

**Central Coastal Plain
Capacity Use Investigation
Report**

North Carolina
Department of Environment and Natural Resources
Division of Water Resources

November 1998

Central Coastal Plain Capacity Use Investigation Report

Summary of Findings and Recommendations

There is increasing evidence of present and future ground water overdrafts and potential water supply shortages and damage to aquifers within the following fifteen North Carolina counties: Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne and Wilson (see Figure 1). Within these counties ground water from the Black Creek and Upper Cape Fear aquifers is being withdrawn at a rate that exceeds the available recharge. This overdraft of ground water and potential damage to the economy has led the North Carolina Division of Water Resources to recommend creating a capacity use area under the 1967 Water Use Act. A capacity use area would regulate water use through permitting to avoid damage to the ground water resources and to maintain the yield of those sources of water indefinitely.

Demands for water exceed the safe yields of the Black Creek and Upper Cape Fear aquifers such that other sources of water must be brought on line by water supply systems. Surface water, other aquifers, and improved water management methods will be used to meet this deficit. The availability of surface water sources in these counties is affected by water quality issues. Therefore, this capacity use area is proposed to include regulation of both surface and ground water withdrawals. The high-yielding Castle Hayne aquifer is available in the eastern portion of the affected area. The proposed capacity use area includes these counties to promote controlled development of alternative supplies. Because of the geographical area encompassed by this proposed Central Coastal Plain Capacity Use Area, the existing Capacity Use Area No. 1 declaration and rule should be repealed when this proposed rule becomes effective.

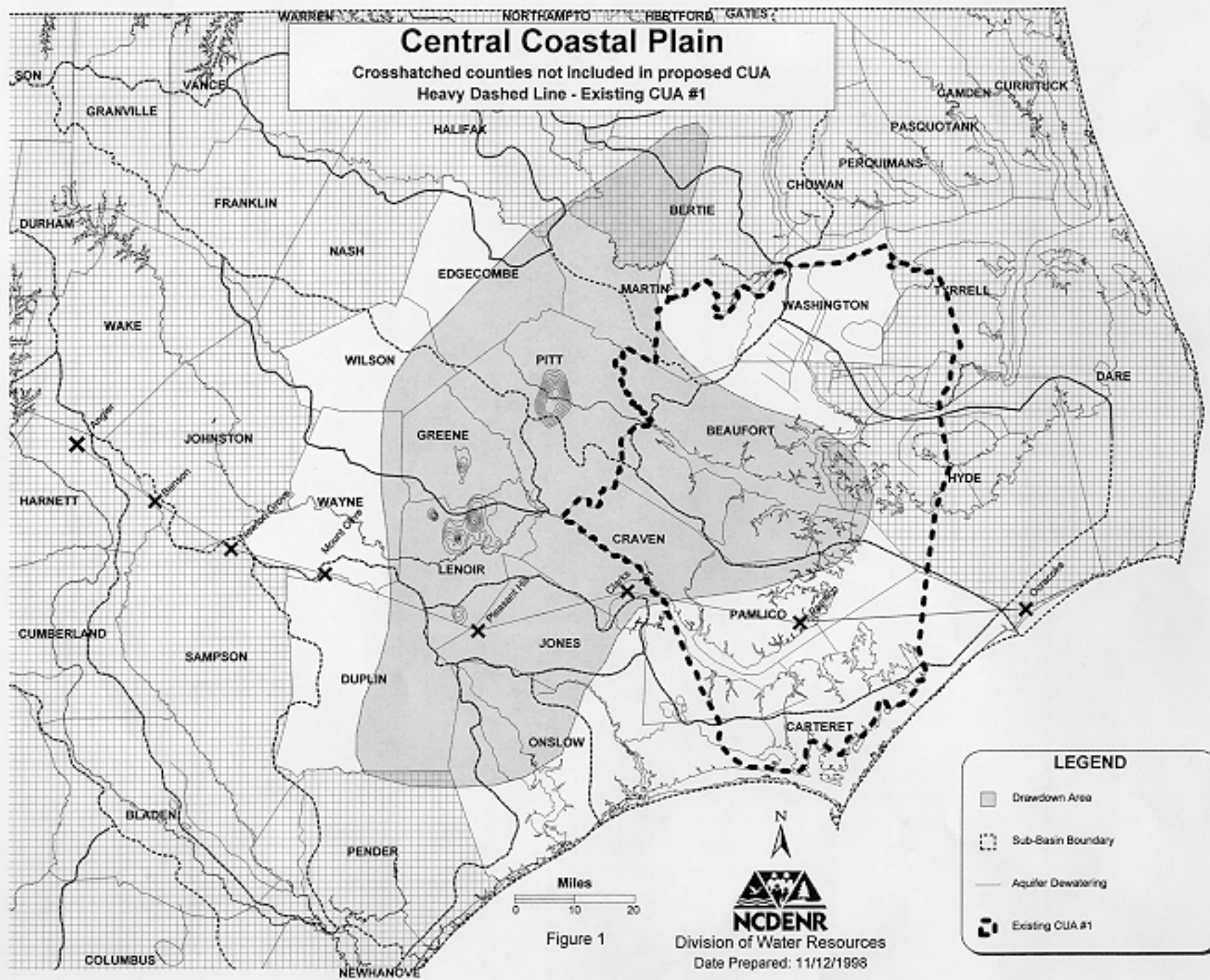
The Division's reasons for recommending the Central Coastal Plain Capacity Use Area fall under the following headings:

1. Water level drawdowns. Water level drawdown trends range up to eight feet per year.
2. Dewatering. Dewatering is occurring in several of these counties; water levels have been drawn down below the top of the aquifer by as much as 150 feet.
3. Current and projected water use. Current and projected water use indicates a growing deficit in water supply.
4. Alternate water sources. Alternate water supply sