on the coast, which tends to be wealthier than the nation as a whole.

With more than half of the US population and 60% of the world population living in the coastal zone, and coastal ecosystems are under constant pressure from development and exploitation (National Oceanographic and Atmospheric Association 2002). Greater urbanization and industrialization associated with these large and growing populations are responsible for an array of estuarine impacts, including declines in water quality, loss of habitat, and decreased biodiversity far beyond a metropolitan area's boundaries. Further, trends indicate that the size of cities is increasing faster than population growth thus intensifying the effects of urbanization on estuarine resources (Grimm et al. 2000). Short of drastically curbing population growth, it seems that the main challenge to estuarine ecosystem management is to balance coastal development with the maintenance of clean, functional, and sustainable ecosystems (National Oceanographic and Atmospheric Association 2002). According to Kennish (2000: 2), "most of these [impacting estuaries and coastal systems] problems are directly coupled to poorly planned coastal development, pollution, and accompanying modification and destruction of habitats."

2.4: Coastal Management

Since humans populated the coast, their activities have changed the environment and affected the functions and services important to ecosystems. The history of coastal management began with the choices made by small populations such as the placement of leftover oyster shells or the location of pathways through the marsh to get to high ground. Later management decisions were based on more formal environmental philosophies often originating through religious paradigms. More recently, environmental advocates such as Henry David Thoreau and John Muir brought a more secular form of environmental advocacy. Throughout the 19th and 20th centuries, progress continued to protect wild and significant natural areas of the country. With the support of President Theodore Roosevelt, the formation of the National Forest and National Wildlife Refuge systems marked the beginning of environmental protection as a policy agenda.

The history of U.S. coastal policy and management is best understood as a dynamic process, whereby competing coalitions work together to produce plans, policies, programs and actions that affect the conservation and development of the coastal areas and resources. In the 20th Century, the earliest expressed public interest in the management of the nation's coasts focused primarily on recreation. According to Zile (1974: 236-237):

> The combination of more time away from breadwinning work, a generally prosperous economy, and a popular feeling that leisure should not be wasted, created a demand for places where people could feel that they were having a good time… outdoor recreation moved up to among the top ten economic activities of the nation by the mid-1960's.

However, new concerns emerged alongside the agitation to save the shorelines for recreation. Rachel Carson's *Silent Spring* (1962) alerted the country to land use practices that harmed the environmental and warned of threats to human health. When the Cuyahoga River caught fire in Cleveland, OH on June 22, 1969 (the last in a series of fires), a major response was the enactment of the Clean Water Act or Federal Water Pollution Control Act Amendments of 1972. According to Zile (1974: 241), the new concerns raised by these and other events entered politics as "a set of proposals for protecting the most critically endangered coastal habitats, the estuaries." The passage of the Clean Water Act marked the first time the federal government provided a structure for regulating point source pollution discharges into local water bodies, and was also the first environmental regulation to place heavy burdens on local governments (Gerlak, 2005).

Also in 1972, the Coastal Zone Management Act (CZMA) was passed to provide protection for coastal shores and waters from pollution and overdevelopment. As the U.S. and coastal populations increased, changing philosophies and recognition that the coastal areas were not simply wastelands for dumping industrial and household waste resulted in legislation that continues to guide and influence state and local governments in their use of environmental resources. The CZMA emerged from an intense national re-evaluation of the effectiveness of U.S. environmental protection and land use planning. While comprehensive national land use policy was discussed at the time, coastal management became the narrower alternative to federally mandated land use planning and regulation. The CZMA was written with the recognition that the coastal zone has a host of unique characteristics, problems, and management needs that seemingly had "outrun the abilities of local governments" (Godschalk, 1992: 97).

2.4.1: Coastal Area Management Act of 1972

Population and economic forces have placed great strains on the nation's coastal waters and adjacent shorelands. From the declaration of Pelican Island in Florida as the first National Wildlife Refuge to the efforts to restore Chesapeake Bay, many of the earliest and oldest efforts to protect water, species and unique landscapes have occurred along the nation's coastlines. According to Godschalk (1992a), the Coastal Zone Management Act (CZMA) of 1972 emerged

from an intense national re-evaluation of the effectiveness of U.S. environmental protection and land use planning, in which some argued that coastal management was just one component of the larger land use policy arena. This re-evaluation was prompted by many related interests, including advocates of outdoor recreation, marine resource development, estuarine pollution and land use policy, whose disparate goals combined to form the final legislation. While Godschalk (1992) points out that the political will for national land use legislation never materialized, the CZMA was seen as a narrower alternative, and provides a framework for intergovernmental implementation and land use planning that is unparalleled in federal regulation.

The CZMA was enacted by the 107th Congress in recognition of the many ecological, cultural, historic and aesthetic benefits of the coastal zone and the need to effectively manage these resources. As noted in Section 1451 (c) of the legislation:

> (T)he increasing and competing demands upon the lands and waters of our coastal zone occasioned by population growth and development, including requirements for industry, commerce, residential development, recreation, extraction of mineral resources and fossil fuels, transportation and navigation, waste disposal, and harvesting of fish, shellfish, and other living marine resources, wildlife, nutrient-rich areas, permanent and adverse changes to ecological systems, decreasing open spaces for public use and shoreline erosion.

As such, along with other coastal protection and guidance measures, the CZMA requires coastal states to help local governments develop plans for land use that will guide growth while protecting the integrity of coastal waters and wetlands. These plans, alongside local laws that guide development, are drawn and implemented by a wide variety of local, regional and state officials.

The CZMA was relatively broad and simple. It declared the following as national policy in Section 1452 of the legislation:

a. (T)o preserve , protect, develop, and where possible, to restore, to enhance, the resources of the Nation's coastal zone for this and succeeding generations,
b. to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve the use of the land and water resources of the coastal zone giving full consideration to ecological, historic, and esthetic values as well as to needs for economic development,
c. for all Federal agencies engaged in programs affecting the coastal zone to cooperate and participate with state and local governments and regional agencies in effectuating the purposes of this title, and

d. to encourage the participation of the public, of Federal, state, and local governments and of regional agencies in the development of coastal zone management programs.

As outlined in the 1972 legislation, and refined in subsequent iterations, coastal management under the CZMA is not simply top-down control nor bottom-up decision making. Rather, the process is a complex combination where leadership roles and policy initiatives shift over time. The dynamics are based on consensus-based policy goals and competition among stakeholders on the specific means to achieve them (Godschalk 1992a). This system is inherently adaptive, experimental and collaborative in nature, which Mazmanian and Sabatier (1989) note has been relatively successful in managing the nation's coastal areas.

To take advantage of federal assistance, states began to establish coastal zone management programs and sought citizen participation in their programs. State coastal management programs were required to define the boundaries of the coastal zone, as well as acceptable development practices and areas of particular concern (Godschalk 1992a). In addition federal "consistency" provisions required all federal agencies to ensure that their licenses, permits and financial assistance are consistent with the approved state coastal management program (i.e. federal activities and development projects must be consistent with the state management programs). With passage of the CZMA, coastal zone management was fully underway. While there were critics on either side of the debate, many recognized that the collaborative nature of the legislation provided state and local governments with latitude in constructing a management regime, and ensured that federal agencies would respect state plans through the consistency requirements. Currently, coastal zone programs have been developed in 34 of the 35 coastal states. Only Illinois, with 63 miles of Lake Michigan shoreline, has failed to initiate a management program. In contrast, the State of North Carolina was one of the first states to establish guidelines for coastal zone management.

2.4.2: North Carolina Coastal Area Management Act of 1974

The United States Congress passed the CZMA in 1972, encouraging coastal states to preserve our coasts health by establishing programs to manage, protect and promote the nation's fragile coastal resources. Immediately after the passage of this Federal legislation, North Carolina began to develop a blueprint for protecting coastal resources. After years of studying and planning, the North Carolina General Assembly adopted the Coastal Area Management Act (CAMA)(NC Gen. Stat. 113A-100 et seq. 2001) in 1974. Coming in the middle of what Heath

and Hess (2007: 535) refer to as a period of "prolific environmental law-making," the Act was adopted in response to threats to the region's resources from poor development practices and pollution. The act created a comprehensive growth management program for cooperative state and local management of the 20-county coastal region bordering the Atlantic Ocean and the Albemarle and Pamlico Sounds (Figure 2.2)(Heath and Hess 2007). After two years of contentious debate (Heath and Owens 1994) and another two years of legal challenges from coastal property owners (Heath and Hess 2007) the final legislation included a regulatory permitting program for 'areas of environmental concern' (AECs); a state-mandated local land use planning program; a state land area acquisition program; and state-to-local grants for planning activities and technical assistance. The AECs consist of sensitive areas like shorelines and coastal wetlands, and comprise roughly 6% of the entire coastal region. In order to implement CAMA, the legislation created a political board, the Coastal Resources Council (CRC) to establish policies for the N.C. Division of Coastal Management within the Department of Environmental and Natural Resources. Under the planning component, local governments (i.e. counties and delegated municipalities) are required to produce plans that are consistent with administrative rules developed by the state's CRC; however, the act specifically prohibits the CRC from requiring that localities implement their plans outside of the AECs (NC Gen. Stat. 113A-100 et seq. 2001).

The State addresses environmental protection issues directly through the regulatory permitting program for AECs. Of all of the programs carried out under CAMA, the direct regulatory program generates the greatest amount of public debate and occupies the majority of the CRCs energy. Over the nearly four decades since the program's inception, the CAMA program has delineated areas in need of special protection, created a regulatory framework for implementing protective measures, coordinated related state and federal programs, and acted as a quasi-judicial body for contested matters. For the most part these areas consist of the coastal water bodies, immediate coastal shorelines, small shoreline buffer areas and coastal wetlands. In order to regulate and limit development in these sensitive areas, each North Carolina coastal county has a Local Permit Officer (LPO), who makes determinations of appropriateness and mitigation measures before issuance of permits for construction. Depending on the scope of development, either a minor or a major CAMA permit may be necessary before commencing work. CAMA regulations have been coordinated with other State and Federal programs, but

were never intended to replace other coastal regulatory programs. As such, CAMA streamlined and coordinated the application process though multiple permits are still required. While the streamlining of development permitting has been very successful, Heath and Owens (1994) note that substantive policy coordination between agencies has been less successful. One requirement of the federal coastal zone management statute is that federal actions be consistent with approved state coastal management plans. However, the CRC efforts to secure coordinated, consensus-based policies on issues such as coastal water quality have been difficult to achieve. Additional legislation introduced in 1989 further strengthened direct CAMA enforcement, created a coastal reserve system, and added new AECs for outstanding resources and primary nursery areas (Heath and Owens 1994).

Less directly, the State (through the CRC) regulates development by mandating local land use planning throughout the entire coastal region, rather than having a unified statewide coastal planning strategy. Prior to the adoption of CAMA, a majority of local governments in North Carolina's coastal zone had no land use planning programs or implementing ordinances. While contentious, the call for local planning came from local communities demanding an expanded role in CAMA, and an evolving recognition that comprehensive planning was necessary for effective coastal management. The planning program established by CAMA in 1974 created a state-local partnership that focused heavily on the involvement of local officials and interest groups. Guidelines set out by the CRC established the general framework of the plan, specified data to be collected, mandated public participation in the production of the plan, and encouraged periodic updates of the local plans to meet CRC requirements (Heath and Owens 1994). CAMA guidelines provided a framework for the plan and a process for plan preparation, but left substantive policy and implementation decisions to local officials. Within two years of the effective date of CAMA, nearly all of the counties many municipalities had adopted land use plans. Subsequently, more municipalities adopted CAMA land use plans, and continued financial support from the State guaranteed regular updates to adopted municipal/county plans. The state program has historically been enhanced by the funds and requirements of the federal program and in turn requires and funds local governments to develop coastal land use plans.

The National Oceanic and Atmospheric Administration (NOAA) approved the North Carolina Coastal Management Program in 1981. The perceived need to protect both natural resources and foster economic development is apparent throughout CAMA, and the mandate was

crafted to "strike a balance" between the environment and the economy (Norton, 2001: 177). North Carolina's mandate was crafted as a compromise between the perceived opposing needs of environmental protection and economic development. Despite early and regular success with the program, resource degradation and rapid development remained an issue in the coastal zone. A state blue-ribbon commission was convened in 1994 to report on the continued decline of North Carolina's coastal resources, and identified the need to improve the quality, implementation and coordination of local plans as one of the key mechanisms to reverse the decline (North Carolina Coastal Futures Committee 1994). These recommendations resulted in revisions to the CAMA land use planning guidelines [15A NCAC 7B] that were less complicated, required more thorough analysis of land suitability, and created "Management Topics" to guide the development of local policies. As noted in the *North Carolina Technical Manual for Coastal Land Use Planning* (2002) the revised guidelines require more in-depth analysis of natural systems and land suitability, and they call for policies that address specific requirements of land use Management Topic. In addition, the Management Topics require more extensive policy analysis than has been general practice in the land use planning program.

According to Heath and Owens (1994) the experience with land use planning under CAMA has been largely positive, in large part because of the active partnerships established between state and local governments, and the effort expounded to balance public interests in both development and the preservation of coastal resources. However, CAMA still faces challenges moving forward. Despite revisions to the CAMA land use planning guidelines, the inability to require local communities to implement the plan outside of the AECs hampers the ability to address coastal resources in a comprehensive manner. Further, continued environmental decline means that additional ecosystem management issues must be included in local land use plans (e.g. biodiversity, consistency/concurrency with other environmental programs, cumulative and secondary impacts of development, sustainable growth) to protect and restore natural resources. These issues present even more complicated technical and institutional hurdles than have been considered in the past.

2.4.3: The National Estuary Program

The National Estuary Program (NEP), managed by the Environmental Protection Agency (EPA), was created when Congress reauthorized the Clean Water Act in 1987. The program is a federally-sponsored pollution abatement initiative designed to identify nationally significant

estuaries threatened by pollution, development or overuse and to recommend management actions to restore and maintain the environmental quality of these natural resources. The development of the NEP, which currently encompasses 28 estuaries, was directly related to a public outcry over such issues as beach closures, fish kills and a deteriorating coastal environment. The decisions and activities of this program – unlike traditional regulatory approaches to water management – target a broad range of issues and engage local communities in order to encourage local responsibility for management of the estuaries. It is believed that this type of inter-organizational approach will help to foster the likelihood of long-term success because each stakeholder sees the results of his/her efforts. The program focuses not only on water quality, but also on maintaining the chemical, physical and biological health of the entire ecosystem – as well as its economic, recreational and aesthetic values.

Administration of each NEP includes a Management Conference convened by the Administrator of the EPA, which includes various committees that serve as the central components of the program. An Executive Director, a technical and outreach staff, scientific and technical advisory committees, and citizen advisory committees support the Management Conference. Consisting of representatives from local, state and federal government agencies, business and industry, citizens groups, and academic institutions working collaboratively on multiple environmental issues, the Management Conference is charged with describing the conditions of the estuary and developing a Comprehensive Conservation and Management Plan (CCMP). The CCMP includes a detailed report of the specific environmental conditions and development pressures facing the estuary, as well as strategies for conserving and managing the estuary's resources. The report must outline corrective actions to protect and improve the system, including specific goals, objectives and implementation strategies based on systematic, basin-wide assessments of pollution and other anthropocentric impacts. As noted by Wilson (2000: 17):

> A primary strength of the CCMP lies in the collaborative, stakeholder-driven consensus approach. Various stakeholders often have differing views about issues affecting their estuary-and about the best way to restore and protect that estuary-and working through those differences can sometimes be challenging. But ultimately, the CCMP process requires that all parties to the final plan must come to agreement on actions recommended in the CCMP and on working together to ensure effective plan implementation.

Key to the CCMP is the Implementation Strategy. Each NEP, building on existing programs and traditional water quality control measures, is expected to tailor corrective measures to specific communities, coastal watershed and related estuaries. Each program is tasked with addressing a whole range of environmental, economic, and social value problems facing the estuary and establishing a goal for dealing with each situation. Critical to this is building and sustaining long-term public support to carry out solutions that are agreed upon in the CCMP plan. While the EPA is directed to provide grants, technical assistance and management assistance to help state and local governments achieve the goals outlined in the plan, each NEP is required to identify a long-term funding strategy to support the program and implementation of the plan. As previously mentioned, there are currently 28 National Estuary Programs established throughout the U.S. Collectively the NEPs have created a significant knowledge base and wealth of experience in dealing with the problems that threaten the health of virtually all estuaries.

2.4.4: Albemarle-Pamlico National Estuary Program

In response the rapid decline of estuaries of national significance nationwide, U.S. Environmental Protection Agency (EPA) established the National Estuary Program (NEP) in 1987 to develop consensus-based management plans for large-scale water systems. In 1985, even before the National Estuary Program was officially written into legislation, the federal government and the states of NC and VA initiated the Albemarle Pamlico Estuary Study (APES). APES was a 3-stage process undertaken to inventory environmental conditions, recommend a new management framework, and develop strategies for implementing estuarine restoration. The APES was the precursor to the Albemarle-Pamlico National Estuary Program (APNEP), which was among the first National Estuary Programs established in 1987. APNEP is a partnership of the U.S. Environmental Protection Agency (EPA) and the North Carolina Department of Environment and Natural Resources (NC DENR), in cooperation with the Virginia Department of Conservation and Recreation (VA DCR). Section 320 of the Clean Water Act directs EPA to develop plans for attaining or maintaining water quality in an estuary. This includes: (1) protection of public water supplies, (2) protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife, (3) allowance of recreational activities, in or on water, and (4) the requirement of point and nonpoint source pollution controls (Natural Resources Leadership Institute 2004). After years of study and consensus-based ecosystem planning, the APNEP Comprehensive Conservation and Management Plan (CCMP)

was ratified in 1994 to meet the goals of Section 320 (Wilson, 2000). The mission of APNEP is to identify, restore, and protect the significant resources of the Albemarle-Pamlico Sounds. In order to achieve this mission, the CCMP contains five management plans that address regional concerns: Water Quality, Vital Habitats, Fisheries, Stewardship and Implementation.

A unique environmental protection program, APNEP targets a broad range of issues including improving water quality in the estuary while maintaining the integrity of the whole system. Much like the CAMA planning mandate, the APNEP CCMP distinctly strives to balance the chemical, physical and biological properties of the estuary with the economic, recreational and aesthetic values through partnerships and community involvement. The geographic scope of the program includes 36 North Carolina counties and 19 counties and incorporated cities in southeastern Virginia (Figure 2.4). The area includes 5 major river basins – the Chowan, the Pasquotank, Roanoke, Tar-Pamlico, and the Neuse; and encompasses seven sounds – the Albemarle, Bogue, Core, Croatan, Currituck, Pamlico and Roanoke. At approximately 88,000 square kilometers (30,000 square miles), APNEP has the largest area of all of the NEPs (Natural Resources Leadership Institute 2004).

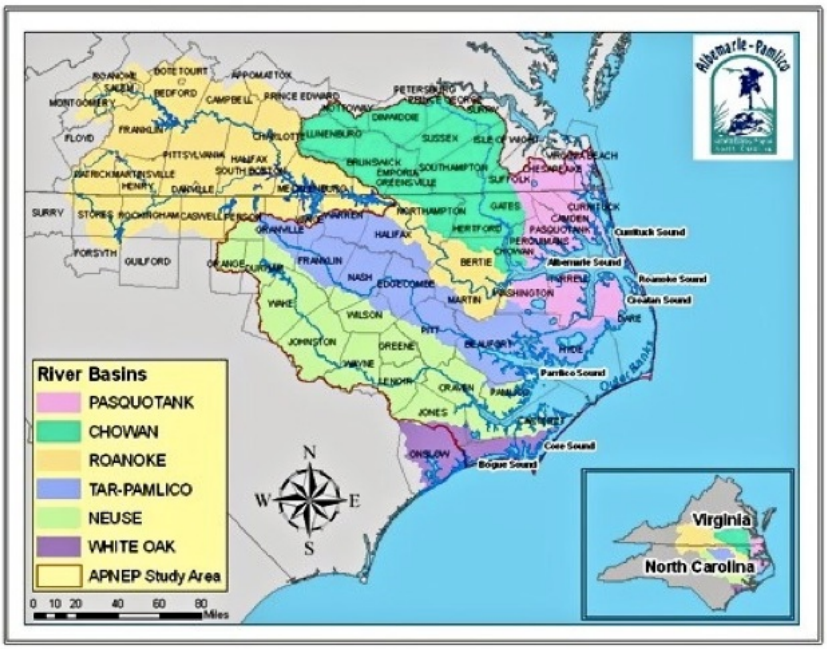

Figure 2.4: Albemarle-Pamlico National Estuary Program Boundaries
Source: Albemarle-Pamlico National Estuary Program

The organizational structure of the APNEP consists of six councils: five Regional Councils – one from each major river basin – and one Coordinating Council. The five regional councils were set up in 1997 to foster public input and advise/consult with environmental management agencies on river basin issues and the implementation of management programs. While operating somewhat autonomously with regard to developing and implementing strategies for local action, the regional councils are responsible for providing direction on projects and funding levels to the Coordinating Council, and documenting progress to APNEP program administration. The 29-member Coordinating Council is tasked with devising program policy, and guaranteeing interagency coordination and local government input. The Coordinating Council both advises and consults with the Regional Councils, and is responsible for documenting progress on CCMP priorities to NC DENR and US EPA. In addition, the APNEP has a program administration staff responsible for coordination, planning and successful implementation of the CCMP. Administered through the Office of Conservation and Community Affairs in the North Carolina DENR, APNEP has staff located throughout the State to address the various needs of the program.

Like other estuaries, the Albemarle-Pamlico system face both challenges and opportunities. Some of the environmental problems include over enrichment of nutrients, pathogen contamination, toxic chemicals, alteration of freshwater flow, loss of habitat, declines in fish and wildlife populations, and introductions of invasive species, all of which cause declines in overall ecosystem health. In its CCMP, APNEP (like most other NEPs) cite development and excessive use (such as greater riverine traffic) as the greatest threats to water quality. The CCMP identifies nonpoint sources, including forestry, construction, agricultural and urban runoff as significant contributors to water quality impairment in the system (Albemarle-Pamlico National Estuary Program 1994). The Albemarle-Pamlico Estuary region is one of the fastest growing non-urban areas in the country. Encompassing an area that has seen steady growth since the 1970's, population estimates in the region are approximately 3 million people as of the year 2010. The nature of development and expansion has been largely determined by a high-demand and restrictive development environment along the coast and sound areas, and largely uninhibited development in the inland counties of NC. In order to protect and restore water quality and vital habitats in the Albemarle-Pamlico estuarine system, the CCMP specifically calls for regional/ecosystem-based planning for each of the watersheds and APNEP-

sponsored local planning outside of the coastal zone (Albemarle-Pamlico National Estuary Program 1994: 131)

From its inception, the process of APNEP program development and implementation was based on the rational planning model. Goals and objectives were first identified, data collection programs were initiated, alternate management strategies were identified, and program and planning choices were made. The ultimate formal product of the program development process was the CCMP that all agencies and interest groups agreed to before it was ratified by the State. In reality, the program's evolution has not been so linear. From the beginning, information management and data collection have been key aspects of the APNEP. While there was a strong push to understand population growth and development demands in the region early on, water quality and habitat inventories have dominated information development. In 2002, an Implementation Review conducted by the US EPA determined inadequate progress in the implementation of the CCMP, which required an update to the CCMP program objectives and the operating structure. Completed in 2004, the changes to the program included the addition of Scientific and Technical Advisory Committees, as well as the addition of staff to assist Regional Councils with project implementation.

2.5: Local Comprehensive Planning Framework

In North Carolina coastal counties and municipalities, Coastal Area Management Act (CAMA) Land Use Plans are completed by the community or for the community by the State. In the CAMA plan, six management strategies must be addressed: public access, land use compatibility, infrastructure carrying capacity, natural hazard areas, water quality, and consistency (Farris 2002). Plans must also effectively guide development and land use in a manner consistent with CAMA goals, and if a policy has a negative impact on one of the management goals, then the plan must include additional policies that address ways to mitigate the impacts. As outlined by Dalton and Burby (1994), the CAMA planning mandate is moderately strong, requiring consistency between local plans and state goals, and between regulations and plans.

CAMA Comprehensive plans in North Carolina include all of the physical and human attributes of current communities (demographics) and their needs for future development. Elements generally include existing land uses, projections and analysis of future need for land,

and an analysis of developable land (suitability analysis). Plans completed under the CAMA requirements also include an environmental vulnerability component as a component of coastal resiliency. The concept of resiliency is more prevalent in newer plans, and is closely aligned with the concept of sustainability. Resiliency as it is addressed in the CAMA plans generally encompasses the community's ability to overcome coastal change such as storms, sea level rise and development while maintaining a high quality of life. This broad interpretation of the term allows it to span a variety of disciplines, and therefore it fosters an integrated approach to help coastal communities plan to maintain the quality of their environment, as well as their safety within it (Brand and Jax 2007). While CAMA plans tend to be very thorough, and include all of the aforementioned best planning practice, they are not statutorily binding. Without enforcement, it tends to be difficult to hold decision-making bodies to the plan. In addition, rapid population change has challenged the ad hoc community decision-making that has long occurred in small communities.

Despite attempts to implement regional and statewide planning mandates for the entire State of North Carolina (Heath and Hess 2007), land use planning is only required in coastal jurisdictions, thus comparison of planning by North Carolina's coastal, Piedmont, and mountain communities is informative (Dalton and Burby 1994). Without a mandate, communities outside of the coastal zone are not required to complete a comprehensive plan, and there is no requirement for consistency between local plans and state goals or between regulations and plans. While many of the more rural areas do not conduct or maintain comprehensive plans, rapid population throughout the State has seen many municipalities and regions conduct extensive planning efforts. In addition, there are many different types of resource management plans across the State (e.g. watershed plans, regional ecosystem plans, and open space preservation plans) that provide a basis for city and countywide land use and resource management decisions. In this sense, comprehensive plans are an important tool throughout the State for accomplishing many of the goals of ecosystem management because they are the starting point for specific ordinances, land development codes, and environmental activities at the local level. They often incorporate and implement the goals and objectives of more regional environment activities such as the APNEP CCMP. Most importantly, as noted by Brody (2008: 7) comprehensive plans are where the "rubber hits the road" when it comes to managing critical natural habitats and ecological processes over the long term. If ecosystem approaches to

management are going to be effectively implemented, they must be rooted in the local policies guiding development decisions.

In support of these types of efforts, State legislation enacted in 1969 created regional councils, which provide organizational support for 17 multi-county planning and development regions in the State. These Regional Councils are forums where local officials determine priorities for the larger area in which there communities are located. While these are non-governmental bodies, their mission is primarily to support land use, transportation and environmental planning at a regional level. These organizations carry out approved programs and policies, and provide local governments and agencies with planning grants and technical assistance.

2.6: A Laboratory for Studying Ecosystem Planning and Management

As outlined, the State of North Carolina has a combination of institutional, regulatory, geographical, and biological characteristics that make it an ideal setting within which to examine ecosystem planning at the local level. Although the CAMA mandate only requires an ecosystem approach to management for the coastal area, strong support for land use planning and a wealth of resource management plans provide non-CAMA communities an opportunity to implement the principles of ecosystem management. North Carolina also contains ecosystems that have been identified for preservation and restoration, fragile coastal environments, and intense pressure for development statewide that will allow me to test the feasibility of using local planning to advance the concept of ecosystem management.

3: Planning for Ecosystems: Foundations, Theories and Evidence

3.1: Introduction

Because ecosystem approaches to planning require an understanding of natural sciences, as well as political, social and economic contexts, it is necessary to draw on a variety of literature sources to define key concepts and components. This review of literature provides a foundation for a better understanding of the major considerations when planning for ecosystems. In particular, the following three conceptual areas are examined: ecosystem science and its link to management; intergovernmental implementation and systems thinking; and collaborative planning. This lays the foundation for a review of plan quality literature, which is one of the methodological building blocks of this study. These literatures provide a theoretical framework in both natural and social sciences that support the practice of ecosystem management, and its connection to land use planning.

3.2: Ecosystem Management

> If there is one thing about ecosystem management upon which people agree, it is that the term means different things to different people. (Yaffee, 1998: 714)

Resource management is undergoing major changes; what Franklin (1997: 21) refers to as a "paradigm shift of massive proportions." Foremost among these changes is a shift from traditional management regimes to a more holistic, ecologically-based approach. Ecological system, or ecosystem management has emerged as the framework for meeting the technical and social challenges of natural systems while still recognizing the realities of human interaction and development. From federal initiatives to neighborhood collaborations, resource management agencies and non-governmental organizations at all levels are developing and implementing ecosystem management programs (Gerlach and Bengston 1994; Wondolleck and Yaffee 2000). While ecosystem management is not new, it has rapidly gained prominence as environmental degradation accelerates and knowledge of ecosystem function becomes more available.

3.2.1: The Evolution of Ecosystem Management

Ecosystem science and management are often seen as modern-day answers to address contemporary environmental issues. To a degree, an ecosystem perspective is new – at least some of the science and technology are new. However, it is also old - the concepts of holistic thinking, land stewardship, and maintaining a balance between people and their environment have been around for a long time. The concept of the ecological system, or ecosystem, was first

introduced by the English botanist Arthur G. Tansley (1935) who wrote of a holistic and integrative system characterized by the dynamic equilibrium maintained between living organisms and their environment. According to Cortner and Moote (1999) the work of Tansley and his contemporaries was greatly influenced by the emerging systems theory, which looked at any system (social, chemical or physical) as a whole made up of patterns of structure and behavior. In 1949 Aldo Leopold wrote his famous *A Sand County Almanac,* which encouraged people to take care of the land as a "whole organism" in an ethical manner so as to keep the system in good working order. Leopold, through his work with the U.S. Forest Service and the University of Wisconsin, recognized many of the interdisciplinary principles of ecology, economics and geography associated with modern-day ecosystem management. With Eugene Odum's 1953 publication of *Fundamentals of Ecology,* the concept of the ecosystem was transformed into the central unit for ecological analysis. As noted by Odum (1953: 10) in his justification for using ecosystems as a unit of analysis:

> Living organisms and their nonliving (abiotic) environment are inseparably interrelated and interact upon each other. Any area of nature that includes living organisms and nonliving substances interacting to produce an exchange of materials between the living and nonliving parts is an ecological system or ecosystem.

As a concept, an ecosystem is the complex community of organisms and their environment that work together as an integrated unit. In real terms, ecosystems are very complex *places*, where plants, animals, soil, water, climate, people and the processes of life and industry work together (or against each other) to maintain life. These systems are dynamic, changing through natural and man-made influence. Natural system classification or rigid guidelines for ecosystem boundaries rarely exist. Ecosystems vary greatly across complex gradients in space and time. Ecosystems can be as complex as the largest cities and as simple as a tidal pool.

While the literature on ecosystem science is vast, it contributes to the discussion of ecosystem planning by laying the natural science and ecological foundation necessary to understand how/why this approach differs from traditional land use or resource planning. In particular, the literature focuses on concepts essential to understanding ecosystem functions, and by extension how these concepts are integrated into management regimes. The literature on ecosystem science and management focuses on three key principles that must be considered

when constructing frameworks to address ecosystem problems. Christensen et al (1996) summarized these key principles in their report to the Ecological Society of America on the scientific basis for ecosystem management. This work helped to link ecosystem science concepts to the broad management framework. The following outlines the underpinnings of the ecosystem approach (Christensen et al. 1996):

1. Broad scales – Ecosystem function includes inputs, outputs, the cycling of materials and energy, and the interactions of organisms that all work at different temporal and spatial scales. Boundaries that are appropriate for the study or management of one process may be inappropriate for others. Thus an ecosystem approach to management requires a broad and adaptable view.

2. Structure, diversity and integrity – Ecosystem approaches seek to maintain biodiversity and complexity as critical components when strengthening ecosystems against disturbances. Management of biodiversity requires a broad perspective and recognition that the complexity and functions of any location is heavily influenced by the whole system.

3. Dynamicism – Ecosystems are dynamic in space and time. Over time many processes, both natural and anthropogenic, alter all or part of a landscape that need to be addressed by any management framework. The challenge for ecosystem management is to be adaptive and ever vigilant about improving understandings of natural systems.

These three principles provide insight into what is required to achieve effective ecosystem management. First, ecosystem management must consider ecological systems as a complex whole, and the components within the system in the context of relationships with each other and with other systems, rather than in isolation. Once the system has been broadly defined, it is important that management frameworks strive to maintain biodiversity by protecting critical habitats that protect the structure, diversity and integrity of the system as a whole. Finally, an ecosystem management approach must emphasize the need for systematic research, data collection, and monitoring; and be adaptive enough to change with changing ecological conditions (Franklin 1997; Grumbine 1994; Haeuber 1996; Wondolleck and Yaffee 2000; Yaffee 1996).

The ecosystem concept developed out of the science of ecology, but ecosystem science has broadened to include other sciences as well. While the underpinnings of ecosystem science started in the early- to mid-20th Century, by the 1970's ecosystem ecologists realized that they did not have the necessary expertise in disciplines like chemistry, geology, and hydrology to

fully study ecosystem functions. Further, as political interests and government funding placed a greater emphasis on the ecological impacts of development decisions, a more diverse cadre of scientific disciplines, including social sciences and economics, were integrated into the evolving discipline. Other synthesis disciplines, such as conservation biology and ecological economics, emerged concurrently to address the perceived shortcomings in each of these fields. Although there is debate among these disciplines as to the best way to achieve ecological sustainability, ecologists increasingly embrace the integrated and comprehensive nature of ecosystem science as critical to ecosystem management. Ecosystem science provides the tools for understanding the interconnections within and between landscapes.

3.2.2: A Political History of Ecosystem Management

Natural resource management has changed dramatically from its inception at the beginning of the 20th Century. Resource management was born out of a fear that valuable natural commodities were being lost. The relative disappearance of seemingly inexhaustible resources taught new lessons about blatant waste and helped create a whole new profession that focused on the sustainable uses of these resources. The birth of the Progressive political era at the turn of the 20th Century brought with it a new concern for conservation and public disgust of the excesses of modern industry.

Aided by President Theodore Roosevelt who made conservation a high priority in his administration, Gifford Pinchot, the first Chief of the U.S. Forest Service helped to develop a new approach to natural resources. His goal, which guided resource management for the first half of the 20th Century, was based on a utilitarian ethic and strived to produce "the greatest good for the greatest number for the longest time" (Dunsky and Steinke 2004). This form of resource management focused first on the wise and prudent use of resources, and employed a *multiple-use* approach that allowed the public to enjoy these resources until they were needed for production. Pinchot stated "the first great fact about conservation is that it stands for development" and that "the first duty of the human race on the material side is to control the use of the earth and all that therein is" (Dunsky and Steinke 2004). Pinchot's push for the efficient use of resources for current and future generations was part of the foundation for sustainable use, but still focused primarily on the exploitation of resources for industry over pristine environments, or the preservation of resources for their secondary benefits.

World War II and the post-war development boom saw an even more dramatic industrialization of natural resources. The Baby Boom, a robust economy, and a building frenzy as people migrated from farms and city centers to the suburbs witnessed heavy use of public and private lands and extraction of minerals. At the same time Americans were becoming more active, heading out into the great outdoors to enjoy public parks and lands at an unprecedented rate. By the late 1950's multiple-use paradigm was becoming strained as more and more resources were being extracted or impacted to facilitate development, and more citizens came to expect pristine conditions when they arrived on public lands.

During the 1960's and 1970's, resource management changed substantially. In particular, management shifted from a resource extraction/exploitation model to a landscape model that recognized the complexity of systems and the interconnected links between natural and social systems. Many credit the critical writings of Rachel Carson (on pesticides), Jacques-Yves Cousteau (on the condition of the world's oceans), Paul Ehrlich (on overpopulation), Lewis Mumford (on urbanization) and others with precipitating the Environmental Movement. However compelling these arguments may now seem, it is highly unlikely they caused rapid action considering the forces aligned against environmental policy. It is more likely that a general increase in the public awareness of environmental issues, coupled with a number of environmental disasters that made the public sensitive to disasters that previously may have had little publicity are what forced Congress to respond with legislation (Rome 2003). A huge oil spill in January of 1969 sent vast quantities of crude oil onto the beaches of Santa Barbara and neighboring towns; the burning of Cleveland's Cuyahoga River in June of the same year; fish killed by toxic dumps in the Hudson River; beaches fouled by garbage and medical waste; environmental concern grew as reports multiplied.

In 1969 the U.S. Congress passed the National Environmental Policy Act (NEPA) requiring all federal agencies to take account of environmental factors, and in rapid succession many more environmental laws followed. This period of frenetic law-making (often referred to as the Environmental Decade) was quite exceptional: it was contrary to the normal incremental approach which distinguishes most political processes. Rather than focusing primarily on the exploitation of resources, NEPA focused on the role of the Federal government as a trustee of the environment for future generations; the provision of healthy, safe and productive environments for all citizens; achieving a balance between population and resource use; among other more

balanced objectives than envisioned by Pinchot. By the early 1980's, the United States boasted one of the most comprehensive and longstanding environmental policy frameworks in the world addressing everything from water and air quality to endangered species and toxic waste. However, scientists and managers realized they were still not stopping the rapid decline of critical natural resources.

While Leopold and Odum made some of the greatest advances in thinking about systems-based land management in the early 20th Century, it wasn't until the early 1970's and later that ecosystem management began to be proposed as a model for natural resource management (Grumbine 1994). By the late 1980's an ecosystem approach to land management was supported by scientists, managers and others. Early programs and proposals focused on specific areas, such as the Chesapeake Bay (1983), Yellowstone National Park (1985), and the Everglades (1991) and emphasized the need for interagency cooperation to promote species conservation and viability. In 1988, James Agee and Darryll Johnson published their book, *Ecosystem Management for Parks and Wilderness,* which presented the first theoretical framework for ecosystem management. Agee and Johnson's framework was unique because it not only included general goals for ecosystem management, but also processes for achieving these management goals. The authors suggested that there are essential elements that set ecosystem management apart from traditional resource management methods. These elements include: ecologically defined boundaries, clear management goals, interagency cooperation, monitoring of management results, national support and leadership, a recognition of the complexity of the system and the impact humans have on ecosystems (Agee and Johnson 1988).

By 1992, Agee and Johnson's call for national support and leadership was being realized. In that year the U.S. Forest Service altered its resource-based management focus to include ecosystem management. As noted by Thomas (1996), the U.S. Forest Service was the first federal agency to adopt an ecological approach to the management of public lands. In 1992, Chief F. Dale Robertson stated that an ecosystem approach to management would be employed by the U.S. Forest Service to achieve sustainability in the national forests and grasslands. In 1993, Secretary of the Interior Bruce Babbitt announced that an ecosystem approach to management would be used to protect and restore habitat and endangered species populations in the National Park System. Together the Department of the Interior and the U.S. Forest Service

managed almost 700 million acres of land, well over one-fourth of the land in the United States (Gerlach and Bengston, 1994), indicating a significant shift in natural resource management.

By the mid-1990's, most Federal agencies with resource protection responsibilities had officially adopted ecosystem management as their management paradigm. While this was a dramatic shift, it should be noted that "ecosystem management" meant very different things to different groups. Yaffee (1998: 714) notes in his essay on the conceptualization of ecosystem management, "some said that when environmental groups heard the term *ecosystem management*, they heard *ecosystem*; when development and commodity interests heard the term, they heard *management*." This was no different at the Federal level. While providing guidance on various aspects of resource management, what the Federal government did not do was officially define ecosystem management as a concept. As such there has been much confusion about what ecosystem management is, and what an effective ecosystem management program looks like. While this often makes it hard to move forward, Hauebner (1996) points out that this may be the saving grace, as communities and stakeholders were allowed to define ecosystem management in their own terms and come to local consensus.

3.2.3: Defining Ecosystem Management

In the United States, ecosystem-based management developed in response to a widespread dissatisfaction with the traditional approach to land-use and natural resource management practices. Despite a shift toward ecosystem management in the natural resource community, a widely accepted definition has not necessarily emerged. This is not surprising considering it often takes decades for a single definition to emerge when a concise model is being formulated and implemented (Grumbine 1997; Hauebner 1996; Hirt 1994). However, there is broad scholarship, out of which comes a general consensus about the principles that define ecosystem-based management. Grumbine's seminal work "What is Ecosystem Management" (1994) was written to highlight an emerging framework of ideas and principles that practitioners could use as a working guideline in ecosystem management efforts. These themes, outlined in Table 3.1, were used to craft a working definition for ecosystem management upon which all others were built.

Table 3.1: Grumbine's Dominant Themes of Ecosystem Management (1994, 1997)	
Hierarchical Context	A "systems" perspective that recognizes multiple levels of biodiversity and the connections between all scales of a problem
Ecological Boundaries	Management requires working across administrative and political boundaries to define ecological boundaries at appropriate scales
Ecological Integrity	The conservation of viable populations of native species, maintaining natural disturbance regimes, reintroduction of native species, etc.
Data Collection	Ecosystem management requires more data collection (i.e. habitat inventories, species population assessments, etc.) as well as better management and use of existing data
Monitoring	Managers must track the results of their actions so that success or failure may be measured quantitatively
Adaptive Management	Adaptive management assume that scientific knowledge is provisional and dynamic, and focuses on management as a learning process that is flexible and continually needs to be adjusted
Interagency Cooperation	Using ecological boundaries requires cooperation between Federal, state and local management agencies, as well as private parties
Organizational Change	Implementing EM requires changes in the structure of land management agencies and the way they operate. This may range from simple (forming an interagency partnership) to complex (changing professional norms and power relationships)
Humans Embedded in Nature	People cannot be separated from nature. Humans are fundamental influences on ecological patterns and processes and are in turn affected by them
Values	Regardless of the role of scientific knowledge, human values play a dominant role in ecosystem management goals.

Ecosystem management has been proposed as a new approach to resource management, and a body of literature has developed describing various ideas about the appropriate goals and methods of such an approach. Summarizing much of this literature, Grumbine (1994: 31) sets forth a working definition as follows:

> Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term.

As stated, many government agencies have picked up on the evolving concept of ecosystem management and have developed definitions to guide their land management activities. For example, U.S. Forest Service Chief Jack Ward Thomas (1996: 704) describes ecosystem management as:

> A holistic approach to natural resource management, moving beyond a compartmentalized approach focusing on the individual parts of the forest. It is an approach that steps back from the forest stand and focuses on landscape and its position in the larger environment in order to integrate the human, biological and

physical dimension of natural resource management. Its purpose is to achieve sustainability of all resources.

Another example is the seven "pillars" of ecosystem management as outlined by the Environmental Protection Agency (EPA). Robert Lackey (1998: 5-8) writing for the EPA outlines the principles that guide EPA-led projects:

1. Ecosystem management reflects a stage in the continuing evolution of social values and priorities; it is neither a beginning nor an end.
2. Ecosystem management is placed-based and the boundaries of the place of concern must be clearly and formally defined.
3. Ecosystem management should maintain ecosystems in the appropriate condition to achieve desired social benefits; the desired social benefits are defined by society, not scientists.
4. Ecosystem management can take advantage of the ability of ecosystems to respond to a variety of stresses, natural and man-made, but there is a limit to the ability of all ecosystems to accommodate stressors and maintain a desired state.
5. Ecosystem management may or may not result in emphasis on biological diversity as a desired social benefit.
6. The term sustainability, if used at all in ecosystem management, should be clearly defined – specifically, the time frame of concern, the benefits and costs of concern, and the relative priority of the benefits and costs.
7. Scientific information is important for effective ecosystem management, but is only one element in the decision-making process that is fundamentally one of public or private choice.

Much like sustainability, the literature indicates that there may be as many definitions of *ecosystem management* as there are groups trying to define it. Grumbine (1997: 42) refers to this as the "politics of definition" which surround all new concepts. While there has been widespread support for its practice and implementation, the ways people understand ecosystem management is often related to their interests, values, and knowledge (Franklin 1997; Yaffee 1998). To regulatory and resource management agencies, adopting an ecosystem approach has meant shifting from a narrow perspective of managing a single resource (e.g. air, water, trees, or fish) to a broader perspective that focuses on all resources and human impacts (Hartig et al. 1998). To planners and development managers, implementing this approach has meant looking beyond specific jurisdictions and addressing regional environmental issues, such as habitat fragmentation and land conservation, in local land use plans (Brody 2003c).

3.2.4: Criticisms of Ecosystem Management

Despite a relative consensus about the broad principles and overarching goals of EM, there are serious challenges to implementation. As Gerlach and Bengston (1994) point out, many of the challenges for ecosystem management are raised in societal debates about the interactions of humans and the natural environment. These debates are informed by diverse and competing ideas, and are carried out in courts, legislatures, media, scholarly publications and conferences across the country (Cortner and Moote 1999; Gerlach and Bengston 1994). Inherent to these debates is a long cultural tradition of humans viewing themselves as separate from nature, and thus not required to think of the human impact on natural systems (Beatley 1994; Grumbine 1997).

Beyond the debate of the relationship between humans and the environment, ecosystem management is a concept based on ambiguous, uncertain, and rapidly changing information. Because ecological and social systems are complex, problems to be solved are often unclear or have multiple causes. Blanco (1994: 22) characterizes those intractable, seemingly unsolvable issues inherent to planning and environmental management as "wicked problems." Further, there is no single best way to implement an ecosystem approach for management. Each ecosystem presents a unique set of natural and socio-economic conditions, as well as stakeholders and institutions. As noted by Gerlach and Bengston (1994: 20), "when the ecological side of ecosystem management (with its potential for ever-expanding scale and systemic scope) interacts with its social side of participatory decision making (with its potential for ever-expanding participation), decisions will be extremely hard to reach."

The debate over how to operationalize the terms and values of ecosystem management also differs significantly (Christensen et al. 1996; Lackey 1998). One side of this debate views the restoration and maintenance of ecosystem health as the overarching goal of management (Grumbine 1994; Grumbine 1997). Another side of the debate views human needs as equally or more important than ecosystem health (Salwasser 1994; Zeide 1998). Yet another view of ecosystem management sees it simply as a process of interagency coordination and collaborative decision making to develop goals appropriate to the ecosystem in question (Keystone Center, 1996). Yaffee's (1998) study of the meaning of ecosystem management points out, however, that the confusion over the definitions and objectives of EM has concealed two important points:

that practitioners are moving ahead in spite of academic and policy debates, and; striving for some aspects of an ecosystem approach, as difficult as it might be, is better than the status quo.

Ecosystem management is founded on the principle of ecological sustainability, or preserving ecosystem integrity while maintaining benefits for human populations (Norton 1992). Ecosystem management thus presumes land use will occur, but proposes preserving or enhancing ecosystem integrity as a key component in development decisions. Ecosystem management therefore involves not only a dramatic shift in natural resource management practices, but also a fundamental restructuring of the historical practices of land use planning and development (Beatley 2000; Brody 2003c; Montgomery et al. 1995). Arguably, the most important of these involves tailoring development management to landscape conditions and creating a more symbiotic relationship between science and land use planning (Leopold 1949). Under present ecosystem management frameworks science generally precedes planning, and analyses tend to focus on broad resources (wetlands, forests, etc.) rather than specific projects. This approach makes it difficult for planners or development managers to obtain and translate vast quantities of information to specific cases (Cortner and Moote 1999). Therefore, Montgomery et al (1995) note that more effective ecosystem management will require the role of science to expand to include evaluating alternative scenarios against specific landscapes. Further, planning needs to recognize spatial and temporal scales over which natural systems operate. This presents a fundamental change from land use planning that is based on political boundaries and competition between jurisdictions. In fact, under current legal and regulatory systems effective ecosystem management may be a goal that is difficult to achieve.

While the literature on ecosystem management is vast, it tends to emphasize an understanding of ecological processes, rather than the social processes involved in achieving effective ecosystem management. Much of the literature tends to assume a high level of ecological knowledge, and often emphasizes "complete" information and/or scientific certainty - both unattainable goals. As such, decisions on ecosystems may be delayed in favor of more study, which can ultimately paralyze any action at all. Further, within the ecosystem management literature, there tends to be much less written about the collective choices that need to be made to improve ecosystem health. Salwasser (1994) notes that "ecosystem management is more about people than anything else." The ability to overcome the politics of land use and resource management, and achieve collaborative solutions is the key to successful ecosystem

management. Therefore, to fully understand how the concept of ecosystem management is linked to land use planning it is necessary to explore literature that examines stakeholder collaboration and organizational decision-making. In particular, this literature moves the "systems" concept beyond the natural environment to include the organizations that are operating within an ecosystem, and how these organizations can accommodate the effective management of complex natural systems.

3.3: Organizational Decision Making and Systems Thinking

As outlined by Grumbine (1994) and others, ecosystem approaches to management depend on collaboration across political, administrative and ownership boundaries. Ecosystem management units are defined ecologically rather than politically, which means greater coordination at all levels to achieve effective management of complex systems. In order to achieve effective ecosystem management, decisions must be made collectively since it is exceedingly rare that one jurisdiction would have control over all aspects of a system. As noted by Brody (2008: 21) in his study of ecosystem management in the State of Florida:

> While (this) natural system is intricately connected over broad spatial and temporal scales, the land use decision-making framework is limited to local jurisdictions and some limited input from regional planning councils. Uncoordinated local land use decisions have cumulative negative impacts on the system as a whole.

Ecosystem management requires a delicate balance of mutually defined social values and legal mandates to achieve environmental sustainability. Recognizing the diversity of opinion among social values and concerns, the literature on ecosystem management advocates open communication, information sharing and collaboration among all stakeholders to solve major environmental problems (Cortner and Moote 1999; Gray 1989). As such, the roles of historically separate groups may need to be redefined: scientists become educators and public relations specialists; resource managers become technical advisors proficient in the language of ecology; and all participants become responsible for ecosystem sustainability rather than maintaining a narrow, interest-based focus. To address these aspects so crucial to ecosystem management, the following provides an overview of the organizational decision-making literature, and how this body of work relates to ecosystem management. In particular I examine systems thinking as a conceptual framework, and more specifically the collaborative planning and intergovernmental

implementation literature to understand how these aspects of collective decision-making improve the ability to plan for ecosystems.

Resource managers and land use planners are regularly expected to anticipate the consequences of their actions and avoid unintended consequences without comprehensive information about the resources they are managing. As noted in the review of ecosystem management literature, this is due to a number of reasons. First, natural systems are complex, and while information is available to assist in decision-making it is often uncertain. Second, relevant information is often fragmented and scattered, making it difficult for managers and planners to utilize. Third, differing views of management (protection vs. production) often appear early on in the decision-making process as different people hold different values about how systems should be managed. Finally this uncertain, fragmented and conflicting picture of resource management can result in resource managers and planners continually dealing with symptoms rather than the underlying causes of management problems. However, a large body of literature proposes that solutions may be found in the application of *systems thinking* to understand the natural and social systems associated with natural resource and ecosystem management.

Systems thinking is a body of theory and methods intended to enable practitioners and researchers a better way to understand complex, nonlinear social and environmental systems. Initially utilized by technical model builders, it evolved at MIT in the 1970's and 80's to provide a basis for tools and processes aimed at accelerating organizational learning. Under this mode of thought, individuals working within organizations must acquire systems thinking approaches to management, where individuals are able to step back and view a whole system before making management decisions. The overarching goal of systems thinking is to develop a common language and way of collaboratively conceptualizing complex policy and strategy issues (Senge 1990). According to Senge (1990) systems thinking stands in contrast to positivist or reductionist thinking because it concerns the understanding of a system's linkages and interactions (both human and ecological) underlying natural resource problems. Senge (1990) posits that systems thinking requires a shift that enables individuals and organizations to see larger processes at work, and to see themselves as active participants in problem solving efforts.

Systems thinking is the process of understanding how things influence one another within a whole. In nature, systems thinking is the recognition that elements such as air, water, plants,

animals, etc. are an integrated network rather than a collection of individual elements. In organizations, systems consist of people, structures, and processes that work together to make an organization healthy or unhealthy. As noted by Grumbine (1997: 43) "systems thinking not only refers to conceptions of biodiversity; it embeds science in policy, politics and cultural adaptation as well." There are clear applications of systems thinking to understanding and planning for ecosystems. A consequence of ecosystem perspectives, which look at the interrelatedness of environmental issues within a system, is that these kinds of problems cannot be solved by traditional management regimes. Systems problems require individuals and organizations capable of seeing and addressing the issues facing the entire system (Grumbine, 1997). As noted by Brody (2008: 22) "having the ability to look at the entire ecological system, even if it extends beyond a planner's jurisdiction is a critical aspect to effectively managing ecosystems."

The result of a systems thinking approach to resource management is a *learning organization* (Senge 1990). A learning organization actively creates, captures, transfers, and mobilizes knowledge to enable it to adapt to a changing environment (Cohen and Levinthal 1990). The management structure and policies of a learning organization must be flexible and responsive to the changing conditions of complex systems. In practical terms, learning organization brings all players to the table (in this case planners, resource managers, property-owners, citizens, politicians, etc.) to mobilize and integrate knowledge from diverse sources to solve a problem or address an issue. Conversely, the learning organization must learn from mistakes and/or recognize when old solutions no longer apply and need to be adjusted. Thus, the key aspect of organizational learning is the interaction that takes place among individuals because this process is necessary for collective learning.

When it comes to managing ecosystems that are constantly changing over time, a planning or resource management agency must develop the characteristics of a learning organization. While this seems intuitive, the actuality of preparing plans and maintaining organizations that are capable of changing with the environment is very difficult. It is for this reason that systems thinking has attracted critical attention. Thompson and McHugh (2002: 87), for example, have argued that there is a tendency for a narrow 'management plus psychology' perspective that has little to do with real-life situations. In an attempt to produce a science of organizations, the authors contend that the main focus has been on identifying generalizations about behavior in work situations and applying them to all organizations, regardless of their

nature. In particular, they contend that theorists have paid scant attention to the differences between organizations that are subject to market forces and those which are not. Further, the literature falls short when it comes to understanding how to accomplish sweeping changes and set up alternative scenarios. Thompson and McHugh (2002) contend that this has resulted in a massive - but vague and over-theoretical - body of literature with little practical value.

Regardless, systems thinking provides a basis for other concepts, such as intergovernmental implementation and collaboration, that offer the beginnings of alternative institutional design models to deal with ecosystem problems. Further, systems thinking introduces the idea that management of complex systems is a constantly evolving process rather than a linear process. These are all important concepts that lead to a more thorough understanding of what constitutes effective ecosystem management and what makes a high quality ecosystem management plan (Brody 2008).

3.4: Collaborative Planning

Natural resource planning in the United States has witnessed a marked shift toward collaboration in the last thirty years. In 1970, public involvement in natural resource management called for establishment of hearings, review-and-comment periods, and a flow of top-down information to the general public from agency decision-makers. Today, such processes seek the active participation of many parties in decision-making processes and in implementation partnerships (Wondolleck and Yaffee 2000). This shift is apparent at the federal level with regard to U.S. water policy, where collaborative efforts have emerged as the preferred tool to balance environmental concerns and consumptive uses. As opposed to the top-down, federally-driven approaches of the past, today there is a broad recognition of water policy becoming increasingly intergovernmental, place-based, collaborative, and experimental (Gerlak 2003). This is true for other environmental policy arenas as well, including mining control (Menzel 1989; Miller 1989), natural resource management (Wondolleck and Yaffee 2000), and habitat conservation/biodiversity management (Beatley 1994; Beatley 2000). The collaborative planning literature contributes to the principles of effective ecosystem management because it focuses on the people and processes of making land use and resource management decisions. Much like the intergovernmental implementation literature, this body of work focuses on collective decision-making and conflict management because in most cases no single entity has jurisdiction over all

aspects of an ecosystem. The need to involve varied interests and values into a single resource management framework is unavoidable if ecosystem management is to be achieved.

3.4.1: The Emergence of the Collaborative Planning Model

The discipline of planning emerged more than a century ago as a 'rational' discipline whose goal was to identify the common good and organize society in its image. The profession's roots in the Progressive reform movement were reflected in arguments for planning as a "fourth power" of government, promoting the general or public interest over narrow interests of groups or individuals (Klosterman 2001). As noted by Allmendinger (2002: 54) in his study of the development of planning theory, early planners looked to create a system of bureaucracy and rational decision-making that separated facts from values.

> The proper concern of rational decision-making should be with facts. Values, ends, goals and so on were the realm of politics… Formal rationality is concerned with means and efficiency. It is not related to ends. When given ends or objectives a formally rational approach will seek to meet those ends in the most efficient and effective way. If the end is to travel between A and B, then a straight line is the formally most rational way of doing it. Such means are based on logic or reason.

At the end of the 19th and beginning of the 20th centuries, it was perceived that the irrational forces of urban life – politics and poverty in particular – needed to be tamed through rationality and the rules of science. Planning was part of the means by which this could be achieved. It was assumed that "the state could 'take charge' and 'control' spatial organization and the location of development" more effectively and efficiently than others (Healey 1997: 5). Those who worked in public organizations such as planning agencies had the responsibility to act rationally and in an impartial and single-minded way towards the achievement of the 'public good'.

By mid-century, however, social scientists and even planners had begun to question many of the rational foundations of the profession and practice of urban planning. Large-scale planning efforts such as Urban Renewal, which encouraged local governments to seize privately held land for private development at a reduced price (subsidized by the federal government), were at the heart of many of this debate. Rather than taming the ills of urban areas, Urban Renewal earned the reputation of tearing cities apart, demolishing established neighborhoods that planners, politicians, and developers had declared blighted to make room for luxury housing and office complexes. According to Martin Anderson (1964), the author of the controversial book

The Federal Bulldozer, the ultimate result of the implementation of Urban Renewal programs in cities was that more homes were destroyed than were actually built, and that pre-dominantly low-rent dwelling units were demolished to be replaced by high rent ones. While the intent of Urban Renewal was to attract economic growth and provide housing stability in central cities, implementation resulted in displacement of poor, predominantly minority residents and use of vacated land mainly for commercial, high-rent residential and institutional purposes (Fainstein et al. 1986).

By the 1960's and 1970's, the criticisms of the large-scale planning efforts such as Urban Renewal, and the planning profession in general, were many. People galvanized to question the necessity for unbridled growth and wholesale urban restructuring. There was a gradual acknowledgment that the technocratic approach to addressing urban problems employed by planners and others had failed. Sandercock (1998) accuses planning in its technocratic mode of being anti-democratic, race- and gender-blind, and culturally homogenizing. As noted by Thorns (2002: 179) the 1960's and 1970's saw a growing critique of planning from all parts of the political spectrum, which argued:

> Planning, rather than a mechanism for social change and improved quality to the urban environment, was inherently conservative and more about maintaining the power and position of planners than meeting the needs of urban communities and diverse populations.

There was a considerable loss of faith in the practice of planning; and the profession struggled to find a rationale or theoretical base for its operation. Planning was increasingly attacked in the popular press, academic literature, and there was a general push to allow the market to correct the problems planning and Urban Renewal had created. Theorists advanced a series of critiques against the profession, and a rational planning model that pushed for a universally acceptable 'public good' (Anderson 1964; Gans 1965; Jacobs 1961; Mumford 1961). Rather than a single perspective, they called for a more inclusive process that took into account the diversity found in urban environments. Key to this new planning approach was a strong emphasis on public participation (Arnstein 1969). Lane (2001) notes that this closely paralleled conservation's response to ecological complexity and environmental change. Fainstein et al (1986: 219) refer to this phase in planning as the "confrontation period", which was marked by the eruption of the civil rights, antiwar and environmental movements in many urban areas. Just as the Progressive

reform movement had given rise to the profession of planning at the turn of the 20th century, the organization and prevalence of urban social movements in the 1960's and 1970's was to dramatically change planning and many other aspects of the urban experience.

Increasingly diverse theoretical perspectives have characterized urban planning since the 1980's. In contrast to modernist urban theory, which sought universal applications, contemporary urban planning theory generally embraces individuality and regional diversity. More often than not, these perspectives strive for equity, and incorporation of the values and norms of the community in planning efforts. No longer is the goal to "create a system of bureaucracy and rational decision-making that separated facts from values" (Allmendinger 2002:54), but rather to create joint decision-making approaches that emphasize collective action (Godschalk 1992b). This third phase, beginning in approximately the 1990's, has seen a partial recovery and new basis for planning with the emergence of the new agenda of sustainability and sustainable development (Campbell 1996; Thorns 2002). The report *Our Common Future* (1987: 8) from the United Nations WCED set forth the most common definition of the concept: "Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs." While on the surface sustainable development may seem like a simple concept, the ability to confront the challenges of reversing environmental degradation and reducing overconsumption and poverty has proven elusive. Beatley and Manning (1998: 3) note that within the planning profession "there is a general sense that sustainability is a good thing, but will… require definition and elaboration." Despite perceived shortcomings, efforts to translate the concept into practice have been high on local planning and political agendas for roughly two decades, and has again revived the idea that planning can be visionary and accomplished on a large scale.

3.4.2: Collaborative Planning for Ecosystem Management

At a theoretical level, collaborative planning is based in the notion of communicative rationality, which is a set of theories that try to explain human rationality as a necessary outcome of successful communication. These theories are tied to the philosophies of Habermas (1984) whose concepts of communicative rationality and communicative action reflect a consensus-building process built on interests; and Giddens (1984) who recognized the importance of forums in societal decision-making. In particular, Habermas' work resonates with collaborative planning because it provides a conceptual platform for the local community to mutually debate and reach

consensus on public issues related to land use planning and resource management. The work of theorists such as Gruber (1994), Innes (1996), Booher (Innes and Booher 1999a; Innes and Booher 1999b), Forester (1993) and others have drawn upon the concepts of communicative action and communicative rationality to develop the theoretical foundation for applied collaborative planning.

As it relates to resource management, definitions for collaborative planning efforts are as diverse as the resources they manage. They can be called public-private partnerships, ecosystem management, community-based environmental protection or alternative dispute resolution (Ryan and Klug 2005). Despite differences in name, several common characteristics define collaborative planning arrangements. Such efforts are generally place-based, cooperative and involve multiple parties (Wondolleck and Yaffee 2000). Often groups are organized from the bottom-up at a community level, and participation is face-to face and voluntary. Regardless of structure, almost all collaborative planning efforts are consensus-based (Brody 2008). Gray (1989) characterizes collaboration as a process whereby diverse stakeholders work together to resolve conflict or develop and advance a shared vision. Porter and Salvesen (1995) note that the concept of collaborative planning, like regional planning, was borne out of a need to address problems with greater than local significance. Collaborative environmental planning differs from traditional regional planning, however, in its focus on conflicts between development and the protection of natural resources in an area such as an estuary or watershed rather than an area defined by a metropolis or political boundaries. Ideally, such collaborative planning efforts offer something for everyone in areas where intense development pressures collide with strong interests in natural resource protection (Innes and Gruber 2005; Porter and Salvesen 1995).

3.4.3: Collaboration for Conflict Resolution

Two decades ago, the field of dispute resolution largely focused on settlement of intensive conflicts through short-duration intervention (Bacow and Wheeler 1984). Today, the field is moving toward more pre-emptive conflict management work, where processes seek to build long-term relationships and establish the groundwork for collaborative action (Wondolleck and Yaffee 2000). Previously, natural resource management focused on management of isolated public land management units, where agency decision-makers relied on technical models to maximize production of a narrow set of goods (Wondolleck 1988). Today, management is moving toward an ecosystem-scale perspective where agency officials collaborate with a range

of groups to manage for a broad set of values across a fragmented landscape (Johnson et al. 1999).

As noted by Brody (2008: 25), the field of conflict resolution "offers specific tools and techniques to facilitate conflict management, such as appropriate forums, the use of a single text (this would be the plan in the study), and the use of a third party as a mediator or facilitator." Since ecosystem management and planning are, by definition, exercises in conflict management; conflict management techniques such as information sharing and alternative dispute resolution processes contribute to an understanding of how to plan for ecosystems.

3.4.4: Challenges to Collaborative Planning for Ecosystems

By all accounts, collaborative planning processes are challenging. As it relates to ecosystem management, collaborative planning requires conflicts to be resolved and decisions to be made across ecological, political, generational, and property boundaries. While all resource management decision-making can be contentious, when management divisions are defined ecologically rather than politically, even greater coordination is required between all agencies involved. As noted by Cortner and Moote (1999), collective action on this scale requires the acquiescence, if not active support, of a broad array of organizations and individuals. From a purely practical standpoint, if any of these stakeholders disagree or feel their needs are unmet by an ecosystem management plan, there is little chance for plan implementation. Studies of collaborative conservation observe that collaboration in practice has focused primarily on land use planning to achieve environmental goals (Duerksen et al. 1997; Koontz 2005). In particular, Koontz (2005: 460) notes "governments and citizens have sought, through land use planning, to combine the interests and insights of multiple stakeholders to develop plans for watershed management, habitat protection, farmland preservation, and other purposes."

The growth in collaborative efforts has been matched by a growth in research examining the process. Much work has focused on the role collaboration plays in resource management, and what factors are associated with its rise in popularity (Cortner and Moote 1999; Grumbine 1994; Wondolleck and Yaffee 2000). Another body of work has focused on developing theories of and evaluation techniques for collaborative efforts (Connick and Innes 2003; Innes and Booher 1999a; Innes and Booher 1999b; Innes and Booher 2004). Still more empirical studies have looked at collaboration with an emphasis on the characteristics of the planning process and contents of resulting plans (Conroy and Berke 2004; Koontz 2003).

While planning processes are important in their own right, one cannot fully understand the results of collaboration unless you look beyond the plans to implementation. In this respect, the research on collaborative planning and it reliance on land use plans is more limited. Laurian et al (2004) note that comprehensive plans are often characterized as lengthy documents that are little used. Talen (1997) observes that there are relatively few studies about the implementation of local plans, and thus practitioners know little about whether plans make a difference in development management. However, there is a large body of work that examines the factors affecting implementation of local plans. When theorizing on what influences plan implementation, Talen (1997) distinguishes between the internal and external factors of implementation. The internal factors of plan implementation include the planning process itself, flaws in planning goals, and the weakness or complexity of plans. To date, empirical studies have primarily focused on planning goals, or plan quality, as an internal determinant of plan implementation (Berke et al. 2002; Berke et al. 1997; Brody and Highfield 2005; Dalton and Burby 1994).

External factors influencing plan implementation, as identified by Talen (1997), include complexity of local political context, uncertainty in the issues at hand, and a lack of support for or commitment to planning. As already noted, ecosystem management faces serious challenges to implementation because of the inherent uncertainties and ever changing understanding of the issues. Its strength, and also its weakness, is the need to coordinate and agree on the importance of regional environmental issues at the local level. Burby and May (1998: 96) refer to this as the 'commitment conundrum', whereby local governments lack the interest or will to take on large-scale environmental problems. Researchers and policy makers have proposed intergovernmental policies to address the commitment issue. However, as Dalton and Burby (1994) point out, local governments are often reluctant to partner in intergovernmental arrangements, and can impede efforts to accomplish environmental goals through management of land use.

3.5: Intergovernmental Mandates and Ecosystem Planning

Perhaps the most difficult aspect of planning for ecosystems is changing the 'systems' of land use policy and political fragmentation to manage growth. While the goals and objectives of ecosystem management appear sound and logical, and are agreed upon in theory, the critical challenge for land use and environmental management involves reconciling the conflicting goals and uses of land (Beatley and Manning 1997; Dale and Haeuber 2001; Platt et al. 1994). Diverse

goals for the use of land include resource-extractive activities such as forestry, agriculture, fisheries, and mining; infrastructure for human settlement including housing, transportation, and industrial centers; recreational activities; services provided by ecological systems such as flood control, water supply, and pollution filtration; support of aesthetic, cultural, and religious values; and sustaining the composition and integrity of natural systems (Dale and Haeuber 2001). These visions often conflict with one another, and difficult land use decisions develop as stakeholders pursue different land use goals. Local versus regional or broad-scale perspectives also provide different views of the implications of land use and ecosystem management. According to Godschalk (2004: 5):

> Twenty-first century land use planning faces both an opportunity and a threat. On the one hand, it is widely counted on and expected to deliver both sustainable development and livable communities. One the other hand, it must cope with serious conflicts in the values related to these beguiling visions, which represent the big visionary ideas of contemporary urban planning.

In addition to the difficulties associated with the varying goals and uses of land between private landowners, there is also the need to reconcile environmental and regional management issues with the more parochial practice of local land use planning.

Platt (2004: 335) contends that "privatism and localism are the twin sacred cows of land use and development in the United States." While some states have enacted laws requiring local governments to plan for growth, the majority of states leave the decisions of how, and if land use planning will be done to local authorities. In large, multi-jurisdictional metropolitan areas, governing bodies are highly fragmented and are based on a home rule system. Each is given authority by the state to determine its own land uses, development practices, and management strategies. Along with this autonomy, jurisdictions are also expected to be financially solvent, generally accomplished through the collection of property taxes. As a result, growth patterns are affected by rivalry among jurisdictions, as they compete with one another to attract economic development and maintain high residential property values in an effort to further their tax bases (Logan and Molotch 1987). Local oversight of the private market, however, has often yielded undesirable results, including wasteful land use patterns, degradation of air and water, loss of biodiversity, traffic congestion, decline of older cities and neighborhoods, lack of affordable housing, and natural disaster losses. The literature indicates the degree to which local governments provide local public goods (including environmental protections, social

programming, etc.) depends on several factors. These factors include economic health (Norton 2005b; Peterson 1981), growth pressures (Lubell et al. 2005), development interests (Fleischmann and Pierannunzi 1990; Logan and Molotch 1987; Lubell et al. 2005), the presence of mandates (Bollens 1992; Burby and May 1997); commitment to the process (Burby and May 1998), and community characteristics including previous growth patterns and demographics (Feiock 2004). However, Norton's (2005) study of growth management in North Carolina indicates that local officials are generally more likely to align themselves closely with development interests than environmental interests, and are more likely to voice strong support for environmental issues as a general principal rather than a growth inhibitor.

3.5.1: Environmental Policy and Intergovernmental Implementation

With increasing frequency since the 1970's, federal and state policymakers design programs that embrace or mandate implementation by federal-state and state-local levels of government. For example, this practice can be seen at the federal level in fashioning environmental regulatory policies aimed at reducing pollution and limiting environmental damage caused by industry (Menzel 1989). For more than two decades, U.S. environmental policy has shifted, or devolved, responsibility for environmental management decisions *away* from the federal government *toward* lower jurisdictions, particularly states and regional partnerships. Gerlak (2003) contends that this trend began with the passage of the Pacific Northwest Electric Power Planning and Conservation Act in December of 1980, and was continued in the subsequent Water Resources Development Act and amendments to the Clean Water Act (CWA) in 1987. A key component of the Congressional CWA amendment was the establishment of the National Estuary Program, a non-regulatory, collaborative watershed approach for protecting coastal water quality (Gerlak 2003; Kennish 2000). The central piece of this EPA-led program is the Management Conference, which brings together representatives from local, state, and federal government agencies, business and industry, citizens groups, and academic institutions to work cooperatively on multiple environmental issues (EPA 2006). To date, research indicates that the National Estuary Program is considered to be quite successful in building regional cooperation and resolving conflict in designated estuaries (Gerlak 2003; Lubell 2004).

New Federalism, which began during the Nixon administration but reached its height during the 1980s, focused on returning decision-making power to state and local governments

through intergovernmental policies (Gerlak 2003). Menzel's (1989: 160) study of federal and state mandates asserts "intergovernmental implementation mandates prescribe, in principle, regularized and permanent patterns of behavior and interaction among implementation authorities and others (e.g. citizens, special interest groups, etc)." This characterization is consistent with the more precise and policy-oriented terminology employed by Wright (1988) to describe intergovernmental arrangements. Wright offers a model of intergovernmental relations in which authority is overlapping and in which substantial areas of governmental operations involve national, state, and local units or officials; in which the power and influence of any one jurisdiction or official is significantly limited. In predetermining relationships and limiting power of any one agency, conflict and competition are thus avoided. This is one reason why federal and state policymakers find implementation mandates so attractive. However, Menzel's (1989) study concludes that intergovernmental implementation mandates are not as effective as rational arguments suggest as they can exacerbate conflict among implementation authorities or others and contribute to ineffective implementation.

Although the arguments for and against the federal devolution of environmental authority are numerous, there is relatively little research regarding the local implementation of federal mandates (Berke et al. 1996). In the U.S., virtually every state has directed local governments to protect sensitive areas, and many states have required local governments to manage growth (Bollens 1992; DeGrove and Metzger 1995; Kusler 1980). Burby and May (1997) note that in many instances, these directives were following requirements set forth by the Federal government. However, state and federal requirements are often perceived by local government as an infringement on home rule, inflexible, out of line with local priorities, and under funded. As a consequence, local governments may lack the commitment to participate in intergovernmental arrangements, and are thus unwilling to implement various environmental ends through management of land use (Burby and May 1998; Dalton and Burby 1994). Therefore, it is important to investigate which factors influence the successful implementation of intergovernmental environmental policy.

3.5.2: State Mandates and Intergovernmental Implementation

In order to deal with the environmental consequences of urban development on environmental systems, and the need to address ecosystems as a whole, there has been a widespread expansion of state-mandated land-use planning programs. These programs, generally

referred to collectively as growth management, evolved out of the environmental movement of the 1960's and 1970's and have generally resulted in an increased state presence in local land use decision-making to achieve results on a larger-than-local scale. A fundamental purpose of these intergovernmental growth management programs has been to infuse regional concerns – especially regional environmental – into local land use planning. In most cases, the result has been a system where states or regional bodies have pre-emptive authority over land-use decisions made at the local level, especially in critical environmental areas and for large-scale developments (Bollens 1992).

Over the past four decades, state and regional governments in the U.S. have steadily expanded their involvement in local land use planning practices through intergovernmental planning mandates (Carruthers 2002a). State mandates of local planning reflect the challenges of intergovernmental implementation (Goggin et al. 1990; Mazmanian and Sabatier 1989). In particular, there has been an emphasis at the state level to modernize land-use legislation to address problems associated with urban development. As noted by Salkin (1999: 602) in an assessment of land use law at the end of the 20th century:

> Seventy-five years ago we did not have the extensive public infrastructure that exists today. Scientific testimony regarding the impacts of land use decision-making on clean air and clean water had not been developed, and we had not yet experienced the population growth and land development which took place over the ensuing decades, particularly in our suburban areas and rural countryside.

Starting with the State of Hawaii in 1961, a 'new age' of land use planning began, chronicled in the literature as the "quiet revolution", to address environmental issues associated with development (Weitz 1999: 267). Since that time, many states have prepared statewide land-use and infrastructure plans, mandated planning at the local and regional levels, and adopted local consistency requirements for local and regional plans (Ben-Zadol 2005; Nelson and Duncan 1995). Evolving out of the environmental movement of the late 1960s and early 1970s, this shift is not so much about improving local planning for its own sake as it is about using improved local planning to improve regional growth management and to address regional environmental/economic issues (Bollens 1992; Carruthers 2002b; Norton 2005a; Salkin 1999; Weitz 1999).

A major purpose of state-mandated local planning is to reduce urban sprawl, defined as "low density, discontinuous, suburban-style development, often characterized as the result of rapid, unplanned, and/or uncoordinated growth" (Carruthers 2002a: 312). This response to sprawl stems not only from environmental concerns, but also the inefficient use of public infrastructure, increasing traffic congestion, decreased affordable housing, and declining central cities. However, notes Norton (2005a: 55), "it is especially animated by quality-of-life and environmental concerns stemming from the ongoing loss and fragmentation of arable farmland, natural open space, viable wildlife habitat, and functioning wetlands; the continuing decline of water quality from nonpoint sources of pollution; and the decreasing resilience of communities to natural hazards such as catastrophic forest fires and coastal storms."

Numerous states have adopted or revised existing legislation mandating a consistent set of goals and standards for local land use. Though the numbers vary according to the definition of state-mandated land use planning (Salkin 1999; Weitz 1999), by 2001 at least 11 states had adopted comprehensive state-wide growth management legislation and several others had adopted narrower legislation covering sub-state areas (Burby and May 1997). Although specific requirements and enforcement mechanisms vary from state to state, a common objective is to coordinate the planning activities of local governments and governmental agencies in a way that produces a uniform framework for dealing with the pressures of rapid population growth and land development (Burby and May 1997). Carruthers (2002b: 1960) notes "by creating a better match between the local scale of land-use regulation and the regional scale of growth pressures, state planning mandates seek to increase the overall quality of planning across metropolitan areas." In order to clarify what constitutes a state growth management program, Weitz (1999: 276) suggests that, at minimum, the program combines in a single statute:

1. Provisions for local or regional land development (comprehensive) planning (whether mandatory or optional for all or just some local governments), and

2. A state land planning agency or commission or regional commission(s) that has the authority to review and to approve local comprehensive plans.

As outlined by Burby and May (1997), these state planning requirements also test intergovernmental arrangements. Have these states done an adequate job of designing mandates and structuring their implementation so that local governments are persuaded to plan for, as well as manage growth? Have the states coordinated their various environmental and other regulatory

programs so that they reinforce local planning and growth management? Do state planning programs have a substantive impact on the outcome of urban and regional development? Literature demonstrates that in the absence of planning mandates at the state or regional level, local governments are usually ineffective in preserving natural resources, containing urban sprawl, and improving the efficiency of infrastructure delivery (Conroy and Berke 2004; DeGrove and Metzger 1995; Nelson and Duncan 1995; Nelson and French 2002). However, despite their considerable promise for reducing sprawl, growth management programs remain controversial because there is little rigorous empirical evidence of their effectiveness (Burby and May 1997).

To date little is know about the actual contribution these programs make to integrate growth management efforts across a region, and critics suggest that growth management may lead to severe negative impacts by promoting lower densities, inflating property values, and slowing population growth (Anthony 2003; Ben-Zadol 2005; Salkin 1999). Carruthers (2002) argues that state growth management efforts a) threaten local autonomy, b) continue to struggle with inconsistency, and c) that little is known about the eventual impact on the outcome of future development. Even as it gains support, Norton (2005) notes that little is known about growth management programs' impact, effectiveness, and implementation experiences. Moreover, much of the work that has been done is based on case study research that has collectively lacked conceptual coherence (Norton 2005a; Talen 2003). Most recent studies of growth management have generally classified different management approaches and intergovernmental structure (Bollens 1992; Weitz 1999), examined growth management's ability to alter urban development (Carruthers 2002a), and explored growth management's ability to create 'better plans' (Catlin 1997; Deyle and Smith 1998; Norton 2005b). However, these studies have not addressed the impact of growth management efforts on the environmental issues that spurred them. More significantly, Blanco (2004) contends that no studies have assessed that effectiveness of state growth management efforts to deal with regional environmental issues.

4: Research Design and Methodology

4.1: Introduction

Results from the previous chapters indicate that effective ecosystem management requires a firm ecosystem science foundation, and depends on a collaborative - and sometimes coercive - model to achieve success. What is less clear in the previous chapters is what effective ecosystem management looks like in practice. Studies of ecosystem management tend to focus on localized ecosystem management programs, or individual aspects of ecosystem management (e.g. stakeholder collaboration or ecological processes), rather than the how the combination of these efforts that work together to achieve results. Little is understood is how varied local and factors influence ecosystem management, and how/why ecosystem management is implemented at the local level. While the State of North Carolina has a combination of institutional, regulatory, natural characteristics that make it an ideal setting for effective ecosystem management, resources and environmental quality continue to decline. Similar situations can be found across the American Southeast region and in many of the nation's coastal areas.

Rather than look at one program or community in isolation, this thesis investigates several efforts in combination to determine which factors most influence effective ecosystem management. This study was conducted in two parts. The first part of the study includes a plan quality analysis of twenty communities in the State of North Carolina that examined general trends in plan quality and the ability of local comprehensive plans in North Carolina to incorporate the principles of ecosystem management. The second part of the study is an analytical case study of three North Carolina Cities: New Bern, Wilmington and Greenville. These three communities were included in the plan quality analysis, and provide a greater understanding of how and why ecosystem management is implemented at the local and regional scale. This chapter includes a brief discussion of plan quality, which is a key concept of the methodology, as well as a detailed discussion of the data collection methodology used for the study.

4.2: Plans and Plan Quality: The Dependent Variable

As outlined in Chapter 3, Christensen et al. (1996) describe the underpinnings of the ecosystem approach as the following: broad scales; a recognition of the complexity and function of ecological units; and the ability to be adaptive and ever vigilant about the changing conditions of natural systems. In order to achieve ecological sustainability, or more effectively balance

ecosystem integrity with human demands, it is necessary to include the preservation or enhancement of ecosystem health as a key component in development decisions (Norton 1992). In order to operationalize planning for ecosystems and the link between ecosystem management and development decisions, it is necessary to take the essential elements from each thread of literature and create a framework for effective ecosystem planning. In his work *Ecosystem Planning in Florida* (2008), Brody provides a framework of ideas and principles that practitioners may use as a guide for developing ecosystem management regimes (Table 4.1).

TABLE 4.1: BRODY'S PRINCIPLES OF EFFECTIVE ECOSYSTEM MANAGEMENT AND PLANNING

Principle	Result
Protecting regionally significant habitats	Recognizes ecological boundaries and integrity as key planning concerns, and facilitates the management of regional biodiversity.
Developing a sense of place	Emphasizes the human component (i.e. values, decision making, etc) in addressing trans-boundary resources.
Incorporating systems thinking	Focuses on the needs of the ever-changing natural system, as well as the organizational structure required to manage these systems.
A proactive approach to planning and management	Establishes a protective framework in the beginning stages of decline rather than relying solely on restorative measures.
Practicing adaptive management	Allows for flexibility in management regimes to account for the changing conditions in ecosystems; geared toward uncertainty, monitoring/assessment and feedback.
Inter-organizational collaboration and capabilities within ecosystems	Requires cooperation between Federal, state and local management agencies, as well as private parties. Collaboration and conflict management are key components to increasing the effectiveness of ecosystem management.
Building informal relationships	Effective management at the ecosystem level requires an understanding and integration of various organizational cultures in order to work toward a collective resource protection vision.
Sharing power and information	Power and information need to be shared freely within the formal and informal management framework to facilitate collaborative action.
Focused education and training	People must be taught to understand the interconnectedness of ecological and social systems in order to effect long-term change.

Once identified, it is important to understand how the concepts and principles of effective ecosystem management can be incorporated into a local plan. Ecosystem approaches to planning require an understanding of a variety of contexts to define key concepts and components. The previous review of literature provides a baseline for understanding the major considerations when planning for ecosystems, which in turn lays the groundwork for a review of plan quality literature. A comprehensive plan is the official document adopted by a local government setting forth its general policies regarding the long-term physical development of a community. Increasingly, local governments are using comprehensive plans to create balanced alternatives to uncontrolled growth (Beatley, 2005). In relation to managing ecosystems, a comprehensive plan

embodies the principles of ecosystem management and provides direction for implementation. It also provides the foundation for all other regulations that will protect landscapes and ecological processes. According to Brody (2008) plans, planning tools and plan quality provide measureable indicators for ecosystem management. The ability to develop, code, and measure indicators within a plan has made plan quality a widely used instrument by which to quantitatively assess the quality of management efforts.

In the United States, a local plan is generally considered an articulation of a collaborative process (Kaiser and Godschalk 1995). It is both an indicator of the quality of the planning process and the strength of implementation (Talen 1996). In their work *Urban Land Use Planning*, Kaiser, Godschalk and Chapin (1995) identify the core characteristics of plan quality: a strong factual basis, clearly articulated goals and appropriately directed policies. The authors emphasize that land use plans should include long-range goals that represent the diversity of community values and policy directives that serve as a framework for achieving those goals. The plan should contain a strong factual basis that includes an analysis of existing physical and social conditions. However, this factual basis does not determine the goals and objectives, but rather serves as the "necessary discipline underlying the vision" of the plan (Kaiser and Godschalk 1995: 58).

Extensive research has been done to empirically test the Kaiser, Godschalk and Chapin (1995) concept of plan quality by evaluating the factual basis, goals and policies of natural hazard plans (Berke & French, 1994; Berke et al., 1996; Burby & May, 1997; Deyle & Smith, 1998; Nelson & French, 2002), environmental protection plans (Berke et al., 1997; Norton, 2005), and the inclusion of sustainability directives in comprehensive plans (Conroy and Berke 2004). Dalton and Burby (1994) provide further support for the importance of these three conceptual characteristics in explaining a community's commitment to planning. They defined and measured plan quality based on the factual basis, goals and policy characteristics and considered the influence of plan quality on local adoption of land use policies limiting development in hazard areas. A key finding was that plan quality was a strong predictor of local success at limiting development in hazard-prone areas. Building on the work of Kaiser, Godschalk and Chapin (1995) and Dalton and Burby (1994), Berke and Godschalk (2008) included two additional conceptual dimensions in plan quality evaluation: 1) *internal plan quality* (e.g. do plan policies appear to correspond to and advance the articulated plan goals)

needed to guide land use in the future; and 2) *external plan quality* (e.g. do plan policies correspond to stakeholder values, such as how well they advance sustainable development or water resources protection. Baer (1997) also includes *comparative plan quality* (e.g. comparing plans across different localities) as an important criteria in his plan quality evaluation model.

Brody defined and measured ecosystem plan quality (2003) by adding ecosystem considerations to existing concepts of what constitutes a high quality plan. Brody's protocol builds on and extends the previous conceptions of plan quality (which identify factual basis, goals and policies as its core components (Kaiser et al., 1995)) by adding the two additional components of inter-organizational coordination and capabilities for ecosystem management, and implementation mechanisms. The first of these additional components captures those collaborative and conflict management components that are required with ecosystem management approaches. The second component measures how likely goals, objectives and policies in the plan are to be implemented (not if implementation has actually occurred). As noted by Brody (2008: 40) "this component captures, among other issues, the concepts of ecological monitoring, enforcement, and a commitment to put the adopted plan in place. The addition of these components to original conceptions enables the definition of plan quality to more effectively capture the principles of ecosystem management." Building on this, Brody (2003c) conceptualizes ecosystem plan quality through the following five components:

1. Factual basis refers to an understanding and inventory of existing resource issues, environmental policies, and stakeholders' interests within the ecosystem. This takes both written and visual forms, and serves as the resource inventory and the problem identification instrument upon which policy decisions are made.
2. Goals and objectives guide the implementation of ecosystem management and contain both general statements of long-term goals and specific measurable objectives.
3. Inter-organizational coordination captures the ability of a local jurisdiction to collaborate with neighboring jurisdictions and organizations to manage what are often trans-boundary natural resources. This element of ecosystem plan quality specifically addresses joint fact-finding, information sharing, intergovernmental agreements and integration with other plans in the region (e.g. a higher level ecosystem plan, such as the NEP CCMP).

4. Policies, tools and strategies represent the heart of the plan because they set forth action to protect critical habitats and related natural systems. Policies include regulatory tools such as buffer requirements, as well as incentive tools, land acquisition programs, and education efforts.
5. Finally, for comprehensive plans to be effective implementation procedures must be clearly defined and specified for all stakeholders. This includes timelines for action, regular plan updates and monitoring of resource conditions and policy effectiveness.

Together, Brody (2008) contends that these five plan components constitute the potential for a local plan to manage and protect the integrity of ecological systems. Brody (2008: 39) proposes that comprehensive land use plans are the "ideal policy instrument that can encapsulate and implement the major principles of ecosystem management at the local level." While comprehensive plans are limited because they only apply to single jurisdictions and are not traditional ecosystem plans, they provide a good measure for ecosystem management capabilities at the local level. A plan's content and policies often determine a local jurisdiction's level of natural resource use, participation in regional/ecosystem planning efforts, and ability to protect critical natural habitat essential to maintaining ecosystem function (Brody 2003b; Porter and Salvesen 1995). Adopted comprehensive plans serve as strong indicators of the actions local jurisdictions will take, as opposed to informal or voluntary arrangements that characterize many ecosystem plans (Yaffee 1996).

The studies mentioned previously not only help to form an understanding of how to measure ecosystem plan quality, but also yielded insights into the factors that influence of plan quality. For example, Berke et al. (1996) examined the positive influences of wealth and local commitment to planning on plan quality associated with natural hazards. A key finding of this study was that jurisdictions with wealthier populations generally have more resources to devote to planning staffs and plan development. The study also found that residents with high incomes also tend to be more educated, and therefore have more time and interest in participating in planning processes, particularly when it comes to environmental issues. Brody (2003a) found that higher population levels increased the quality of local plans with regard to ecosystem management. In general, he found that jurisdictions with larger populations usually have more complex environmental problems, as well as more financial resources and expertise to devote to

plan development. Similarly, Berke et al. (1999) found that population growth (as an indicator of development pressure) increased the quality of environmental plans. Literature indicates that local governments responding to a state comprehensive planning mandate are: a) more likely to have prepared comprehensive plans, and b) are likely to have higher quality plans than local governments without a mandate (Burby & May, 1997; Grimm et al., 2000). In short, state planning mandates have been found to be an important factor in determining the quality of local comprehensive plans, and thus growth management efforts (Beatley & Manning, 1997; Burby & May, 1997; Platt et al., 1994). Finally, Burby and May (1998) examined the significance of planning capacity (e.g. the number of planners that contribute to the development of the plan) on the quality of plans. A key finding of this study is that the higher the planning capacity of a jurisdiction, the higher the quality of the plan.

4.3: Research Questions & Hypotheses

The principle focus of this study is on how local communities can effectively address ecosystem-level problems through land use planning. In order to do this, I examined the ability of local comprehensive plans for communities participating in a large ecosystem-based management program (e.g. the Albemarle/Pamlico National Estuary Program) to embody and implement the principles of ecosystem management. Further, I wanted to understand how state-mandated growth management influences the implementation of ecosystem management. While ecosystem approaches take place at a variety of scales and political levels, this research focuses on the role of local jurisdictions. In particular, it investigates the degree to which local communities incorporate the recommendations on land use and resource conservation from ecosystem management programs into their own comprehensive plans. While this analysis focused on the local plans of a particular area, policy implications extend more generally to the ability of local jurisdictions to embrace ecosystem management principles.

Using quantitative and qualitative data, this study examined the following questions:

- To what extent does participation in a collaborative, ecosystem-based planning process as a voluntary action influence local land use policy?
- To what extent do state mandates for ecosystem-based planning influence local land use policy?
- How important are local factors, relative to ecosystem-based planning participation, in explaining the quality of local plans and implementation of ecosystem directives?

- How can plans, planning processes, and ecosystem management programs be improved to more effectively address the needs of ecosystems?

Based on these research questions, and the theoretical and empirical literature previously reviewed, this dissertation proposes three main hypotheses:

- Hypothesis one contends that ***participation in collaborative ecosystem planning as a voluntary action will improve the ecosystem plan quality of local land use plans***. Collaborative planning efforts are designed to reduce conflict and produce results within intergovernmental networks. Therefore, I expect to find that local communities that have participated in collaborative planning efforts such as the APNEP planning process (through CCMP development or through interaction with APNEP through local land use planning efforts) will be more likely to capture ecosystem management directives in their plans.

- Hypotheses two contends that ***ecosystem planning through state mandate will be more effective than collaborative efforts at improving ecosystem plan quality of local land use plans***. The literature demonstrates that in the absence of planning mandates at the state or regional level, local governments are often ineffective at addressing regional issues. It follows, then, that the plans produced by local communities with a planning mandate designed to address regional/coastal environmental issues should be of higher quality than those produced by those communities affiliated with less coercive efforts.

- Hypothesis three contends that ***higher levels of ecosystem plan quality will lead to increased plan implementation***. Significant research has relied on plan quality as a de facto indicator of implementation. As such, I expect to find that the higher the ecosystem quality of the plan, the more likely it is to be implemented locally. However, research has also shown that local contextual factors, such as development pressure, economic health, and commitment to planning, are also critical variables influencing land use policymaking and implementation.

4.4: Plan Quality Analysis

I obtained the evidence for this portion of the study by examining the land use plans from a sample of 20 communities in the State of North Carolina, and collecting considerable information about the CAMA mandate, regional environmental programming and the local contexts within those communities. The sample population was based on local incorporated jurisdictions in North Carolina that have recently conducted updates to their comprehensive plans. A sampling frame was obtained through a list of local incorporated jurisdictions throughout the State of North Carolina and was subjected to the following sampling strategy. First, the sample of local jurisdictions was limited to those with an estimated 2007 population of 5,000 or more to make certain that the sample is not overly skewed toward small communities

and that the communities chosen are large enough to support a planning department and/or planning process (Berke & French, 1994). Second, large cities such as Raleigh and Charlotte were excluded from the sample because it is believed that these jurisdictions have very different contextual factors that may skew the sample (Berke et al., 1996). Third, the sample was divided into four groups: CAMA communities, APNEP communities, communities in both programs, and communities in neither program (Table 4.2).

TABLE 4.2: PLAN CONTENT ANALYSIS JURISDICTIONS

Program	Jurisdiction	Population
CAMA	WILMINGTON	99,623
	JACKSONVILLE	74,614
	OAK ISLAND	8,178
	CAROLINA BEACH	5,883
APNEP	GREENVILLE	76,058
	ROCKY MOUNT	56,844
	HOLLY SPRINGS	19,684
	ROANOKE RAPIDS	16,419
	HILLSBOROUGH	5,551
BOTH	NEW BERN	28,170
	HAVELOCK	22,170
	ELIZABETH CITY	19,505
	WASHINGTON	10,055
	MOREHEAD CITY	9,462
	KILL DEVIL HILLS	6,584
NEITHER	HIGH POINT	100,432
	STATESVILLE	26,122
	EDEN	15,444
	ARCHDALE	9,268
	BREVARD	6,687

The methodology for choosing these communities is as follows: those cities with no collaborative or mandated ecosystem planning provide the baseline for measurement, and are expected to have the lowest ecosystem plan quality scores of the group. Those communities in the APNEP boundaries have participated in the CCMP planning process, have the CCMP as both a guide for local land use planning, and should still have exposure to the program and collaborative opportunities. Therefore the APNEP communities are expected to have higher plan quality scores than those communities with no ecosystem planning exposure. The presence of a state mandate is expected to yield even higher plan quality scores than a collaborative effort, and therefore those communities within the CAMA boundaries are were chosen to test this hypothesis. Finally, if based on these assumptions those communities with a mandate and the collaborative benefit of the APNEP program are expected to have the highest plan quality scores.

For the CAMA communities and the communities in both CAMA and APNEP boundaries, I studied all of the communities that met of the study criteria. For the APNEP communities and those communities in neither program, a random sample was chosen from all communities that met the criteria.

Once chosen, I evaluated each jurisdiction's comprehensive plan against the evaluation protocol determining a high-quality ecosystem plan. The plan-coding protocol I used was similar to that used by Brody to study comprehensive plans in Florida, tailored to the specific circumstances in the State of North Carolina. Table 4.3 summarizes Brody's (2003c) conceptual indicators for assessing the quality of land use plans as it relates to ecosystem management. A comparison of local plans using the ecosystem plan quality protocol allowed me to test hypotheses one and two, and empirically evaluate the influence of each ecosystem-based planning process on plans and development management. The results of this analysis are discussed in Chapter 5, and the coding protocol worksheets used for this study is included in Appendix A.

TABLE 4.3: ECOSYSTEM PLAN CODING PROTOCOL		
Factual Basis		
Resource Inventory		
Ecosystem Boundaries/Edges	Indicator/Keystone Species	Vegetation/Wildlife Classified
Areas with High Biodiversity/Species Richness	Ecological Zones/Habitat Types	Graphic Representation of Trans-boundary Resources
Threatened/Endangered Species	Habitat Corridors	Ecological Functions
Climate/Soil Classified	Wetlands Mapped	Invasive/Exotic Species
Marine/Water Resources	Surface Hydrology	Other Prominent Landscapes
Ownership Patterns		
Conservation Lands Mapped	Management Status Identified for Conservation Lands	Network of Conservation Land Mapped
Human Impacts		
Population Growth	Fragmentation of Habitat	Wetlands Development
Loss of Fisheries/Marine Habitat	Existing Environmental Regulations Described	Value of Biodiversity Identified
Water Pollution		Other Factors/Impacts
Goals and Objectives		
Protect Integrity of Ecosystem	Protect Rare/Endangered Species and Habitats	Protect High Biodiversity
Establish Priorities for Native Species/Habitat Protection	Maintain Connection Among Wildlife Habitats	Restore Ecosystems/Critical Habitat
Protect Rare/Unique Landscape Elements	Goals are Clearly Defined	Presence of Measurable Objectives
Maintain Intergenerational Sustainability of Ecosystems		Balance Human Use with Maintaining Habitats
Inter-Organizational Coordination		
Other Organizations/ Stakeholders Identified	Coordination within/with Other Stakeholders Specified	Intergovernmental Bodies Specified
Information Sharing	Joint Database Production	Coord. w/Private Sector
Integration with Other Plans/Policies	Intergovernmental Agreements	Commitment of Financial Resources
Links Between Science and Policy Specified	Conflict Management Processes	
Policies, Tools and Strategies		
Resource Use Restrictions	Density Restrictions	Buffer Requirements
Removal of Exotic/Invasive Species	Conservation Zones/Overlay Districts	Urban Growth Boundaries to Exclude Habitat
Access Restrictions	Protected Areas/Sanctuaries	Habitat Restoration Actions
Density Bonuses	Phasing of Development	Controls on Construction
Mitigation Banking	Preferential Tax Treatments	Fee Simple Purchase
Conservation Easements	Other Land Acquisition Techniques	Transfer of Development Rights
Implementation		
Designation of Responsibility	Provision of Technical Assistance	Identification of Costs or Funding
Provision of Sanctions	Clear Timetable for Implementation	Regular Plan Updates and Assessments
Enforcement Specified	Monitoring/Adaptive Mgmt.	

4.5: Analytical Case Studies

To supplement the plan quality data, and to more effectively address my third hypothesis, I conducted analytical case studies of three North Carolina communities included in the plan quality analysis: New Bern, Wilmington and Greenville. In his work *Case Study Research,* Yin (2009: 9) notes that "how" and "why" questions, which tend to be more explanatory in nature, are likely to lead to the use of case studies. In this case the overarching question focuses on how and why communities adopt and implement ecosystem management policies and principles. Yin (2009: 11) defines a case study as an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, most appropriate when the boundaries between phenomenon and context are not clearly evident. Further, Yin (2009: 11) indicates that case studies are appropriate when there are more variables of interest than data points, and as a result the inquiry relies on multiple sources of evidence and data triangulation. This study draws from the plan quality analysis, as well a number of other sources of data including governmental environmental reports, U.S. Census data and projections, historical data (e.g. newspaper articles, public meeting minutes), and a telephone survey of local officials. Catlin's (1997) study of land use planning and environmental protection in Florida posits that detailed case studies are necessary to portray a clear picture of local implementation. Each case study city was chosen after the plan content analysis was complete to supplement the findings, and to provide insights into the implementation of these directives within each community

I selected Wilmington as one of the case study cities for several reasons. First, it is located in the coastal zone, and is therefore obligated to meet the CAMA requirements for coastal planning. Next, it is a fast growing community, located within one of the fastest growing regions in the country, and experiences large seasonal populations that bring with them unique ecosystem and infrastructure protection needs. Finally, the City of Wilmington actually has two land use plans, one CAMA-mandated plan (which scored highly on the plan quality) and another land use plan that includes few ecosystem-based policies. In conducting this case study, I want to gain an understanding of how each of these plans is implemented, where the conflicts and opportunities lie for a community with two land use plans, and what local factors most influence the implementation of ecosystem-based management policies. The results of the Wilmington, NC case study can be found in Chapter 6.

New Bern was also chosen as a case study city because of its unique location on the Inner Banks and its inclusion in both the CAMA and the APNEP jurisdictions. A truly regional approach was taken when updating the land use plans for New Bern and neighboring River Bend and Trent Woods by combining the three communities into one coordinated planning document. This choice was made because the communities were in close proximity to each other, and because they were all located in the same drainage basin, therefore requiring the plan to address needs of regionally significant habitats in the area. The New Bern case will provide unique insight into inter-organizational coordination, and how other communities can learn from the regional ecosystem perspective adopted by these communities. The results of the New Bern, NC case study can be found in Chapter 7.

Finally, I selected the City of Greenville as a case study because of its inclusion in the APNEP jurisdiction and its location in the inner coastal plain. After completion of the plan quality analysis, it became apparent that Greenville had a much higher quality ecosystem plan than other APNEP jurisdictions or any other communities without a mandate. As such there are unique factors at work in Greenville that have influenced and improved plan quality as it relates to ecosystem management. Studying Greenville as a case study city will provide additional insight into how and why ecosystem management strategies are adopted and implemented at the local level without a mandate. Results of the Greenville, NC case study can be found in Chapter 8 of this dissertation.

5: Plan Content Analysis

5.1: Introduction

This chapter moves from concepts to application by testing the ecosystem plan quality protocol developed in the previous chapter through a plan content analysis. This portion of the study measures the ability of local comprehensive plans in North Carolina to incorporate the principles of ecosystem management. This analysis permits me to answer the first research question: *to what extent does participation in a collaborative, voluntary ecosystem-based planning process influence local land use policy?* Further, it allows me to determine whether, on average, the plans prepared under mandates and/or collaborative but voluntary programs are of higher quality than those prepared under no mandate, addressing the research question: *to what extent do state mandates for ecosystem-based planning influence local land use policy*?

5.2: Sample

The first step in this portion of the study was to draw a sample of plans that are representative of local comprehensive plans across the state. The study population was based on all local jurisdictions (towns and cities) in North Carolina that have completed a comprehensive plan. The population was then divided into four groups: those communities located only within the boundaries of the Albemarle-Pamlico National Estuary Program (APNEP), those communities located only within the boundaries of the Coastal Area Management Act (CAMA), communities located within the boundaries of both CAMA and APNEP, and finally communities not found within the boundaries of either program. I then drew a sample of twenty communities using the following sampling strategy:

1. The sample included only those jurisdictions with a 2007 estimated population of 5,000 or more to make sure that the community had the capacity to complete and implement a comprehensive plan, and also to make sure that the sample was not skewed toward small communities (Berke & French, 1994).

2. The sample also excluded large cities such as Raleigh and Charlotte because these cities have very different contextual factors that may skew the sample (Berke et al., 1996).

3. Finally, the sample communities had to have recently (within the past 8-10 years) completed or updated their comprehensive plan.

Based on this sampling strategy, the sample for this study includes all of the CAMA-only communities, and all of the communities in both the CAMA and APNEP programs, that met the

aforementioned criteria. For the APNEP-only communities and those communities in neither program, a random sample was chosen from those communities that met all of the criteria.

5.3: Scoring the Plans

Based on Berke et al. (1996) and Brody's (2008) methodology, each indicator in the ecosystem plan protocol was measured on a 0-2 ordinal scale where 0 is not identified, 1 is suggested and 2 is fully detailed or mandatory. As per Berke et al. (1996: 84) policies were considered 'mandatory' if they contained words such as will, require, must or mandate. Within the Factual Basis component of the plans, which generally include a written and visual inventory of existing resources, indicators were measured on a 0-2 ordinal scale where 0 is not identified, 1 is mapped *or* catalogued, and 2 is mapped *and* catalogued. This deviation assured that all plan quality items remained on a 0-2 ordinal scale while also recognizing that a strong factual basis requires both written and visual elements. Collectively these indicators capture the principles of ecosystem management and provide a method to measure and compare each plan in the sample.

Once the plans were coded using the ecosystem plan protocol (Appendix A), three types of scores were calculated. First, an overall measure of plan quality was determined for each plan component and for overall plan quality, as done by Berke et al. (1996) and Berke et al. (1997). Indices were constructed for each plan component based on three steps. First, the actual scores for each indicator were summed within each plan component. Second, the sum of the actual scores was divided by the total possible score for each component. Third, this fractional score was multiplied by ten, placing each plan component on a 0-10 scale. Adding the scores of each component (factual basis; goals and objectives; inter-organizational coordination and capabilities; policies; and implementation) resulted in a total plan quality score. The maximum score for each plan is fifty.

Second, to further analyze the results from evaluating plans against the planning protocol, I employed several additional measures based on the techniques used by Godschalk et al. (1999). These measures looked at each issue-based indicator in the protocol from three perspectives: their presence (breadth), their quality and a total quality issue score. The item breath score equals the number of plans that address the item divided by the number of plans in the sample (0-1 scale). Effectively, this measures the percentage of the sample that includes an indicator in the planning protocol. The item quality score equals total score of all plans that address an item divided by the number of plans that address the item (0-2 scale converted to a 0-1 scale). This

measures not only if the indicator was included, but its level of detail or the strength of a particular policy. Finally, the total issue quality score is tabulated to add the item breadth to the item quality scores (0-2 scale). The total issue quality score combines the previous two measures to provide a clearer picture of the overall quality of an indicator. The significance of an item that may not often be included in plans, but when included is done so with high quality can thus be factored into the overall score of a plan. This total set of scores provided a clearer picture of the ability of local communities to capture ecosystem management principles by detailing each indicator separately. In this way I was able to more fully understand where the strengths and weaknesses in capturing ecosystem management principles lie.

Finally, indices for total plan quality were calculated for each jurisdiction to better understand which specific communities have high or low plan quality as it relates to ecosystem management. As outlined in Section 5.4.3, this provides a clearer picture of which ecosystem-based programs are more effectively incorporating ecosystem management principles and policies in local land use plans. This also allows me to begin looking at local contextual factors, and how these may be influencing plan quality.

5.4: Plan Content Assessment

5.4.1: Overall Ecosystem Plan Quality

Results from the first phase of analysis provide an overall evaluation of how well local jurisdictions in North Carolina are incorporating the principles of ecosystem management into their comprehensive plans. As outlined in Table 5.1, after scoring the plans using the ecosystem plan protocol, the mean score for total ecosystem plan quality is 18.535, which on a scale of 0-50 indicates that local jurisdictions are a long way from managing ecological systems effectively. Mean scores for all plan components, which are measured on a scale of 0-10, are also relatively low despite a strong state planning mandate to protect critical habitats and ecological functions, and the presence of strong ecosystem management programs (i.e. APNEP).

Overall, inter-organizational coordination is the lowest scoring component, which indicates either a lack of recognition of the trans-boundary nature of ecosystems within the plans or an unwillingness to collaborate with other jurisdictions to manage resource over the long term. Interestingly, Brody's (2008) study of land use plans in Florida found that local jurisdictions scored highest on the inter-organizational coordination component - a reflection of a strong state mandate for inter-governmental coordination that is not present in the State of North Carolina.

In this study, the goals and objectives component is the highest scoring plan component, suggesting that local jurisdictions have the intent to protect regionally significant habitats and the integrity of ecosystems. As noted by Kaiser, Godschalk & Chapin (1995) the goals and objectives are a reflection of the community's values, sense of place and commitment to maintaining the integrity of natural systems for future generations. Specific scores for each plan component are discussed in greater detail in the following sections.

Table 5.1: Descriptive plan quality scores for each plan component		
Plan Component[a]	Mean	Standard Deviation
Factual Basis	3.649	1.799
Goals and Objectives	4.189	1.574
Inter-organizational Coordination	3.453	1.831
Tools, Policies & Strategies	3.729	1.287
Implementation	3.512	1.923
Total Ecosystem Plan Quality[b]	18.535	7.167
[a] Maximum score by plan component is 10.00; [b] Maximum score for total ecosystem plan quality is 50.00		

5.4.2: Plan Component and Item Scores

Results from the second phase of analysis provide a more detailed examination of each plan component, and the ability of local jurisdictions to capture ecosystem management principles in land use plans by examining each of the plan coding protocol items individually.

5.4.2.1: Factual Basis

As noted in Chapter 4 the factual basis of a plan refers to the inventory of existing resource issues, environmental policies, and stakeholders' interests within the ecosystem. This takes both written and visual forms, and serves as the resource inventory and the problem identification instrument upon which policy decisions are made. The factual basis of any plan organizes relevant information in sufficient detail to provide a clear, accurate picture of the problem (Kaiser et al. 1995). Without a strong factual basis, communities will find it difficult to state the problem situation in simple, precise or meaningful terms and will rarely be able to link goals and action.

As shown in Table 5.2, the mapping of conservation lands had the overall highest score, with 90% of all jurisdictions including conservation lands within the plan, and with such great detail that the issue quality score (.95) was also the highest of this component. This can be related to the fact that almost all coastal and inner coastal jurisdictions have Areas of Environmental Concern (AECs) or areas of natural importance that are regulated by the North

Carolina Coastal Resources Commission. As per the CAMA planning mandate, AECs must be mapped and regulated as public trust areas within the local land use plan. In addition, the State of North Carolina regulates Public Water Supply AECs and Natural and Cultural Resource AECs statewide, further explaining the high incidence (breadth) and quality of this indicator. The management of conservation lands also scores highly, as many of the conservation lands mapped already have management regimes in place. Similarly, where an AEC is related to species richness or high biodiversity (e.g. breeding grounds or nurseries) the descriptions are in great detail thus resulting in a high issue quality score.

Table 5.2 indicates that more than half of all plans inventory ecosystem boundaries (67%), ecological functions (62%), ecological zones (52%) and trans-boundary resources (52%). These issues form the key building blocks for identifying and managing ecosystems. Further, when these items are included in the plan, the inventory is extensive, resulting in high issue quality scores. For example, while just over half of the plans assessed describe and map trans-boundary resources, when they do the descriptions are done in great detail. This results in an issue quality score of .82 for an overall issue quality score of 1.34. However, scores indicate that the majority of plans continue to concentrate on traditional land use and environmental elements within ecosystems such as population growth (95%), road density (76%), soil types (76%), wetlands (67%) and surface hydrology (76%). The breadth and quality (.88) of surface hydrology within plans can be attributed to the emphasis at the state-level on floodplain management throughout the state due to the frequency of hurricanes and flooding. Other important issues for understanding ecosystem function, such as species ranges, distribution of species, keystone species and invasive species tend to be less well represented in the plans. In fact, none of the plans sampled map or describe keystone species or invasive species, both of which get to the heart of measuring ecosystem resiliency and biodiversity. Habitat corridors and networks of conservation lands, both essential parts of maintaining landscapes and allowing natural movement of species, receive some of the lowest scores in issue breadth, indicating that few communities are emphasizing this aspect of ecosystem management. Wildlife mapping and classification (62%) is more likely to be included over vegetation or marine resource mapping though the quality of the marine description is generally higher.

Human impacts described and mapped tend to be closely related to the typical urban environmental problems, such as water pollution (76%) and nutrient loading (71%). Federal

water quality regulations and major environmental disturbances such as beach closures, shellfish bed closures and pfiesteria outbreaks make these impacts easily identifiable. In contrast, none of the plans sampled addressed habitat fragmentation, which is one of the most critical development-related impacts affecting ecosystem health. Few of the plans address similar development-related issues such as wetlands development (33%), alteration of waterways (19%) or biodiversity value (14%). Existing environmental regulations are almost always mentioned (86%) and when appropriate they were also described in high quality. Rarely did any of the plans sampled include a gap analysis, which identifies the "gaps" where species and natural communities are not represented and thus threaten biodiversity. However, a major component of the 2002 update of the CAMA regulations requires coastal communities to include a Land Suitability Analysis, which evaluates the relative suitability of land for development. While the analysis does not provide site-specific results or make recommendations about how individual landowners may or may not use their land, it does provide a detailed description of the carrying capacity of the property. As a result, while less than half of the jurisdictions (43%) include a carrying capacity indicator in their plans, when they do they are of the highest quality (1.00) and rank among the highest in this category. For the most part the communities that do include the carrying capacity analysis are CAMA communities that have updated their plans since 2002.

TABLE 5.2; ISSUE-BASED SCORES FOR FACTUAL BASIS PLAN COMPONENT			
Indicator	Issue Breadth	Issue Quality	Total Issue Quality
Resource Inventory			
Soils Classified	0.76	0.88	1.64
Surface hydrology	0.76	0.88	1.64
Wetlands	0.67	0.86	1.53
Ecosystem boundaries/edge	0.67	0.78	1.45
Areas with high biodiversity/species richness	0.52	0.91	1.43
Other water resources	0.62	0.77	1.39
Graphic representation of trans-boundary resources	0.52	0.82	1.34
Ecological zones/habitat types	0.52	0.80	1.32
Other predominant landscapes	0.38	0.94	1.32
Ecological functions	0.62	0.69	1.31
Threatened/endangered species	0.48	0.65	1.13
Distribution of species	0.33	0.79	1.12
Marine resources	0.33	0.79	1.12
Wildlife classified	0.62	0.38	1.00
Vegetation cover	0.43	0.55	0.98
Climate described	0.24	0.70	0.94
Habitat corridors	0.14	0.50	0.64
Invasive/exotic species	0.00	0.00	0.00
Indicator/keystone species	0.00	0.00	0.00
Ownership Patterns			
Conservation lands mapped	0.90	0.95	1.85
Management status identified for conservation lands	0.62	0.85	1.47
Network of conservation lands mapped	0.33	1.00	1.33
Distribution of species within network of conservation lands	0.19	0.63	0.82
Human Impacts			
Existing environmental regulations described	0.86	0.75	1.61
Population growth	0.95	0.65	1.60
Road density	0.76	0.84	1.60
Water pollution	0.76	0.84	1.60
Carrying capacity measured	0.43	1.00	1.43
Other factors/impacts	0.48	0.95	1.43
Nutrient loading	0.71	0.70	1.41
Loss of fisheries/marine habitat	0.43	0.78	1.21
Value of biodiversity identified	0.14	0.83	0.97
Wetlands development	0.33	0.64	0.97
Alteration of waterways	0.19	0.50	0.69
Incorporation of Gap Analysis data	0.05	0.50	0.55
Fragmentation of habitat	0.00	0.00	0.00
Source: Adapted from Brody, 2008: 53			

5.4.2.2: Goals and objectives

As noted in Chapter 4 the goals and objectives of a plan are what guide the implementation of ecosystem management and contain both general statements of long-term goals and specific measurable objectives. Kaiser, Godschalk and Chapin (1995) state that the goals and objectives are key to linking clearly defined problems and values to administration and

enforcement of regulations. The authors further posit that without clear goals, defined by stakeholders through collaboration, a community's land use planning program will fail to achieve progress - regardless of how conscientiously regulations are implemented and public investments made (Kaiser et al. 1995: 82). Overall, the goals and objectives component of the sampled plans scored the highest for overall ecosystem plan quality. Table 5.3 reports the number of times a goal or objective in the ecosystem planning protocol was reported by the plans sampled. Overall, quality scores for the goals and objectives were average, with all of the indicators (other than those for high biodiversity, which was not mentioned in any of the plans) scoring somewhere between .60 and .81 on the issue quality scale. In line with Berke et al. (1996) this is likely explained by the diffuse nature of goals, and the fact that goals generally do not prescribe specific actions or detailed measurements.

The majority of plans include broad goals to protect the integrity (90%) and natural processes (90%) of ecosystems; native habitats and species (86%); and unique or rare landscapes (76%). However, comparatively few plans cite more specific objectives involved in managing ecosystems such as intergenerational sustainability (29%), the protection of endangered species (24%), or the representation of species within protected areas (19%). In fact, none of the jurisdictions sampled identify biodiversity as a goal or objective driving future development decisions. These findings are in line with Brody's (2008) study of Florida land use plans, which suggests that while plans frequently state general (and often vague) goals related to ecosystem management, they are often unable to incorporate specific objectives that would provide the foundation for precise land use tools and policies.

The need to balance human use with maintaining viable wildlife populations (62%) is frequently noted in the plans sampled. Based on Norton's work *Striking a Balance Between Environment and Economy in North Carolina* (2005b) this is fairly expected in North Carolina as the ecosystem management efforts and CAMA have been crafted to achieve this type of balance. Along with other federal coastal zone management programs, North Carolina's CAMA program was designed to give equal importance to the competing substantive goals of environmental protection and economic development rather than emphasizing environment above all (Norton 2005b). In North Carolina coastal areas, policies within plans are quite often directly related to the loss of fisheries and similar issues that are related to economic benefits to coastal communities. Further, the same percentage of jurisdictions sampled establish the need to set

priorities for restoring ecosystems/habitats (62%) within their communities. This can be directly related to the loss of fisheries and habitats, and thus the loss to coastal economies identified as a priority by the State in the CAMA regulations. Brody (2008: 54) notes that this reflects "the degraded state of many urban areas… Most jurisdictions have little remaining viable habitat to protect due to rapid urban development in the 1970s and 1980s, and instead must focus on goals to restore badly degraded natural systems." Less well represented in the plans sampled are the objectives of maintaining large intact patches of native species (48%) and maintaining wildlife corridors (43%), both of which are critical objectives in managing ecological systems effectively.

TABLE 5.3: ISSUE-BASED SCORES FOR THE GOALS AND OBJECTIVES PLAN COMPONENT

Indicator	Issue Breadth	Issue Quality	Total Issue Quality
Goals are clearly specified	1.00	0.74	1.74
Establish priorities for habitat protection	0.86	0.81	1.67
Protect natural processes/functions	0.90	0.74	1.64
Protect integrity of ecosystem	0.90	0.66	1.56
Presence of measurable objectives	0.86	0.69	1.55
Protect rare/unique landscape elements	0.76	0.75	1.51
Other goals to protect ecosystem	0.67	0.68	1.35
Balance human use with maintaining viable wildlife populations	0.62	0.73	1.35
Restore ecosystems/critical habitat	0.62	0.62	1.24
Maintain intact patches of native species	0.48	0.75	1.23
Maintain connection among wildlife habitats	0.43	0.67	1.10
Maintain intergenerational sustainability of ecosystems	0.29	0.67	0.96
Protect rare/endangered species	0.24	0.60	0.84
Represent native species within protected areas	0.19	0.63	0.82
Protect high biodiversity	0.00	0.00	0.00

Source: Adapted from Brody, 2008: 54

5.4.2.3: Inter-organizational coordination and capabilities

The inter-organizational coordination component of a plan outlines the ability of a local jurisdiction to collaborate with neighboring jurisdictions and organizations to manage what are often trans-boundary natural resources. As outlined by Grumbine (1994) and others, ecosystem management requires coordination between all stakeholders to achieve effective management of complex systems. This element of ecosystem plan quality specifically addresses joint fact-finding, information sharing, intergovernmental agreements and integration with other plans in the region (e.g. an inter-jurisdictional ecosystem plan such as the APNEP Comprehensive Conservation and Management Plan [CCMP]). This component of the plans scored the lowest for overall ecosystem plan quality, which may reveal a weak commitment toward collaboration

between agencies or across political boundaries, and few specifics on how to achieve inter-organizational coordination for resource management. Table 5.4 shows that all of the jurisdictions sampled mention integration of other environmental plans and policies in the region into their local planning frameworks, and when they do it is of high quality (.83), thus making it the highest scoring item in this component. This indicates that incorporating regional environmental efforts such as state-designated areas of environmental concern (AECs) and regional watershed management planning is an essential part of achieving ecosystem management at the local level. Interestingly enough, while a commitment to integrating regional environmental plans into local planning efforts was present, none of the communities within the APNEP boundaries mention the CCMP as a coordinating plan. As will further be discussed in Further, most (90%) communities sampled identify other organizations and stakeholders that may be impacted by local resource management decisions. This, coupled with the large percentage (76%) of communities that mention and/or mandate coordination with neighboring organizations and with the private sector, reveals a strong commitment to the concept of collaboration for ecosystem management.

This only tells part of the story, as issue scores are not nearly as strong when it comes to describing the specifics of inter-organizational coordination. Only about half (52%) of the plans sampled identify mechanisms for coordination within a jurisdiction or what intergovernmental agencies would be responsible for trans-boundary resource management. A slightly higher percentage (57%) of communities identify intergovernmental agreements, generally between local municipalities, within their local land use plans. The same percentage of communities discuss committing financial resources to the management of trans-boundary resources, but this number may be deceptive as these commitments are primarily for existing traditional resource management programs that rarely cross community boundaries. Other inter-organizational coordination specifics such as joint database production (19%), information sharing (38%) and identifying the link between science and policy (33%) are identified by far fewer communities than the general commitment to ecosystem management. With regard to joint database production and information sharing, while the overall breadth scores were low, the issue quality scores are relatively high. In other words, when these issues are included in the plan, communities generally show a strong commitment to carrying them out by fully detailing or mandating these activities. Finally, conflict resolution and the ability of multiple stakeholders to

manage conflicting goals and objectives for ecosystems is a cornerstone to successful ecosystem management. However, none of the communities sampled mention conflict resolution or indicate local strategies to achieve collective bargaining.

When looking at the literature, there are several studies that suggest the relatively low score for inter-organizational coordination and capabilities is expected. In Burby & May's (1997) multi-state assessment of planning for natural hazards, the authors concluded that state mandates for local comprehensive planning improve the quality of both local plans and local development management programs. The same researchers found that the state mandate that yielded the highest quality local plans was North Carolina's CAMA program, which produced plans that were of higher quality on average than those produced under Florida's more coercive and California's less coercive mandates (Burby and May 1997: 105-106). North Carolina's mandate was crafted as a collaborative state-local partnership, under which the state puts great emphasis on local land use planning and specifies general procedures, goals and topic areas, but leaves considerable flexibility to local jurisdictions in preparing the plans, adopting specific policies and the implementation of regulations (Burby and May 1997; Heath and Hess 2007; Heath and Owens 1994; Norton 2005a). However, unlike the State of Florida (Brody 2008), the State of North Carolina does not require an intergovernmental coordination plan element to address the critical factors necessary to foster collaboration. Consequently when comparing the results of Brody's (2008) study of Florida ecosystem plan quality, the influence of mandated intergovernmental coordination is evident. A similar plan content analysis of local land use plans in the State of Florida revealed that the inter-organizational coordination and capabilities component was the highest scoring plan component, reflecting the fact that a general intergovernmental coordination element is required in all plans. This suggests that if the State of North Carolina wants to improve inter-organizational coordination, and as a land use planning for ecosystem management, the CAMA mandate may need to be updated to include stronger inter-governmental coordination requirements.

TABLE 5.4: ISSUE-BASED SCORES FOR THE INTER-ORGANIZATIONAL COORDINATION AND CAPABILITIES PLAN COMPONENT			
Indicator	Issue Breadth	Issue Quality	Total Issue Quality
Integration with other plans/principles	1.00	0.83	1.83
Other organizations/stakeholders identified	0.90	0.74	1.64
Coordination with other organizations/jurisdictions specified	0.76	0.84	1.60
Intergovernmental agreements	0.57	0.75	1.32
Coordination with private sector	0.76	0.53	1.29
Coordination within jurisdiction specified	0.52	0.68	1.20
Intergovernmental bodies specified	0.52	0.64	1.16
Information sharing	0.38	0.75	1.13
Commitment of financial resources	0.57	0.50	1.07
Other forms of coordination	0.14	0.83	0.97
Joint database production	0.19	0.75	0.94
Links between science and policy specified	0.33	0.57	0.90
Position of jurisdiction within bioregion specified	0.29	0.50	0.79
Conflict management processes	0.00	0.00	0.00
Source: Adapted from Brody, 2008: 55			

5.4.2.4: Policies, tools and strategies

As noted in Chapter 4 the policies, tools and strategies for ecosystem management represent the heart of the plan because they set forth action to protect critical habitats and related natural systems. Policies include regulatory tools such as buffer requirements, as well as incentive tools, land acquisition programs, and education efforts. Results for this component demonstrate that plans tend to favor traditional land use policies such as subdivision regulations, capital improvements programming and performance zoning; and traditional environmental protection policies, such as resource use or density restrictions around critical habitat, conservation zones and buffer requirements to protect sensitive lands (Table 5.5). In each case the majority of communities sampled identify these tools as essential for managing ecosystems. When included in the plan, the quality of these indicators also tends to be relatively high, indicating a commitment by the community to implementing these regulations. This is not surprising, as most communities have had these tools in place for long periods of time, and therefore have an established track record for implementation. A majority of communities include provisions for maintaining or expanding protected areas or sanctuaries (76%) but far fewer (33%) go so far as to set urban growth boundaries that do not include critical habitats. This does not bode well for ecosystem management, as a land use planning approach that is truly ecosystem-based will "require more than simply redirecting growth away from a few ecological

hot spots or saving a small amount of habitat. Indeed, what will also be required is a fundamental rethinking of types and forms of urban growth" (Beatley 2000: 8). While some traditional land use and environmental regulations are well represented, others that more closely relate to environmental management such as the phasing of development to reduce wildlife disturbance, fencing controls to protect resources, and the restriction of vehicular traffic near significant habitats, are less represented. Although mainstream policies play an important role in ecosystem management, the evidence also shows that less commonly used growth management tools that focus on both overall growth patterns (e.g. targeting growth away from critical habitats) and site-specific measures (e.g. construction controls and site plan review) show promise for protecting regionally significant habitats. As expected, other proactive regulatory measures like the removal of exotic or invasive species, habitat restoration or the protection of resources in other jurisdictions are far less represented.

Despite their effectiveness in protecting critical habitats and ecological systems (Duerksen et al., 1997; Beatley, 2000), new and creative incentive-based policies are far less represented than regulatory techniques. The most common tool used by communities is clustering development away from critical habitats (76%) with the provision of density bonuses for cluster development a close second (71%). Far less represented, but arguably more effective incentive-based tools such as transfer of development rights, preferred taxation for conservation development or mitigation banking are far less represented. Overall, the quality of these items is just average, indicating that when incentive-based policies are included they are not necessarily mandatory, causing the overall issue quality score for these policies to be relatively low.

Seventy-one percent of the jurisdictions sampled mention conservation easements to protect critical habitats as a preferred policy, however these policies generally tend not to be mandatory in nature. This may be a reflection of the state-level emphasis on establishing conservation easements, through programs such as the NC Conservation Grant Fund, the NC Wildlife Grants Program, the NC Conservation Easement Program and the NC Farmland Preservation Fund that assist property owners with the donation of development rights to the state for preservation of critical habitats (NCDENR 2010a). Further, the state has developed a generous Conservation Tax Credit Program to accomplish statewide conservation goals of habitat conservation and public access to important habitats. Land acquisition of critical habitats by public entities, generally in the form of fee simple purchase, was mentioned by 61% of the

sampled communities. Other techniques such as the creation of land trusts and public-private partnerships were also mentioned by approximately half of the communities sampled.

Other non-regulatory techniques are also important indicators of determining ecosystem plan quality. For example, approximately half (52%) of all of the jurisdictions sampled include policies for monitoring ecological processes and human impacts on ecosystems, which is an essential component of adaptive management (Franklin 1997; Grumbine 1994; Yaffee 1996). For the most part, these monitoring policies are associated with water quality issues and monitoring required by the State. Approximately 62% of the plans include programs designed to educate the public on the importance of protecting habitat and ecosystems. Yaffee (1996) notes that although the environmental planning arena largely overlooks educating the public, policies that build an understanding of environmental problems and build a commitment to protecting ecosystems over the long term are critical to ecosystem management. In line with the aforementioned traditional land use tools such as capital improvements programming, a majority of plans (67%) include policies to control public investment in large infrastructure projects. Conversely, none of the plans sampled include the designation of special taxing districts for acquisition funds. This is not surprising considering the fact that nationally, the designation of special taxing districts to raise funds for land acquisition is found primarily in South Florida and Arizona. The practice is generally related to larger projects, such as the restoration and preservation of critical habitats related to the restoration of the Everglades, and is still somewhat rare for local jurisdictions.

TABLE 5.5:
ISSUE-BASED SCORES FOR THE POLICIES, TOOLS AND STRATEGIES PLAN COMPONENT

Indicator	Issue Breadth	Issue Quality	Total Issue Quality
Regulatory Tools			
Subdivision standards	1.00	0.88	1.88
Capital improvements programming	0.76	0.88	1.64
Buffer requirements	0.76	0.86	1.62
Conservation zones/overlay districts	0.81	0.76	1.57
Targeted growth away from habitat	0.76	0.78	1.54
Resource use restrictions	0.81	0.71	1.52
Performance zoning	0.81	0.68	1.49
Density restrictions	0.76	0.72	1.48
Site plan review	0.57	0.88	1.45
Protected areas/sanctuaries	0.76	0.69	1.45
Controls on construction	0.76	0.66	1.42
Restrictions on native vegetation removal	0.52	0.73	1.25
Phasing of development	0.48	0.70	1.18
Other regulatory tools	0.14	1.00	1.14
Habitat restoration actions	0.52	0.55	1.07
Public or vehicular access restrictions	0.19	0.75	0.94
Actions to protect resources in other jurisdictions	0.43	0.50	0.93
Urban growth boundaries to exclude habitats	0.33	0.57	0.90
Fencing controls	0.19	0.63	0.82
Removal of exotic/invasive species	0.05	0.50	0.55
Incentive-based Tools			
Clustering away from habitats	0.76	0.69	1.45
Density bonuses	0.71	0.67	1.38
Preferred tax treatments	0.29	0.67	0.96
Transfer of development rights	0.38	0.50	0.88
Mitigation banking	0.24	0.50	0.74
Other incentive-based tools	0.05	0.50	0.55
Land Acquisition Programs			
Conservation easements	0.71	0.50	1.21
Fee simple purchase	0.62	0.58	1.20
Other land acquisition techniques	0.48	0.60	1.08
Other Policies			
Control of public investment and projects	0.67	0.75	1.42
Public education programs	0.62	0.73	1.35
Monitoring of ecological health and human impacts	0.52	0.64	1.16
Designation of special taxing districts for acquisition funds	0.00	0.00	0.00

Source: Adapted from Brody, 2008: 57

5.4.2.5: Implementation

In the end, if comprehensive plans are going to manage ecosystems effectively, implementation procedures must be clearly defined and specified for all stakeholders. This includes timelines for action, regular plan updates and monitoring of resource conditions and policy effectiveness. When theorizing on what influences plan implementation, Talen (1997)

distinguishes between the internal and external factors of implementation. The internal factors of plan implementation include the planning process itself, flaws in planning goals, and the weakness or complexity of plans. Empirical studies have focused primarily on plan quality as an internal determinant of plan implementation. For the purposes of this study, it is important to note that the indicators measure a jurisdiction's ability to implement its plan in the future, not if the plan was actually implemented after adoption.

Results for this component demonstrate that the majority of jurisdictions include the essentials of plan implementation, such as designation of responsibility, a clear timetable for implementation, and regular updates or assessments (Table 5.6). This is to be expected, as each of these components is required under the CAMA mandate (50% of communities are under CAMA jurisdiction). However, the data indicate that even those communities outside of the CAMA mandate recognize the need for clear implementation strategies. Further, each of these indicators has high quality scores, indicating a clear commitment to implementing ecosystem management strategies. More often than not, when communities have cost outlays or fiscal obligations to environmental management goals (e.g. CWA requirements) they are identified in the plan as well. Fewer communities (43%) identify monitoring for plan effectiveness as a priority for plan implementation, but when they do the monitoring processes are fully detailed or mandatory. This is a clear reflection of the fact that the CAMA mandate requires biannual monitoring and plan updating for effectiveness. The literature on ecosystem management clearly emphasizes the need to monitor effectiveness and incorporate new information into plans as crucial to adaptive, ecosystem management (Christensen et al. 1996; Franklin 1997; Grumbine 1994). Jurisdictions in this sample rarely cite the provision of technical assistance (29%) or specify enforcement measures (19%) within their plans, and none of the jurisdictions outline sanctions for failure to comply with ecosystem management policies. The dual issues of enforcement and sanctions are important because they ensure that those policies and projects outlined in the plan are actually implemented and/or adhered to by the public (Brody 2008).

TABLE 5.6: ISSUE-BASED SCORES FOR THE IMPLEMENTATION PLAN COMPONENT			
Indicator	Issue Breadth	Issue Quality	Total Issue Quality
Clear timetable for implementation	0.76	0.81	1.57
Regular plan updates and assessments	0.67	0.86	1.53
Designation of responsibility	0.71	0.77	1.48
Monitoring for plan effectiveness and response to new information	0.43	0.89	1.32
Identification of costs or funding	0.62	0.50	1.12
Provision of technical assistance	0.29	0.67	0.96
Enforcement specified	0.19	0.75	0.94
Provisions of sanctions	0.00	0.00	0.00
Source: Adapted from Brody, 2008: 58			

5.4.3: Overall Plan Quality for Each Jurisdiction

Plan quality scores were also calculated for each jurisdiction in the study to better understand which communities have high or low quality plans, and whether there is a connection between the community's inclusion in an ecosystem management program and plan quality. As shown in Table 5.7, the City of Wilmington/New Hanover County Joint CAMA plan, the Havelock plan and the Oak Island plan stand out as having the highest scoring plans overall. Each of these communities falls under the CAMA mandate requirements (and thus are in the State-defined coastal zone) and has updated their plans within the last five years. It should also be noted that the City of Wilmington actually has two land use plans, one written to meet the CAMA requirements and one that is not. The Wilmington land use plan that is not written to CAMA specifications actually scores among the lowest of all of the plans sampled with an overall plan quality score of 9.64 out of 50 possible points, making it the second lowest scoring plan behind the City of Archdale. The implications of a community having two land use plans, and how each is implemented will be discussed further in the City of Wilmington case study (Chapter 6).

Table 5.7 outlines total plan quality scores and provides basic statistical information on the plan quality indices prepared in the four different program types. The table reveals several key findings. One is that mean scores for overall plan quality are considerably higher for mandate plans than for those prepared under no mandate. Short of the relatively low scoring Wilmington plan (which was essentially produced under no mandate) the CAMA mandate appeared to have the most influence on ecosystem plan quality. Another finding indicates that plan quality scores for those communities located within the APNEP jurisdiction are higher than

those outside the confines of any program, but that the program does not have the same influence as the state mandate. Even for those communities within the confines of both programs, the overall plan quality scores are lower than CAMA-only communities. An interesting note here is that the APNEP-only scores are not significantly higher without the inclusion of the City of Greenville. I suspect that this is a result of the impacts of Hurricane Floyd in 1999, and will further study the factors that led to such a high quality plan within the APNEP jurisdiction further in the Greenville case study (Chapter 8). Finally, the table indicates that the amount of variability as measured by standard deviations is substantially higher for plans prepared under a mandate. This suggests that the quality of mandate plans varies more than non-mandate plans. Berke et al. (1996) indicate that the variation among plans in mandate communities is often attributable to local contextual factors such as local commitment, local capacity and the local land development market. It should also be noted that part of the effect I am attributing to the presence of a mandate could also be caused by communities in mandated areas that may be better able and more inclined to plan, even without the mandate, than communities in non-mandate areas (Berke et al. 1996).

For the most part, when examining specific plan components, communities tend to have one or two plan components that stand out from the others in terms of influencing plan quality. For example, the City of Havelock scored highly on factual basis (6.39) and goals and objectives (6.33) that counterbalanced lower scores in inter-organizational coordination and capabilities (3.93) and tools, policies and strategies (3.64) and resulted in a high plan quality score. The lack of consistency among plan component scores is an important factor in explaining how a plan, as a total land management package, actualizes the principles of ecosystem management. Similarly, the City of Greenville had high scores for goals and objectives (6.33) and inter-organizational coordination and capabilities (6.43), as opposed to the factual basis (3.33) and implementation (3.13) scores that pulled the total plan quality score higher.

TABLE 5.7: TOTAL PLAN QUALITY		
Program	Community	Plan Quality Score
BOTH	Elizabeth City	22.16
	Havelock	25.92
	Kill Devil Hills	20.62
	Morehead City	16.38
	New Bern	25.56
	Washington	20.86
	Mean	21.92
	Median	21.51
	Standard Deviation	3.54
CAMA*	Carolina Beach	21.92
	Jacksonville	24.67
	Oak Island	25.61
	Wilmington LUP	9.64
	Wilmington CAMA	36.08
	Mean	23.58
	Median	24.67
	Standard Deviation	9.46
APNEP	Greenville	27.35
	Hillsborough	14.36
	Holly Springs	15.92
	Roanoke Rapids	13.16
	Rocky Mount	17.75
	Mean	17.71
	Median	15.59
	Standard Deviation	5.65
NEITHER	Archdale	3.33
	Brevard	12.79
	Eden	13.15
	High Point	11.76
	Statesville	15.87
	Mean	11.38
	Median	12.79
	Standard Deviation	4.75
** CAMA-only communities w/out Wilmington LUP = Mean: 27.07, Median: 25.14, SD: 6.21*		

5.5: Discussion

While the results are encouraging, based on the results above one can infer than local jurisdictions in the State of North Carolina have not been able to effectively incorporate the principles of ecosystem management into their planning frameworks. Though strong interest in ecosystem management exists at the state and regional levels, this commitment has not entirely filtered down to the local level, or local jurisdictions have not been able to translate the principles of ecosystem management into their land comprehensive plans.

The factual basis component of the plans sampled lacks detail, and often fails to deal with many of the issues associated with ecosystem management. While communities like Washington and Havelock have high quality inventories of existing resource issues, environmental policies, and stakeholders' interests within the ecosystem, others such as Archdale and Roanoke Rapids do not have a factual basis component in their plan. Often these and other communities choose instead to rely on separate (and often outdated) documents that are neither part of the legal plan nor circulated to the public. In general, communities sampled are good at including those things mandated by CAMA or some other governmental agency (e.g. Clean Water Act regulations through EPA), and including traditional land use and environmental principles. However, the inclusion of more innovative environmental management practices such as mapping habitat corridors/networks or conducting gap analysis for biodiversity is rare.

In general the communities sampled exhibit a broad commitment to the concept of ecosystem management, but rarely include the clear or concise goals that are required to guide implementation, nor did they provide specific measurable objectives. While some communities, such as Oak Island and Wilmington have strong ecosystem goals and objectives, most others provide relatively vague goals with little focused intent or measurability. When measureable objectives are stated, they are often related to no net loss of wetlands and rarely extend to specific measures such as acreage of protected habitat or water quality standards. Further, the plans sampled rarely capture ecosystem-specific objectives such as intergenerational sustainability or the protection of endangered species and biodiversity. In order to effectively manage ecological systems, communities must focus on more specific and measurable objectives to guide implementation.

Low scores in inter-organizational coordination and capabilities in all communities except Wilmington (CAMA) and Greenville indicate that while the basic intent to coordinate beyond jurisdictional and organizational boundaries is present, most plans lack the specific policies and procedures of coordination. While other environmental regulations and resource stakeholders are clearly identified, more specific inter-organizational techniques such as information sharing, joint database production and the linking of science and policy are left out. The inclusion of these types of collaborative techniques and detailed descriptions would promote the more focused coordination needed to protect trans-boundary resources. As evidenced in the State of Florida (Brody, 2008) the strength of the inter-organizational mandate is directly related

to inter-organizational plan quality and the ability of local communities to work collaboratively. The inability, or reluctance, of local communities to include inter-organizational coordination indicates that the State may need to mandate a strong collaborative component into local plans.

Overall, the tools, policies and strategies component of the plans sampled tend to focus on traditional regulatory land use tools (e.g. zoning, subdivision regulations, etc.) and environmental policies (e.g. buffer requirements) rather than ecosystem-based approaches. A greater reliance on innovative practices, such as incentive-based rather that regulatory approaches, would allow communities to expend their growth management toolbox and increase the quality of their plans. As noted by Beatley (2008: 8) a "fundamental rethinking of types and forms of urban growth" is necessary to meet the challenges of managing ecosystems.

Finally, the implementation plan component in the sample communities tends to fall short when it comes to giving the policies "teeth". Generally, the plans are fairly good at designating responsibility within a jurisdiction, establishing timetables for implementation and plan updates. However, rarely do communities outline sanctions for non-compliance or elaborate on enforcement mechanisms and penalties. One of the most frequent criticisms of planning, and plans in general, is that they are not implemented after adoption.

Based on these factors, when held up against a model of effective ecosystem management, local plans in North Carolina do not do a particularly good job of adopting the principles and practices of ecosystem management. Aside from a few communities, such as Havelock and possibly Wilmington, plans are not effectively incorporating the principles of ecosystem management into their planning frameworks. As noted by Brody (2008: 60) this is "an important warning sign when it comes to protecting a State's critical natural resources over the long term." Based on the empirical evidence presented here, local, regional and state agencies will need to work together to strengthen all five plan components to better consider the needs of entire systems.

6: Wilmington, NC Case Study

6.1: Introduction

Results from the last chapter indicate that local jurisdictions have not necessarily been able to effectively incorporate the principles of ecosystem management into the planning framework. However, these results are not uniform across jurisdictions. As expected, there are multiple factors and processes that influence the quality of comprehensive plans with regard to ecosystem management. The results from Chapter 5 also reveal that overall ecosystem plan quality is higher for those communities with the CAMA planning mandate. As discussed in Chapter 4, the inclusion of case studies in this work allows me to address my third research question: *how important are local factors, relative to ecosystem-based planning participation, in explaining the quality of local plans and implementation of ecosystem directives?* Focusing on this question, I have chosen to include the City of Wilmington as a case study for several reasons. First, it is located in the coastal zone, and is therefore obligated to meet the CAMA requirements for coastal planning. Next, it is a fast growing community, located within one of the fastest growing regions in the country. Finally, the City of Wilmington has two land use plans, one CAMA-mandated plan (which scored highly on the plan content analysis) and separate land use plan that includes few ecosystem-based policies.

In this chapter I further test my first and second hypotheses, and test my third hypothesis to see if the quality and content of the plan is indicative of the degree of implementation. I begin with an examination of the environmental, social and planning environments in the Wilmington area to gain a greater understanding of the specific needs of the ecosystem and those factors driving plan development and implementation. Next, I conduct a detailed plan evaluation to understand what ecosystem issues are being addressed by the comprehensive plan and which are not. From there I take a closer look at the implications the plan quality has on implementation of the plan locally, and for ecosystem management as a whole. Rather than deduce plan implementation from spatial or policy analysis, this thesis investigates the question of implementation through a total of seven telephone interviews with public and elected officials, environmental program managers, and local environmental advocates working in the Wilmington area.

6.2: The Physical Environment

The Wilmington metropolitan area is located in southeastern North Carolina, within an area known as the "Lower Cape Fear" region. The Wilmington MSA encompasses an area of approximately 2,311 square miles and includes the counties of New Hanover, Pender and Brunswick. The principal cities of each county are Wilmington, Burgaw and Oak Island, respectively (Figure 6.1). The Cape Fear River separates Brunswick County from New Hanover and Pender counties, and the Northeast Cape Fear tributary separates Pender from New Hanover. The average elevation is approximately 38.5 feet above sea level, ranging from mean sea level at the coast in Brunswick and New Hanover counties to 115 feet above sea level in Pender County (NCGS 2011).

Figure 6.1: Wilmington Regional Map
Source: Wilmington Urban Area Metropolitan Planning Organization

The climate is hot and humid in the summer, but the coastal areas are generally cooled by sea air breezes (Weaver 1977: 1). Winter is cool but has occasional brief cold spells, though snow is rare in the area (Ibid). Average annual rainfall is approximately 54 inches, with more than 60% of this falling during the growing season between April and September. Analysis of drought severity and frequency indicate that the region has experienced the effects of two recent severe droughts from 1998-2002 and again from 2007-2009 (J. Weaver, 2005; NCFSWC 2011). Extreme weather events including hurricanes, tropical storms and major rain events are an important factor controlling the ecology of the region.

The City of Wilmington and its outlying region are located entirely within the Lower Cape Fear River basin, which drains the largest watershed in North Carolina (Mallin, 2001). The Cape Fear River itself is 200-miles long, and the basin covers approximately 9,324 square miles or 16.5% of the total land area of the state (Figure 6.2) (NCWRC 2005). The Cape Fear River basin can be classified as having three distinct regions: the upper Cape Fear including the headwaters in the Piedmont, the middle Cape Fear including the fall line and the sandhills regions, and the lower Cape Fear including the coastal estuarine region and its blackwater streams, peatlands and swamps. Much of the headwaters are located in, and flow through, heavily urbanized areas (e.g. Durham, Greensboro and High Point) that significantly impact water quality throughout the basin. Blackwater streams, which get their name from the dissolved organic solids prevalent around swamp forests, have a high rate of endemism due to their unique habitats, and suffer acutely from poor water quality (Ibid). The Cape Fear estuarine region differs from most other estuaries in North Carolina because it is open to the sea, has a significant tidal effect, and drains broad areas of coastal plain. Cape Fear is typical of the kind of systems found in the Southeast United States running from lower North Carolina through South Carolina, Georgia and Northern Florida. Most of the other large estuaries in North Carolina are bordered by barrier islands, which tend to restrict flow and tidal influence.

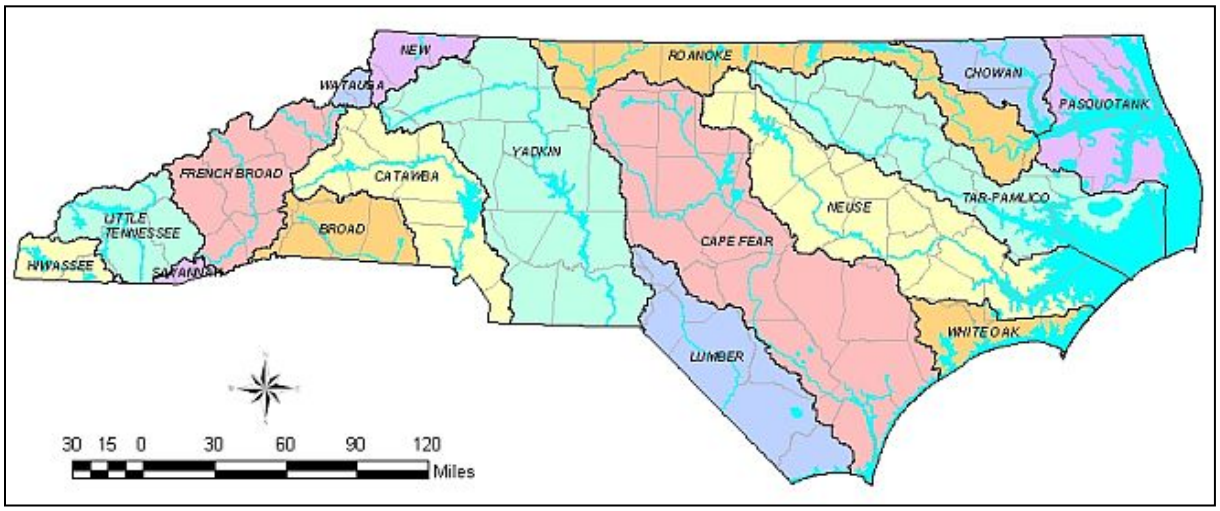

Figure 6.2: North Carolina River Basin Map
Source: North Carolina Division of Public Health

The lower Cape Fear basin is extremely rich and diverse in both habitats and wildlife. The estuarine regions contain abundant salt marsh and lowland swamp forest, as well as sandy beaches that serve as major nesting areas for sea turtles. The adjoining regions are primarily tidal creeks, which tend to be some of the most productive ecosystems in the world. These areas serve as primary nursery areas for larval and juvenile fish, and as migratory routes for anadromous fish populations such as striped bass and herring. While these fish populations were historically fished commercially, habitat degradation and migratory route impediments have caused either closing or reductions in these once-important fisheries. Tidal creeks are also notable because they are the only significant tidal freshwater marshes in the State of North Carolina (Mallin et al., 2000). Other natural regions surrounding the estuary include longleaf pine savannahs, old-growth forests, Carolina bays, and lime sinks. Currently, there are 27 species on the North Carolina Protected Plant list that are thought to occur in the lower river basin (NCWRC 2005).

This diverse natural habitat is home to an array of wildlife. According to the *North Carolina Wildlife Action Plan* (2005) there are approximately 42 mammal, 197 bird and 57 reptile/amphibian species occurring in this area of North Carolina. The lower Cape Fear is part of the Atlantic Flyway, which provides key resources to waterfowl migrating from the Caribbean north to Greenland. At least 22 threatened and endangered species are thought to use the varied habitats of the lower Cape Fear system. These species include the red-cockaded woodpecker, the Southeast bald eagle, the shortnose sturgeon, the Eastern cougar, the American alligator, sea

turtles and the occasional manatee. Invasive species are also a concern in the basin, and species such as the flathead catfish and the red swamp crayfish have become established and are negatively impacting native species populations (NCDENR 2002).

According to the *Cape Fear River Basinwide Water Quality Plan* (2005) the basin is one of the fastest developing areas in the state and the effects of development are impacting water quality. Today the basin has approximately 730 miles of impaired waters, meaning that the pollution loads exceed EPA-acceptable total maximum daily loads (TMDLs) (NCDWQ 2005). Causes of impairment include sediment, fecal coliform, ammonia, chlorides, low dissolved oxygen, turbidity, nutrients, mercury and other point and non-point source pollutants. Sedimentation is a major issue in the basin, and is caused by agricultural practices, forestry, construction, and stormwater discharge in urbanized areas. Population in the basin grew from just under 1.5 million people to over 1.8 million people between 1990 and 2000 (NCDWQ 2005). This basin has approximately 24% of the state's residents and contains all or part of 114 municipalities in 26 counties, including six of the ten fastest growing counties in the state (NCDWQ 2005). This rate of growth is expected to continue especially around established urban areas. The overall population of the basin is approximately 197 people/square mile, with densities as high as 1,000/square mile or more in coastal communities (NCOSBM 2010). Further, according to the *Cape Fear River Basinwide Water Quality Plan* (2005) 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 (28.9%) over the next 15 years. Associated with this growth will be increasing strain on water resources for drinking water, wastewater assimilation and runoff impacts. There will also be a loss of natural areas and increases in impervious surfaces associated with the construction and land development.

The Cape Fear watershed is the most heavily industrialized basin in North Carolina, with numerous industries using the river in the upper watershed, and 11 major industrial discharges in the Wilmington area. Major industries include textiles, chemical manufacturing, forestry and agriculture. Hundreds of turpentine distilleries once dotted the historically vast longleaf pine forests of the region. The products of these trees – tar, pitch, turpentine and rosin – distinguished Wilmington and the surrounding area as the world's leading exporter of naval stores in the 18th and 19th centuries. It is this rich export history that lent the nickname "Tar Heel" to inhabitants of the state. However, early over-harvesting of the longleaf pine encouraged farmers to turn the

decimated forests into cotton and tobacco farms instead. Later, hog and poultry farms located in the basin, making it one of the most concentrated livestock production regions in the country. Today, animal production is primarily large-scale concentrated animal feeding operations (CAFOs), where animals are raised together in long, enclosed buildings. Approximately 5 million of North Carolina's hogs are located in the Cape Fear basin, and two counties in the region (Duplin and Sampson) produce more hogs than any other region in the United States (Mallin et al. 2000b). Overall, the State of North Carolina ranks second in U.S. hog and turkey production, and fifth in the US for chicken production (ERS/USDA 2011). The waste lagoons and sprayfields associated with CAFOs are a considerable contributor to poor water quality in the basin. Other major industries in the basin include more than 280 regulated point source municipal and industrial wastewater discharges, timber production and crop agriculture.

Non-point sources impacts on water quality in the Wilmington region are from a broad range of land use activities and weather-related events. Unlike point source pollution, non-point source pollution is diffuse and occurs irregularly, depending on rainfall events and land disturbance. Major non-point sources of pollution in the basin include agriculture and livestock production, forestry and the conversion of land to urban and suburban uses. Recent studies indicate that urban land uses in have increased from an estimated 370,000 acres in 1982 to 627,000 in 1997. At this rate of conversion, it is estimated that well over one million acres in the basin will be in urban land cover by 2020 (NCDWQ 2005). Water quality declines in the basin are most evident in streams in and around urban centers and interstate corridors (Beach 2002). In the Cape Fear River basin, over 300 miles of impaired stream miles are associated with urban or urbanizing areas (Wilmington-New Hanover County 2006). According to Beach (2002), urban growth is the greatest threat to aquatic resources. The impacts on lakes and rivers as development surrounding metropolitan areas consumes forests and fields can be significant and permanent if stormwater runoff is not controlled (Mallin et al. 2000b). Further, the loss of watershed vegetation to impervious surfaces results in increased runoff and flooding frequency, and the inability of the environment to absorb and diffuse non-point source impacts.

In addition to regular rainfall events, the lower Cape Fear River system has been struck repeatedly by hurricanes and tropical storms in recent years. According to Mallin et al. (2002) the ecosystem-level effects of recent hurricanes are evident in the severe degradation of water quality, benthic community displacement and large-scale fish and shrimp kills. Over the past

fifteen years, the Cape Fear Estuary region was hit by Hurricanes Bertha and Fran (1996); Hurricane Bonnie (1998); and Hurricanes Dennis, Floyd and Irene (1999). Three of these storms - Fran, Bonnie and Floyd – had major, long-lasting effects on the areas aquatic resources.

In the State of North Carolina, all named streams have been classified according to their "best usage" (Wilmington-New Hanover County 2006: 65). This use support classification is based on water chemistry data and involves computing values in violation of applicable North Carolina standards. For planning and monitoring purposes, the Cape Fear River basin is divided into 24 sub-basins. New Hanover County and the City of Wilmington are drained by three of the 24 sub-basins (17, 23 & 24). Sub-basins 17 and 24 include the coastal areas, comprised mainly of tidal estuarine waters and the extreme southern portion of the Cape Fear River. Sub-basin 23 includes the northern portion of New Hanover County north of Wilmington and portions of Pender, Duplin and Onslow Counties. According to the 2005 *Cape Fear River Basinwide Water Quality Plan* the main causes of partially supported or impaired streams (including sounds and estuaries) in these three sub-basins are multiple non-point sources of pollution including agriculture, urban runoff, septic tanks and marinas.

6.3: The Social Environment

A fundamental step to understanding the issues facing the City of Wilmington and the region is to examine past growth trends and future projected growth patterns. Over the past several decades Wilmington and the surrounding region have experienced considerable population growth. Since World War II, Wilmington's growth rate has generally been between 2% and 4% annually. While there have been some peaks, and a considerable slow-down after the Atlantic Coast Line Railroad left in 1955, the city has more than doubled in size since 1980 (City of Wilmington NC 2004). From 1990 to 2010, the City of Wilmington population grew at an annual rate of approximately 3.5% (Table 6.1), which is almost three times the state's 1.2% annual growth rate for the same period. As evidenced in Table 6.1 and Table 6.2, the New Hanover County growth trend is comparable to that of the city. To a certain extent this is because significant areas of the county adjacent to the City of Wilmington have developed rapidly as land within the city becomes scarcer and more expensive. This relatively low-density development is possible because of the widespread availability of public water and wastewater in unincorporated areas. The city through cooperative agreements between the city and the county, are generally providing these services. Historically these areas have been annexed into the City when

densities reach pre-determined levels. At projected growth rates, the City of Wilmington forecasts that it will be "built-out" by approximately 2025, making the provision of services and annexation of adjacent unincorporated land an important part of the long-term growth strategy (City of Wilmington NC 2004: 6).

TABLE 6.1: WILMINGTON GROWTH TRENDS AND PROJECTIONS 1990-2020						
LOCATION	1990	2000	2010	GROWTH % 1990-2010	ESTIMATED POPULATION 2020	ESTIMATED GROWTH % 1990-2020
City of Wilmington	55,530	75,838	95,944	72.7%	120,727	117.4%
New Hanover County	120,284	160,307	202,667	68.5%	233,681	94.3%
Wilmington MSA	171,269	233,450	362,315	111.5%	499,202	191.5%
Data Sources: U.S Census Bureau, North Carolina Office of State Budget and Management (Projections)						

Wilmington is the cultural, educational and economic center of southeastern North Carolina, and has been a catalyst for considerable regional growth. Beyond the immediate Wilmington area there has also been robust growth in the incorporated coastal communities of Wrightsville Beach, Carolina Beach and Kure Beach in New Hanover County. Collectively, between 1960 and 2010 these communities have seen their populations grown tremendously (Table 6.2). Further, the Wilmington MSA, which includes Brunswick and Pender Counties, has also experienced explosive growth. As noted in Chapter 2, Brunswick County, which is situated between the fast-growing cities of Wilmington and Myrtle Beach, SC, is one of the fastest growing counties in the nation. Figure 6.3 shows that in addition to the Piedmont corridor metropolitan areas (Raleigh/Durham and Charlotte), the Wilmington MSA has experienced some of the strongest population growth in the state. According to 2000 U.S. Census, the Wilmington MSA ranked 14th in the nation in terms of percentage of growth over the previous decade (City of Wilmington NC 2009).

TABLE 6.2: WILMINGTON REGIONAL POPULATION TRENDS 1910-2010				
YEAR	NEW HANOVER COUNTY	UNINCORPORATED	WILMINGTON	BEACH TOWNS (WRIGHTSVILLE, CAROLINA, KURE)
1910	32,037			
1920	40,620			
1930	43,010			
1940	47,935	14,528	33,407	
1950	63,272	18,229	45,043	
1960	71,742	25,521	44,013	2,208
1970	82,996	33,069	46,169	3,758
1980	103,471	53,950	44,000	5,521
1990	120,284	56,386	55,530	8,368
2000	160,307	73,163	75,838	11,306
2010	202,667	92,833	95,944	13,890
Data Sources: U.S Census Bureau				

As the Wilmington region continues its vigorous growth as predicted by the State Demographics branch of the Office of State Budget Management (Table 6.1), it is important to note some of the demographic characteristics of the population. Orr and Stuart (2004) note that the State of North Carolina ranks fifth in the nation in terms of population gain from net domestic migration from 2001 to 2005. This is significant, as historically the state lost more people this way than it gained (Figure 6.4). The heaviest loses were in the 1950s, but by the 1970s for the first time in modern history a substantial in-migration was recorded. This has continued to increase in recent years, reaching nearly 1.4 million more residents moving to the state than leaving between 1990 and 2005. This flood of new residents is rapidly changing the North Carolina landscape, both literally and figuratively. Not only are several NC metro areas among the fastest growing in the nation, but Orr and Stuart (2004) note dramatic shifts in other areas such as racial composition, cultural amenities and political affiliation. These larger trends are fully evident in the Wilmington region. Favorable climate, proximity to Atlantic Ocean beaches, a sizable historic district and cultural amenities combine to make it a magnet for tourists, second-homebuyers and retirees (City of Wilmington NC 2004).

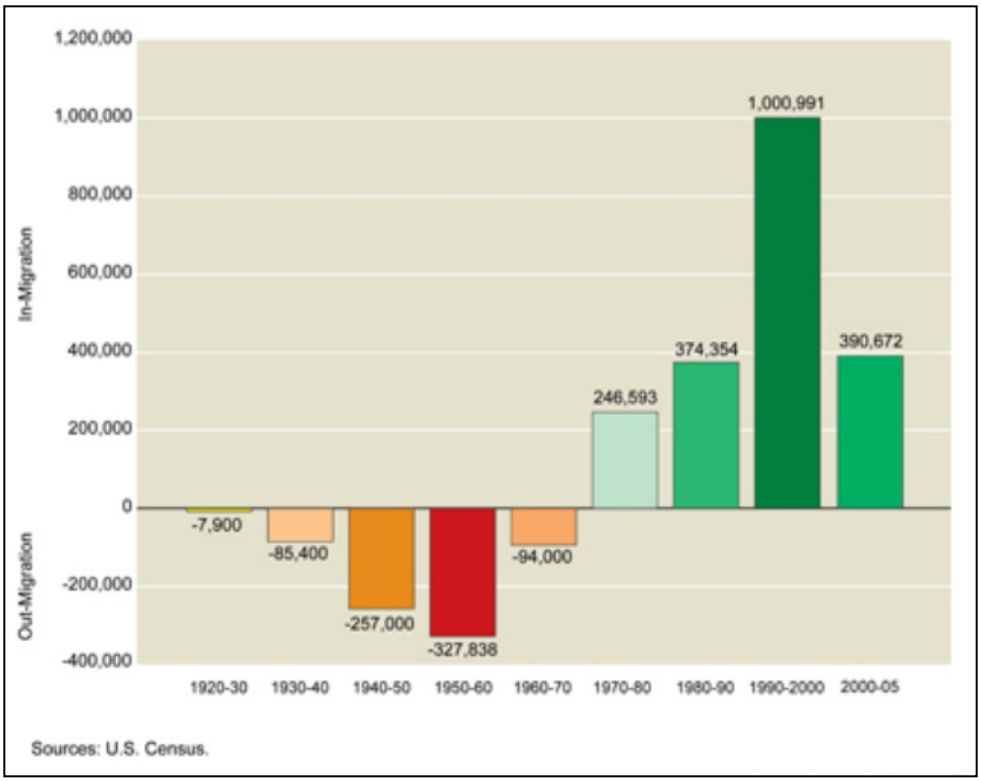

Figure 6.3: Net Population Migration in North Carolina
Source: Orr and Stuart, 2004

One of the most significant aspects of this shifting population is its age structure. Referred to by Johnson and Kasarda (2011) as the "silver tsunami", the percentage of the population over 65 years in the Wilmington area has increased as the area becomes a retiree destination. While some of the rise in proportion is a reflection of the general aging of the U.S. population - caused by improved health care and healthier living – the rest is generally attributed to net migration of people over the age of 65. As shown in Table 6.3, the percentage of the population in Wilmington that is over the age of 65 (15.3%) is dramatically higher than the county (12.8%) and the state (12.7%). Along with a steady increase in the age of the community, retirees also tend to be empty nesters, which reduces household size (Johnson and Kasarda 2011). Table 6.4 indicates a steady decline in the average number of people per household in the Wilmington region. Interestingly, given the high percentage of the Wilmington population over 65, the median age of the city's population is lower (34.5) than that of the county (37.9) and the state (36.3). This is due to the counterbalancing effect the 13,071 students enrolled at the University of North Carolina Wilmington (UNCW). As a result of both of these factors (college

students and retirees), New Hanover County and the City of Wilmington have experienced dramatically increased residential construction activity.

TABLE 6.3: PERCENTAGE OF POPULATION OVER 65 YEARS 1990-2010				
COMMUNITY	1990	2000	2010	2010 Median age[a]
City of Wilmington	15.9%	15.3%	15.3%	34.5
New Hanover County	12.6%	12.8%	13.8%	37.9
State of North Carolina	12.1%	12.0%	12.7%	36.3
Data Sources: U.S Census Bureau, North Carolina Office of State Budget and Management (Projections) [a] Median Age is based on 2010 US Census data				

TABLE 6.4: HOUSEHOLD SIZE 1990-2020				
TENURE	1990	2000	2010	2020 Projected
City of Wilmington	2.27	2.11	1.95	1.79
New Hanover County	2.40	2.25	2.11	1.96
North Carolina	2.54	2.49	2.47	2.46
United States	2.63	2.59	2.63	2.67
Data Sources: U.S Census Bureau, North Carolina Office of State Budget and Management (Projections)				

In the most general terms, the demand for housing increases with population growth. Therefore, increases in population and changing population characteristics are determinants of residential construction activities. As previously noted, over the past several decades Wilmington and the surrounding region have experienced considerable population growth as a result of in-migration of retirees and others; thus the supply of housing and developable land has become more costly. According to the City of Wilmington's *Land Use and Projected Future Build-Out Report* (2007) the city is approximately 90% developed. In order to accommodate the growing demand for housing that reflects the needs and wants of consumers, residential construction in the City of Wilmington has focused on smaller infill development and multi-family settings while larger single-family homes and large-scale subdivisions are mainly in the unincorporated areas of the county.

An examination of housing characteristics reveals an increase in the construction of multi-family housing units in both the city and the county (Figure 6.6). This general trend, coupled with the gradual decline in average household size, is a result of increases in the college student population and the in-migration of retirees ('empty-nesters'). In addition, land values throughout the City of Wilmington and coastal areas of New Hanover County have risen dramatically making the cost of single-family homes unobtainable for many. The relatively modest amount of single-family construction within the City has occurred primarily on vacant lots in recently annexed areas in typical suburban density patterns. Rather, residential

construction in the City tends to be equal parts single- and multi-family, or favor multi-family development. Despite the trend towards smaller household sizes and multi-family uses, construction of single-family housing within the unincorporated county continued at a very rapid pace between 1999 and 2004 (City of Wilmington NC 2004; Wilmington-New Hanover County 2006).

The City of Wilmington serves as the economic, cultural and services hub for southeastern North Carolina. The historic attractions, mild climate, waterfront location, and business opportunities have made the region one of the fastest growing in the country. The Milken Institute/Greenstreet Real Estate Partners *Best Performing Cities Index* for 2009 ranked the Wilmington MSA 34th in the nation in the largest metropolitan areas category for its ability to create and sustain jobs. Fortune Small Business ranked Wilmington MSA 14th among mid-sized metropolitan areas for "Best Places to Launch Small Business"; Forbes Magazine ranked Wilmington 5th in the "Best Cities for Technology Jobs" in the number of information-sector jobs created since 2000; and the Builder Market Health Report ranked Wilmington 17th of the "20th Healthiest Housing Markets for 2010". Wilmington and New Hanover County have diverse economic climates, which rely heavily on tourism, pharmaceuticals/healthcare, manufacturing, and government. According to the City's *Comprehensive Annual Financial Report* (2010), no single employer dominates the local economy. Major employers in the City with over 1,000 employees include the New Hanover Health network (4,890), the New Hanover County Board of Education (4,130), General Electric (3,000), UNCW (1,810), Pharmaceutical Products Development, Inc. (1,800), New Hanover County (1,670), Cape Fear Community College (1,260), Verizon Wireless (1,200), the City of Wilmington (1,075), and Corning (1,000). Numerous State and Federal agencies have regional agencies in the area, and the City is home to the State's largest port.

Tourism is the area's largest economic sector in terms of employment and revenues. Nearby beaches, the historic riverfront area, and a variety of special events and attractions are a draw for tourism business. The U.S. Travel Association prepared the *2010 Economic Impact of Travel on North Carolina Counties* study for the North Carolina Division of Tourism, Film, and Sports Development. This study reveals that in 2010 the economic impact from domestic travel in New Hanover County was estimated at $400.88 million. This represents 5,040 local jobs with a supported payroll of $91.62 million (U.S. Travel Association 2010). Tourism is also among

the State's fastest growing industries, and North Carolina maintained its rank as the sixth most visited state in the U.S., behind California, Florida, Texas, New York, and Pennsylvania - New Hanover County ranks 9th in the state for economic impact by tourism (U.S. Travel Association 2010). However, it is important to note that a tourism-based economy also tends to be heavily affected by economic downturns, in both travel dollars and slow-downs in construction. According to the North Carolina Department of Commerce, while economic impact from travel in 2009 was less than 2010 ($390.38 vs. $400.88 million), jobs related to tourism and annual payroll were both higher in 2009, indicating an overall slowdown in the regional tourism industry.

6.4: The Planning Environment

This study took into consideration both the 2004 *Choices: The City of Wilmington Future Land Use Plan* and the 2006 *Wilmington-New Hanover County Joint Coastal Management Plan*. The Wilmington Development Services Department - which oversees most elements of development management including community-wide and small-area planning; transportation and traffic analysis; environmental planning and review; and historic preservation - participated in both of these planning processes. The City currently has a staff of 20 planners/land use staff, which is generally seen as enough to cover current development needs. However, the department has lost 3 planners to budget cuts during the past 3 years, and there is concern that an uptick in the housing market will mean the department is under capacity. Notably, New Hanover County has an agreement with the City of Wilmington to provide building inspection and permitting services countywide. While this arrangement minimizes city expense, development coordination and information sharing is somewhat hampered. However, there has been no indication that a significant problem exists with this arrangement and it is expected to continue.

New Hanover County is included in the 20-county coastal zone, and is therefore required to prepare a land use plan that provides for the protection, preservation, orderly development and management of the coastal area. Wilmington and New Hanover County have jointly prepared a CAMA plan since the law was enacted in 1974. The plan reviewed in this study was the fifth update of the original plan, which was originally adopted by the City and County in 1976 (Wilmington-New Hanover County 2006). Previous updates to the original plan were made in accordance with State rules and planning guidelines in 1981, 1986, 1993, and 1999. The Wilmington-New Hanover County 2006 CAMA Plan update is an official document that was

adopted by both the Wilmington City Council and the New Hanover County Board of Commissioners. Public hearings for the Plan were held in March of 2006 and were followed by adoption. The Plan was officially certified by the State in late 2006, and is used by regional, State and Federal agencies in making coastal project consistency determinations and funding and permit decisions. While the plan provides guidance to the City and County officials in their decisions on new development proposals and redevelopment plans, development and zoning regulations, and new policies and programs, it is not statutorily binding in the sense of a standard ordinance.

The first comprehensive plan for the City of Wilmington written in 2004, and is intended to guide the physical development of the City for a 20-year period. The plan drew heavily on the 1999 Wilmington-New Hanover County CAMA plan vision statement, and subsequently refined the output based on a series of public input meetings. Interviews with Wilmington planners indicate that the *Choices* plan, which was written the when the community was nearly built-out, was done so in recognition that there were elements of the landscape (e.g. design guidelines, infill development, redevelopment) that were not being covered by the CAMA plan. Therefore, it was important at the City level to create a plan locally to meet those planning needs. As noted in the *Choices* Plan:

> Wilmington has never had a clear policy direction on future land use and physical growth of the City. Many communities have a long planning history of making development decisions based on comprehensive plans… We have the distinct disadvantage of starting from scratch in a nearly built-out community in the 21st Century (City of Wilmington NC 2004: 11).

While this plan includes some environmental protection elements, the CAMA plan is generally regarded as the environmental plan for the City. Therefore, there are few large-scale ecosystem components within the plan.

Interviews with Wilmington planners and regional environmental program managers indicate that there is a general commitment by the staff and citizenry to planning in the Wilmington region - and particularly in the City itself. This is most likely tied to the fact that this is a high growth area that is striving to maintain high-quality habitats or restore severely degraded systems (Burby and May 1998; Fleischmann and Pierannunzi 1990). However, there is general recognition by planners and local environmental activists that local officials will only

support ecosystem planning efforts that meet state minimum requirements, and will generally need to be "tricked into" surpassing these standards. As noted in the *Choices* plan:

> Wilmington does not have a history of being a planning-friendly community. There have been more failed attempts at planning than successful plans. The overall community has been somewhat apathetic about planning efforts, so organized special interests and very vocal citizens opposing specific projects in their back yard have generally been the dominant voices over the past several decades (City of Wilmington NC 2004: 11).

Regardless, there is a general recognition at the City-level and by local environmental activists that Wilmington is one of the "bright spots" on the coastal NC planning landscape. There is a commitment at the staff level to push sound environmental practices in the area. As noted by a Wilmington planner:

> There is a concerted effort by the staff to make a good case for environmental protection on development proposals so that it is easier for local officials to support… There is generally a willingness to support environmental policies as long as they don't get in the way of development. Then it becomes about the staff making a very good case and then I usually get my way.

This gets at Burby and May's (1998) commitment conundrum, which maintains that in order for environmental policy to be implemented at the local level the local staff needs to be committed to supporting such efforts. Further, the City of Wilmington and New Hanover County actively participate in other regional ecosystem planning efforts such as the Cape Fear Arch Conservation Collaboration, which identifies conservation resources in NC and northern SC, and Lower Cape Fear River Association initiatives.

6.5: Plan Evaluation

Results from the first phase of analysis (Chapter 5) provide an overall assessment of how well the City of Wilmington incorporated the principles of ecosystem management into its comprehensive plans. As shown in Table 6.5, the total ecosystem plan quality score for the Wilmington – New Hanover County Joint CAMA Plan is 36.08 (compared to a mean total ecosystem plan quality score of 18.54), which on a scale of 0-50, indicates a strong commitment by the City and the County to ecosystem management. Overall this plan scored the highest among all of the communities/plans sampled. The factual basis component is the lowest scoring plan component, which may demonstrate a lack of knowledge regarding the existing level of critical natural resources within the jurisdiction. In contrast, the inter-organizational plan

component scores highly suggesting a strong commitment toward collaborating within the jurisdiction, coordination between incorporated municipalities and the County, and collaboration with inter-governmental agencies and neighboring communities. Specific scores for each plan component are discussed in greater detail in the subsequent sections of this chapter, and provide a more detailed examination of a local jurisdictions' ability to incorporate the principles of ecosystem management by unpacking the results from the plan coding protocol item by item.

On the other hand, the total ecosystem plan quality score for the City of Wilmington *Choices* plan is 9.64, which on a scale of 0-50 indicates a minimal effort to manage ecological systems at the local level. Overall, this plan scored the lowest among all of the communities/plans sampled. This seems to present a conflict within the community – seeming to both embrace and ignoring the need to plan for ecological systems. However, interviews with Wilmington staff indicate that this was by design. When the *Choices* future land use plan was written before the most recent update of the CAMA plan, it was written in anticipation of a CAMA update. As noted by a Wilmington planner:

> The two plans were really a chicken and egg process. The future land use plan was written by the city for the city, and tried to capture the big ideas of the CAMA plan. CAMA was done by the County for the City and the County but with City input… The two have influenced each other and are really seen as a whole development package… they are seen as 2 parts of a much larger puzzle including regional conservation plans, regional transportation plans, neighborhood plans that all work together and have their own role.

Notably, the *Choices* plan does prioritize the protection of vegetation and native plant species in the community, and includes a resource inventory, goals & objectives, and regulatory tools to restrict native vegetation removal. Further, the plan also utilizes standard land development tools such as subdivision standards, site plan review, and controls on construction to achieve these efforts. However, based on the fact that the *Choices* plan is really not intended to address environmental issues I will be examining only the CAMA plan for ecosystem plan quality. A complete accounting of the *Choices* plan quality scores is included in Appendix B.

Table 6.5: Descriptive plan quality scores for each plan component			
Plan Component	CAMA	City of Wilmington *Choices*	Overall Mean Plan Scores
Factual Basis	5.69	1.25	3.649
Goals and Objectives	7.33	2.33	4.189
Inter-organizational Coordination	8.57	1.79	3.453
Tools, Policies & Strategies	6.36	3.64	3.729
Implementation	8.13	0.63	3.512
Total Ecosystem Plan Quality	36.08	9.64	18.535

[a] Maximum score by plan component is 10.00; [b] Maximum score for total ecosystem plan quality is 50.00

6.5.1: Factual Basis

In looking at the CAMA plan, the Factual Basis score of 5.69 (Table 6.5) is the lowest scoring component of this plan, which, as noted above, may demonstrate a lack of knowledge regarding the existing level of critical natural resources within the jurisdiction. However, Factual Basis score of 5.69 is well above the mean total ecosystem plan quality score of 3.65. Items within the Factual Basis plan component are grouped into three categories. First, the Resource Inventory component includes indicators such as mapping ecosystems and habitat boundaries, describing ecological functions, and the ability to classify wildlife and vegetation. In order to protect the ecological infrastructure of a landscape, the plan must also identify critical habitat, areas of high biodiversity, and corridors that facilitate the movements and migration of key species. Second, the Ownership Pattern category characterizes the existing management of critical habitats and areas of high biodiversity. To identify new land for protection, the plan must begin by identifying the existing network of protected areas. The Resource Inventory components combined with the Ownership Patterns components generally provide the basis for a gap analysis that can greatly assist planners in generating plans and making development decisions that effectively manage ecosystems. Human Impacts, the third category of the factual basis component of a plan deals with identifying resource problems associated with human development. Indicators in this category include human population growth, the development of wetlands, water pollution and nutrient loading, and habitat fragmentation.

In the Resource Inventory category (Table 6.6), the plan mapped and catalogued several of the key elements for identifying and managing ecosystems, but failed to include other critical elements. The plan clearly identifies and maps the Lower Cape Fear River Basin and aquifer recharge areas (ecological boundaries/edges); the location and function of Primary Nursery

Areas (PNAs), estuarine systems, barrier-beach complexes, and floodplains (ecological functions); and the distribution of marine resources and some rare species (distribution of species). However, other important elements for understanding species within ecosystem systems, such as indicator or keystone species, endangered or threatened species, and exotic or invasive species, are not identified despite the fact that these data are readily available from the state. Habitat corridors between natural areas, an essential component of maintaining the landscape mosaic because they allow for natural movements of species, are not mapped or described in the plan. While the plan includes a thorough discussion of the larger Cape Fear River Basin and other trans-boundary resources are not graphically represented. Further, the plan does not mention areas of high biodiversity or species richness, despite the fact that this information is readily available from the state's Natural Heritage Resource Program. Vegetation cataloguing and mapping, and particularly that of local wetlands, is more thorough than wildlife identification, which is limited to the description of purpose for the State's Areas of Environmental Concern (AECs). The plan also included several traditional environmental components within the jurisdiction, such as soil types, wetlands, and surface water features.

The Human Impacts listed and described in the plan concentrate primarily on typical urban environmental problems, such as water pollution and nutrient loading, as required by the CAMA land use planning regulations (Table 6.6). Federal water quality monitoring regulations and obvious environmental disturbances such as shellfish bans and beach closures are thoroughly outlined and discussed. The plan thoroughly describes both the ecological and economic impacts attributable to the loss of fisheries, and includes maps of closed shellfish areas and impacted PNAs. However, the plan fails to address some of the most pertinent issues related to habitat degradation and ecosystem decline in the North Carolina coastal zone - habitat fragmentation and the alteration of waterways - and only briefly discusses wetlands development. While one would expect to find the description of population growth and road density in any comprehensive plan (and this one is no exception), these elements are not necessarily linked to their impact on ecosystems, but rather to the provision of capital improvements and infrastructure capacity. It is important to note that habitat fragmentation, wetlands loss and increases in road density are cited as having the greatest adverse impact on ecosystems and the decline of biodiversity within these systems (Beatley 2000).

Notable is the thorough cataloguing and mapping of most Ownership Patterns (Table 6.6) and the measurement of carrying capacity within the jurisdiction. As required by the state, AECs, Natural Heritage Resource Areas, and estuarine systems are established and regulated by the Coastal Area Management Act, and any activities within these areas require management plans and CAMA permits. As expected, these areas are clearly catalogued and mapped in the CAMA plan, and there is a thorough description of the management status and requirements within these areas. In addition to state requirements, the County Zoning Ordinance and City Land Development Code establish "Conservation Overlay Districts" to protect sensitive areas through required preservation of the resource. These areas have been digitized and mapped in GIS, and while they may overlap with state- or federally-protected areas, the plan notes that local regulations are generally more stringent within these areas (Wilmington-New Hanover County 2006: 72). While each of these resources is mapped, there is little or no discussion of the 'network' or the distribution of species within the network - both important elements for understanding ecosystem processes. Another requirement of the CAMA plan is the inclusion of a *land suitability analysis* and *land suitability map*. The analysis is a process for determining a planning area's approximate supply of land that is suitable for development. This analysis includes consideration of a number of factors, including natural system constraints, compatibility with existing land uses and development patterns, existing land use policies, and the availability of community facilities. The resulting map then shows vacant or underutilized land that is suitable for development. Collectively the land suitability analysis and map measure the carrying capacity of developable land, and provide the foundation for future land use recommendations. Unfortunately, the land suitability analysis does not include spatial representations of areas with high biodiversity, and thus is unable to provide guidance on a gap analysis that would prioritize areas of high biodiversity before they become degraded.

Table 6.6: Issue-based scores for the factual basis plan component		
Indicator	Score	Result
Resource Inventory		
Ecosystem boundaries/edge	2	Mapped & Catalogued
Ecological functions	2	Mapped & Catalogued
Distribution of species	2	Mapped & Catalogued
Vegetation cover	2	Mapped & Catalogued
Soils classified	2	Mapped & Catalogued
Marine resources	2	Mapped & Catalogued
Other water resources	2	Mapped & Catalogued
Surface hydrology	2	Mapped & Catalogued
Wildlife classified	1	Mapped & Catalogued
Graphic representation of trans-boundary resources	1	Mapped & Catalogued
Ecological zones/habitat types	1	Mapped *or* Catalogued
Wetlands	1	Mapped *or* Catalogued
Areas with high biodiversity/species richness	1	Not Identified
Habitat corridors	0	Not Identified
Invasive/exotic species	0	Not Identified
Threatened/endangered species	0	Not Identified
Indicator/keystone species	0	Not Identified
Climate described	0	Not Identified
Other predominant landscapes	0	Not Identified
Ownership Patterns		
Conservation lands mapped	2	Mapped & Catalogued
Management status identified for conservation lands	2	Mapped & Catalogued
Network of conservation lands mapped	1	Mapped & Catalogued
Distribution of species within network of conservation lands	0	Not Identified
Human Impacts		
Population growth	2	Mapped & Catalogued
Road density	2	Mapped & Catalogued
Nutrient loading	2	Mapped & Catalogued
Water pollution	2	Mapped & Catalogued
Loss of fisheries/marine habitat	2	Mapped & Catalogued
Existing environmental regulations described	2	Mapped & Catalogued
Carrying capacity measured	2	Mapped & Catalogued
Wetlands development	1	Mapped *or* Catalogued
Fragmentation of habitat	0	Not Identified
Alteration of waterways	0	Not Identified
Value of biodiversity identified	0	Not Identified
Incorporation of Gap Analysis data	0	Not Identified
Other factors/impacts	0	Not Identified

6.5.2: Goals and Objectives

The Goals and Objectives component of the plan represents the aspirations, problem statement and needs that are premised on shared community values (Kaiser et al. 1995). These statements can be either broad value statements or specific measurable objectives that guide the implementation of ecosystem management. In either case, goals and objectives help prioritize issues and problems facing the community. The Wilmington CAMA plan scored 7.33 on the Goals and Objectives component (Table 6.5), which on a scale of 0-10 indicates a fairly strong commitment to ecosystem management. Wilmington's Goals and Objectives score of 7.33 is well above the mean total ecosystem plan quality score of 4.19. Table 6.7 indicates those goals and objectives that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

The plan includes broad goals to protect the integrity of the Cape Fear River Basin, including estuaries, PNAs and Outstanding Resource Waters (ORWs) for this and future generations (intergenerational sustainability). In addition, the plan sets forth goals to protect the natural functions of these areas, as well as protecting floodplains and watershed resources as environmentally significant resources. The plan clearly prioritizes the protection of wetland ecosystems, including detailed goals and objectives maintaining large intact tracts of wetlands, trees and native species; establishing priority wetlands areas for preservation; and restoring wetland and vegetated buffers. Further, the plan includes objectives to protect rare or unique landscapes, including prohibitions of development on barrier islands and estuarine island systems. However, the plan does not cite more specific objectives involved in managing ecosystems, such as protecting biodiversity hotspots, protecting rare or endangered species, or representing native species within protected areas. While the plan does prioritize the protection of greenways, and the development of greenways as part of a larger Natural Areas Master Plan, it does not delineate these greenways as critical to maintaining wildlife corridors but rather as recreation amenities. This suggests that while the jurisdiction is able to state general (and often vague) goals related to ecosystem management and priority landscapes, it is less able to incorporate specific objectives that could drive precise land use tools and policies. However, when specific objectives are included, they are generally well articulated, measurable and include inter-organizational partners when appropriate.

Table 6.7: Issue-based scores for the goals and objectives plan component		
Indicator	Score	Result
Protect integrity of ecosystem	2	Fully Detailed or Mandatory
Protect natural processes/functions	2	Fully Detailed or Mandatory
Maintain intact patches of native species	2	Fully Detailed or Mandatory
Establish priorities for native species/habitat protection	2	Fully Detailed or Mandatory
Protect rare/unique landscape elements	2	Fully Detailed or Mandatory
Maintain intergenerational sustainability of ecosystems	2	Fully Detailed or Mandatory
Balance human use with maintaining viable wildlife populations	2	Fully Detailed or Mandatory
Restore ecosystems/critical habitat	2	Fully Detailed or Mandatory
Other goals to protect ecosystem	2	Fully Detailed or Mandatory
Presence of measurable objectives	2	Fully Detailed or Mandatory
Goals are clearly specified	1	Suggested but not detailed
Maintain connection among wildlife habitats	1	Suggested but not detailed
Protect high biodiversity	0	Not Identified
Protect rare/endangered species	0	Not Identified
Represent native species within protected areas	0	Not Identified

6.5.3: Inter-organizational Coordination and Capabilities

The Inter-organizational Coordination and Capabilities component of the plan captures the ability of a local jurisdiction to collaborate with neighboring jurisdictions and organizations to manage resources that extend across multiple jurisdictions and ownership patterns. This element of the plan is particularly important to effective ecosystem management because it represents the degree to which the local community is able to recognize the trans-boundary nature of systems and coordinate with other parties within and outside jurisdictional boundaries. The Wilmington CAMA plan scored 8.57 on the Inter-organizational Coordination and Capabilities (Table 6.5), which on a scale of 0-10 indicates a very strong commitment to collaboration and coordination. This compares to a mean total ecosystem plan quality score of 3.45 for all communities surveyed. Not only is the highest scoring component of this plan, overall this plan had the highest Inter-organizational Coordination and Capabilities among all of the communities/plans sampled. Table 6.8 indicates the plan components that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

Overall, results for this category reveal a strong commitment toward collaborating within the jurisdiction, coordination between incorporated municipalities and the County, collaboration with inter-governmental agencies and the UNCW, and to a lesser extent with neighboring communities. The plan notes in detail coordinating with other organizations to protect resources

within jurisdictional boundaries as well as those that cross several administrative lines. State and federal agency partners mentioned include UNCW, the North Carolina Department of Transportation (NCDOT), NCDWQ, NCDENR, US EPA and the US Army Corps of Engineers. Further, there are several intergovernmental bodies and agreements included as key partners, including the Wilmington/New Hanover County Watershed Management Advisory Board, the Lower Cape Fear River Program (LCFRP) and Cape Fear River Association (CFRA), and the New Hanover County Soil & Water Conservation District. Given the fact that this is a joint City-County plan, there is a great deal of coordination between the City of Wilmington and New Hanover County, including the coordinated updating of land use regulations, the implementation of joint City/County plans, coordination between the parks/open space departments, and the establishment of joint City/County councils for infrastructure and resource protection. The plan expresses a clear commitment to integrating other plans, such as the *Cape Fear River Basin Water Quality Plan,* the *Cape Fear River Corridor Plan,* and the City of Wilmington *Choices* future land use plan into the local planning framework. The incorporation of regional environmental efforts are an essential part of achieving ecosystem approaches to management at the local level. The presence and strong commitment of UNCW to regional environmental issues provides the plan with an extra level of coordination and cooperation in the areas of joint database production, information sharing, and providing recommendations on connecting scientific findings with policy directives. Currently UNCW coordinates with the City/County and other regional governmental bodies to monitor water quality throughout the basin, and provides guidance on how factors such as animal lagoons, construction standards, public education, and watershed/stormwater management plans impact local resource quality. Scores are not as strong when it comes to describing the specifics of positioning the jurisdiction within the bioregion (maps and directives still tend to stop at the county border) and committing the financial resources necessary to bring together various parties to manage ecosystems. Finally, the plan fails to mention conflict management processes to resolve resource conflicts prevalent in ecosystem management. While the plan is quite thorough in outlining inter-organizational coordination and capabilities, the lack of conflict resolution directives means there are few "how-to" details for bringing parties together to work on common natural resource problems (Brody 2008: 24)

Table 6.8: Issue-based scores for inter-organizational coordination and capabilities plan component		
Indicator	Score	Result
Other organizations/stakeholders identified	2	Fully Detailed or Mandatory
Coordination with other organizations/jurisdictions specified	2	Fully Detailed or Mandatory
Coordination within jurisdiction specified	2	Fully Detailed or Mandatory
Intergovernmental bodies specified	2	Fully Detailed or Mandatory
Joint database production	2	Fully Detailed or Mandatory
Coordination with private sector	2	Fully Detailed or Mandatory
Information sharing	2	Fully Detailed or Mandatory
Links between science and policy specified	2	Fully Detailed or Mandatory
Intergovernmental agreements	2	Fully Detailed or Mandatory
Integration with other plans/principles	2	Fully Detailed or Mandatory
Other forms of coordination	2	Fully Detailed or Mandatory
Position of jurisdiction within bioregion specified	1	Suggested but not detailed
Commitment of financial resources	1	Suggested but not detailed
Conflict management processes	0	Not Identified

6.5.4: Policies, Tools and Strategies

The Policies, Tools and Strategies component is the core of the plan because these are policies that substantiate the goals and objectives by setting forth actions to protect critical or endangered habitats. These policies include traditional regulatory tools such as land use and density restrictions, restrictions on native species removal, and buffer requirements. In addition to traditional regulatory tools, more innovative incentive-based approaches are also included in this component, such as clustering away from sensitive habitats, density bonuses, transfer of development rights (TDRs), and mitigation banking. Land acquisition programs are another important component of this category because it indicates the desire and ability of local jurisdictions to fund the purchase of critical habitats and sensitive environmental resources. Finally, educational efforts are also included in this component, as these types of programs are essential for engaging stakeholders in the planning process and in generating an effective, enforceable plan. The Wilmington CAMA plan scored 6.36 on the Inter-organizational Coordination and Capabilities (Table 6.5), well above the mean total ecosystem plan quality score of 3.729, which on a scale of 0-10 indicates a moderate commitment to specifying the policies and tools necessary to protect ecosystem resources. Table 6.8 indicates the tools, policies and strategies that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

The Regulatory Tools component demonstrates that the plan tends to favor traditional environmental policies, such as resource use restrictions in wetland areas, estuaries, and on

barrier islands; construction controls limiting impervious cover and promoting low-impact development around critical habitats; and protected areas to protect wetlands and watershed resources. In addition, the County Zoning Ordinance and City Land Development Code establish "Conservation Overlay Districts" to protect sensitive areas through required preservation of the resource. Other traditional environmental policies evident in the plan include the use of capital improvements programming to slow development, site plan review, density restrictions in floodplains, maintenance of tree canopy and prohibitions of clear cutting in wetland areas (i.e. restrictions on native species removal), and buffering along tidal creeks and waterways to improve water quality. However, other regulations such as fencing controls to allow for the movement of native species, phasing of development to reduce wildlife disturbance, or the removal of exotic or invasive species to improve biodiversity are not included. While mainstream policies play an important role in ecosystem approaches to management, the literature suggests that less commonly used growth management tools focusing on growth patterns (e.g. targeted growth areas), specific site-related regulations (e.g. conservation subdivision standards or performance zoning), and the protection of resources in other jurisdictions may allow for more significant gains in protecting regionally significant habitats (Duerksen et al. 1997). In this case the plan makes mention of these types of policies (regulating growth patterns, site-specific regulations, and/or protection of resources in other jurisdictions), but does not fully detail how such regulations would be implemented in the Wilmington/New Hanover region. Also mentioned but not fully detailed are actions to restrict vehicular use around sensitive habitats.

Incentive-based tools enjoy less specification than regulatory approaches in the plan despite their effectiveness in protecting critical habitats and ecological systems (Beatley 2000; Duerksen et al. 1997), In line with the inclusion of traditional regulatory tools such as construction controls promoting low-impact development, the plan also fully details incentive-based tool such as density bonuses and clustering provisions to encourage such low-impact development. However, other incentive-based options like TDRs or mitigation banking are mentioned but not fully developed, despite strong state-level programming and regulatory frameworks allowing for such practices. Further, the plan makes no mention of preferred tax treatments or the designation of special taxing districts for acquisition (see Other Policies in

Table 6.9), despite a generous state-level conservation tax credits designed to promote private preservation.

Unique to the Wilmington/New Hanover County area at the time the plan was written was the presence of the Watershed Management Advisory Board (WMAB). As a result of the 1993 Wilmington-New Hanover County CAMA Land Use Plan, the County initiated an Estuarine Watershed Management Program that led to the development of tidal creek watershed profiles and long-term water quality monitoring conducted by UNCW. After receiving a $6 million grant from the North Carolina Clean Water Management Trust Fund (1998) to implement water quality enhancement strategies, the WMAB was established to advise how the funds would be spent. A major accomplishment of the WMAB, which continued to meet through the end of 2007, was the acquisition of riparian buffer areas, conservation easements, and targeted barrier and estuarine islands through fee simple purchase and other Land Acquisition Programs. Beyond the work of the WMAB, the plan fully details policies to acquire conservation easements along greenways for the dual purpose of resource conservation and recreation. While the WMAB is no longer in existence, the success of the program is evidenced by the clear plan for key property acquisition and the need to acquire property in order improve surface water quality in the basin. Other land acquisition techniques discussed, though in much less detail, are the implementation of conservation trusts and public/private partnerships to conserve sensitive resources.

There are several other non-regulatory policies that are well represented in the plan, and are important indicators of ecosystem plan quality. As previously mentioned, the presence of UNCW and their commitment to regional environmental issues greatly strengthens the ability of the City and County to regulatory monitor ecological health and impacts, an essential component of adaptive management. Monitoring policies are primarily associated with water quality issues, but also include policies related to wetlands habitats, floodplains and barrier islands. The plan does include an urban services boundary and density reductions for property without public services (i.e. water and wastewater), though these policies are more closely tied to infrastructure development rather than critical habitat protection. Finally, the plan fully details educational programs on the importance of protecting habitat and ecological systems. Although the environmental planning arena largely overlooks educating the public, including these types of

policies can also build and understanding of ecological problems and commitment to protecting ecological systems (Yaffee 1996).

Table 6.9: Issue-based scores for the policies, tools and strategies plan component		
Indicator	Score	Result
Regulatory Tools		
Resource use restrictions	2	Fully Detailed or Mandatory
Density restrictions	2	Fully Detailed or Mandatory
Buffer requirements	2	Fully Detailed or Mandatory
Controls on construction	2	Fully Detailed or Mandatory
Conservation zones/overlay districts	2	Fully Detailed or Mandatory
Protected areas/sanctuaries	2	Fully Detailed or Mandatory
Targeted growth away from habitat	2	Fully Detailed or Mandatory
Capital improvements programming	2	Fully Detailed or Mandatory
Site plan review	2	Fully Detailed or Mandatory
Habitat restoration actions	2	Fully Detailed or Mandatory
Restrictions on native vegetation removal	1	Suggested but not detailed
Public or vehicular access restrictions	1	Suggested but not detailed
Performance zoning	1	Suggested but not detailed
Subdivision standards	1	Suggested but not detailed
Urban growth boundaries to exclude habitats	1	Suggested but not detailed
Actions to protect resources in other jurisdictions	1	Suggested but not detailed
Removal of exotic/invasive species	0	Not Identified
Fencing controls	0	Not Identified
Phasing of development	0	Not Identified
Other regulatory tools	0	Not Identified
Incentive-based Tools		
Density bonuses	2	Fully Detailed or Mandatory
Clustering away from habitats	2	Fully Detailed or Mandatory
Transfer of development rights	1	Suggested but not detailed
Mitigation banking	1	Suggested but not detailed
Other incentive-based tools	0	Suggested but not detailed
Preferred tax treatments	0	Not Identified
Land Acquisition Programs		
Fee simple purchase	2	Suggested but not detailed
Conservation easements	2	Suggested but not detailed
Other land acquisition techniques	1	Suggested but not detailed
Other Policies		
Control of public investment and projects	2	Fully Detailed or Mandatory
Public education programs	2	Fully Detailed or Mandatory
Monitoring of ecological health and human impacts	2	Fully Detailed or Mandatory
Designation of special taxing districts for acquisitions	0	Not Identified

6.5.5: Implementation

The final component of ecosystem plan quality measured is Implementation, which measures the ability of a plan to become a lasting document that influences other regulation and encourages collective action. For a comprehensive plan to be effective, implementation must be clearly defined and laid out of all affected parties (Kaiser et al. 1995). The Implementation

component of the plan focuses on the designation of responsibility for action, timelines, enforcement standards and sanctions, as well as monitoring activities to determine the success of policies and respond to scientific information. In this manner the Implementation component of the plan incorporates the concept of adaptive management and flexibility in managing ecological systems that are constantly changing both spatially and temporally. The Wilmington CAMA plan scored 8.13 on the Implementation component (Table 6.5), compared to a mean total ecosystem plan quality score of 3.51, which on a scale of 0-10 makes a compelling case that the Wilmington-New Hanover County plan will be implemented. However, it is important to note that this component does not measure whether the plan was actually implemented. Table 6.10 indicates the implementation indicators that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

There are three components dictated by CAMA regulations for inclusion in all state-approved CAMA plans that are essential for implementation after adoption: clear timetables for designation implementation, plan updates every 5 years, and assessment of plan policies for effectiveness every two years, each of which are fully detailed in the plan. Notable is the inclusion of assessment of plan effectiveness and the ability to incorporate new information, as the literature indicates these are essential elements for effective ecosystem management (Brody 2003c). Further, the working partnership between UNCW and the City/County has already established an efficient system of information provision and technical assistance between various agencies and organizations. However, while the plan specifies what agency is responsible for enforcing various policies therein, it does not identify funding for implementation or require sanctions against those who do not follow plan recommendations. The inclusion of these policies is important because in ensures that policies and projects required in the plan actually come to fruition and are adhered to by the public.

Table 6.10: Issue-based scores for the implementation plan component

Indicator	Score	Result
Designation of responsibility	2	Fully Detailed or Mandatory
Provision of technical assistance	2	Fully Detailed or Mandatory
Clear timetable for implementation	2	Fully Detailed or Mandatory
Regular plan updates and assessments	2	Fully Detailed or Mandatory
Enforcement specified	2	Fully Detailed or Mandatory
Monitoring for plan effectiveness and response to new information	2	Fully Detailed or Mandatory
Identification of costs or funding	1	Suggested but not detailed
Provisions of sanctions	0	Not Identified

6.6: Implications for Implementation and Ecosystem Management

6.6.1: Improve the Factual Basis of the Plan to Include Biodiversity

The protection of biodiversity is considered one of the overarching goals of ecosystem management (Christensen et al. 1996; Grumbine 1994). Because species diversity is believed to be a fundamental component of long-term maintenance of viable ecosystems, the identification of high biodiversity patches or habitats is essential to managing ecosystems. Biodiversity is often operationalized as species richness, and is generally seen as being the intersection of key species that support the overall function and processes of the system (Beatley 2000). For this reason, the first step in addressing biodiversity in a land use plan is through an inventory of species rich habitats and species concentrations, and incorporating available data on existing conditions. However, less than half of all of the plans scored in Chapter 5 discussed areas with high biodiversity or the distribution of species, and none of the plans included information on invasive/exotic species or keystone species, both of which get to the heart of measuring ecosystem resiliency and biodiversity. While the Wilmington-New Hanover plan includes a thorough inventory of the watershed and wetland areas, there is little or no mention of species habitats or biodiversity. As noted in Section 6.4.1 of this case, strong factual basis helps a community understand what resources are being adversely impacted by development and what needs to be protected. With a greater understanding of existing sensitive resource, planners and planning participants may be more likely to incorporate ecosystem management policies into their plans and development regulations (Brody 2003c; Brody 2008).

Incorporation of ecosystem components, such as identification of species richness, areas of high biodiversity, and habitat corridors will help the community better implement the overall principles of ecosystem management. For example, the jurisdiction can make use of the North Carolina Gap Analysis Project (NC-GAP) digital maps of land cover, areas of high biodiversity, and the network of conservation lands across the state. The inclusion of these maps could be analyzed in combination with existing land use patterns and environmental conditions to identify potential conservation zones and vital corridors. A CAMA program manager noted that the lack of this, and other critical ecosystem-based elements, is likely a result of the CAMA regulations rather than a lack of information. When asked whether the plans were based on the best scientific evidence available, the CAMA program manager said:

> We get the information from the sister agencies for the land suitability analysis and obviously that's a whole process that needs to be revisited and enhanced because obviously technology and the resources available have dramatically changed in the 10 years since the more formal rules were put together to assist local governments.

In 2002, the CRC implemented a more formal process and resource inventory requirements for all certified CAMA plans. This included the land suitability analysis and environmental composite map that measure the carrying capacity of the area. However, since these requirements were put in place the ability of local plans to embody the principles of concepts such as high biodiversity or species richness have dramatically improved. Currently the Coastal Resource Commission is re-addressing the land use planning regulations and making adjustments and changes and provide new guidance to local communities, and it waits to be seen whether these changes will include directives for including biodiversity measures in CAMA plans. However, it was not so long ago that communities paid little attention to the identification and protection of wetlands. Through concerted effort and technical assistance, today almost all of the communities in this study identify wetland areas, and particularly in the coastal zone limit development to maintain wetland ecosystems. With this in mind it is not impossible to imagine putting forth the same effort for other aspects of ecosystem management.

6.6.2: Ecosystem Management as an Elusive Concept

An emerging theme from my interviews with several environmental program managers and a local environmental advocate is the belief that CAMA plans are written vaguely so that they don't impede the development process they are supposed to be regulating. When discussing the local commitment to planning in general, a CAMA program manager noted:

> Local governments tend to avoid adopting policies they think the state might use against them, which causes an avoidance of policy being as clear or direct as it could be.

As noted by a local environmental activist:

> Many of the CAMA plans are written so that they will have no effect on those permit decisions. They are so general in their wording that there is nothing to be consistent with… and that is typically by design… General statements of 'we want the environment protected' rather than specific statements that are actually measurable.

This is in line with Norton's (2005b) observation in North Carolina that local officials on the whole supported local CAMA planning as a means to craft a community vision without

hampering development. As noted by Norton (2005: 199):

> (T)he vagueness in policy statements allowed local officials to use their plans to address local concerns without also having to constrain local development activities for the sake of addressing regional resource protection concerns.

In order to effectively manage ecosystems, there needs to be clear directives and specific ecosystem management goals and policies. The Wilmington-New Hanover plan does well identifying objectives or policy directives, however, the goals are somewhat vague and difficult to measure. As a result, the plan is not as strong with specific and/or robust tools and policies, as evidenced by the lower plan quality score on this component. In order to create a plan that is more effective, the community needs to include more specifics, particularly for goals, to guide the implementation of ecosystem management initiatives. Strong objectives need more measureable targets within to be effective. For example, the goal to "protect natural resources" comes across as vague and hard to interpret. However, the goal to "protect and enhance viable native ecological communities to protect ecological functions and the diversity of plants and animals" is much more specific and effective at generating strong policies. Similarly, an objective to "reduce non-point source pollution in estuaries" is far less effective than one to "reduce levels of nitrogen and phosphorous in Pamlico Sound by 25% by the year 2015."

However, there was mention that Wilmington is one of the bright spots in the coastal management landscape. When asked whether local officials are willing to go beyond state minimum environmental protection requirements, a local environmental activist noted:

> I think the process has gotten so routine that they are not even challenged to think that way anymore. In the cases where they are challenged they are willing to go the extra distance but usually that is driven from within the community itself… We work with communities that have an interest in the environment and in Wilmington there has been a huge amount of interest in low-impact development techniques and retrofits and stormwater plans and again there is that local interest… we are not trying to generate interest it is already there.

There is recognition both within the jurisdiction, and by program managers and activists in the region, that the City of Wilmington does go beyond minimum requirements and strives to be clearer about environmental objectives. In addition to local Conservation Area (CA) overlays that increase protection within AECs, the city is implementing low impact development initiatives and participating in super-regional conservation efforts. However, many of these

efforts are not evident from an examination of the plan, and as previously noted, development in the region has continued apace while its ecological health continues to decline. This supports Norton's (2005) findings that even those NC localities doing a better job of addressing environmental protection in their plans, the plans are still being used primarily to manage economic development in their part of the coastal region.

6.6.3: The Need for Consistency Between Local and Regional Plans

There is considerable literature on state planning mandates and how they affect local planning. There is a recognition that mandates lead to plans in communities that otherwise would not do planning (Berke et al. 1996). There is also evidence that planning mandates improve the quality of local plans (Berke and French 1994; Berke et al. 1996; Nelson and French 2002). However, it is often the commitment of local planning staff and officials to planning, the sense of duty to follow through with planning efforts, and a vocal citizenry are primary motivators in plan implementation (Burby and May 1998; Fleischmann and Pierannunzi 1990; Norton 2005b). As such it is critical to have local buy-in from citizens, administrators and staff during the process, and to coordinate those local efforts to have more local investment in regional environmental efforts. . As previously mentioned, the *Choices* future land use plan was written by the city for the city, and made an effort to capture the general concepts of the CAMA plan. The CAMA plan was written by the county, for the city and the county, but with city input. However, as noted by an environmental program manager:

> Because local governments are weary of the plan being used against them, local governments outside of the coastal zone are probably more likely to use their plan than those in the coastal zone… the sweat equity and investment in the plan may actually institutionalize some of the influence of the plan.

A local environmental activist echoed this sentiment in noting that communities like Greenville, which are outside of the coastal zone and provide their own funding for planning, are more likely to implement their plans than many of the CAMA communities. However, unlike the other CAMA communities surveyed, Wilmington has both a CAMA and a local land use plan. This provides the unique opportunity to coordinate the extensive factual basis; tools and policies; inter-organizational coordination; and implementation components into the local plan relatively easily. A planner in Wilmington notes:

> We need better coordination between the two plans because it depends on who sees the development request… the implementation of environmental regulations varies depending on where the development is going and the CAMA tier in which it is occurring.

In order to achieve effective ecosystem management, there needs to be coordination between the two plans. Currently Wilmington is working on an update to the *Choices* plan that will more closely reflect the goals and objectives of the CAMA plan. The sweat equity at the local level may go a long way to guaranteeing that the principals of ecosystem management are implemented.

6.6.4: CAMA in Trouble?

North Carolina's CAMA was enacted largely in response to environmental threats from ongoing development occurring throughout the state's coastal region for the reasonable purpose of balancing the environment and the economy (Heath and Hess 2007; Heath and Owens 1994). In order to balance these dual efforts, the state established a state-local partnership for managing growth within the coastal region, with local governments having the initiative to plan and the state establishing AECs and providing funding and technical assistance to local governments. As noted by a coastal manager:

> From the early days of CAMA and the CRC, proponents had to limit the prescriptiveness of the planning mandate out of political necessity to get it through the legislature… This means that the state does not have a coastal plan – the original plan had a state plan but that was removed… The state relies on the local communities for direction.

Historically the state has provided funding for technical assistance, seed money for the planning process and/or the hiring of consultants, and grants to update land use regulations. However, all community assistance funding for the CAMA program ended in 2009. The program is currently wrestling with ways to assist local governments without any money, and far fewer staff than once employed by the state to address coastal issues. The CAMA act requires the CRC to review the rules and make adjustments and changes to the local plan requirements, which have historically triggered the requirements to update local plans. As noted by a CAMA program manager: "for the past 25 years there have been funds available to assist local communities with these updates and now there aren't." This has the potential to be devastating to coordinated ecosystem management efforts without funding or technical assistance for updates. A local environmental activist notes:

> I am fairly pessimistic on state mandates for planning. I think actually with the CAMA plans now there is not actually mandate for updating the plans and from this point forward it will be up to local initiative to update the plans. I think some communities will… those that understand the value of trying to plan ahead even without funding… because there are communities who feel the need to do them.

As a result of the lack of funding (and the perceived 'vagueness' of CAMA plans), local environmental groups appear to be shifting focus away from these larger efforts toward more small area/focus plans and partnering with communities to implement low-impact development in the area. Without an overarching state plan for the coastal zone, there is the potential to have an even more piecemeal approach to planning for the coastal ecosystem.

6.7: Conclusion

Based on the results above, one can infer that the City of Wilmington has been able to effectively incorporate the principles of ecosystem management into its planning framework. This analysis presents three important findings in terms of ecosystem management and its implementation at the local level. First, these findings indicate that state mandates are effective at advancing regional environmental goals, and encouraging planning in places where it may not otherwise happen. Interviews with local planners and the Wilmington *Choices* land use plan both indicate that there was minimal planning history in the region. However, participation in the CAMA planning process resulted in a land use plan that scored well above the mean for total ecosystem plan quality scores (36.08 vs. 18.54). Results from this case study strongly support the hypothesis that state mandates positively affect the ecosystem plan quality of local plans.

Second, and somewhat unexpectedly, the fact that the process was community-driven (the plan was written by the county with input from the city) rather than consultant-driven was highly influential on both the plan quality and plan implementation. Interviews with local planners, program managers, and environmental advocates reveal the need to localize the planning process. Without local participation to cultivate support and commitment for the plan, interviewees repeatedly note that CAMA plans rarely have an impact on development decisions outside of required CAMA permitting areas. However, when the process is locally-driven, the plan is more likely to be implemented, and is also more likely to be incorporated into, or coordinated with, other local planning efforts. Given these findings, planning researchers need

to more seriously consider the impact of consultants and consultant-driven processes versus locally-driven processes on plan quality and implementation.

Third, local contextual factors were also important in determining ecosystem plan quality and implementation. In particular, development pressure and local staff commitment to ecosystem management are key factors influencing land use decision-making in the Wilmington area. Extreme development pressure in the city, county, and entire region has encouraged land use and environmental planning in areas that never before planned for growth. Rapid development and the negative consequences of poorly planned development are critical variables influencing the creation and implementation of local plans. Further, local commitment to the process (through participation in the CAMA planning efforts), and implementation of the plan is crucial. Not only does the staff realize the need to create strong cases for environmental protection, current elected officials and environmental advocates note the importance of preserving key resources to "strike the balance" (Norton, 2005) between economy and the environment. In Chapter 9, I summarize the impact these findings and those from the other case study cities have on ecosystem planning research and their implications for planning and public policy.

7: Case Two: New Bern, NC

7.1: Introduction

Results from Chapter 5 indicate that local jurisdictions have not been able to effectively incorporate the principles of ecosystem management into the planning framework. However, these results are not uniform across jurisdictions. As expected, there are multiple factors and processes that influence the quality of comprehensive plans with regard to ecosystem management. As discussed in Chapter 4, the inclusion of case studies in this work allows me to address my second research question: *which factors and processes influence the quality of comprehensive plans, and the degree to which they are implemented?* Focusing on this question, I have chosen to include the City of New Bern as a case study for two reasons. First, New Bern was chosen because of its unique location on the Inner Banks and its inclusion in both the CAMA and the APNEP jurisdictions. Second, the New Bern CAMA plan was chosen because it adopted a regional approach, including land use and environmental directives for New Bern and neighboring River Bend and Trent Woods.

In this chapter I further test my first and second hypotheses, and test my third hypothesis to see if the quality and content of the plan is indicative of the degree of implementation. I begin with an examination of the environmental, social and planning environments in the New Bern area to gain a greater understanding of the specific needs of the ecosystem and those factors driving plan development and implementation. Next, I conduct a detailed plan evaluation to understand what ecosystem issues are being addressed by the comprehensive plan and which are not. From there I take a closer look at the implications the plan quality has on implementation of the plan locally, and for ecosystem management as a whole. Rather than deduce plan implementation from spatial or policy analysis, this thesis investigates the question of implementation through a total of five telephone interviews with public and elected officials, environmental program managers, and local environmental advocates working in the New Bern area.

7.2: The Physical Environment

The New Bern metropolitan area is located in North Carolina's "Inner Banks" region, and encompasses and area of approximately 1,813 square miles. The New Bern region includes Craven, Jones and Pamlico Counties, who's major cities are New Bern, Maysville and Oriental respectively (Figure 7.1). Craven County is also home to Marine Corps Air Station (MCAS)

Cherry Point - the largest MCAS in the World – located in Havelock. New Bern is located at the confluence of the Neuse and Trent Rivers, and is located in the Lower Coastal Plain physiographic region. The area is generally flat, with a gentle slope to the southeast. Elevations range from 94 feet above sea level at the Surrey Scarp (which divides the Middle Coastal Plain from the Lower Coastal Plain) in Jones County to sea level in the marshes and floodplains of the central and southeastern portions of Pamlico and Craven Counties (Barnhill 1979; Goodwin 1989).

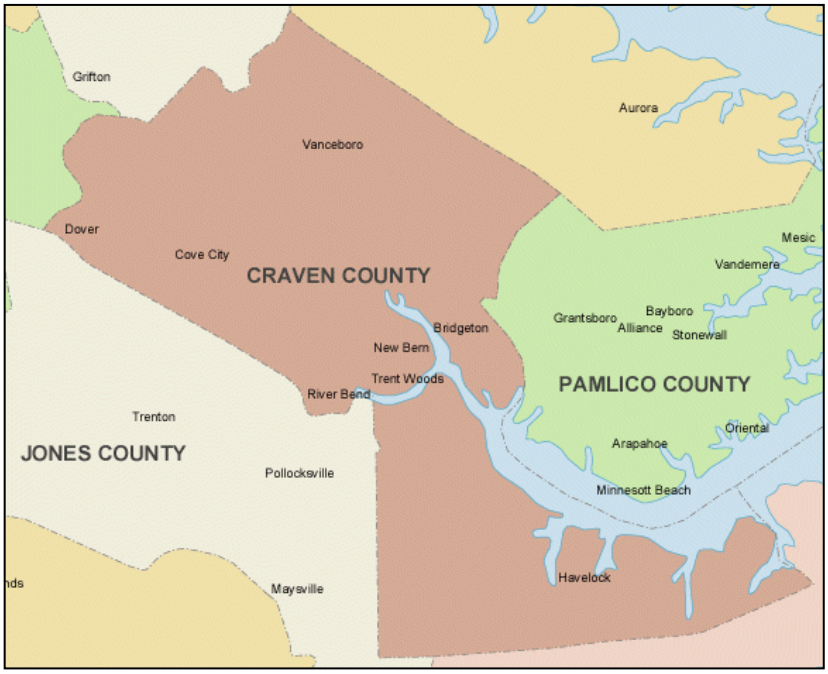

Figure 7.1: New Bern/Craven County Regional Map
Source: North Carolina Office of the Treasurer

Climate in the New Bern area is hot and humid in the summer, but the coast is frequently cooled by coastal sea breezes. In summer the average temperature is 79 degrees, and the average daily maximum temperature is 89 degrees (Goodwin 1989). The growing season for most agriculture in the area is from April until late September, which is when the majority (60%) of precipitation falls (Goodwin 1989). Average annual rainfall is roughly 60 inches, and summer thunderstorms account for a large portion of this precipitation (Goodwin 1989). Hurricanes occasionally cross the area, and storm surge periodically floods low-lying areas along the Neuse and Trent Rivers. Analysis of drought severity and frequency indicate that the region has experienced two recent severe droughts from 2001-2002 and again from 2007-2009 (NCDENR 2010b). The average winter temperature is 48 degrees, and conditions are fairly mild. Some snow

occurs almost every winter, but accumulations are generally small and the average seasonal snowfall is roughly 2 inches.

The City of New Bern and its metro region are located almost entirely within the Lower Neuse River Basin. The Neuse River Basin originates in the north central Piedmont region of North Carolina, and extends southeast through the Coastal Plain region until it flows into the Pamlico Sound (Figure 7.2). The basin is bordered by the Tar-Pamlico River Basin to the north, and the Cape Fear River Basin to the south and southwest. Encompassing approximately 6,200 square miles, the Neuse River Basin is the third largest basin in North Carolina, and one of only four river basins that are located entirely within the state. The Neuse River itself is the longest river in the state, with a total length of approximately 248 miles (NCDENR 2010b). According to the *North Carolina Wildlife Action Plan* (2005: 480) the basin is comprised of 77 municipalities within 18 basin counties, and is one of the most developed and highly populated areas in the state.

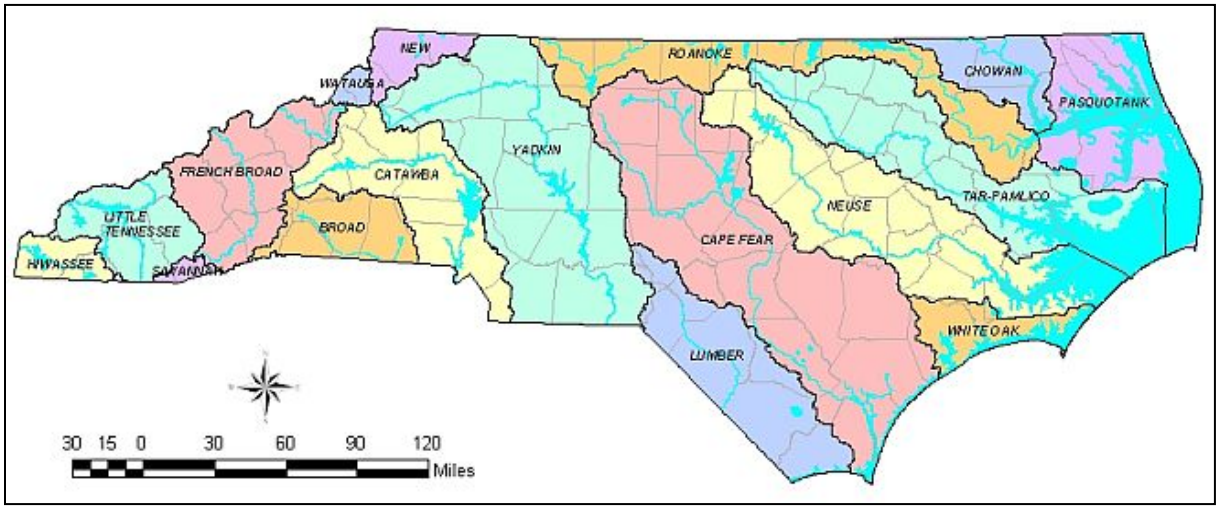

Figure 7.2: North Carolina River Basin Map
Source: North Carolina Division of Public Health

The Neuse River originates in the north central portion of the state, northwest of the City of Durham and flows for roughly 22 miles before it is impounded behind Falls Lake Dam. This structure and the resulting reservoir supply the City of Raleigh and surrounding communities with drinking water. In addition to Falls Lake there are 16 other reservoirs, most in the Upper Neuse Basin, that have been created for water supply, flood control and recreational purposes (NCDENR 2010b). Once past Falls Lake, the river flows as freshwater through the Piedmont and Coastal Plain until it reaches New Bern, where it turns into a 40-mile long brackish tidal estuary

before it empties into the Pamlico Sound (NCDENR 2007a). Major tributaries in the basin include the Eno River, Flat River, Little River, Trent River, Crabtree Creek, Swift Creek and Contentnea Creek (NCWRC 2005). Geologically the Neuse has two distinct portions: the upper one-third in the Piedmont and the lower two-thirds in the Coastal Plain. The upper Neuse, including the Flat, Eno and Little Rivers, features relatively flat terrain with sluggish pools, highly erodible soils, low summer flows and limited ability to assimilate oxygen-consuming wastes (NCWRC 2005). Slow-moving blackwater streams, low-lying swamps and productive estuarine waters characterize the Coastal Plain portion. The Pamlico Sound estuary, which is somewhat protected from oceanic influences by the Outer Banks, has a tendency to receive excessive nutrient loads from upstream waters and sedimentation that causes eutrophic conditions.

The Neuse River Basin contains many rare plant and animal species. Nine animals of aquatic or wetland habitats are federally listed as endangered. The basin is home to 17 species of rare freshwater mussels and snail species. Two of these freshwater mussels, the dwarf wedgemussel and the Tar River spinymussel occur in the streams of the Piedmont and Upper Coastal Plain, and are federally listed. Stormwater runoff containing sediment and pollution is the greatest threat to these species, which require clean water to survive and thrive. The Neuse and the Tar-Pamlico Basins contain the only known populations of the Neuse River waterdog (Carolina mudpuppy) and the Carolina madtom (a freshwater catfish), as well as the endangered Roanoke bass, Carolina darter and shortnose sturgeon. Other federally listed basin species include the leatherback turtle, Atlantic Ridley sea turtle, the West Indian manatee and piping plover and bald eagle, which are found primarily in estuarine habitats.

Because the Neuse River spans two physiographic regions – the Coastal Plain and the Piedmont – the river basin contains a wide array of natural communities, both upland and wetland. The basin contains the full array of estuarine wetland communities, such as salt marsh, brackish marsh, estuarine fringe loblolly pine forest and some small areas of tidal freshwater marsh, that provide habitat and spawning areas for anadromous fish and shellfish (NCWRC 2005). Other natural regions surrounding the estuary include longleaf pine savannahs, old-growth swamp and hardwood forests, and pocosin woodlands. The basin also contains many Significant Natural Heritage Areas – areas containing an abundance of rare or high-quality plant and animal communities or geologic features - as designated by the North Carolina Natural

Heritage Program (NCDENR 2010b). In addition to valuable environmental habitats, the Neuse River Basin includes many recreational waters used for boating and fishing.

As previously noted, the basin is comprised of 77 municipalities within 18 basin counties, and is one of the most developed and highly populated areas in the state. The *Neuse River Water Resources Plan* (2010b) notes that 54% of the basin population lives in 10% of the basin land area. Major cities include Raleigh, Durham and Cary in the upper basin and Goldsboro, Kinston and New Bern in the lower basin. The most urbanized section of the river runs through the Piedmont from the Falls Lake Reservoir to southern Johnston County, in an area commonly known as the Research Triangle. The basin has a population of 1,687,462 (NCDENR 2011), containing approximately 18% of North Carolina's total population. According to Elsin et al. (2010) more than two-thirds of the basin's population relies on the Neuse and its tributaries for drinking water, and the basin supplies water to some of the state's fastest growing populations. Overall population density is 211 people/square mile, compared with a statewide density of 196 people/square mile. Basinwide land cover consists of forested/wetland (45%), cultivated cropland (29%), urban land uses (13%), open water (10%) and the remainder is managed natural area (NCDENR 2009). There is wide variety of publicly owned lands in the Neuse River Basin, including ecologically significant public lands in the Eno River State Park, on Cedar Island and along the Atlantic coast. In addition to Eno River State Park, the state manages the William B. Umstead State Park, Waynesborough State Park, Cliffs of the Neuse State Park and the Occoneechee Mountain State Natural Area. Federally owned land in the Neuse basin includes both military and natural resource reservations, including Cherry Point MCAS, Cape Lookout National Seashore, Cedar Island National Wildlife Refuge and a portion of the Croatan National Forest (NCDENR 2009).

Water quality has been an issue in the Neuse River Basin for over a century. In the entire basin, 459 freshwater stream miles (14%), 13,538 freshwater acres (76%), 35 saltwater stream miles (25%) and 57,648 saltwater acres (16%) were impaired for one or more surface water quality standards (NCDENR 2009). The *Neuse River Basinwide Water Quality Plan* (2009) identifies several development-related sources that are negatively impacting surface water in the basin. Increasing population leads to increased demand for freshwater and wastewater discharges, and population projections in the basin predict more than 2 million residents by 2020 (NCWRC 2005). Currently there are over 400 point source waste discharge permits that

contribute 13% of the nitrogen and 23% of the phosphorous to the ecosystem (NCDENR 2009). Beyond the increased demand for water supply and discharge, land-disturbing activities associated with population growth (e.g. road construction and maintenance; industrial, commercial and residential development; loss of natural areas and increases in impervious surfaces) are also a major source of pollution. Within the New Bern area, development is exploding as the Atlantic Coast (Outer Banks) become overdeveloped or too expensive and development creeps up along rivers and tributaries to the "Inner Coast." Stormwater runoff in urbanized areas carries sediment, nutrients and toxic substances (i.e. metals, pesticides, fertilizers, hydrocarbons) that affect the aquatic ecosystem and raise fecal coliform bacteria levels resulting in impairment of recreation and shellfish harvesting uses downstream. Urban development in the basin is altering the watershed hydrology, resulting in downstream flooding, streambank erosion, increased turbidity and degraded habitats (NCDENR 2009). Additionally, atmospheric deposition of nitrogen from cars and factories has been linked to decreased water quality.

Non-point source pollution from agriculture and forestry has also degraded aquatic habitats in the basin. For many years, nutrient-laden waste from concentrated animal feeding operations (CAFOs) in the state's Coastal Plain has overloaded the entire Neuse Basin with nitrogen, phosphorous and ammonia. Excessive amounts of these nutrients feed explosive algal growth (eutrophication), which depletes oxygen in the water and has caused come of the largest fish kills in the nation (Paerl et al. 1998). Fish kills are caused by the "upwelling or mixing of hypoxic/low dissolved oxygen bottom water resulting in very low dissolved oxygen levels throughout the water column, leading to large fish kills that affect most species in the area" (NCDENR 2009: 264). Algal blooms and low dissolved oxygen in the upper portion of the water, combined with hypoxic conditions (oxygen depletion) in the bottom water, have a detrimental effect on the biological conditions within the ecosystem. As recently as 2009, the Neuse River experienced massive fish kills that resulted in the death of an estimated 3.5 million menhaden and similar finfish. It is also thought the nutrients from hogs and poultry farms have led to periodic outbreaks of *Pfisteria piscicida*, a tiny one-celled organism that produces a neurotoxin deadly to fish and exceedingly harmful to humans (NCDENR 2009). Repeated outbreaks of *Pfisteria* in the basin have placed the Neuse on the national radar. American Rivers, a national conservation organization, included the Neuse River on its annual "Endangered

Rivers" watch list in 1995, 1996, 1997 and 2007. Further, the situation on the Neuse and other eastern North Carolina rivers spurred the N.C. Legislature in 1997 to enact a statewide moratorium on the creation of new hog farms, though an additional half million swine have been added to production since the moratorium was enacted (Mallin and Cahoon 2003; NCDENR 2009).

Another major consideration in the Neuse River Basin is water quality problems associated with drought. Unlike water quality problems associated with rainfall events and stormwater runoff, drought conditions tend to concentrate pollutants in streams due to reduced flow. While rainfall in the New Bern area hovers around 60 inches/year, rainfall in the Raleigh/Durham area is generally much lower (approximately 45 inches/year). Further, the central portions of the state have experienced severe droughts in five of the last ten years, primarily during the summer months that are generally the most critical months for water quality. Dissolved oxygen is naturally lower because of high temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. While the frequency of acute impacts due to non-point source pollution are reduced, the collective effect of pollutants that stored up on land surface mean more nutrients are quickly delivered to streams when it does rain. As stream flows decrease, there is less habitat available for aquatic species, particularly around lake shorelines. There is also less water available for irrigation and for water supplies, which puts a strain on natural and man-made systems throughout the basin.

7.3: The Social Environment

A fundamental step to understanding the issues facing the City of New Bern and the region is to examine past growth trends and future projected growth patterns. Located in Craven County, New Bern is approximately 110 miles southeast of the state capital, Raleigh, and the Outer Banks beaches lie approximately 35 miles west. While Craven County has not experienced the explosive growth of some other areas of North Carolina, it has maintained steady 1 to 1.5% annual population growth. Yet, New Bern's historic Inner Banks waterfront location, cultural amenities, and proximity to Atlantic Ocean beaches have proven very attractive, and over the past several decades New Bern and the surrounding municipalities have experienced considerable population growth. The 2010 U.S. Census indicates that the populations of New Bern, River Bend, and Trent Woods were 29,524, 3,119 and 4,155 respectively. The population change between 2000 and 2010 was growth of 27.7% in New Bern,

6.7% in River Bend, and very little change (-.8%) in Trent Woods (Table 7.1). However, during the last Census decade from 1990 to 2000, Trent Woods experienced the highest rate of growth with a rate of 77.2%. New Bern grew during this period at a rate of roughly 33% and River bend grew by more than 21%. According to the *New Bern Regional Land Use Plan* the growth in population in the region is attributed to expansion of military facilities and the in-migration of retirees.

TABLE 7.1: NEW BERN AREA GROWTH TRENDS AND PROJECTIONS 1990-2020

LOCATION	1990	2000	2010	GROWTH % 1990-2010	ESTIMATED POPULATION 2020	ESTIMATED GROWTH % 1990-2020
New Bern	17,363	23,128	29,524	60.0%	36,344	83.1%
River Bend	2,408	2,923	3,119	29.5%	3,319	35.9%
Trent Woods	2,366	4,192	4,155	75.6%	4,321	82.6%
Craven County	81,613	91,436	103,505	26.8%	124,260	52.3%

Data Sources: U.S. Census Bureau and the N.C. State Data Center

As the New Bern area continues to grow over the next decade (Table 7.1), it is important to note some of the demographic characteristics of the population. One of the most significant aspects of this growing regional population is its age structure. Referred to by Johnson and Kasarda (2011) as the "silver tsunami", the percentage of the population over 65 in the New Bern area has increased dramatically as the area becomes a retiree destination. While some of the rise in proportion is a reflection of the general aging of the U.S. population – caused by improved health care and healthier living – the rest is generally attributed to the net migration of people over the age of 65. As shown in Table 7.2, the percentage of the population in New Bern that is over the age of 65 (17.9%) is higher than the County (15.3%) and dramatically higher than that of the state (12.7%). Even more dramatic is the proportion of the same population in the smaller communities of River Bend (37.3%) and Trent Woods (24.1%), both of which have become retirement destinations. This is also evident in the median age of River Bend and Trent Woods, which is significantly higher than New Bern, Craven County and the state. Along with a steady increase in the age of these communities, household sizes have also steadily declined, as retirees tend to be empty nesters (Johnson and Kasarda 2011). Table 7.3 indicates a steady decline in the average number of people her household in the New Bern area. As a result, the New Bern area has experienced dramatically increased residential construction activity.

TABLE 7.2: PERCENTAGE OF POPULATION OVER 65 YEARS 1990-2010				
LOCATION	1990	2000	2010	Median Age[a]
New Bern	16.8%	17.9%	17.9%	38.8
River Bend	27.7%	36.9%	37.3%	56.8
Trent Woods	16.1%	22.1%	24.1%	50.2
Craven County	11.2%	13.4%	15.3%	36.2
State of North Carolina	12.1%	12.0%	12.7%	36.3
Data Sources: U.S. Census Bureau a Median Age is based on 2010 U.S. Census data				

TABLE 7.3: HOUSEHOLD SIZE 1990-2010			
LOCATION	1990	2000	2010
New Bern	2.33	2.26	2.25
River Bend	2.18	2.08	2.08
Trent Woods	2.57	2.48	2.41
Craven County	2.64	2.50	2.45
State of North Carolina	2.54	2.49	2.47
United States	2.63	2.59	2.63
Data Sources: U.S. Census Bureau			

New Bern has undergone a major revitalization, particularly in the three National Register historic districts. This includes the renovation of historic properties, condominium development, waterfront redevelopment, a new convention center, and a variety of commercial structures. The downtown area has a large concentration of government, institutional uses and professional offices. Pedestrian-oriented retail development is also concentrated in the historic downtown area, and there have been several mixed-use projects built to encourage residential uses in the downtown area to support retail and commercial uses. New Bern has residential throughout the City, most of which is low-density single-family development. Since 2000, the City of New Bern has annexed roughly 1,200 acres of undeveloped land at the request of property owners seeking infrastructure in advance of development. For the most part this property has since been developed as year-round housing units with some commercial uses. The Town of River Bend was developed as a residential, resort-oriented retirement community. The housing stock is comprised primarily (89%) of single-family residences. Similarly, Trent Woods is roughly 96% single-family residential, almost all of which are owner-occupied. Newly developed residential areas include Township 7 south of the Trent River that contains Carolina Colours, a 2000-unit New Urbanist TND and several other large-scale single-family residential developments. Seasonal and recreational population does have an important effect in the regional economy, but the seasonal population does not seem to have a major effect on local housing –

rather an in-migration of active and retired military personnel and relocating retirees has had a significant impact on development in the area.

Regionally, economic growth has kept pace with the expansion of the housing market. Craven County has maintained an extremely strong economy over recent decades, driven by a strong military presence, solid growth in the tourist sector, and industrial/manufacturing firm recruitment. The economies of New Bern, River Bend and Trent Woods, and Craven County as a whole, are based primarily on services, wholesale and retail trade, manufacturing, finance/insurance/real estate and public administration employment sectors. In the mid-1970s, to reverse decline and deterioration in New Bern's downtown, major public and private investment was made in the downtown and waterfront areas. To date, more than $200 million has been invested, and New Bern has become the retail and commercial services center of Craven County. Given the amount of investment in the downtown area, including residential and commercial development, travel and tourism have become substantial components of the New Bern economy.

Top employers in the New Bern area include the Cherry Point Marine Corps Air Station (MCAS) at Havelock, the U.S. Department of Defense, the State of North Carolina and the County. Craven County's regional hospital and medical facilities also account for a large portion of the total area employment. Top manufacturing employers include Hatteras Yachts, BSH Home Appliance Corporation, and Weyerhauser, Inc. Recent expansions to the Marine Corps presence in the region have brought roughly 35,000 additional marines and sailors to eastern North Carolina (Camp Lejeune in Jacksonville, MCAS in Havelock, and New River in Jacksonville), which have spurred ancillary economic development in the area (City of New Bern 2008). This expansion will offer additional economic opportunities and present growth challenges to the region.

7.4: The Planning Environment

This study looked at the 2008 *New Bern Regional Land Use Plan,* which is the second regional land use plan for the communities of New Bern, River Bend and Trent Woods. These three communities are in close proximity to each other, have common boundaries and may places, and are located within the same watershed drainage basin. New Bern and Trent Woods have some shared utilities, and the highway network provides common linkages among all three communities. The regional approach to this document was taken in order to establish policies

that help guide all three local governments in land use and zoning decisions, while still recognizing the distinct planning needs among the three communities. The CAMA plan update addresses a study area that includes the area of southwestern Craven County, the municipal limits of the City of New Bern, the New Bern Extraterritorial Jurisdiction (ETJ), the Town of River Bend, the Town of Trent Woods, and extends outwards to include an area approximately two miles beyond existing municipal boundaries. Planning in New Bern is undertaken by the Planning and Inspections Department, with a staff of approximately 16, the majority of which are building inspectors. In both River Bend and Trent Woods, the Zoning Administrator undertakes all planning and development decisions.

7.5: Plan Evaluation

Results from the first part of this study (Chapter 5) provide an overall assessment of how well the City of New Bern, and adjacent communities of Trent Woods and River Bend, incorporated the principles of ecosystem management into their comprehensive plan. As shown in Table 7.4, the total ecosystem plan quality score for the New Bern Regional Land Use Plan is 25.56, which on a scale of 0-50 indicates a moderate effort to manage ecological systems at the local level. This compares to a overall mean plan quality score of 18.54 for all communities sampled. Mean scores for plan components, other than the Factual Basis, register fairly low on a scale of 0-10 despite a strong state mandate to protect critical habitats and ecological functions in the coastal zone.

The Goals and Objectives are the lowest scoring component of the plan and seem to suggest relatively weak community-wide commitment to ecosystem management. In contrast, the Factual Basis component scores a fairly high 7.19 (on a scale 0-10). A high score for this component demonstrates a relatively good understanding of the existing level of critical resources within the study area. The disparity between these two components suggest a relatively good understanding of the existing level of critical resources within the study area, but a difficulty in translating resource needs into broad value statements or measurable objectives. Specific scores for each plan component are discussed in greater detail in the subsequent sections of this chapter, and provide a more detailed examination of a local jurisdictions' ability to incorporate the principles of ecosystem management by unpacking the results from the plan coding protocol item by item.

Table 7.4: Descriptive plan quality scores for each plan component		
Plan Component	New Bern CAMA	Overall Mean Plan Scores
Factual Basis	7.19	3.649
Goals and Objectives	3.67	4.189
Inter-organizational Coordination	3.93	3.453
Tools, Policies & Strategies	5.15	3.729
Implementation	5.62	3.512
Total Ecosystem Plan Quality	25.56	18.535

7.5.1: Factual Basis

In looking at the CAMA plan, the Factual Basis score of 7.37 (Table 7.4) is by far the highest scoring component of the plan, which demonstrates a relatively good understanding of the existing level of critical resources within the study area. This is well above the overall mean plan score of 3.65 for the Factual Basis component. Items within the Factual Basis plan component are grouped into three categories. First, the Resource Inventory component includes indicators such as mapping ecosystems and habitat boundaries, describing ecological functions, and the ability to classify wildlife and vegetation. In order to protect the ecological infrastructure of a landscape, the plan must also identify critical habitat, areas of high biodiversity, and corridors that facilitate the movements and migration of key species. Second, the Ownership Pattern category characterizes the existing management of critical habitats and areas of high biodiversity. To identify new land for protection, the plan must begin by identifying the existing network of protected areas. The Resource Inventory components combined with the Ownership Patterns components generally provide the basis for a gap analysis that can greatly assist planners in generating plans and making development decisions that effectively manage ecosystems. Human Impacts, the third category of the factual basis component of a plan deals with identifying resource problems associated with human development. Indicators in this category include human population growth, the development of wetlands, water pollution and nutrient loading, and habitat fragmentation.

In the Resource Inventory category (Table 7.5), the plan mapped and catalogued several key elements for identifying and managing ecosystems, but only touched upon or failed to mention several other critical elements. The plan clearly identifies and maps the Neuse River Basin and aquifer recharge areas (ecological boundaries/edges); critical surface water quality zones and wetland/forested areas (ecological zones/habitat types); and species dispersal in

wetlands, water resources (shellfish) and natural areas (distribution of species). The regional nature of this plan lends itself to a graphic representation of trans-boundary resources, but goes even further in identifying environmentally significant areas located outside of the study area that may or may not have regulatory protection. These areas include Deep Gully, the Neuse River floodplain, and the Cool Springs Sand Ridge and Swamp – each of which is an area of high biodiversity/species richness and outside of the study area. However, other important elements for understanding species within ecosystems, such as identifying and mapping indicator/keystone species and exotic/invasive species, are not included despite being readily available from the state. Further, the plan includes a list of threatened or endangered species in the County, but does not map these to indicate high concentrations or areas to conserve when it comes to making development decisions. Habitat corridors between natural areas, an essential component of maintaining the landscape dynamic because they allow for natural movement of species, are not mapped or described in the plan. Wetlands cataloguing and mapping is more thorough than wildlife or vegetation identification, which for the most part are limited to the description of the State's AECs. As expected, the plan thoroughly describes and maps traditional environmental components including soil types and surface hydrology.

The Human Impacts listed and described in the plan concentrate primarily on typical urban environmental problems, such as water pollution and nutrient loading, as required by the CAMA land use planning regulations (Table 7.5). Federal water quality monitoring regulations and obvious environmental disturbances such as shellfish bans and fish kills common to the Neuse River are thoroughly discussed and mapped when appropriate. Unlike many of the other plans surveyed, this plan discusses the importance of biodiversity within coastal and non-coastal wetlands, and the overarching need to protect these areas from development. However, the plan fails to address some of the most pertinent issues facing the North Carolina coastal zone, including habitat fragmentation and the alteration of waterways. While a discussion of population growth and road systems are expected, there is little if any connection between these issues and their impact on ecosystems. Rather, these issues are linked primarily to capital improvements and infrastructure capacity. Notably, Beatley (2000) identifies habitat fragmentation, wetlands loss and increases in road density as the issues having some of the most adverse effects on ecosystems and the biodiversity within these systems.

The New Bern Regional Land Use Plan fully catalogues and maps most of the elements of Ownership Patterns (Table 7.5), as well as the carrying capacity of the resources within the study area. As required by the state, AECs and Natural Heritage Resource Areas are established and regulated by CAMA, and any activities within these areas require management plans and CAMA permits. These areas are clearly delineated in the plan and there is a thorough description of the management status and requirements within these areas. In addition, the plan identifies unprotected significant natural heritage areas within the County that should be prioritized for future regulatory protection. While conservation lands are mapped, there is only a cursory discussion of current or future networks of conservation lands, and therefore almost no discussion of the distribution of species within a conservation network – both important elements for understanding ecosystem processes. As noted in the Wilmington case study, CAMA land use plans are required to include a *land suitability analysis* and a *land suitability map*. The analysis is a process for determining a planning area's approximate supply of land that is suitable for development. This analysis includes consideration of a number of factors, including natural system constraints, compatibility with existing land uses and development patterns, existing land use policies, and the availability of infrastructure and public services. The resulting map then shows vacant or underutilized land that is suitable for development. Collectively the land suitability analysis and map measure the carrying capacity of developable land, and provide the foundation for future land use recommendations. Unfortunately, the land suitability analysis does not include spatial representations of areas with high biodiversity (beyond areas such as 'wetlands' which are generally seen as contributors to improved water quality rather than areas of biodiversity), and thus is unable to provide guidance on a gap analysis that would prioritize areas of high biodiversity before they become degraded.

Table 7.5: Issue-based scores for the factual basis plan component		
Indicator	Score	Result
Resource Inventory		
Ecosystem boundaries/edge	2	Mapped & Catalogued
Ecological zones/habitat types	2	Mapped & Catalogued
Distribution of species	2	Mapped & Catalogued
Areas with high biodiversity/species richness	2	Mapped & Catalogued
Soils classified	2	Mapped & Catalogued
Wetlands mapped	2	Mapped & Catalogued
Surface hydrology	2	Mapped & Catalogued
Graphic representation of trans-boundary resources	2	Mapped & Catalogued
Other water resources	2	Mapped *or* Catalogued
Ecological functions	1	Mapped *or* Catalogued
Wildlife classified	1	Mapped *or* Catalogued
Vegetation cover	1	Mapped *or* Catalogued
Threatened/endangered species	1	Mapped *or* Catalogued
Habitat corridors	0	Not Identified
Invasive/exotic species	0	Not Identified
Indicator/keystone species	0	Not Identified
Climate described	0	Not Identified
Other predominant landscapes	0	Not Identified
Ownership Patterns		
Conservation lands mapped	2	Mapped & Catalogued
Management status identified for conservation lands	2	Mapped & Catalogued
Network of conservation lands mapped	1	Mapped *or* Catalogued
Distribution of species in network of conservation lands	1	Mapped *or* Catalogued
Human Impacts		
Nutrient loading	2	Mapped & Catalogued
Water pollution	2	Mapped & Catalogued
Loss of fisheries/marine habitat	2	Mapped & Catalogued
Existing environmental regulations described	2	Mapped & Catalogued
Carrying capacity measured	2	Mapped & Catalogued
Other factors/impacts	2	Mapped & Catalogued
Population growth	1	Mapped *or* Catalogued
Value of biodiversity identified	1	Mapped *or* Catalogued
Road density	0	Not Identified
Wetlands development	0	Not Identified
Fragmentation of habitat	0	Not Identified
Alteration of waterways	0	Not Identified
Incorporation of Gap Analysis data	0	Not Identified

7.5.2: Goals and Objectives

The Goals and Objectives component of the plan represents the aspirations, problem statement and needs that are premised on shared community values (Kaiser et al. 1995). These statements can be either broad value statements or specific measurable objectives that guide the implementation of ecosystem management. In either case, goals and objectives help prioritize issues and problems facing the community. The New Bern Regional CAMA plan scored 3.67 on

the Goals and Objectives component (Table 7.4), which on a scale of 0-10 is the lowest scoring component of the plan and appears to demonstrate weak community-wide commitment to ecosystem management. This is well below the overall mean plan score of 4.19 for the Goals and Objectives component for all communities surveyed. Table 7.6 indicates those goals and objectives that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

The most clearly detailed element of the Goals and Objectives component of the plan is the goal of balancing human use with maintaining environmental quality. Specifically, the plan's Land Use Compatibility goal strives to:

> Ensure that development and use of resources or preservation land minimizes direct and secondary environmental impacts; avoids risks to public health, safety and welfare; and is consistent with the capability of the land based on considerations of interactions of natural and manmade features (City of New Bern 2008: 70).

At this point it is important to note that the plan has only few, very broad goals that "provide the overall direction and purpose for the framework of the plan" (City of New Bern 2008: 67). Additional goals make mention of the protection and restoration of AECs and other fragile areas, the maintenance and enhancement of water quality, and the protection and enhancement of wetlands, floodplains, rivers, and streams. While each is mentioned, none are as clear as the previously stated goal, and for the most part the goals and objectives deal exclusively with the enhancement of resources to improve water quality. The plan does not cite specific goals or objectives involved in managing ecological systems, such as protecting biodiversity hotspots, protecting rare or endangered species, maintaining intact patches of native species, or representing native species in protected areas. Further, the plan does not cite the maintenance or restoration of wildlife corridors as an aspiration or concern of the community. Overall, this suggests that these jurisdiction are able to articulate concerns related to traditional environmental management issues (i.e. water quality, nutrient loading, wetlands), but are unable to articulate broader concepts of ecosystem management or specific objectives that could drive precise land use tools and policies. Noteworthy is that each of the very broad goals identified by the community are linked to the corresponding CAMA management goals and planning objective. This results in a much clearer purpose and intent for the goal/objective, and qualities that are ultimately measureable, even if they aren't necessarily effective for managing ecosystems.

However, linking very broad goals to relatively generic management goals and planning objectives without tailoring them to the needs of the community and the ecosystem will do little to push the community in the direction of effective ecosystem management.

Table 7.6: Issue-based scores for the goals and objectives plan component

Indicator	Score	Result
Balance human use with maintaining viable wildlife populations	2	Fully Detailed or Mandatory
Presence of measurable objectives	2	Fully Detailed or Mandatory
Goals are clearly specified	2	Fully Detailed or Mandatory
Protect integrity of ecosystem	1	Suggested but not detailed
Protect natural processes/functions	1	Suggested but not detailed
Establish priorities for native species/habitat protection	1	Suggested but not detailed
Protect rare/unique landscape elements	1	Suggested but not detailed
Other goals to protect ecosystem	1	Suggested but not detailed
Maintain intergenerational sustainability of ecosystems	0	Not Identified
Maintain intact patches of native species	0	Not Identified
Restore ecosystems/critical habitat	0	Not Identified
Maintain connection among wildlife habitats	0	Not Identified
Protect high biodiversity	0	Not Identified
Protect rare/endangered species	0	Not Identified
Represent native species within protected areas	0	Not Identified

7.5.3: Inter-organizational Coordination and Capabilities

The Inter-organizational Coordination and Capabilities component of the plan captures the ability of a local jurisdiction to collaborate with neighboring jurisdictions and organizations to manage resources that extend across multiple jurisdictions and ownership patterns. This element of the plan is particularly important to effective ecosystem management because it represents the degree to which the local community is able to recognize the trans-boundary nature of systems and coordinate with other parties within and outside jurisdictional boundaries. The New Bern Regional Land Use Plan scored 3.93 on the Inter-organizational Coordination and Capabilities (Table 7.4), which on a scale of 0-10 indicates a fairly weak commitment to collaboration and coordination. This is only slightly above the overall mean plan score of 3.45 for the Inter-organizational coordination component of all communities surveyed. Table 7.7 indicates the plan components that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

First, it is important to mention again that the municipalities of New Bern, River Bend and Trent Woods have prepared a regional land use plan that not only requires each municipality to

draft the plan together, but also to plan for the ETJ two miles outside of the incorporated limits. As such, the plan scores high marks for coordination with other jurisdictions and organizations. The plan also discusses coordinating with Craven County to create a countywide master plan, working closely with State water quality departments, and working with the North Carolina Cooperative Extension on agricultural and forestry best practices. Other plans that work in concert with or need to be incorporated into the plan are outlined, including the *Well Head Protection Plan*, the *Neuse River Basinwide Water Quality Plan*, the *Neuse River Nutrient Sensitive Waters Management Strategy* (Neuse Buffer Rules), and the various development ordinances for each municipality. The plan touches on the need to coordinate with private property owners and the need to look for funding to acquire privately owned property for conservation, but does not actually commit fund to the effort. While the plan mentions the need to connect scientific findings (i.e. monitoring) with regulations, other key ecosystem management components such as joint database production and information sharing are lacking. Noticeably absent is the identification or coordination with local intergovernmental organizations, such as the Lower Neuse Riverkeeper or the Albemarle-Pamlico National Estuary Program (APNEP). Finally, the plan fails to mention conflict management processes to resolve conflicts prevalent in ecosystem management. While not unexpected, the lack of conflict resolution directives in the plan means there are few "how-to" details for bringing parties together to work on common natural resource problems (Brody 2008: 24).

Table 7.7: Issue-based scores for inter-organizational coordination and capabilities plan component

Indicator	Score	Result
Other organizations/stakeholders identified	2	Fully Detailed or Mandatory
Coordination with other organizations/jurisdictions specified	2	Fully Detailed or Mandatory
Integration with other plans/principles	2	Fully Detailed or Mandatory
Other forms of coordination	2	Fully Detailed or Mandatory
Coordination with private sector	1	Suggested but not detailed
Links between science and policy specified	1	Suggested but not detailed
Commitment of financial resources	1	Suggested but not detailed
Coordination within jurisdiction specified	0	Not Identified
Intergovernmental bodies specified	0	Not Identified
Joint database production	0	Not Identified
Information sharing	0	Not Identified
Intergovernmental agreements	0	Not Identified
Position of jurisdiction within bioregion specified	0	Not Identified
Conflict management processes	0	Not Identified

7.5.4: Policies, Tools and Strategies

The Policies, Tools and Strategies component is the core of the plan because these are policies that substantiate the goals and objectives by setting forth actions to protect critical or endangered habitats. These policies include traditional regulatory tools such as land use and density restrictions, restrictions on native species removal, and buffer requirements. In addition to traditional regulatory tools, more innovative incentive-based approaches are also included in this component, such as clustering away from sensitive habitats, density bonuses, transfer of development rights (TDRs), and mitigation banking. Land acquisition programs are another important component of this category because it indicates the desire and ability of local jurisdictions to fund the purchase of critical habitats and sensitive environmental resources. Finally, educational efforts are also included in this component, as these types of programs are essential for engaging stakeholders in the planning process and in generating an effective, enforceable plan. The New Bern Regional Land Use Plan scored 5.15 on the Policies, Tools and Strategies (Table 7.4), which on a scale of 0-10 indicates a moderate commitment to specifying the policies and tools necessary to protect ecosystem resources. In comparison, the overall mean for the Policies, Tools and Strategies component is 3.73. Table 7.8 indicates the tools, policies and strategies that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

In line with the Goals and Objectives section of the plan, the Regulatory Tools component demonstrates that the jurisdiction tends to favor traditional environmental policies to incentive-based approaches to resource management. Elements that are fully detailed and/or mandatory include resource use and density restrictions in wetlands and estuaries; construction controls promoting low-impact development in fragile environments and conservation zones; and targeting growth away from critical habitats and floodplains. Other traditional environmental policies fully detailed in the plan include the use of capital improvements programming to slow development and improve water quality; the phasing or intensification of development only as infill or in areas with available infrastructure capacity; and buffering within developed areas and along rivers and streams to improve water quality (i.e. the 'Neuse Buffer Rules'). However, other regulations such as restrictions on native species removal, fencing controls to allow for the movement of native species, and the removal of exotic or invasive species to improve biodiversity are not included. While traditional resource management policies play an important

role in ecosystem management, the literature suggests that less commonly used growth management tools focusing on growth patterns (e.g. target growth areas), site-related regulations (e.g. conservation subdivision standards and performance zoning), and the protection of resources in other jurisdictions may allow for more significant gains in protecting regionally significant habitats (Duerksen et al. 1997). In this case the plan does a fairly good job of mentioning each of these types of policies (regulating growth patterns, site-specific regulations, and/or the protection of resources in other jurisdictions). For example, the plan encourages the preservation of natural features of a site including topography and existing vegetation; the reduction of coastal and non-coastal wetlands from the calculation of a site's development density; and other types of low-impact site-specific regulations. The plan also mentions the need to protect regional resources and implement agriculture and forestry BMPs, though it does not fully detail how such regulations would be implemented in the New Bern region. Also fully detailed are actions to restrict vehicular use around sensitive habitats, though these regulations only apply to the City of New Bern.

Despite their effectiveness in protecting critical habitats and ecological systems (Beatley 2000; Duerksen et al. 1997), incentive-based tools enjoy less specification than regulatory approaches in the plan. There are some policies included in the plan that are fully detailed and thus the item scores very well. First, in line with the inclusion of traditional regulatory tools such as construction controls promoting low-impact development, the plan also fully details the use of density bonuses and clustering provisions to encourage similar development. Second, the plan also advocates use-value tax assessments as a means of preserving the farming base and encouraging large agricultural, horticultural, and forestland by taxing on the present use value rather than the market value. The preservation of these types of land uses (agriculture, horticulture and/or forestry) is often key to the conservation of large tracts of open space and creating linkages between critical habitats. Unfortunately, other incentive-based options like TDRs and mitigation banking are not included in the plan, despite strong state-level programming and regulatory frameworks allowing for such practices. Further, the plan makes no mention of other land acquisition programs such as fee simple purchase or conservation easements as preferred methods to preserve critical habitats or protect sensitive resources.

Other non-regulatory techniques are also important indicators of ecosystem plan quality. For example, the plan fully details educational programs on the importance of protecting habitat and ecosystems. The plan states:

> Keeping the citizens of the New Bern Region aware of land development issues and needs should be a continuous process… To expect that citizens are made aware of all of these matters solely during the Land Use Plan preparation process is unrealistic. An ongoing public education program could benefit not only the Land Use Plan preparation but also the community's overall planning program. (City of New Bern 2008: ix)

Although the environmental planning arena may overlook educating the public as a critical component in the planning process (Yaffee 1996), it is clear that the community (or at least those drafting the plan) understood the need to build an understanding of regional ecological problems in order to build a commitment to protecting ecosystems. The plan also includes provisions that link development to capital improvements and the provision of public services (i.e. water and wastewater), though these policies are almost exclusively tied to restoring water quality rather than being balanced with critical habitat protection. Monitoring policies are primarily associated with groundwater resources and the protection of aquifer resources from excessive downdraw and pollution infiltration.

Table 7.8: Issue-based scores for the policies, tools and strategies plan component		
Indicator	Score	Result
Regulatory Tools		
Resource use restrictions	2	Fully Detailed or Mandatory
Density restrictions	2	Fully Detailed or Mandatory
Buffer requirements	2	Fully Detailed or Mandatory
Public or vehicular access restrictions	2	Fully Detailed or Mandatory
Phasing of development	2	Fully Detailed or Mandatory
Controls on construction	2	Fully Detailed or Mandatory
Subdivision standards	2	Fully Detailed or Mandatory
Targeted growth away from habitat	2	Fully Detailed or Mandatory
Capital improvements programming	2	Fully Detailed or Mandatory
Performance zoning	1	Suggested but not detailed
Habitat restoration actions	1	Suggested but not detailed
Actions to protect resources in other jurisdictions	1	Suggested but not detailed
Site plan review	1	Suggested but not detailed
Conservation zones/overlay districts	1	Suggested but not detailed
Protected areas/sanctuaries	1	Suggested but not detailed
Restrictions on native vegetation removal	0	Not Identified
Removal of exotic/invasive species	0	Not Identified
Fencing controls	0	Not Identified
Urban growth boundaries to exclude habitats	0	Not Identified
Other regulatory tools	0	Not Identified
Incentive-based Tools		
Density bonuses	2	Fully Detailed or Mandatory
Clustering away from habitats	2	Fully Detailed or Mandatory
Preferred tax treatments	2	Fully Detailed or Mandatory
Transfer of development rights	0	Not Identified
Mitigation banking	0	Not Identified
Other incentive-based tools	0	Not Identified
Land Acquisition Programs		
Fee simple purchase	0	Not Identified
Conservation easements	0	Not Identified
Other land acquisition techniques	0	Not Identified
Other Policies		
Control of public investment and projects	2	Fully Detailed or Mandatory
Public education programs	1	Suggested but not detailed
Monitoring of ecological health and human impacts	1	Suggested but not detailed
Designation of special taxing districts for acquisition funds	0	Not Identified

7.5.5: Implementation

The final component of ecosystem plan quality measured is Implementation, which measures the ability of a plan to become a lasting document that influences other regulation and encourages collective action. For a comprehensive plan to be effective, implementation must be clearly defined and laid out of all affected parties (Kaiser et al. 1995). The Implementation

component of the plan focuses on the designation of responsibility for action, timelines, enforcement standards and sanctions, as well as monitoring activities to determine the success of policies and respond to scientific information. In this manner the Implementation component of the plan incorporates the concept of adaptive management and flexibility in managing ecological systems that are constantly changing both spatially and temporally. The New Bern CAMA plan scored a 5.62 (scale 0-10) on the Implementation component (Table 7.4). It is important to note that this component does not measure whether the plan was actually implemented. Table 7.9 indicates the implementation indicators that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

There are three components dictated by CAMA regulations for inclusion in all state-approved CAMA plans that are essential for implementation after adoption: clear timelines for implementation, plan updates every five years, and assessment of plan policies between updates – and each of these policies is fully detailed in the New Bern plan. The literature indicates that the ability to monitor plan effectiveness and incorporate new information into updates is fundamental to managing ecosystems (Brody 2008). However, while the plan specifies whether one or all jurisdictions are supposed to implement elements of the plan, it does not necessarily designate who within the community is responsible for the action. Nor does the plan fully detail the costs or funding sources for implementation, or who is responsible for enforcement, though each component is at least mentioned. These, combined with the provision of sanctions (which are also absent from the plan) are important because they ensure that policies and projects required in the plan actually come to fruition and are adhered to by the public.

Table 7.9: Issue-based scores for the implementation plan component

Indicator	Score	Result
Regular plan updates and assessments	2	Fully Detailed or Mandatory
Clear timetable for implementation	2	Suggested but not detailed
Monitoring for plan effectiveness and response to new information	2	Suggested but not detailed
		Suggested but not detailed
Designation of responsibility	1	Suggested but not detailed
Identification of costs or funding	1	Suggested but not detailed
Enforcement specified	1	Not Identified
Provisions of sanctions	0	
Provision of technical assistance	0	Not Identified

7.6: Implications for Implementation and Ecosystem Management

7.6.1: Improve the Factual Basis of the Plan to Include Biodiversity

The protection of biodiversity is considered one of the overarching goals of ecosystem management (Christensen et al. 1996; Grumbine 1994). Because species diversity is believed to be a fundamental component of long-term maintenance of viable ecosystems, the identification of high biodiversity patches or habitats is essential to managing ecosystems. Biodiversity is often operationalized as species richness, and is generally seen as being the intersection of key species that support the overall function and processes of the system (Beatley 2000). For this reason, the first step in addressing biodiversity in a land use plan is through an inventory of species rich habitats and species concentrations, and incorporating available data on existing conditions. However, less than half of all of the plans scored in Chapter 5 discussed areas with high biodiversity or the distribution of species, and none of the plans included information on invasive/exotic species or keystone species, both of which get to the heart of measuring ecosystem resiliency and biodiversity. While the Factual Basis component of the New Bern plan was the highest scoring component of the plan, there is little or no mention of species habitats or biodiversity. As noted in Section 7.5.1 of this case, strong factual basis helps a community understand what resources are being adversely impacted by development and what needs to be protected. With a greater understanding of existing sensitive resource, planners and planning participants may be more likely to incorporate ecosystem management policies into their plans and development regulations (Brody 2003c; Brody 2008).

Incorporation of ecosystem components, such as identification of species richness, areas of high biodiversity, and habitat corridors will help the community better implement the overall principles of ecosystem management. For example, the New Bern plan could make use of the North Carolina Gap Analysis Project (NC-GAP) digital maps of land cover, areas of high biodiversity, and the network of conservation lands across the state. The inclusion of these maps, analyzed in combination with existing land use patterns and environmental conditions, will help identify potential conservation zones and vital corridors. A CAMA program manager noted that the lack of this, and other critical ecosystem-based elements, is likely a result of the CAMA regulations rather than a lack of information. When asked whether the plans were based on the best scientific evidence available, the CAMA program manager said:

> We get the information from the sister agencies for the land suitability analysis and obviously that's a whole process that needs to be revisited and enhanced because obviously technology and the resources available have dramatically changed in the 10 years since the more formal rules were put together to assist local governments.

In 2002, implemented a more formal process and resource inventory requirements for all certified CAMA plans. This included the land suitability analysis and environmental composite map that measure the carrying capacity of the area. However, since these requirements were put in place the ability of local plans to embody the principles of concepts such as high biodiversity or species richness have dramatically improved. Currently the Coastal Resource Commission is re-addressing the land use planning regulations and making adjustments and changes and provide new guidance to local communities, and it waits to be seen whether these changes will include directives for including biodiversity measures in CAMA plans. However, it was not so long ago that communities paid little attention to the identification and protection of wetlands. Through concerted effort at the state and federal level, today almost all of the communities in this study identify wetland areas, and particularly in the coastal zone, limit development to maintain wetland ecosystems. With this in mind it is not impossible to imagine putting forth the same effort for other aspects of ecosystem management such as biodiversity.

7.6.2: Ecosystem Management as an Elusive Concept

As noted in the Wilmington case study, an emerging theme from my interviews with several environmental program managers and a local environmental advocate is the belief that CAMA plans are written vaguely so that they don't impede the development process they are supposed to be regulating. When discussing the local commitment to planning in general, a CAMA program manager noted:

> Local governments tend to avoid adopting policies they think the state might use against them, which causes an avoidance of policy being as clear or direct as it could be.

As noted by a local environmental activist:

> Many of the CAMA plans are written so that they will have no effect on those permit decisions. They are so general in their wording that there is nothing to be consistent with… and that is typically by design… General statements of 'we want the environment protected' rather than specific statements that are actually measurable.

This is in line with Norton's (2005b) observation in North Carolina that local officials on the

whole supported local CAMA planning as a means to craft a community vision without hampering development. As noted by Norton (2005: 199):

> (T)he vagueness in policy statements allowed local officials to use their plans to address local concerns without also having to constrain local development activities for the sake of addressing regional resource protection concerns.

In order to effectively manage ecosystems, there needs to be clear directives and specific ecosystem management goals and policies. As noted in section 7.5.2 of this case, the goals and objectives component of this New Bern plan is the lowest scoring component. The lack of clear directives and measureable actions means there are few specifics to guide implementation measures. As a result, the plan is not as strong with specific and/or robust tools and policies. In order to create a plan that is more effective, the community needs to include more specifics, particularly for goals, to guide the implementation of ecosystem management initiatives. Strong objectives need more measureable targets within to be effective. For example, the goal to "protect natural resources" comes across as vague and hard to interpret. However, the goal to "protect and enhance viable native ecological communities to protect ecological functions and the diversity of plants and animals" is much more specific and effective at generating strong policies. Similarly, an objective to "reduce non-point source pollution in estuaries" is far less effective than one to "reduce levels of nitrogen and phosphorous in the Neuse River by 25% by the year 2015."

7.6.3: Focusing Planning Efforts on the Fringe

As noted in Section 7.3 of this chapter, the City of New Bern has dramatically expanded its corporate limits through annexation of adjacent unincorporated property for residential development. However, the use of annexation as a key growth strategy creates an inherent conflict between encouraging low-density, sprawling development that most negatively impacts ecosystems, and effective management of these systems. Because an outward expansion of growth away from urban cores tends to occur in environmentally sensitive or undisturbed areas, there is a distinct need to focus planning efforts on the urban fringe. This will help to reduce habitat fragmentation, identify key wildlife corridors, and establish growth buffers before these areas become degraded. While the New Bern plan has strong regulations for riparian protection and limiting development in jurisdictional floodplain and wetlands areas, other planning

strategies such as urban growth boundaries, targeted growth areas, and the identification of regionally significant habitats are omitted.

7.6.4: Regional Ecosystem Management Program Omitted

My interest in this topic focused originally on the ability of collaborative planning efforts to improve plan quality and influence land development policy. In particular, I wanted to understand how alternative non-regulatory efforts such as the National Estuary Program, whose purpose is to create intergovernmental networks that come together to address regional environmental issues in nationally significant ecosystems. In this case the Albemarle-Pamlico National Estuary Program (APNEP), which includes the New Bern area in its boundaries, has a plan that clearly outlined goals and objectives for four key elements of the estuary: water quality, vital habitats, fisheries, land use planning/stewardship – and an implementation strategy for each of these elements. The primary stewardship objective is as follows: "Promote local and regional planning that protects the environment and allows for economic growth" (APNEP 1994: 131). The corresponding management strategy and action items clearly outline the need to expand comprehensive planning to the larger estuarine region, and to support local planning by providing economic funding incentives and technical assistance (APNEP 1994: 131-133). However, it is clear from the New Bern plan quality analysis that APNEP had little to no involvement or coordination with local planning efforts. In fact, none of the plans survey in Chapter 5 mentioned APNEP, indicating that it had little if any participation in, or influence on, land use or environmental planning in the communities within its boundaries.

7.6.5: Unrealized Regional Potential of Plan

Cornerstones of ecosystem science and management are as follows: 1) ecosystem functions occur on broad spatial and temporal scales, 2) ecosystem function depends on maintaining its structure and diversity, and 3) ecosystems are dynamic over time and space (Christensen et al. 1996; Cortner and Moote 1999; Grumbine 1994). Based on these principles, several conclusions can be made for what makes an effective ecosystem management plan. First, the plan must consider the ecosystem as a whole rather than just a single medium or a single fragment. Second, while looking at the system as a whole, the plan must concentrate on protecting critical habitats that support the function, integrity and structure of the natural system. Finally, the plan must be adaptive to respond to constantly changing conditions. A key reason for including New Bern as a case study was because this plan is truly regional in scope, and

requires coordination across political and organizational boundaries to be effective. The ability to protect regionally significant habitats across jurisdictional boundaries is a key component of effective ecosystem management, and is the only way to maintain the function and diversity within natural systems. However, this study found that while the plan is intended to protect trans-boundary resources, regional implementation of the plan is not necessarily happening. Interviews with local administrators in River Bend and Trent Woods indicate that neither community views the plan as something to be administered locally, although there are a series of land use, infrastructure and conservation directives for each community contained within. Further, interviews with planners in the City of New Bern indicate that the City effectively relies on state and federal agencies to make development decisions in the coastal zone.

With this understanding in mind, a closer examination of the plan indicates that many of the goals, objectives, and policies are clearly only supporting bare minimum state and federal requirements for conservation in the region. For example, the objective to "protect, maintain and conserve coastal and 404/401 wetlands and open space as established by State standards" (see New Bern plan page 85) is immediately followed by statements that support no expansion of state protected areas or conservation policies. This can also be seen in support of the state's Neuse River Rules for riparian buffering and other water quality measures. Further, determination and implementation of these regulations are placed squarely with the appropriate state or federal agency rather than the local government. When asked about the effectiveness of local CAMA plans to address ecosystem issues, a local environmental advocate noted the following:

> I think with most of these plans the environment is a secondary issue… there are more immediate issues the local community is trying to deal with and they are relying more on the state and federal levels to deal with environmental management… there are many, many plans that just regurgitate the state regulations.

This sentiment was echoed by a CAMA program manager in the following:

> Local governments don't tend to differentiate between AECs and non-AECs as far as their policy and their efforts. If anything they don't tend to make a special effort to exceed state minimum in the AECs.

However, this is not necessarily a regulatory issue that will be improved by new CAMA requirements. As noted by the same CAMA program manager:

> The CAMA Act does allow the state to formally get into the consistency between the land use plan and the regulations but this has never been exercised. Local governments would not exceed… there would be considerable amount of push back if this were to happen.

Rather, it would seem that local commitment and capacity will need to be expanded in order to achieve local implementation of the plan beyond minimum requirements. Local participation in the CAMA planning process will be necessary to increase commitment to the plan. In both the River Bend and Trent Woods instances, the zoning administrators were not part of the process, but rather town councilmen. While their participation is not in question, it is clear why neither administrator has a commitment to implementation of the plan beyond state or federal agency review. As evidenced in the Wilmington and Greenville case studies, quite often it is the commitment of local planners and administrators to the plan that guarantees its implementation.

7.6.6: Consultant-driven Process

Of the three plans examined for these case studies, the New Bern plan is clearly more generic than the other two. In fact, much of the description and factual basis is very similar to other CAMA plans surveyed for the larger plan quality analysis in Chapter 5. A major difference between the New Bern Plan and those in Wilmington and Greenville is the use of consultants to complete the plan rather than local planning agencies. A CAMA program manager noted that "90% of the CAMA plans are written by consultants." CAMA program managers and local environmental advocates repeatedly mentioned this as an impediment to implementation. In most cases the criticism of this is that the consultant-driven process provides very little opportunity for local participation that would build commitment to the process and improve the possibility of implementation. As noted by a local environmental advocate:

> Because one of the issues is in the 20 coastal communities that they are mandated to do these plans and many of them have chosen to use consultants and instead of it being a community-based effort it becomes a consultant-driven exercise.

Further, the same advocate noted:

> Many of the CAMA plans are written so that they will have no effect on those permit decisions… many times the consultants actually guide the local governments to make them written in such a way that they really won't have any influence over permit decisions.

However, a review of literature on the evolution of the CAMA legislation in North Carolina indicates that this was not the intent of the Act (Heath and Hess 2007; Heath and Owens 1994). Rather, the legislation was intended to be a locally-driven exercise that raised awareness of, and commitment to, planning and orderly development in the coastal zone in response to severe degradation of the ecosystem. Instead, many CAMA plans have become something that are heavily data driven (as evidenced by the high Factual Basis score of the New Bern plan) with weak policy statements that do little to tailor regulations to local needs. As noted by a local environmental program manager:

> From the early days of CAMA and the CRC there was an early member… he was a developer who stuck his neck out to get the act passed because he saw the value of planning. Later he reflected on the fact that on paper it went from something that was a locally-driven exercise to something that was a consultant-driven exercise and had really gone off track from the original vision of what the program was.

While what is needed is more funding and technical assistance to jurisdictions so that they may more actively participate in the CAMA process, CAMA programming for local governments is currently unfunded (as discussed in Chapter 6), which means that even the consultant-driven efforts may not happen. While this does not bode well for even the piecemeal coastal planning currently taking place, it does mean that future CAMA updates will be locally-driven exercises, and thus may result in higher quality plans with more local commitment to implementation. However, it appears as though some support of the CAMA process is waning. As expressed by a regional environmental program manager:

> For a number of years we really tried to make the CAMA plans more effective including some very concerted efforts when they were being updated and we were inserting ourselves into the process… and then little over a decade ago the state actually put a moratorium on the update of the plans that we pushed for because we just weren't seeing them produce any real results. So the CRC went through a process of updating the land use planning rules and took it very seriously… and we were pretty happy with the rules that were adopted but then everything just went back to the way it was before which just led me to conclude that a state mandate on local land use planning is just never going to work if you don't have the home grown interest in making the plans effective.

This would make it seem that support for large-scale ecosystem management, or at least management in its current form, is losing support just as planners and environmental managers are gaining an appreciation of its effectiveness.

7.7: Conclusion

Based on the results above, one can infer that the City of New Bern has somewhat effectively incorporated the principles of ecosystem management into its planning framework. This analysis presents three important findings in terms of ecosystem management and its implementation at the local level. First, these findings indicate again that state mandates are effective at advancing regional environmental goals, and encouraging planning in places where it may not otherwise happen. Interviews with local planners and the absence of other comprehensive planning efforts in the tri-city area (New Bern, River Bend and Trent Woods) indicate that the CAMA planning process was crucial to local ecosystem planning. Therefore, results from this case study strongly support the hypothesis that state mandates positively affect the ecosystem plan quality of local plans. However, there was no indication that participation in APNEP planning process had an impact on local ecosystem plan quality. Further, as previously mentioned there was no evident APNEP participation in the CAMA land use planning process either, thus there was little opportunity to capture ecosystem directives from the CCMP. Therefore, results from this study do not support the hypothesis that participation in a collaborative, ecosystem-based planning process positively affects the ecosystem plan quality of local plans. This is not to say that collaborative, ecosystem-based planning is necessarily ineffective, but that in this case the program itself was ineffective at working with communities to influence land use policy.

Second, and somewhat unexpectedly, the fact that the process was consultant-driven was highly influential on both the plan quality and plan implementation. Interviews with local planners, program managers, and environmental advocates reveal that there is little local commitment to the CAMA effort beyond the CAMA permitting requirements. Though the plan does a fairly good job of capturing the existing level of critical resources in the area, much of the rest of the plan is relatively weak on ecosystem management directives. There are few measurable targets or objectives, and there is little intent by any of the communities to use this plan beyond the mandated AECs. This indicates that without local participation to cultivate support and commitment for the plan, CAMA plans (or any plans for that matter) will have an impact on development decisions. However, when the process is locally-driven, as evidenced in Wilmington and Greenville, the plan is more likely to be implemented, and is also more likely to be incorporated into, or coordinated with, other local planning efforts. Given these findings,

planning researchers need to more seriously consider the impact of consultants and consultant-driven processes versus locally-driven processes on plan quality and implementation. In Chapter 9, I summarize the impact these findings and those from the other case study cities have on ecosystem planning research and their implications for planning and public policy.

8: Case Three: Greenville, NC

8.1: Introduction

Results from Chapter 5 indicate that local jurisdictions have not been able to effectively incorporate the principles of ecosystem management into the planning framework. However, these results are not uniform across jurisdictions. As expected, there are multiple factors and processes that influence the quality of comprehensive plans with regard to ecosystem management. As discussed in Chapter 4, the inclusion of case studies in this work allows me to address my second research question: *which factors and processes influence the quality of comprehensive plans, and the degree to which they are implemented?* Focusing on this question, I chose the City of Greenville as a case study because of its inclusion in the APNEP jurisdiction and its location in the inner coastal plain. After completion of the plan quality analysis, it became apparent that Greenville had a much higher quality ecosystem plan than other APNEP jurisdictions or any other communities without a mandate. As such there are unique factors at work in Greenville that have influenced and improved plan quality as it relates to ecosystem management.

In this chapter I further test my first and second hypotheses, and test my third hypothesis to see if the quality and content of the plan is positively correlated to the degree of implementation. I begin with an examination of the environmental, social and planning environments in the Greenville area to gain a greater understanding of the specific needs of the ecosystem and those factors driving plan development and implementation. Next, I conduct a detailed plan evaluation to understand what ecosystem issues are being addressed by the comprehensive plan and which are not. From there I take a closer look at the implications the plan quality has on implementation of the plan locally, and for ecosystem management as a whole. Rather than deduce plan implementation from spatial or policy analysis, this thesis investigates the question of implementation through a total of six telephone interviews with public and elected officials, environmental program managers, and local environmental advocates working in the Greenville area.

8.2: The Physical Environment

The Greenville metropolitan area is located in central eastern North Carolina, within an area known as the "Mid-East" or "Inner Banks" region, which encompasses an area of roughly 917 square miles and includes the counties of Pitt and Greene. The principal cities in each

county are Greenville and Snow Hill respectively (Figure 8.1). The Tar River separates Pitt County in half, with the City of Greenville almost entirely on the southwest bank of the River. The metropolitan area is located in the Inner Coastal Plain physiographic region, which generally has low elevations that range from areas of gently rolling hills to floodplain areas that are nearly flat (Karnowski et al. 1974: 131). Elevations range from near sea level in the eastern and southeastern portions of Pitt County to approximately 124 feet above sea level in the western portion of the county near Farmville (Karnowski et al. 1974).

Greenville's climate is moderate and influenced heavily by its proximity to the Atlantic Ocean. The typical weather is hot and humid in the summer, with the temperature reaching 90° or higher about half of the days in an average summer. The approximate length of the growing season in the area is about 220 days, and generally lasts from March until early November. Average annual rainfall is 48 inches, and summer thunderstorms account for a large portion of this precipitation (Karnowski et al. 1974). Analysis of drought severity and frequency indicate that the region has experienced two recent severe droughts from 2001-2002 and again from 2007-2009 (NCFSWC 2011; Weaver 2005). Some snow occurs almost every winter, but accumulations are generally small and melt within a few hours. Blanketing effect of snow that lasts for several days is extremely rare in the Greenville area.

Figure 8.1: Eastern North Carolina Regional Map
Source: East Carolina University

Hurricanes and tropical storms only occasionally retain destructive force when they move inland as far as Pitt County, however these coupled with major rain events are an important factor in the ecology and environmental quality of the region. In 1999, North Carolina experienced a series of hurricanes: Hurricane Dennis (September 3-7), Floyd (September 14-17),

and Irene (October 17-18) in rapid succession (Casteel et al. 2006; Mallin et al. 2002; Paerl et al. 2000). The torrential rain associated with each of these storms caused widespread flooding over a period of several weeks, with nearly every river basin in the eastern part of the state exceeded 500-year flood levels. Overall, the Tar River suffered the worst flooding, exceeding 500-year flood levels along its lower stretches and cresting 24 feet above flood stage (Casteel et al. 2006). Flooding began in Rocky Mount, as much as 30% of which was underwater for several days. Further downstream, Greenville and the surrounding area suffered very heavy flooding, and damages in Pitt County alone were estimated at $1.6 billion (Paerl et al. 2000). In addition to substantial property damage in the area, Paerl et al. (2000) and Mallin et al. (2002) document a long-term set of physical, chemical and ecological effects to the watershed including sustained algal blooms, hypoxia, displacement of ecosystem species and a rise in fish disease.

The City of Greenville is located almost entirely within the Lower Tar River basin, which is part of the larger Tar-Pamlico River basin – the fourth largest basin in the state. The Tar-Pamlico River basin stretches 180 miles from its headwaters in the Piedmont to the Atlantic Ocean (Figure 8.2) (NCDENR 2010c). The basin covers 5,440 square miles, drains 2,355 miles of freshwater streams and is one of only four of the seventeen major river basins in North Carolina whose boundaries are located entirely within the state (NCWRC 2005). The Tar-Pamlico River basin has two distinct portions: the upper one-fifth including the headwaters in the Piedmont known as the Upper Tar River and Fishing Creek sub-basins, and the lower four-fifths in the Coastal Plain (NCDENR 2010c). The Piedmont portion, running through relatively flat terrain, is characterized by highly erodible soils and low summer flows with limited ability to assimilate oxygen-consuming wastes (NCDENR 2010c; NCWRC 2005). Within the lower basin there are three distinct sub-basins: the Lower Tar River that runs through Greenville, the Pamlico River that flows east from Washington, and the Pamlico Sound that stretches from the mouth of the Pamlico River to the Outer Banks. Throughout the Coastal Plain portions of the basin there are slow-moving blackwater streams, low-lying swamps and highly productive estuarine waters (NCWRC 2005). Similar to the Piedmont streams, blackwater Coastal Plain streams have limited ability to assimilate oxygen-consuming wastes based on their naturally low dissolved oxygen content. The Pamlico estuary, which is somewhat protected from oceanic influences by the Outer Banks, has a tendency to receive excessive nutrient loads from upstream waters and sedimentation resulting in eutrophic conditions. Due to excessive nutrients that caused massive

algal blooms and fish kills, the entire Tar-Pamlico River basin was designated as Nutrient Sensitive Water (NSW) by the United States Environmental Protection Agency (U.S. EPA) in 1989 (Luchette and Crawford 2008). The same year the State of North Carolina called for measures to reduce nutrient pollution in the watershed, resulting in a series of programs to address nutrient loading and water quality (Luchette and Crawford 2008; Mallin et al. 2000a). While these programs have been somewhat successful, the basin still experiences regular beach and fisheries closures, and to date no comprehensive plan has been created to address all of the issues plaguing the watershed (Mallin et al. 2000a).

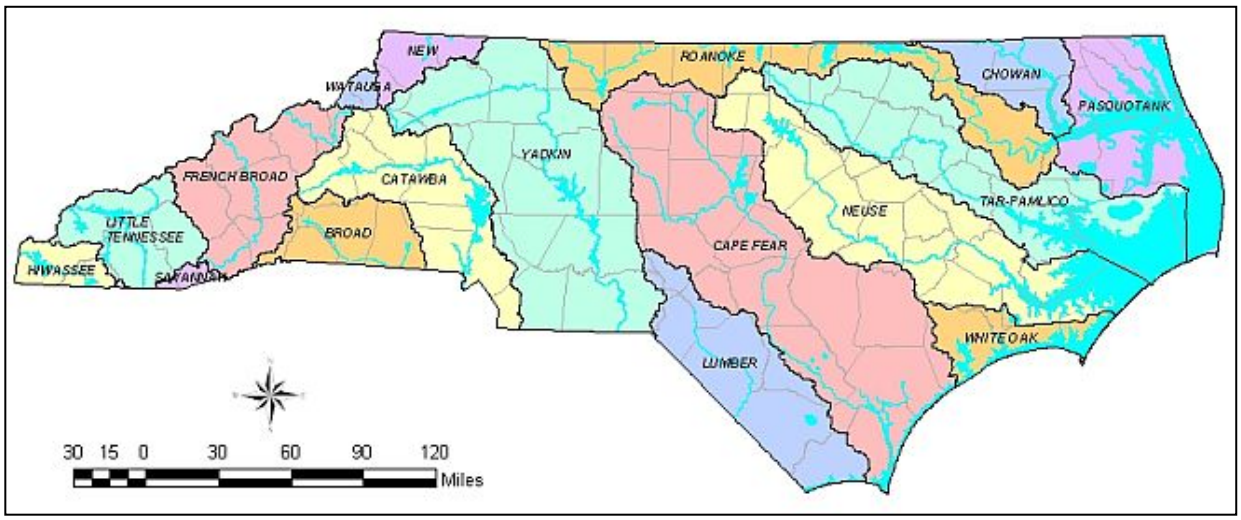

Figure 8.2: North Carolina River Basin Map
Source: North Carolina Division of Public Health

There are 50 municipalities within the 16 counties in the Tar-Pamlico River basin. Rocky Mount, Greenville, Henderson, Oxford, Tarboro and Washington are the largest of these municipalities. Development and population growth center around Greenville, Rocky Mount and smaller municipalities within commuting distance of the capital Raleigh, while other communities are stagnant or are losing population (NCDENR 2010c). According to the 2010 Census, the population in the basin is 472,629, up 14% from the 2000 population of 414,929. At a population density of 87 people/square mile, compared with a statewide density of 196 people/square mile, the basin is relatively rural (NCDENR 2010c). Basinwide land cover consists of forested and wetland areas (55%), cultivated cropland (28%), open water area (10%), and urban areas (7%) which occupy the smallest percentage of total land area (NCDENR 2010c). Publicly owned lands in the basin include three National Wildlife Refuges (Lake Mattamuskeet, Pocosin Lakes, and Swanquarter) and two State Parks (Goose Creek and Medoc Mountain).

North Carolina's largest lake, Lake Mattamuskeet is also located within this basin (NCDENR 2007b).

The Tar-Pamlico River basin is a very complex and dynamic system. The Upper Tar River and Fishing Creek portions of the basin provide essential habitat for several threatened and endangered aquatic species. Twelve rare freshwater mussels, including the federally endangered Tar River spiny mussel and the dwarf wedgemussel, can be found in the upper river basin (NCDENR 2007b; NCWRC 2005). Freshwater mussels are filter-feeding organisms, filtering plankton and detritus from the water. Because of their feeding method all twelve of these species are extremely sensitive to alterations in habitat hydrology or water quality due to sedimentation or pollution. Other federally listed endangered species in the middle and lower basin's include the West Indian manatee, the American alligator, the loggerhead sea turtle and the red-cockaded woodpecker (NCDENR 2007b). The state further lists as endangered or threatened the peregrine falcon, bald eagle, gull-billed tern and the piping plover. Declines in these and many other species in the basin are often indicative of deteriorating habitat quality (Hall et al. 1999; Prince 1999). The loss of old growth oak, pine savannah and white cypress threaten some of the most significant flyways and bird areas in the world (NCDENR 2007b). While the vegetation-based natural communities of the floodplains and adjacent uplands have not been thoroughly catalogued to date, it is known that many of the forested habitat and riparian buffers in these areas have been lost to agriculture and development, and these losses have had a significant impact on species richness and environmental quality (Mallin et al. 2000a; Prince 1999).

For decades the Lower Tar and Pamlico Rivers have been plagued with environmental problems. According to the *Tar-Pamlico River Basinwide Water Quality Plan* (2010), nutrient enrichment of the waterbodies within this basin continues to be the primary water quality issue and the focus of regulatory activities. As previously mentioned, excessive nutrient loading from point and non-point source pollutants has resulted in the entire system being designated as Nutrient Sensitive Water (NSW) (Luchette and Crawford 2008). In addition there are 80 miles of impaired streams in the Tar-Pamlico basin, meaning that the pollution loads exceed EPA-acceptable total maximum daily loads (TMDLs) (NCWRC 2005). Causes of impairment include sediment, fecal coliform, ammonia, chlorides, low dissolved oxygen, turbidity, nutrients, and other point and non-point source pollutants. Pollution sources in the basin include human and

domestic animal waste, residential development, commercial landscaping and golf courses in urbanized areas; point-source discharge facilities; major industry including the world's largest phosphorous mine (Potash Corporation of Saskatchewan, Inc. in Aurora, NC); and agriculture and livestock production including heavy concentrations of unregulated hog and poultry concentrated animal feed operations (CAFOs) (Luchette and Crawford 2008; Mallin et al. 2000a; Mallin et al. 2001; Mallin et al. 2000b).

One of the major issues in the Tar-Pamlico River basin is erosion and sedimentation. Rivers originating in the Piedmont feed most of the large estuaries in North Carolina, and the Pamlico Sound estuary is no exception (Mallin et al. 2000a). In fact, the Tar-Pamlico River feeds into a highly productive estuary that is nursery for more than 90% of all commercial fishing species caught in North Carolina (NCDENR 2007b). In contrast to estuaries that are open to the ocean, the protection of the Outer Banks and the relative calm of the Pamlico Sound create the perfect environment for juvenile fish and shellfish. However these semi-enclosed sounds also tend to have poorly flushed waters that are highly impacted by upstream pollutants including nitrogen, phosphorous and sediments with toxic substances. Every time it rains in the Piedmont, the water erodes the land and soil is washed into the streams. Piedmont soils are largely clays that are reactive and bind well with potential pollutants; thus rapid development in the Piedmont that results in erosion and sedimentation can have a large effect on coastal water quality (Mallin et al. 2000b). Further, though Coastal Plain soils are generally less reactive and sandier, large-scale agriculture and high levels of dissolved organic matter inherent to the draining of swamps also has a negative impact on overall estuarine water quality. As sediments are carried downstream into the Sound they tend to settle out and cover the bottom. The combination of toxic materials bound to the soil, cloudy water due to suspended sediment, and the smothering of submerged aquatic vegetation (SAV) and shellfish have very harmful effects on the Pamlico Sound. Problems include contamination of the extensive shellfisheries with toxic substances and disease, numerous fish kills, decline or loss of shellfish beds because of high siltation and suspended particulates, and an overall decline in fishery harvests (Mallin et al. 2000a; Mallin et al. 2000b).

Nutrients are substances that help plants and animals grow and are necessary for any healthy ecosystem. However, excessive nutrients, and in particular excessive nitrogen and phosphorous present in plant fertilizers and wastes from animals and people, disturb the natural

balance of the Tar-Pamlico River basin. As previously noted, agriculture is prevalent in the basin, with roughly 28% of all land devoted to cropland or pastureland. Historically agriculture in the basin focused on tobacco, grains and cotton, which have contributed heavily to the non-point source nutrients in the estuary. The region contains the state's largest tobacco-producing county (Pitt) and the largest producer of corn, wheat and sorghum (Beaufort). While cropland still common, Mallin et al. (2000a: 58) note that during the 1980s and 90s both cotton and tobacco farming began to decline. In many cases they were replaced by industrialized livestock production, particularly that of swine and poultry. Livestock production in the region is generally conducted in concentrated animal feeding operations (CAFOs), which produce enormous amounts of nitrogen and phosphorous. As noted by Mallin and Cahoon (2003: 369) "on the North Carolina Coastal Plain alone an estimated 124,000 metric tons of nitrogen and 29,000 metric tons of phosphorous are generated annually by livestock." These wastes are primarily either spread on fields as dry litter or pumped into waste lagoons and sprayed liquid onto fields. Like the sediment entering the system, large amounts of nitrogen and phosphorous enter the rivers and estuary through runoff, percolation into groundwater, and volatilization (vaporization) of ammonia. However, the availability of excessive animal manure has not driven major changes in the use of commercial fertilizers, so that the rise of livestock production has created an exponential rise in the total nutrient loads within the basin. Mallin et al. (2000a: 58) state "over 80% of these nutrients remain in the basin and the watersheds are increasingly acting as nutrients 'sinks', some of which enter coastal waters." The result of nutrient loading in these watersheds has been eutrophication of streams, the Pamlico River, and the Pamlico Sound resulting in fish kills and the closure of shellfish beds and swimming beaches.

While the Tar-Pamlico basin is predominantly rural, increased urbanization also has a significant impact on the ecosystem. In well-populated and/or industrialized areas, point source discharges are substantial. Within the Tar-Pamlico basin there are 20 municipal discharge facilities that account for 98% of the known effluent flow in the basin (NCDENR 2010c). Major industrial point sources include the phosphate mining activities, pulp and paper mills, and textile manufacturers (Mallin et al. 2000a). While these uses contribute additional nutrients to the system, each has been heavily regulated for decades and generally meet or exceed established individual nutrient permit limits (NCDENR 2010c). Perhaps the most troubling issue in the basin is floodplain development and the loss of riparian buffers and habitat as population centers grow.

Wetlands, which act as natural filters for pollutants such as fertilizers and animal waste, are threatened throughout the Tar-Pamlico watershed (Mallin et al. 2000a; Mallin et al. 2000b). Typically they are filled in for development, drained for agriculture, or dredged for marinas. Thus, urbanization and population growth have lead to greatly increased non-point source pollution in the region. Pollution has degraded water quality in the sounds and rivers, resulting in declines of important SAV and shellfish.

8.3: The Social Environment

The City of Greenville is the county seat of Pitt County, and is located at the geographic center of Eastern North Carolina. Within an hour's drive of the Greenville area are five other mid-sized cities: Greensboro, Kinston, New Bern, Wilson and Rocky Mount (Greenville 2004: Appendix 3). The Outer Banks beaches lie approximately 100 miles east of the city, and the state capital, Raleigh, is about 80 miles due west. Much of the City's recent growth is due to the growth of East Carolina University (ECU) and the opening of ECUs Medical School. In 2010, the ECU student population (approximately 27,816) accounted for roughly 32% of the City's population. At the end of the 2010-2011 school year, ECU was the third-largest campus in the University of North Carolina system, and has consistently been one of the system's fastest growing campuses. The large college population living in Greenville is reflected in the city's demographics, housing characteristics and economic profile. However, the city is more than a college town. Over the last 25 years, Greenville has emerged as the center of medicine, business, services and financial institutions for the eastern portion of the state. Roughly since World War II, Greenville's growth has been between 2% and 4% annually, and the city has more than doubled in size since 1980 (Table 8.1 and 8.2). From 1990 to 2010, the City of Greenville's population grew at an annual rate of approximately 3.7%, which is more than three times the state's 1.2% annual growth rate for the same period. As evidenced in Table 8.2, Pitt County is also growing rapidly, which to a certain extent is because significant areas of the county and municipalities adjacent to Greenville (namely Winterville and Sampson) have developed as bedroom communities. While population growth in Greenville is the result of a variety of factors, the *Horizons* plan attributes annexation as one of the major contributors (see Appendix page 6). As unincorporated areas adjacent to the city create pressures for services and for coordination with municipal plans, joint agreements between the city, the county, and the utility companies force development on the fringe to petition for annexation. As a result of these agreements, the

city has grown substantially over the past five decades. According to the *Horizons* plan (see Appendix page 6) "the city has more than quadrupled in area since 1960. Between 1990 and 2002, the area of the city increased by 43.2% due to annexations."

TABLE 8.1: POPULATION OF GREENVILLE			
Year	Population	Change in 10 Years	% Change
1950	16,724		
1960	22,860	6,136	36.7%
1970	29,063	6,203	27.1%
1980	35,740	6,677	23.0%
1990	44,972	9,232	25.8%
2000	60,476	15,504	34.5%
2010	84,554	24,078	39.8%
Data Source: U.S Census Bureau			

TABLE 8.2: GREENVILLE GROWTH TRENDS AND PROJECTIONS 1990-2020						
LOCATION	1990	2000	2010	GROWTH % 1990-2000	ESTIMATED POPULATION 2020	ESTIMATED GROWTH % 1990-2020
City of Greenville	44,972	60,476	84,554	88.0%	108,605	141.5%
Pitt County	107,924	133,798	168,148	55.8%	212,952	97.3%
State of North Carolina	6,628,637	8,049,313	9,345,823	41.0%	10,709,289	61.6%
Data Sources: U.S Census Bureau, North Carolina Office of State Budget and Management (Projections)						

The growth rate of student population at East Carolina University will continue to have a significant impact on Greenville's population. A history of ECU notes that the student population in the Fall of 1909 was 174, compared to almost 28,000 in 2010 (ECU 2010). According to the ECU *Main Campus Master Plan* (2010), enrollment is expected to exceed 30,000 by 2012. The large college population living in Greenville is reflected in the city's demographic profile. The median age of Greenville residents – 26 years – is well below the state's average of 36.3 years (Table 8.3). Further, the proportion of the population under 25, which has remained nearly 50% of the population for the last twenty years, is much higher than that of the county or the state (Table 8.3). However, the *Horizons* plan projects that the age structure of the population is likely to change over the next twenty years, following trends seen nationwide. Unlike other areas in Eastern North Carolina such as New Bern and Wilmington, which have seen large in-migrations of retirees, Greenville's aging is a reflection of the general aging of the population (Table 8.4). It is expected that the percentage of the city's population over 65 is likely to increase, while the percentage of children (under 14 years) is expected to decline. The combination of these rising population groups (15-24 and 65+) is already having an

impact on land use patterns, housing preferences, transportation needs and public facilities. In the future, it is expected that these trends will fuel greater demand for multi-family units close to downtown and other service areas, as well as changing demands for public transportation, medical services, recreation and programming to accommodate the senior population (Greenville 2004).

TABLE 8.3: PERCENTAGE OF POPULATION UNDER 25 YEARS 1990-2010				
COMMUNITY	1990	2000	2010	Median Age [a]
City of Greenville	49.0%	47.1%	47.9%	26.0
Pitt County	42.1%	41.2%	40.9%	31.0
State of North Carolina	30.7%	34.4%	33.7%	36.3
Data Sources: U.S Census Bureau [a] Median age based on 2010 U.S. Census data				

TABLE 8.4: PERCENTAGE OF POPULATION OVER 65 YEARS 1990-2010			
COMMUNITY	1990	2000	2010
City of Greenville	8.7%	8.8%	8.3%
Pitt County	9.9%	9.6%	9.9%
State of North Carolina	12.1%	12.0%	12.8%
Data Sources: U.S Census Bureau, North Carolina Office of State Budget and Management (Projections)			

Today, diversity characterizes the housing stock in the City of Greenville, but this was not always the case. For most of its history, Greenville was a relatively small agricultural town dominated by small single-family homes. However, rising land prices, increasing construction costs and changes in consumer preferences fueled by ever increasing student populations resulted in a shift toward multi-family construction. As noted in the *Horizons* plan, multi-family construction was so robust from 1980 to 2000 that it dramatically changed the overall composition of dwellings available in the city from predominantly single- to predominantly multi-family units. In fact, according to the 2010 Census, single-family detached units made up only 37.4% of all dwelling units in the city. Given the current and projected increases in population, the city expects to add an additional 5,700 units of multi-family, 361 duplex and 1,817 single-family units from 2007-2012 (Greenville 2004).

Despite increases in the city's overall housing stock, rising land prices, construction costs, and continued strong demand for housing have contributed to a dramatic increase in housing prices. A major contributor to this price increase was Hurricane Floyd in 1999. Flood waters in the city reached 15 feet above flood stage, inundating roughly 1,900 structures and severely damaging 535 that were later purchased by NCEM. In addition to inundating structures,

flooding from Floyd and subsequent changes in development policy severely limited areas for development – most notably areas within the floodplain and those areas located on the northern bank of the Tar River. This has shifted development patterns in the city, and often encouraged development outside of the municipal boundaries that is later annexed in for service provision. While the primary growth trends in Greenville have always been toward the south and southwest, since Floyd development has occurred mainly in the southeast quadrant of the city near Winterville and well outside of the Tar River floodplain (Figure 8.3). Along with residential development, much of the commercial/retail development has also occurred on the outskirts of the city and away from the downtown area.

Economic growth has kept pace with the expansion of the housing market. The city's healthy economy is reflected in a number of indicators. First, as previously mentioned the city's population has increased between 23% and almost 40% in every decade since the 1950s (Table 8.1). Top employers include ECU and the combined medical sector of Pitt County Memorial Hospital, Brody School of Medicine at ECU, and private practice. Enrollment at ECU grew by over 92% from since 1970, and as noted the university continues to be one of the fastest growing in the UNC system, indicating that these trends will continue into the future. As noted in the *Horizons* plan (see Appendix page 9):

> The economy of Greenville has grown and diversified… The 1970s were marked by rapid industrial growth… The 1980s brought rapid expansion of the service sector. ECU Medical School graduated its first class in 1981… support services and commercial uses were established or expanded in response. Today, Greenville is the leading city in Eastern North Carolina in the areas of business, education, medicine, services, financial institutions, and retail sales.

Economic growth and diversification has created a stable job market. Most Greenville residents are employed in some type of service industry – health, education, retail trade, etc. At the same time manufacturing industries continue to employ a considerable portion of local residents. Since 1990 there have been over fifty new manufacturing firms, including Yale Materials and Proctor & Gamble, established since 1990. However, the percentage of the population employed in the manufacturing sector is declining, while employment in services industries (especially health-related services), is expected to grow.

8.4: The Planning Environment

This study looked at the 2004 *Horizons* plan, as well as the 2010 update, which assessed the effectiveness of the original plan and made recommendations on responsibility and clear timelines for implementation. Planning in the city is undertaken by the Community Development Department, which oversees the divisions of Planning, Historic Preservation, Urban Development and Housing. There is a staff of approximately 30, which staff planners deem sufficient to meet current planning needs. However, as in all three case study communities, the department has been impacted by current economic conditions, and has been unable to replace staff when positions are vacated. It is also important to note that the City of Greenville falls within the boundaries of APNEP, and thus within the purview of its Comprehensive Conservation and Management Plan.

8.5: Plan Evaluation

Results from the first part of this study (Chapter 5) provide an overall assessment of how well the City of Greenville incorporated the principles of ecosystem management into its comprehensive plan. As shown in Table 8.5, the total ecosystem plan quality score for the Greenville *Horizons Comprehensive Plan Update* is 27.35, which on a scale of 0-50 indicates a strong effort to manage ecological systems at the local level without a mandate. This is well above the overall mean plan quality score of 18.54. The Goals and Objectives are the highest scoring component of this plan, indicating that the community values regionally significant habitats and the integrity of ecosystems. On the other hand, Factual Basis and Implementation are the lowest scoring components of the plan, which questions the ability of the plan to identify key resources and to influence other regulation encouraging collective action of ecosystem resources. Specific scores for each plan component are discussed in greater detail in the subsequent sections of this chapter, and provide a more detailed examination of a local jurisdictions' ability to incorporate the principles of ecosystem management by unpacking the results from the plan coding protocol item by item.

Table 8.5: Descriptive plan quality scores for each plan component		
Plan Component	Horizons Plan	Overall Mean Plan Scores
Factual Basis	4.86	3.649
Goals and Objectives	6.33	4.189
Inter-organizational Coordination	5.71	3.453
Tools, Policies & Strategies	5.45	3.729
Implementation	5.00	3.512
Total Ecosystem Plan Quality	27.35	18.535

8.5.1: Factual Basis

In general, the factual basis of a plan provides an inventory of existing resource issues, environmental policies, and stakeholder interests within the ecosystem. In looking at the Greenville plan, the Factual Basis score of 4.86 (Table 8.5) is the lowest scoring component, which may demonstrate a lack of knowledge regarding the existing level of critical natural resources within the jurisdiction. This compares to an overall mean plan score of 3.65 for the Factual Basis component. Items within the Factual Basis plan component are grouped into three categories. First, the Resource Inventory component includes indicators such as mapping ecosystems and habitat boundaries, describing ecological functions, and the ability to classify wildlife and vegetation. In order to protect the ecological infrastructure of a landscape, the plan must also identify critical habitat, areas of high biodiversity, and corridors that facilitate the movements and migration of key species. Second, the Ownership Pattern category characterizes the existing management of critical habitats and areas of high biodiversity. To identify new land for protection, the plan must begin by identifying the existing network of protected areas. The Resource Inventory components combined with the Ownership Patterns components generally provide the basis for a gap analysis that can greatly assist planners in generating plans and making development decisions that effectively manage ecosystems. Human Impacts, the third category of the factual basis component of a plan deals with identifying resource problems associated with human development. Indicators in this category include human population growth, the development of wetlands, water pollution and nutrient loading, and habitat fragmentation.

In the Resource Inventory category (Table 8.6), the plan mapped and catalogued some of the key elements for identifying and managing ecosystems, but did not map or mention several other critical elements. It is important to note early that the effects of Hurricane Floyd, as will be

outlined in greater detail in Section 8.5, heavily influenced the plan. As such, those elements that are described in detail and mapped tend to focus on those aspects of the ecosystem associated with flooding and stormwater retention. For example, the plan fully details the ecological functions of the floodplain and corresponding wetlands, and provides maps for the location and preservation of the floodplain. However, while there is a discussion of the larger Tar-Pamlico River Basin, it is not mapped and few other trans-boundary resources are graphically represented or discussed. Greenville is one of the few communities in the study that mentions habitat corridors within and between natural areas, an essential component of maintaining the landscape mosaic because they allow for natural movements of species. In fact, the following description is included in the *Urban Form* chapter of the plan (See *Horizons* Section 2, page 4), outlining the importance of corridors to both locals and local wildlife:

> In North Carolina's Coastal Plain, natural paths are formed primarily by major rivers and their tributaries. These types of corridors serve as natural drainage ways and wildlife habitat areas. For planning purposes, natural paths provide opportunities for open space, greenway development, and alternative transportation routes for pedestrians and bicycle users.

Unfortunately, other important elements for understanding species within ecosystems, such as the distribution of species, indicator/keystone species, endangered/threatened species, and exotic/invasive species, are not identified. Further, the plan does not mention areas of high biodiversity or species richness, despite the fact that this information is readily available from the state's Natural Heritage Resource Program or the North Carolina Center for Biodiversity located at ECU. Vegetation cataloguing and mapping, and particularly that of local wetlands, is more thorough than wildlife identification, which is limited to the mention of wildlife in relation to habitat corridors. As expected, the plan also includes a description of traditional environmental components, such as soil types, detailed wetlands descriptions, and surface water features.

The Human Impacts described in the plan concentrate primarily on typical urban environmental problems, such as water pollution and nutrient loading, as these are the components most heavily regulated by the state (Table 8.6). Also included in the inventory are federal water quality monitoring regulations and best management practices for stormwater management, wetlands restoration and nutrient reduction. The plan mentions the ecological and economic impacts attributable to events such as sporadic fish kills and loss of submerged vegetation. However, the plan fails to address some of the most pertinent issues related to habitat

degradation and ecosystem decline in the North Carolina - habitat fragmentation and the alteration of waterways - and only briefly discusses wetlands development. While there is a full description of population growth and road density, these elements are not necessarily linked to their impact on ecosystems. Finally, the plan does not include an analysis of the carrying capacity of the ecosystem, or a gap analysis that would prioritize areas of high biodiversity before they become degraded.

For the most part Ownership Patterns (Table 8.6), short of the distribution of species within the network of conservation lands, are fully detailed and mapped. The current conservation area (CA) overlays zones, protected floodplains, and extensive system of City-owned parks are included and the management status for each is described. Throughout the inventory it is clear that the community sees this as a network of conservation land, and is included in the discussions of the environmental conditions as well as the urban form of the city.

Table 8.6: Issue-based scores for the factual basis plan component		
Indicator	Score	Result
Resource Inventory		
Vegetation cover	2	Mapped & Catalogued
Ecological functions	2	Mapped & Catalogued
Surface hydrology	2	Mapped & Catalogued
Habitat corridors	2	Mapped *or* Catalogued
Ecological zones/habitat types	1	Mapped *or* Catalogued
Soils classified	1	Mapped *or* Catalogued
Wetlands	1	Not Identified
Ecosystem boundaries/edge	1	Not Identified
Distribution of species	0	Not Identified
Wildlife classified	0	Not Identified
Graphic representation of trans-boundary resources	0	Not Identified
Other water resources	0	Not Identified
Areas with high biodiversity/species richness	0	Not Identified
Invasive/exotic species	0	Not Identified
Threatened/endangered species	0	Not Identified
Indicator/keystone species	0	Not Identified
Climate described	0	Not Identified
Other predominant landscapes	0	Not Identified
Ownership Patterns		
Conservation lands mapped	2	Mapped & Catalogued
Management status identified for conservation lands	2	Mapped & Catalogued
Network of conservation lands mapped	2	Mapped & Catalogued
Distribution of species within network of conservation lands	0	Not Identified
Human Impacts		
Road density	2	Mapped & Catalogued
Nutrient loading	2	Mapped & Catalogued
Water pollution	2	Mapped & Catalogued
Existing environmental regulations described	2	Mapped & Catalogued
Other factors/impacts	2	Mapped & Catalogued
Population growth	1	Mapped *or* Catalogued
Wetlands development	1	Mapped *or* Catalogued
Loss of fisheries/marine habitat	1	Mapped *or* Catalogued
Carrying capacity measured	0	Not Identified
Fragmentation of habitat	0	Not Identified
Alteration of waterways	0	Not Identified
Value of biodiversity identified	0	Not Identified
Incorporation of Gap Analysis data	0	Not Identified

8.5.2: Goals and Objectives

The Goals and Objectives component of the plan represents the aspirations, problem statement and needs that are premised on shared community values (Kaiser et al. 1995). These statements can be either broad value statements or specific measurable objectives that guide the implementation of ecosystem management. In either case, goals and objectives help prioritize

issues and problems facing the community. The Greenville CAMA plan scored 6.33 on the Goals and Objectives component (Table 8.5), which was the highest scoring component, and on a scale of 0-10 indicates a fairly strong commitment to ecosystem management. This is also well above the overall mean plan quality score of 4.19 for the Goals and Objectives component. Table 8.7 indicates those goals and objectives that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

The plan includes broad goals to protect the integrity of the Tar-Pamlico River Basin, including its wetlands, water resources and environmentally sensitive areas. In addition, the plan sets forth goals to protect the natural functions of wetland areas and floodplains for wildlife and habitat corridors; water conveyance and storage capacity; and greenways and open space corridors. The plan clearly prioritizes the protection of wetland ecosystems, including detailed goals and objectives maintaining large intact tracts of wetlands, trees and native species; establishing priority wetlands areas for preservation; and restoring wetland and riparian buffers. It touches on multi-generational sustainability with the goal of "long-term preservation of environmental quality with a recognition that environmental change occurs" (see *Horizons* Section 3, page 11). However, the plan does not include more specific objectives involved in managing ecosystems, such as protecting biodiversity hotspots, or representing native species within protected areas, and only touches on the goals of protecting endangered species or unique landscapes. This suggests that while the jurisdiction is focused on broad ecosystem goals and measurable objectives related to floodplains and stormwater retention, it is less focused on scientific objectives related to other aspects of the ecosystem. Notable is how little emphasis there is on restoration of habitats. Unlike Wilmington and New Bern, which have been experiencing rapid urban development in sensitive environmental areas for decades, Greenville still has an intact riparian area and viable habitat along the Tar-Pamlico River. As such the focus is much more on acquisition and preservation than restoration of badly degraded natural systems.

Table 8.7: Issue-based scores for the goals and objectives plan component		
Indicator	Score	Result
Protect integrity of ecosystem	2	Fully Detailed or Mandatory
Protect natural processes/functions	2	Fully Detailed or Mandatory
Maintain intact patches of native species	2	Fully Detailed or Mandatory
Establish priorities for native species/habitat protection	2	Fully Detailed or Mandatory
Maintain connection among wildlife habitats	2	Fully Detailed or Mandatory
Other goals to protect ecosystem	2	Fully Detailed or Mandatory
Presence of measurable objectives	2	Fully Detailed or Mandatory
Goals are clearly specified	2	Fully Detailed or Mandatory
Protect rare/unique landscape elements	1	Suggested but not detailed
Protect rare/endangered species	1	Suggested but not detailed
Maintain intergenerational sustainability of ecosystems	1	Suggested but not detailed
Balance human use with maintaining viable wildlife populations	0	Not Identified
Restore ecosystems/critical habitat	0	Not Identified
Protect high biodiversity	0	Not Identified
Represent native species within protected areas	0	Not Identified

8.5.3: Inter-organizational Coordination and Capabilities

The Inter-organizational Coordination and Capabilities component of the plan captures the ability of a local jurisdiction to collaborate with neighboring jurisdictions and organizations to manage resources that extend across multiple jurisdictions and ownership patterns. This element of the plan is particularly important to effective ecosystem management because it represents the degree to which the local community is able to recognize the trans-boundary nature of systems and coordinate with other parties within and outside jurisdictional boundaries. The Greenville *Horizons* plan scored 5.71 on the Inter-organizational Coordination and Capabilities (Table 8.5), which on a scale of 0-10 indicates a moderate commitment to collaboration and coordination. This is well above the overall mean plan quality score of 3.45 for the same component. Table 8.8 indicates the plan components that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

Overall, results for this category reveal a fairly strong commitment to collaborating within the jurisdiction, coordination between the city and state agencies, and to a lesser extent with neighboring communities. The plan notes in detail coordinating with other organizations to protect resources within jurisdictional boundaries as well as those within the ETJ areas. State and federal agency partners mentioned include the US Army Corps of Engineers, NCDWQ, NCDENR, the NC Cooperative Extension, and the Pitt County Soil and Water Conservation

Service. Additionally, there are several intergovernmental bodies and agreements included as key partners including the Tar-Pamlico River Basin Association and the Pitt County Stormwater Advisory Committee. There is a recognition of other plans, such as the *Tar- Pamlico Nutrient Sensitive Water Strategy,* the *Tar River Floodplain Redevelopment Plan,* in addition to numerous local plans that touch on ecosystem issues. However, unlike the City of Wilmington, which has established a strong bond with UNCW, the City of Greenville does not seem to have established the same type of relationship. This is evident in areas such as joint database production, information sharing, and connecting scientific findings with policy directives – all of which were covered by UNCW in the Wilmington plan. Further, there is little coordination between jurisdictions. Scores are not strong when it comes to positioning the jurisdiction within the bioregion (maps and directives still tend to stop at the ETJ border) and committing the financial resources necessary to bring together various parties to manage ecosystems. Finally, this plan, as do all of the plans sampled for this study, fails to mention conflict management processes to resolve resource conflicts prevalent in ecosystem management. While the plan is quite thorough in outlining inter-organizational coordination and capabilities, the lack of conflict resolution directives means there are few "how-to" details for bringing parties together to work on common natural resource problems (Brody 2008: 24)

Table 8.8: Issue-based scores for inter-organizational coordination and capabilities plan component

Indicator	Score	Result
Other organizations/stakeholders identified	2	Fully Detailed or Mandatory
Coordination with other organizations/jurisdictions specified	2	Fully Detailed or Mandatory
Coordination within jurisdiction specified	2	Fully Detailed or Mandatory
Intergovernmental bodies specified	2	Fully Detailed or Mandatory
Intergovernmental agreements	2	Fully Detailed or Mandatory
Integration with other plans/principles	2	Fully Detailed or Mandatory
Joint database production	1	Suggested but not detailed
Coordination with private sector	1	Suggested but not detailed
Links between science and policy specified	1	Suggested but not detailed
Other forms of coordination	1	Suggested but not detailed
Information sharing	0	Not Identified
Position of jurisdiction within bioregion specified	0	Not Identified
Commitment of financial resources	0	Not Identified
Conflict management processes	0	Not Identified

8.5.4: Policies, Tools and Strategies

The Policies, Tools and Strategies component is the core of the plan because these are policies that substantiate the goals and objectives by setting forth actions to protect critical or

endangered habitats. These policies include traditional regulatory tools such as land use and density restrictions, restrictions on native species removal, and buffer requirements. In addition to traditional regulatory tools, more innovative incentive-based approaches are also included in this component, such as clustering away from sensitive habitats, density bonuses, transfer of development rights (TDRs), and mitigation banking. Land acquisition programs are another important component of this category because it indicates the desire and ability of local jurisdictions to fund the purchase of critical habitats and sensitive environmental resources. Finally, educational efforts are also included in this component, as these types of programs are essential for engaging stakeholders in the planning process and in generating an effective, enforceable plan. The Greenville *Horizons* plan scored 5.45 on the Policies, Tools and Strategies component (Table 8.5), compared to an overall mean policy score of 3.73, which on a scale of 0-10 indicates a moderate commitment to specifying the policies and tools necessary to protect ecosystem resources. Table 8.9 indicates the policies and strategies that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

The Regulatory Tools component demonstrates that the plan tends to favor traditional environmental policies, such as resource use restrictions in wetland areas and floodplains; construction controls limiting impervious cover and promoting low-impact development around critical habitats; and conservation areas to protect wetlands and watershed resources. In addition, the city has established conservation area (CA) overlay zones in the Zoning Ordinance to protect sensitive areas through required preservation of the resource. Other traditional environmental policies evident in the plan include the use of capital improvements programming to slow development, site plan review, density restrictions in floodplains, maintenance of tree canopy, and riparian buffering along creeks and rivers to improve water quality. However, other regulations such as fencing controls to allow for the movement of native species, phasing of development to reduce wildlife disturbance, or the removal of exotic or invasive species to improve biodiversity are not included. While mainstream policies play an important role in ecosystem approaches to management, the literature suggests that less commonly used growth management tools focusing on growth patterns (e.g. targeted growth areas), specific site-related regulations (e.g. conservation subdivision standards or performance zoning), and the protection of resources in other jurisdictions may allow for more significant gains in protecting regionally

significant habitats (Duerksen et al. 1997). In this case the plan makes mention of "innovative site planning and subdivision design" (see *Horizons* Section 4, page 4), but does not fully detail how such regulations would be implemented in the City. There are no directives included that protect resources in other jurisdictions or restore regionally significant habitats.

Incentive-based tools, despite their effectiveness in protecting critical habitats and ecological systems (Beatley 2000; Duerksen et al. 1997), enjoy less specification than regulatory approaches in the plan. As previously stated, the plan focuses primarily on floodplain and wetlands conservation. As such, the most detailed incentive-based element of the plan is mitigation banking, which includes ratios for replacement and BMPs. The plan also promotes clustering on development sites to protect sensitive natural areas, though the other tool most closely associated with clustering – density bonuses – is not included. The plan also advocates use-value tax assessments through the NC Conservation Tax Credit Program, which provides an individual or corporation income tax credit for real property donated for conservation purposes. It is these types of incentive-based programs that are key to the conservation of large tracts of open space and creating linkages between critical habitats. The plan includes fully detailed plans for fee simple purchase, conservation easements, and the use of Hazard Mitigation Grant Program dollars as tools for Land Acquisitions in floodplain and wetland areas. Surprisingly, other incentive-based options like TDRs are not included in the plan, despite strong state-level programming and regulatory frameworks allowing for such practices. Finally, the plan fully details public education programming associated with the *Tar-Pamlico Nutrient Sensitive Waters Strategy*, as well as a desire to employ citizens to monitor water quality in the area. Although Yaffee (1996) and others have found that the environmental planning arena largely overlooks public education on environmental issues, policies that educate and engage citizenry also play an important role in understanding ecological problems and protecting ecological systems.

Table 8.9: Issue-based scores for the policies, tools and strategies plan component		
Indicator	Score	Result
Regulatory Tools		
Density restrictions	2	Fully Detailed or Mandatory
Buffer requirements	2	Fully Detailed or Mandatory
Restrictions on native vegetation removal	2	Fully Detailed or Mandatory
Conservation zones/overlay districts	2	Fully Detailed or Mandatory
Protected areas/sanctuaries	2	Fully Detailed or Mandatory
Capital improvements programming	2	Fully Detailed or Mandatory
Site plan review	2	Fully Detailed or Mandatory
Controls on construction	2	Fully Detailed or Mandatory
Subdivision standards	1	Suggested but not detailed
Phasing of development	1	Suggested but not detailed
Performance zoning	1	Suggested but not detailed
Habitat restoration actions	1	Suggested but not detailed
Urban growth boundaries to exclude habitats	0	Not Identified
Public or vehicular access restrictions	0	Not Identified
Resource use restrictions	0	Not Identified
Actions to protect resources in other jurisdictions	0	Not Identified
Targeted growth away from habitat	0	Not Identified
Removal of exotic/invasive species	0	Not Identified
Fencing controls	0	Not Identified
Other regulatory tools	0	Not Identified
Incentive-based Tools		
Clustering away from habitats	2	Fully Detailed or Mandatory
Mitigation banking	2	Fully Detailed or Mandatory
Preferred tax treatments	1	Suggested but not detailed
Density bonuses	0	Not Identified
Transfer of development rights	0	Not Identified
Other incentive-based tools	0	Not Identified
Land Acquisition Programs		
Other land acquisition techniques	2	Fully Detailed or Mandatory
Fee simple purchase	2	Fully Detailed or Mandatory
Conservation easements	2	Fully Detailed or Mandatory
Other Policies		
Public education programs	2	Fully Detailed or Mandatory
Monitoring of ecological health and human impacts	1	Suggested but not detailed
Control of public investment and projects	0	Not Identified
Designation of special taxing districts for acquisition funds	0	Not Identified

8.5.5: Implementation

The final component of ecosystem plan quality measured is Implementation, which measures the ability of a plan to become a lasting document that influences other regulation and encourages collective action. For a comprehensive plan to be effective, implementation must be clearly defined and laid out of all affected parties (Kaiser et al. 1995). The Implementation component of the plan focuses on the designation of responsibility for action, timelines,

enforcement standards and sanctions, as well as monitoring activities to determine the success of policies and respond to scientific information. In this manner the Implementation component of the plan incorporates the concept of adaptive management and flexibility in managing ecological systems that are constantly changing both spatially and temporally. The Greenville *Horizons* plan scored 5.00 on the Implementation component (Table 8.5), which is a fairly good indicator that the plan will be implemented. This compares to an overall mean implementation score of 3.51. It is important to note that this component does not measure whether the plan was actually implemented, but rather the future ability of the community to implement its plan. Table 8.10 indicates the implementation indicators that the plan fully detailed or made mandatory, as well as those elements important to effective ecosystem management that were not identified.

First, it is important to note that this plan was created *by* the local government *for* use by the local government, which according to literature indicates there is a greater chance of the plan being implemented than mandated plans (Burby and May 1997; Norton 2005a). As such, the *Horizons* plan mandates updates of the plan every five years, or at any time that population growth exceeds 5% in two years, which is an essential component for guaranteeing that the plan is relevant and implementable. Additionally, the plan clearly designates what department is responsible for the action, as well as a timeline for implementation. However, the plan does not include directives for the provision of technical assistance, nor does it include a mechanism to assess plan policies between updates. The literature indicates that the ability to monitor plan effectiveness and incorporate new information into updates is fundamental to managing ecosystems (Brody 2008). Notably absent from the plan are costs or funding sources for implementation, or who is responsible for enforcement, and the provision of sanctions. Without the inclusion of these elements, there is no way to ensure that policies and projects required in the plan actually come to fruition and are adhered to by the public.

Table 8.10: Issue-based scores for the implementation plan component

Indicator	Score	Result
Regular plan updates and assessments	2	Fully detailed or mandatory
Designation of responsibility	2	Fully detailed or mandatory
Clear timetable for implementation	2	Fully detailed or mandatory
Provision of technical assistance	1	Suggested but not detailed
Identification of costs or funding	1	Suggested but not detailed
Monitoring for plan effectiveness and response to new information	0	Suggested but not detailed
Enforcement specified	0	Not Identified
Provisions of sanctions	0	Not Identified

8.6: Implications for Implementation and Ecosystem Management

8.6.1: Little Interaction With APNEP

My interest in this topic focused originally on the ability of collaborative planning efforts to improve plan quality and influence land development policy. In particular, I wanted to understand how alternative non-regulatory efforts such as the National Estuary Program, the purpose of which is to create intergovernmental networks that come together to address regional environmental issues in nationally significant ecosystems. In this case, the Albemarle-Pamlico National Estuary Program (APNEP) was established in 1987 and completed its Comprehensive Conservation and Management Plan (CCMP) in 1994. During the development of the CCMP, APNEP was guided by a Management Conference that represented government agencies, university researchers, local governments, citizens, and state and federal agencies; and whose purpose was to study the estuary and produce a strategic plan for its restoration and preservation. Both ECU and the City of Greenville participated in the Management Conference during this time. At the conclusion of the CCMP process APNEP had a plan that clearly outlined goals and objectives for four key elements of the estuary: water quality, vital habitats, fisheries, land use planning/stewardship – and an implementation strategy for each of these elements. The primary stewardship objective is as follows: "Promote local and regional planning that protects the environment and allows for economic growth" (APNEP 1994: 131). The corresponding management strategy and action items clearly outline the need to expand comprehensive planning to the larger estuarine region, and to support local planning by providing economic funding incentives and technical assistance (APNEP 1994: 131-133). However, it is clear from the plan quality analysis, and the Greenville case study in particular, that APNEP had little to no involvement or coordination with local planning efforts. In fact, none of the plans surveyed mentioned APNEP, indicating that it had little if any influence on the ecosystem plan quality of the communities within its boundaries. Rather, APNEP appears to have focused primarily on other implementation CCMP areas such as water quality monitoring, public education and GIS mapping of key resources. While each of these efforts was also identified as a priority of the program, there is recognition at the administrative level that the program has a long way to go in order to meet the planning and technical assistance needs of local communities and the estuary. As a program manager with APNEP notes:

> The current CCMP was implemented in 1994, and since then the program has evolved in its thinking somewhat. Rather than advocating for consistency between separate land use, environmental, or other plans, we hope to provide the tools to allow local planners to seamlessly incorporate environmental information into their overall planning efforts… Despite these efforts, I think it's fair to say that we can improve our services to and relationships with local governments and the organizations that serve them.

Nearly 15 years after the completion of the first CCMP, APNEP is updating its management plan to more closely reflect current conditions and programmatic capacity. In 2002, an implementation review conducted by EPA determined inadequate progress in the implementation of the CCMP, which ultimately led to a re-evaluation of the program and those things that it will ultimately be able to achieve (Natural Resources Leadership Institute 2004). Khator (1999: 72) referred to this as the question of "where do we go from here?" which faces all NEPs. A key finding of the 2002 EPA assessment was an inadequate number of staff to accomplish tasks, and a lack of program autonomy to distinguish the program from other state agencies. This and subsequent reviews of APNEP are undoubtedly what has encouraged the development of a new CCMP, and an evolution in programmatic thinking. As noted by an APNEP planner:

> We continue to identify information gaps that we'd like to see filled, and incorporate information into commonly used tools where possible. We also plan to engage with local governments on other efforts… We have identified this as a high priority for our new plan.

Despite the attractiveness of alternative non-regulatory measures to address environmental issues, APNEP may continue to have a difficult time moving beyond its current monitoring, public education and GIS mapping contexts and into the land use realm without a mandate. As noted by a CAMA program manager, "if it's a formally state-adopted plan, then it must be recognized even if there is no requirement to formally address the policy and implementation." Without formal recognition, consensus among those interviewed indicates local contextual factors such as development pressure, local commitment, and economic conditions will prevail. This supports the literature that in the absence of planning mandates at the state or regional level that level the playing field for all communities, local governments are unlikely to adopt voluntary measures to protect the environment through voluntary collaborative process. However, barring a mandate or dramatically increased capacity, APNEP may need to partner with other organizations such as the North Carolina Coastal Federation that are actively working

with communities on their planning efforts in order to improve ecosystem plan quality. Further, APNEP could assist communities with GIS information sharing that could greatly enhance the factual basis of local plans.

8.6.2: Disaster as an Ecosystem Management Opportunity

At there very heart, all land use planning and development regulations such as zoning ordinances and building codes are inherently hazard mitigation measures (Nelson and French 2002). In addition to structural mitigation measures, Mileti (1999) notes that localities affected by natural disasters also evaluate environmental resources and hazards in an effort to become less vulnerable. It stands to reason that in Greenville, the catastrophic effects of Hurricane Floyd caused the community to re-evaluate environmental resources to foster resiliency and sustainability. There was a realization that wise land use planning that limits expansion into sensitive areas is essential to both environmental quality and hazard mitigation. While there is no overarching guidance for how to manage development in hazard-prone areas, or ecosystems as a whole, there is a hodgepodge of federal, state and regional regulations that provide guidance to local governments on how to craft effective land use regulations. After Hurricane Floyd, the state amended several of its traditional environmental regulations, and in particular those dealing with water quality and wetlands development. Interviews with local planners in Greenville indicate that updated state regulations were important in the planning process. In response to a survey question about the extent to which national, state or regional policy goals for ecosystem uses were considered, a Greenville planner responded:

> I know state policy goals were… we had just gone through Floyd and there were some policy changes at the state level that had policy impact on us as well.

Interviews with planners and participants in the planning process indicate that Floyd created a much greater understanding of the nature of Eastern North Carolina. Following the event in 1999, the City set out to update its comprehensive plan to more closely reflect the conditions on the ground and the best management practices available. Key areas for inclusion in the *Horizons* plan were limiting development in the floodplain, stormwater management, and the maintenance of water quality through preservation and restoration of riparian buffers and wetlands. A Greenville planner noted:

> Before the 2004 update we didn't really look at areas that were sensitive with hydric soils. During the update in 2004 we really made and effort to really study and understand where those areas were and to develop not only mapping but a set of policies largely in response to Floyd and some state mandates and just the community at large feeling that those were important things for us to develop policy around.

As these events occur, there is clearly the opportunity for regional, state and federal environmental managers to work closely with communities to gain a greater understating of local ecosystem conditions and implement ecosystem-based policies. Those elements of ecosystem management that Greenville was able to capture are especially notable because, unlike New Bern or Wilmington, the community does not have a planning mandate. Both environmental activists and a CAMA program manager noted that the "sweat equity" put forth by the City of Greenville to learn about ecosystem issues and address them in a local plan make them more likely to be implemented and enhanced in the future.

However, Nelson and French (2002) point out that the fiscal benefits of development may eventually outweigh the restriction of development in hazard-prone areas. The fear of lost revenue is often reinforced by the strong influence of development interests in local politics (Logan and Molotch 1987) and the ability of local governments to shift the cost of disasters to the federal government through disaster relief or insurance (Berke et al. 1996). Unfortunately Greenville is no exception to the rule. As noted by a Greenville planner:

> With all of what we have done after Floyd we have learned a very important lesson and one thing the Council did that I thought was very good was a land use plan amendment that said that we would pull high density uses out of the environmentally sensitive areas that were prone to flood… In other words we are not saying no to development just saying no to high-density development… And so that worked well for about a year until an influential developer came in and said well I have some property that is in the 100-year flood plain and I need Council to reverse their policy on that. And we had a new Council with a very strong development interest and they went in and instructed staff to remove that and just say that if you're going to be in the 100-year floodplain you can have high density but you need to have a larger freeboard and the roads and parking areas had to be one-foot above BFE. Well, that sounds good but we had a 500-year event and memories can be short and that was just within a year and Council reversed a prior Council's decision and its unfortunate that that happed because we ended up with some very large student developments in areas that had to have boats to go in and get supplies and materials to people during Floyd. So we've got most people out but then we are going back and repeating the same ills and at some point in time it is going to happen again."

A state environmental program manager and Greenville planner noted that the ability to maintain these types of policies and limitations on development patterns becomes about the commitment of the local planning staff to put forth a strong case for ecosystem protection, a governmental body willing to support such efforts, and an engaged citizenry. This is in line with Burby and May's (1998) conclusion that commitment from planning staff and local officials are key variables in influencing policy recommendations. Interviewees indicate that urban areas and locations with very high growth rates, tend to have dramatically more citizen participation in both the planning and development processes, which supports Fleischmann and Pierrannuzi's (1990) finding that there is more support for environmental protection in high growth areas. The greater commitment in urban areas also means that while these ecosystem management policies may be seem more important in urban areas that have more development, the more rural areas may suffer proportionally greater losses without a unified policy or mandated benchmarks to guide land use regulations.

8.6.3: Focusing Planning Efforts on the Fringe

The use of annexation as a key growth strategy creates an inherent conflict between encouraging low-density, sprawling development that most negatively impacts ecosystems, and effective management of these systems. Because an outward expansion of growth away from urban cores tends to occur in environmentally sensitive areas, there is a distinct need to focus planning efforts on the urban fringe and establish corridors and growth buffers before they become degraded. While the Greenville plan has strong regulations for riparian protection and limiting development in jurisdictional floodplain and wetlands areas, other planning strategies such as urban growth boundaries, targeted growth areas, and the identification of regionally significant habitats are omitted.

8.6.4: Transferring Ecosystem Management Programs to the Local Level

As outlined in the plan evaluation component of this case, the community tends to favor traditional environmental policies such as resource use restrictions, medium-specific regulations, and conservation of sensitive resources. However, at the regional and state level North Carolina possesses a wide variety of ambitious ecosystem management plans and programs. Since 1987, the state has been committed to implementing the principles of coastal ecosystem management throughout the 20 coastal communities. Beyond this, there are basinwide watershed plans and the preservation and enhancement of biodiversity through the Natural Heritage Program. While

the City recognizes watershed plans within the local planning effort, other initiatives related to species protection or biodiversity are not recognized. Ecosystem efforts at the federal level are also not well represented in local plans. This indicates that there is a disconnect between the state and local government levels that is hampering the ability of local communities to manage ecosystems.

To implement the principles of ecosystem management at the local level, there must be a more efficient transfer of ideas from state and federal levels of government to local jurisdictions. Greenville, and local jurisdictions in general, are still heavily reliant on traditional environmental regulations – which are not designed to address many of the key components of ecosystem management (e.g. biodiversity, wildlife/species-focus, incentive-based regulations, etc.). If ecosystem management is being emphasized at the state-level, then there needs to be a concerted effort to either create regulations or work with communities to draft these types of regulations. This may be where an organization such as APNEP fits into the process. For example, local jurisdictions such as Greenville could easily include the policies of the APNEP plan to ensure that regional efforts take place at the local level. As outlined by Khator (1999), the City of Sarasota, Florida was able to fulfill many of its environmental goals by adopting the Tampa Bay NEP plan in its comprehensive plan. The state, through agencies such as NC DENR, ECU and others could effectively facilitate local commitment by providing a greater degree of technical assistance or educational outreach to ensure that these programs filter down to the local level where they may have a greater impact. Unlike the City of Wilmington that has a strong relationship with UNCW, the City of Greenville does not have strong ties to ECU. When asked about the relationship between the City and the University a Greenville planner stated:

> Because we have a university community and we are often challenged as to why we are making these recommendations … you have to back it in science. We reach out to them (ECU) but I won't say that we rely upon them because they are a teaching university … they are not in the planning end a heavy research institution.

However, ECU is home to the North Carolina Center for Biodiversity (NCCB) whose central focus is to support and promote all aspects of biodiversity research and education in the state. Beyond a community's citizenry, a university setting with strong environmental department and ecosystem perspective can provide a level of education and technical assistance to the professionals who have to write and administer these types of development regulations.

Cultivating stronger ties with regional, state and federal agencies is critical to taking a local ecosystem approach, especially with things like monitoring, joint database production, intergovernmental coordination, information sharing – all elements that are essential to ecosystem management but weak or lacking in the plan.

8.7: Conclusion

Based on the results above, one can infer that the City of Greenville has effectively incorporated the principles of ecosystem management into its planning framework. This analysis presents three important findings in terms of ecosystem management and its implementation at the local level. First, these findings build upon what was seen in New Bern, giving further indication that participation in APNEP planning process did not have an impact on local ecosystem plan quality. Further, as previously mentioned there was no evident APNEP participation in the CAMA land use planning process either, thus there was little opportunity to capture ecosystem directives from the CCMP. Therefore, results from this study do not support the hypothesis that participation in a collaborative, ecosystem-based planning process positively affects the ecosystem plan quality of local plans. This is not to say that collaborative, ecosystem-based planning is necessarily ineffective, but that in this case the program itself was ineffective at working with communities to influence land use policy.

Second, and somewhat unexpectedly, the fact that the process was community-driven, and occurred after a natural disaster, was highly influential on both the plan quality and plan implementation. Interviews with local planners, program managers, and environmental advocates reveal the importance of community involvement in the process, and how this early participation in the process has created a very vocal constituency that drives plan implementation. Also surprising was the finding that many, inside and outside of the community, see the Greenville plan as the most 'implementable' because of its community-driven nature. Without a mandate, the community had to learn the nuances of the ecosystem and then devise policies to reduce vulnerability in the system and the community. However, this has certainly not been without contention, and it is recognized that it is a constant battle to maintain the environmental protections.

Third, local contextual factors were also important in determining ecosystem plan quality and implementation. In particular, development pressure and local staff commitment to ecosystem management are key factors influencing land use decision-making in the Wilmington

area. Extreme development pressure in the city, county, and entire region has encouraged land use and environmental planning in areas that never before planned for growth. Rapid development and the negative consequences of poorly planned development are critical variables influencing the creation and implementation of local plans. Further, local commitment to the process (through participation in the CAMA planning efforts), and implementation of the plan is crucial. Not only does the staff realize the need to create strong cases for environmental protection, current elected officials and environmental advocates note the importance of preserving key resources to "strike the balance" (Norton, 2005) between economy and the environment. In Chapter 9, I summarize the impact these findings and those from the other case study cities have on ecosystem planning research and their implications for planning and public policy.

9: Conclusion

9.1: Problem Statement and Hypotheses

This thesis has argued that strong local-level environmental and natural resource decision-making is essential for the long-term management of ecosystems. While ecosystem approaches tend to focus on broad spatial scales, the principles and strategies underlying these approaches must be implemented by individual jurisdictions that are often understaffed and in competition with each other for scarce resources. Local policy instruments - such as comprehensive plans and zoning ordinances - that guide the scale and pattern of physical development can be an efficient and effective framework for protecting resources and achieving sustainable ecosystem management. However, the underlying concerns of local governments regarding private property, economic development, and local autonomy often create hurdles to efforts to foster more environmentally-oriented local planning. The findings presented herein highlight the importance of state-mandates and local commitment to planning, and provides insight into how local commitment, capacity, and context play out once the planning process is complete.

The plan quality analysis presented, and subsequent conclusions, draw upon what constitutes high quality local ecosystem planning. I evaluated a plan quality model, based on Brody's (2003c; Brody 2008; Brody and Highfield 2005) methodology, against multiple samples of local jurisdictions throughout North Carolina to identify strengths and weaknesses of local plans, and the ability of various types of ecosystem-based programs to improve plan quality. To supplement the plan quality analysis and to gain a greater understanding of the degree to which these plans are implemented, I evaluated three individual North Carolina communities. The case study research relied on a wide variety of data and methods including U.S. Census data, government documents, historical data collection (e.g. newspaper articles, public meeting minutes), and telephone interviews. All of this empirical data is meant to provide a clear picture of how well local jurisdictions in North Carolina are, alone and collectively, managing ecosystems over the long-term.

For the most part, findings from this thesis indicate that existing planning frameworks and development management processes are not effectively incorporating the principles of ecosystem management. While there is a strong interest in ecosystem management at the state

and federal levels, this commitment has not entirely filtered down to the local level, or local jurisdictions have not been able to translate the principles of ecosystem management into sustainable action items. However, there are several factors that appear to influence the overall ecosystem plan quality, which are related to the hypotheses detailed in Chapter 4. The extent to which the observed results match the predicted results provides the method for assessing the validity of my theoretical propositions.

My first hypothesis proposed that participation in collaborative ecosystem planning as a voluntary action will improve the ecosystem plan quality of local land use plans. In particular, I looked at communities that participated in the APNEP CCMP planning process and/or the influence that APNEP program managers had on local planning processes. Based solely on the overall plan quality scores for communities within the APNEP jurisdiction, it might be inferred that this was the case. However, a closer examination of the case study communities and interviews with APNEP program managers indicate that participation in APNEP planning process had very little impact on local ecosystem plan quality. Therefore, evidence presented does not support the idea that participation in a collaborative, ecosystem-based planning process positively affects the ecosystem plan quality of local plans. This is not to say that collaborative, ecosystem-based planning is necessarily ineffective, but that in this case the program itself was ineffective at working with communities to influence land use policy.

My second hypothesis proposed that ecosystem planning as a state mandate will be more effective than collaborative efforts at improving ecosystem plan quality of local land use plans. These findings indicate that state mandates are effective at advancing regional environmental goals and encouraging planning in places where it may not otherwise happen. Plans created by communities under a mandate were of noticeably higher quality, and were best at capturing traditional environmental/land use policy directives. However, while these plans generally acknowledge the need for regional resource protection, locally mandated plans are rarely go beyond stating support for State minimum resource protection rules and generally rely heavily on state and federal government agencies to implement regional environmental objectives. Further, even the highest quality CAMA plans failed to include many of the broad concepts and strategies that are key to effective ecosystem management (e.g. biodiversity, habitat connectivity, trans-boundary resource protection). Implementation mechanisms that would give planning recommendations greater influence were also noticeably absent.

Finally, my third hypothesis posited that higher levels of ecosystem plan quality lead to increased plan implementation. The findings presented herein provide mixed results. In this context, all but a few of the local contextual factors expected to affect substantive planning and implementation outcomes appear to have been important in North Carolina communities as expected, although some did not operate as anticipated, and there was at least two unexpected factors. Aside from the exceptions, factors that appear to have driven higher ecosystem plan quality and improved plan implementation include extreme development pressure within the community, commitment of local officials to plan development and implementation, and the belief that the economy was strong. Factors that appear to have shifted the focus of local plans away from ecosystem plan quality and implementation include the desire of local officials to maintain autonomy and local reliance on state and federal agencies to address regional environmental issues. Somewhat unexpectedly, whether the process was locally-driven or consultant-driven played a major role in both plan quality and implementation. Results herein indicate that the use of a consultant to conduct the planning process both results in a plan that is of higher quality, but also one that has less community-support, and thus is less likely to be implemented. This finding indicates that plan quality may have little bearing on implementation if the local community is not committed to the planning process or overarching goals. Also unexpectedly, results indicate that a natural disaster may also act as a catalyst for higher plan quality and implementation. In essence all land use planning is essentially hazard mitigation planning. However, results indicate that after a natural disaster, the community is more engaged and willing to accept new ways of thinking and development patterns. The advent of disaster recovery and/or hazard mitigation planning may provide a unique opportunity to shift local land use focus toward and ecosystem approach.

9.2: Significance

These findings suggest several different ways to address my final research question: *how can plans, planning processes, and ecosystem management programs be improved to better accomplish ecosystem management?* From a plan quality perspective, the findings suggest that there are a number of ways that local plans can be improved to more effectively manage ecosystems. First, in order to address the issues of the system, the plan must provide a detailed account of resources and human impacts. Across the board, the factual basis component was one of the weakest portions of the plan. While some elements, such as soils, surface water features,

and wetlands are almost always identified – others key ecosystem management components such as biodiversity, species identification, and habitat fragmentation are almost always missing. This will most certainly require an inter-organizational approach, complete with intergovernmental information sharing and the provision of technical assistance across program areas. Second, in order to achieve more effective ecosystem management, there needs to be more clarity in planning directives. While the goals and objectives components of the plans studied tend to be the strongest element, vague statements and few measurable targets make implementation difficult. Findings reveal the inclusion of ambiguous goals and objectives as a deliberate effort to maintain local autonomy for land use decision-making, especially in mandated planning jurisdictions. However, ambiguity does little to provide clear guidance for implementation of ecosystem management strategies. Third, as planning efforts are generally proficient at including traditional environmental policies (e.g. Section 404 regulations, etc.), other incentive-based tools, acquisition programs, and educational efforts are often missing. While traditional regulations play an important role in ecosystem management, it is the combination of various regulatory and non-regulatory tools and policies that is required effective ecosystem management.

In terms of program design, the findings here suggest a number of obstacles, including local resistance to regional planning directives and a lack of program capacity, can hinder sustainable ecosystem management through local planning efforts. With regard to planning mandates, local resistance to regional growth management, particularly in areas of slower growth, can hinder plan development and implementation. This may be especially true in terms of sustaining regional natural resources. However, theoretical and empirical work on development management suggests that this approach may be the most promising – relative to significantly more or less coercive designs – for improving growth management outcomes (Burby and May 1997). Practically-speaking, increased state-level regulations of land use to address threats in the coastal zone would likely require substantial expansion of the AECs, something planning documents and local officials have opposed even more vehemently than mandated planning (Norton 2005b). Perhaps the largest hurdle is the waning support for government mandates that threatens the long-term success of these programs. While local resistance is well documented, underfunding or elimination of funding at the state-level for local planning assistance means that only those communities truly committed to coastal planning will update CAMA plans. While this may prove beneficial to overall plan quality, it also suggests that

local planning will decline in many communities. Further, local environmental advocates indicate diminishing support for CAMA efforts because of a poor track record in protecting environmental resources and the vagueness of planning efforts.

If substantial increases in direct state regulation of land use appear unlikely, and if local land use planning has proven not to adequately protect ecosystems under CAMA, what might be done to improve the effectiveness of the program rather than abandon it? The findings presented here suggest a number of ways to do so, including relatively straightforward efforts such as facilitating and providing technical support for locally-driven processes rather than maintaining the current consultant-driven model. Another effective effort may be to provide technical assistance with creating consistency between local and regional plans, particularly with regard to elements in the factual basis component that provide the foundation for all goals, objectives and implementation strategies. Key to effective coastal planning, especially in the face of less local planning, is for the state to develop a comprehensive coastal strategy. While CAMA has increased planning efforts in the coastal zone, much of this planning has been piecemeal in focus and geographically fragmented. There is little guidance from the state on large-scale conservation strategies or comprehensive ecological networks. With or without local CAMA community assistance, it is through a comprehensive approach to the coastal ecosystem that smaller actions of conservation and mitigation can add up to meaningful ecosystem management (Beatley 2000). Less straightforward and more challenging, North Carolina's experience also suggests the need for local jurisdictions to consider more rigorously the long-term implications of land use decisions and more effectively address the potential environmental threats resulting from those decisions, rather than simply relying on state and federal government agencies to provide adequate environmental protection. Given the uncertain state of CAMA today, future research should most certainly focus on the evolution of state-mandated planning in North Carolina, as disinvestment and erosion of support for mandates during economic downturns may be seen in other states as well.

Recent trends in environmental policy have been toward more inclusive, participatory efforts that involve multiple stakeholders in natural resource management. This study set out to examine the degree to which collaborative planning impacts local land use policy. Based on the findings of this study, and previous theoretical and empirical work, I suggest that the answer to this question appears to depend in large part on context and the capacity of the program. Across

the cases and communities studied, the policy influence of APNEP perceived by key informants and present in local plans was nil. From the perspective of influencing local land use policy, this may be seen as a failed collaborative effort. Rather than being adaptive, programmatic planning efforts are outdated, and a lack of capacity and direction meant that program managers did not participate in local planning efforts. Rather, improved plan quality scores were indicative of local contextual factors (e.g. natural disaster, development pressure and/or planning commitment) impacting plan quality scores. It is important to note that APNEP is currently working to incorporate planning assistance and improved citizen engagement in an updated CCMP, and the goal is to include more realistic goals for policy influence. While this study measured policy-change as the sole indicator of success, collaborative environmental management scholars stress a variety of outcomes on which to evaluate collaborative efforts (Innes and Booher 1999a; Innes and Gruber 2005; Koontz 2005; Wondolleck and Yaffee 2000). From a discourse perspective, collaborative processes are seen as promoting helpful communication among citizens. From a practical perspective, collaborative efforts are seen as playing an important role in building capacity to address land use issues in the future. While participation in the APNEP planning process did not appear to impact local land use policy, future research may look at these other outcomes so that regional ecosystem planning efforts may be seen in a more positive light.

From a conceptual perspective, the implementation of ecosystem management and sustainable development at any scale will require a paradigm shift. Ecosystem management is founded on the principle of ecological sustainability, presuming land use will occur but proposing the preservation or enhancement of ecosystem integrity as a key component in development decisions. Achieving this end goal requires a fundamental restructuring of both natural resource management and land use planning and development (Beatley 2000; Brody 2003b; Montgomery et al. 1995). Findings indicate that communities are able to capture many important aspects of ecosystem management, but biodiversity conservation has been largely overlooked. Biodiversity conservation in the U.S. has largely been driven by the federal Endangered Species Act (ESA) (Beatley 2000). However, the species-by-species approach taken by the ESA is not well equipped to deal with larger ecosystem-scaled issues of species richness and biodiversity. Therefore, large-scale ecological conservation strategies will need to be developed, including the delineation of comprehensive ecological networks and structures. This type of undertaking and shift in resource conservation would be unparalleled since the federal

updates to Section 404/401 of the Clean Water Act in the 1980s and 90s. Surely the political battles associated with broader, large-scale conservation strategies will be difficult, particularly during an economic downturn. But this problem certainly merits some discussion about the best way to convince the public of the need for a comprehensive biodiversity strategy and the long-term costs associated with inaction. While ecosystem management has historically been a federally-driven process with little federal direction, it is only through a broader approach than the small actions of conservation and mitigation may add up to anything ecologically meaningful.

9.3: Limitations and Further Research

In conducting the various components of this study, there are limitations that should be noted. First, the sample size of the study was too small to study for significance. While the overall plan quality scores for the 20 communities and 21 plans examined provide important information and insight into how each of the programs and local contextual factors influence plan development and implementation, the sample size was too small to test for statistical significance. Therefore, the overall impact of each of these programs is still open to debate and presents another opportunity for future research.

Second, although this study offers a deeper understanding of both collaborative and mandated ecosystem planning, it largely neglects the social and political process of collaboration and intergovernmental decision-making in favor of looking at the end result. An anticipated critique therefore is that the approach is overly deterministic. The goal of the research, however, was to address variation in local land use plans based on participation in an ecosystem planning effort. The nature of the problem demands a comparative approach; this in turn brings data limitations. Further, the study's findings add to calls by Norton (2005) and Talen (1996) for greater attention to urban political structure as it relates to plan implementation. This shortcoming matters because changes in political tenure and citizen involvement can have substantial effects on local plan implementation and the development priorities of communities. This study's focus on land use policy and implementation, and the methodological approach taken offers a way of linking such efforts together. Further, the methodology – if used in a time-series fashion – may be used to trace changes in both political process and potentially link them to changes in land use policy.

Third, it was only after the study was well underway that I realized how little effect APNEP would have on local land use policy. As previously mentioned, this may be seen as a failed collaborative effort. Rather than being adaptive, APNEP's planning directives were outdated, and a lack of capacity and direction meant that program managers did not participate in local planning efforts. However, a limitation in this study is measuring policy-change as the sole indicator of success, while collaborative environmental management literature stresses a variety of outcomes on which to evaluate collaborative efforts. From a discourse perspective, collaborative processes are seen as promoting helpful communication among citizens. From a practical perspective, collaborative efforts are seen as playing an important role in building capacity to address land use issues in the future. While participation in the APNEP planning process did not appear to impact local land use policy, future research may look at these other outcomes so that this and other regional ecosystem planning efforts may be seen in a more positive light. Further, APNEP, a program generally seen by many as a very successful collaborative effort, may have benefit from its own case study to understand the evolution, successes, and failures of the program.

Findings of this study indicate several avenues for future investigation. Important to further studies of commitment and plan implementation are making the connection between land use plans and implementation. Based on the findings of this and similar studies, researchers may need to strengthen the connection between ecosystem plan quality and plan implementation through examination of legally-binding policies such as local zoning ordinances, subdivision regulations and floodplain management ordinances to see if ecosystem management is effectively being implemented. Given the reluctance of local communities to relinquish local autonomy to state mandates, researchers may also find it useful to measure other implementation indicators such as issuance of permits and land cover change as an indicator of plan implementation. Other important avenues for research include investigation of the differences between consultant-driven and locally-driven planning processes, and the effect of each on local plan quality. Beyond this, additional research is needed to investigate the relationship between the process and implementation to better understand the dynamics of privatization on local commitment to planning. Finally, to more fully understand the opportunities for local communities to adopt an ecosystem management perspective, additional research is needed that examines the links between hazard mitigation, disaster recovery, and ecosystem management.

While much research has been geared toward defining the concept and strategies for instituting the broad principles of ecosystem management, comparatively little research has been done to evaluate specific tools and strategies involved in ecosystem management. This thesis built on both of these bodies of work to make a contribution to the ecosystem management and land use planning literature by identifying trends in plan quality for jurisdictions participating in both collaborative and coercive ecosystem planning efforts, and gaining a greater understanding of the implementation of these policies by local governments. Broadly, this work has focused on local implementation of regional environmental programming, and thus has a large audience. This research and the empirical information therein be useful to the following: federal agencies (particularly those implementing/assessing National Estuary Programs); state and regional resource managers; local resource and development managers, and; academics and students of the environmental management and planning disciplines.

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Appendix A: Plan Coding Protocol

	Factual Basis			
	Resource Inventory			
#		Not Identified	Mapped *or* Catalogued	Mapped *and* Catalogued
1	Ecosystem boundaries/edges	0	1	2
2	Ecological zones/habitat types	0	1	2
3	Ecological functions	0	1	2
4	Species ranges	0	1	2
5	Habitat corridors	0	1	2
6	Distribution of species	0	1	2
7	Areas with high biodiversity/species richness	0	1	2
8	Vegetation classified	0	1	2
9	Wildlife classified	0	1	2
10	Vegetation cover mapped	0	1	2
11	Threatened/endangered species	0	1	2
12	Invasive/exotic species	0	1	2
13	Indicator/keystone species	0	1	2
14	Soils classified	0	1	2
15	Climate described	0	1	2
16	Wetlands mapped	0	1	2
17	Surface hydrology	0	1	2
18	Marine resources	0	1	2
19	Graphic representation of trans-boundary resources	0	1	2
20	Other predominant landscapes	0	1	2
21	Other water resources	0	1	2
	Ownership Patterns			
22	Conservation lands mapped	0	1	2
23	Management status identified for conservation lands	0	1	2
24	Network of conservation lands mapped	0	1	2

	Ownership Patterns			
#		Not Identified	Mapped *or* Catalogued	Mapped *and* Catalogued
25	Distribution of species within network of conservation lands	0	1	2
	Human Impacts			
26	Population growth	0	1	2
27	Road density	0	1	2
28	Fragmentation of habitat	0	1	2
29	Wetlands development	0	1	2
30	Nutrient loading	0	1	2
31	Water pollution	0	1	2
32	Loss of fisheries/marine habitat	0	1	2
33	Alteration of waterways	0	1	2
34	Value of biodiversity identified	0	1	2
35	Existing environmental regulations described	0	1	2
36	Carrying capacity measured	0	1	2
37	Incorporation of Gap Analysis data	0	1	2
38	Other factors/impacts	0	1	2
	Goals and Objectives			
		Not Identified	Suggested but not detailed	Fully detailed or mandatory
39	Protect integrity of ecosystem	0	1	2
40	Protect natural processes/functions	0	1	2
41	Protect high biodiversity	0	1	2
42	Maintain intact patches of native species	0	1	2
43	Establish priorities for native species/habitat protection	0	1	2
44	Protect rare/unique landscape elements	0	1	2
45	Protect rare/endangered species	0	1	2

#		Not Identified	Suggested but not detailed	Fully detailed or mandatory
	Goals and Objectives			
46	Maintain connection among wildlife habitats	0	1	2
47	Represent native species within protected areas	0	1	2
48	Maintain intergenerational sustainability of ecosystems	0	1	2
49	Balance human use with maintaining viable wildlife populations	0	1	2
50	Restore ecosystems/critical habitat	0	1	2
51	Other goals to protect ecosystem	0	1	2
52	Goals are clearly specified	0	1	2
53	Presence of measurable objectives	0	1	2
	Inter-organizational Coordination & Capabilities for Ecosystem Management			
54	Other organizations/stakeholders identified	0	1	2
55	Coordination with other organizations/jurisdictions specified	0	1	2
56	Coordination within jurisdiction specified	0	1	2
57	Intergovernmental bodies specified	0	1	2
58	Joint database production	0	1	2
59	Coordination with private sector	0	1	2
60	Information sharing	0	1	2
61	Links between science and policy specified	0	1	2
62	Position of jurisdiction within bioregion specified	0	1	2
63	Intergovernmental agreements	0	1	2
64	Conflict management processes	0	1	2
65	Commitment of financial resources	0	1	2
66	Integration with other plans/principles	0	1	2
67	Other forms of coordination	0	1	2

	Policies, Tools & Strategies			
	Regulatory Tools			
		Not Identified	Suggested but not detailed	Fully detailed or mandatory
68	Resource use restrictions	0	1	2
69	Density restrictions	0	1	2
70	Restrictions on native vegetation removal	0	1	2
71	Removal of exotic/invasive species	0	1	2
72	Buffer requirements	0	1	2
73	Fencing controls	0	1	2
74	Public or vehicular access restrictions	0	1	2
75	Phasing of development	0	1	2
76	Controls on construction	0	1	2
77	Conservation zones/overlay districts	0	1	2
78	Performance zoning	0	1	2
79	Subdivision standards	0	1	2
80	Protected areas/sanctuaries	0	1	2
81	Urban growth boundaries to exclude habitat	0	1	2
82	Targeted growth away from habitat	0	1	2
83	Capital improvements programming	0	1	2
84	Site plan review	0	1	2
85	Habitat restoration actions	0	1	2
86	Actions to protect resources in other jurisdictions	0	1	2
87	Other regulatory tools	0	1	2
	Incentive-based Tools			
88	Density bonuses	0	1	2
89	Clustering away from habitats	0	1	2
90	Transfer of development rights	0	1	2

Policies, Tools and Strategies				
Incentive-based Tools				
#		Not Identified	Suggested but not detailed	Fully detailed or mandatory
91	Preferred tax treatments	0	1	2
92	Mitigation banking	0	1	2
93	Other incentive-based tools	0	1	2
Land Acquisition Programs				
94	Fee simple purchase	0	1	2
95	Conservation easements	0	1	2
96	Other land acquisition techniques	0	1	2
Other Policies				
97	Designation of special taxing districts for acquisition funds	0	1	2
98	Control of public investment and projects	0	1	2
99	Public education programs	0	1	2
100	Monitoring of ecological health and human impacts	0	1	2
Implementation				
101	Designation of responsibility	0	1	2
102	Provision of technical assistance	0	1	2
103	Identification of costs or funding	0	1	2
104	Provisions of sanctions	0	1	2
105	Clear timetable for implementation	0	1	2
106	Regular plan updates and assessments	0	1	2
107	Enforcement specified	0	1	2
108	Monitoring for plan effectiveness and response to new information	0	1	2

Appendix B: Wilmington *Choices* Detailed Plan Quality Scores

Table 6.xxx. Issue-based scores for the factual basis plan component		
Indicator	Score	Result
Resource Inventory		
Vegetation cover	1	Mapped *or* Catalogued
Surface hydrology	1	Mapped *or* Catalogued
Ecosystem boundaries/edge	0	Not Identified
Ecological zones/habitat types	0	Not Identified
Ecological functions	0	Not Identified
Distribution of species	0	Not Identified
Wildlife classified	0	Not Identified
Soils classified	0	Not Identified
Marine resources	0	Not Identified
Graphic representation of trans-boundary resources	0	Not Identified
Other water resources	0	Not Identified
Wetlands mapped	0	Not Identified
Habitat corridors	0	Not Identified
Areas with high biodiversity/species richness	0	Not Identified
Invasive/exotic species	0	Not Identified
Threatened/endangered species	0	Not Identified
Indicator/keystone species	0	Not Identified
Climate described	0	Not Identified
Other predominant landscapes	0	Not Identified
Ownership Patterns		
Conservation lands mapped	0	Not Identified
Management status identified for conservation lands	0	Not Identified
Network of conservation lands mapped	0	Not Identified
Distribution of species within network of conservation lands	0	Not Identified
Human Impacts		
Road density	2	Mapped & Catalogued
Population growth	1	Mapped *or* Catalogued
Nutrient loading	1	Mapped *or* Catalogued
Water pollution	1	Mapped *or* Catalogued
Existing environmental regulations described	1	Mapped *or* Catalogued
Other factors/impacts	1	Mapped *or* Catalogued
Loss of fisheries/marine habitat	0	Not Identified
Carrying capacity measured	0	Not Identified
Wetlands development	0	Not Identified
Fragmentation of habitat	0	Not Identified
Alteration of waterways	0	Not Identified
Value of biodiversity identified	0	Not Identified
Incorporation of Gap Analysis data	0	Not Identified

Table 6.xxx. Issue-based scores for the goals and objectives plan component		
Indicator	Score	Result
Protect integrity of ecosystem	1	Suggested but not detailed
Protect rare/unique landscape elements	1	Suggested but not detailed
Balance human use with maintaining viable wildlife populations	1	Suggested but not detailed
Restore ecosystems/critical habitat	1	Suggested but not detailed
Other goals to protect ecosystem	1	Suggested but not detailed
Presence of measurable objectives	0	Not Identified
Goals are clearly specified	0	Not Identified
Protect natural processes/functions	0	Not Identified
Maintain intact patches of native species	0	Not Identified
Establish priorities for native species/habitat protection	0	Not Identified
Maintain intergenerational sustainability of ecosystems	0	Not Identified
Maintain connection among wildlife habitats	0	Not Identified
Protect high biodiversity	0	Not Identified
Protect rare/endangered species	0	Not Identified
Represent native species within protected areas	0	Not Identified

Table 6.xxx. Issue-based scores for inter-organizational coordination and capabilities plan component		
Indicator	Score	Result
Joint database production	1	Suggested but not detailed
Position of jurisdiction within bioregion specified	1	Suggested but not detailed
Integration with other plans/principles	1	Suggested but not detailed
Other forms of coordination	1	Suggested but not detailed
Other organizations/stakeholders identified	0	Not Identified
Coordination with other organizations/jurisdictions specified	0	Not Identified
Coordination within jurisdiction specified	0	Not Identified
Intergovernmental bodies specified	0	Not Identified
Coordination with private sector	0	Not Identified
Information sharing	0	Not Identified
Links between science and policy specified	0	Not Identified
Intergovernmental agreements	0	Not Identified
Commitment of financial resources	0	Not Identified
Conflict management processes	0	Not Identified
	0	Not Identified

Table 5.5 Issue-based scores for the policies, tools and strategies plan component		
Indicator	Score	Result
Regulatory Tools		
Restrictions on native vegetation removal	2	Fully Detailed or Mandatory
Subdivision standards	2	Fully Detailed or Mandatory
Site plan review	2	Fully Detailed or Mandatory
Density restrictions	1	Suggested but not detailed
Buffer requirements	1	Suggested but not detailed
Controls on construction	1	Suggested but not detailed
Conservation zones/overlay districts	1	Suggested but not detailed
Protected areas/sanctuaries	1	Suggested but not detailed
Habitat restoration actions	1	Suggested but not detailed
Resource use restrictions	1	Suggested but not detailed
Targeted growth away from habitat	0	Not Identified
Capital improvements programming	0	Not Identified
Public or vehicular access restrictions	0	Not Identified
Performance zoning	0	Not Identified
Urban growth boundaries to exclude habitats	0	Not Identified
Actions to protect resources in other jurisdictions	0	Not Identified
Removal of exotic/invasive species	0	Not Identified
Fencing controls	0	Not Identified
Phasing of development	0	Not Identified
Other regulatory tools	0	Not Identified
Incentive-based Tools		
Preferred tax treatments	2	Fully Detailed or Mandatory
Density bonuses	1	Suggested but not detailed
Clustering away from habitats	1	Suggested but not detailed
Mitigation banking	1	Suggested but not detailed
Transfer of development rights	0	Not Identified
Other incentive-based tools	0	Not Identified
Land Acquisition Programs		
Fee simple purchase	1	Suggested but not detailed
Conservation easements	1	Suggested but not detailed
Other land acquisition techniques	1	Suggested but not detailed
Other Policies		
Public education programs	2	Fully Detailed or Mandatory
Monitoring of ecological health and human Impacts	1	Suggested but not detailed
Control of public investment and projects	0	Not Identified
Designation of special taxing districts for acquisition funds	0	Not Identified

Table 6.xxx: Issue-based scores for the implementation plan component		
Indicator	Score	Result
Provision of technical assistance	1	Suggested but not detailed
Designation of responsibility	0	Not Identified
Clear timetable for implementation	0	Not Identified
Regular plan updates and assessments	0	Not Identified
Enforcement specified	0	Not Identified
Monitoring for plan effectiveness and response to new information	0	Not Identified
Identification of costs or funding	0	Suggested but not detailed
Provisions of sanctions	0	Not Identified

Appendix C: Telephone Survey Instrument

I. Introduction:

Hello, my name is Traci Birch and I am calling from the University of New Orleans. I am a PhD candidate at UNO and I am conducting a survey about land use and environmental planning in select communities in the State of North Carolina.

II. Refusal Clause:

We've selected your community for inclusion in this study based on several factors, including inclusion in the NC CAMA, Albemarle-Pamlico National Estuary Program, or both.

III. Basic Respondent/Community Characteristics:

Q1: Title

Could you please tell me what your job title is?

1. Mayor
2. Elected Official
3. Planning Director
4. Planning Staff
5. Other (specify)

(I would like to know the perspective from which you are answering the questions. If you are not comfortable giving me your title, you are free not to do so)

Q2: Consent

Before I begin I need to tell you about the study and get your consent. After I read this information, you can tell me if you would like to proceed.

I am conducting a study about ecosystem management and the ability of local communities to implement ecosystem plans at the local level through land use planning. In this survey, you will be asked a maximum of 32 questions, which will take approximately 25 minute to complete (depending on answers given). Results from this survey will be included in my dissertation, and will ultimately help local and regional officials to create more sustainable plans and implementation strategies with regard to ecosystem services.

Your participation is voluntary and you may stop the interview at any time or choose not to answer any question that makes you feel uncomfortable. Your responses will not be linked to your telephone number, your name or your job title. All information will be kept strictly confidential. If you have any questions concerning your rights as a research subject or concerns regarding research-related injury you may contact Dr. Ann O'Hanlon at University of New Orleans Office of Human Subjects Research at 504-280-3990. If you have any questions about this study you may also contact me at 504-669-7737 or Dr. Marla Nelson at 504-280-3110.

Anyone who completes the interview may receive a summary of the report in order to see how other communities compare to yours.

Q3: Duration

How many years have you been in your current position? How many years have you worked for the community?

(Again this helps me understand the perspective from which you are answering the questions. If you are not comfortable giving me this information, you are free not to do so)

Q4: Master Plan Development

In what capacity did you participate in the most recent comprehensive/CAMA planning process?

(If the answer to Q4 is "not at all" or similar, skip Section IV. Comprehensive Plan Creation and start questions in Section V. CAMA/APNEP Utilization)

Q5: Involvement (open-ended question)

In what capacity do you participate in daily planning and/or development decisions in the community?

(My next set of questions are about your most recent comprehensive planning process and the inclusion of ecosystem management principles into the comprehensive plan.)

IV. Comprehensive Plan Creation

Q6: Sustainability Considerations

In a general sense, to what extent do you think broad social, economic and ecological issues regarding ecosystems were taken into account when creating the comprehensive plan?

Q7: Broad Policy Considerations

To what extent do you think broad ecosystem policies have been defined in your comprehensive plan?

Q8: Intergovernmental Policy Considerations

To what extent do you think national, State or regional policy goals for ecosystem uses were considered when creating the comprehensive plan?

Q9: Ecosystem Principle Prioritization

I am going to read you a list of different factors related to ecosystem management. On a scale of 0 to 10, what is the priority of each of these factors in the Comprehensive Plan?

(Please respond where 0 indicates NO PRIORITY, 10 indicates the HIGHEST PRIORITY, and 5 indicates a MODERATE LEVEL OF PRIORITY for the factor.)

1. ECOSYSTEM OR WATERSHED BOUNDARIES
2. ECOLOGICAL FUNCTIONS
3. PROTECTION OF ENVIRONMENTAL QUALITY

   (Help: By this I mean the protection of specific mediums such as surface water, air or drinking water)
4. BIODIVERSTY
5. SPECIES/HABITAT PROTECTION
6. THREATENED OR ENDANGERED SPECIES PROTECTION
7. CONSERVATION LANDS

   (Help: By this I mean the protection of rare or unique landscapes through conservation, either by purchase or easement)
8. HUMAN IMPACTS
9. FRAGMENTATION OF HABITAT
10. LOSS OF FISHERIES/MARINE HABITAT
11. TRANSBOUNDARY ENVIRONMENTAL RESOURCES
12. COORDINATION WITH NEIGHBORING JURISDICTIONS
13. SUSTAINABILITY
14. Other
15. Don't know
16. Refused

Q10: Ecosystem-based Plan Considerations

To what extent do you think ecosystem-based management plans were taken in to account when creating the plan?

(Help: Ecosystem-based management plans that may have influenced your community's comprehensive plan include the Albemarle-Pamlico National Estuary Program Comprehensive Conservation and Management Plan, previous or neighboring jurisdiction's CAMA land use plans, NC Ecosystem Enhancement Watershed Plans, NC Areas of Environmental Concern (AEC), or the like)

Q11: Best Practices

In your opinion, were conservation and management measures included in the comprehensive plan based on the best scientific evidence available?

Q12: Collaborative Planning

During the planning process, to what extent did your community work with the appropriate regional or State agencies to guarantee coordination between regional policy goals for ecosystem uses and local land use policies?

Q13: Intergovernmental Policy Considerations

Are the geographical data sets for regional and/or State ecosystem use policies/goals available in a GIS format for consideration when making development decisions?

Q14: Collaborative Planning

Were attempts made to identify and engage environmental groups and other stakeholders with an interest in managing ecosystem resources?

Q15: Collaborative Planning

Was the presence of vocal environmental protection advocates an influence in the planning process? What about a highly engaged citizenry?

Q16: Sustainability

In your opinion, were management measures in effect designed to ensure the long-term sustainability of environmental resources?

(My next set of questions relates to your community's CAMA land use plan, the extent to which the CAMA plan is used to make land use decisions, and how the CAMA plan works with other land use regulations adopted by the community)

V. CAMA/APNEP Plan Utilization:

Q16: CAMA Coordination with Other Regulations

Once adopted, was the CAMA plan used to update zoning, subdivision regulations, capital improvements plans or other land use regulations?

Q18: CAMA Plan Use

To what extent do you think the CAMA plan is used to make individual development decisions?

Q19: CAMA Plan Emphasis

What would you say is your local official's plan policy emphasis? Economic and community development or environmental protection?

Q20: Environmental Emphasis

Do you feel that local officials and/or staff are willing to go beyond the State minimum environmental protection requirements, including outside of NC Areas of Environmental Concern (AEC) that could substantially degrade the AEC?

Q21: Development Considerations

I am going to read you a list of different factors related to ecosystem management. On a scale of 0 to 10, what is the priority of each of these factors in site-specific decision-making?

Please respond where 0 indicates NO PRIORITY, 10 indicates the HIGHEST PRIORITY, and 5 indicates a MODERATE LEVEL OF PRIORITY for the factor.

1. ECOSYSTEM OR WATERSHED HEALTH
2. ECOLOGICAL FUNCTIONS
3. PROTECTION OF ENVIRONMENTAL QUALITY

   (Help: By this I mean the protection of specific mediums such as surface water, air or drinking water)
4. BIODIVERSTY
5. SPECIES/HABITAT PROTECTION
6. THREATENED OR ENDANGERED SPECIES PROTECTION
7. CONSERVATION LANDS

   (Help: By this I mean the protection of rare or unique landscapes through conservation, either by purchase or easement)
8. CUMULATIVE EFFECT OF HUMAN IMPACTS
9. FRAGMENTATION OF HABITAT
10. LOSS OF FISHERIES/MARINE HABITAT
11. TRANSBOUNDARY ENVIRONMENTAL RESOURCES
12. COORDINATION WITH NEIGHBORING JURISDICTIONS
13. SUSTAINABILITY
14. Other
15. Don’t know
16. Refused

Q21: Environmental Activism

Has the presence of vocal environmental protection advocates influenced the development process? What about a highly engaged citizenry?

Q22: Environmental Critique

Respond to critiques or explanations heard from environmental groups on development decisions (Miles & Huberman, 1994)

Q23: Consultation with Other Jurisdictions

Have efforts been made to cooperate with adjacent jurisdictions in facilitating the sustainable use of:

1. Coastal or ecosystem resources?
2. Conservation of the environment?

Q24: Consultation with Other Jurisdictions

In the case of activities that may have adverse effect on adjacent jurisdictions, do authorities provide timely information and if possible prior notification?

Q25: Consultation with Other Jurisdictions

Do authorities consult with adjacent jurisdictions in order to improve coastal area or ecosystem management?

(My next set of questions relates to your community's commitment to land use planning generally, and environmental planning in particular.)

VI. Community Planning Commitment/Capacity:

Q26: General Planning Commitment

In your words, what is the local "commitment" to planning in general?

(HELP: In this case, commitment refers to the willingness to support planning goals as outlined in either the land use plan or the CAMA plan.)

Q27: Official Planning Commitment

In a general sense, to what extent do you think the majority of your local elected officials are committed to the idea that land use planning is an appropriate and desirable function of local government?

Specifically, how would you characterize their commitment to land use planning generally on a scale of 0 to 10, where 0 indicates no commitment at all to planning, and 10 indicates a strong level of commitment, and 5 indicates a moderate level of commitment.

Q28: Staff Planning Commitment

In a general sense, what is the administrative staff commitment to planning?

Q29: Staff Planning Capacity?

In a general sense, what is the administrative staff capacity?

(HELP: By this we mean various measures: 1) How many planners are on staff; 2) in your opinion is there enough staff to cope with the work load; 3) does the staff have the right skills; 4) who processes development requests)

Q30: Environmental Planning Commitment

In your words, what is the local "commitment" to planning for the environment?

(HELP: In this case commitment refers to the willingness to support planning goals as outlined in either the land use plan or the CAMA plan as they relate to ecosystems, water quality, watersheds and/or estuaries)

Q31: Environmental Planning Commitment

In a general sense, to what extent do you think the majority of your local elected officials are committed to the idea that land use planning is an appropriate and desirable function of local government?

Specifically, how would you characterize their commitment to land use planning generally on a scale of 0 to 10, where 0 indicates no commitment at all to planning, and 10 indicates a strong level of commitment, and 5 indicates a moderate level of commitment.

Q32: Environmental Responsibility

In your opinion, do you think that environmental protection seen as a luxury or a necessity? How about as somebody else's problem (i.e. our community is not causing the water quality problems, they are 'upstream')?

VII. Closing Remarks

Q33: Close

This is the end of the survey, would you like to receive a transcript of this session or an executive summary of the full survey results upon completion?

1. Yes
2. No

Q34: Comment

Would you like to provide any comments or suggestions either on this survey or on the topic that may help my research?

1. Yes
2. No

That is the end of the survey, thank you again for participating in the study.

Vita

Traci Birch was born in Berea, Ohio on April 19, 1972, the daughter of Susan Mattison Birch and James Ernest Birch. After completing her degree at Berea High School in 1990, she entered Baldwin-Wallace College, also in Berea, and received the degree of Bachelor of Arts in May 1995. She entered graduate school in the College Of Urban and Public Affairs at the University of New Orleans in August of 2001, receiving a Master's in Urban and Regional Planning degree in May of 2003. Since 2003, Traci has worked as a practicing land use and environmental planner, participating in numerous land use planning, community development, and disaster recovery efforts in Southern Louisiana. Following the completion of her Master's degree, Traci was awarded the Crescent City Doctoral Fellowship from the University of New Orleans in August 2003, and entered the Urban Studies Doctoral program. While in the Doctoral program, she has worked as an Assistant Instructor, Teaching Assistant, and Graduate Research Assistant. Traci is a certified planner with the American Institute of Certified Planners, and is a member of the American Planning Association.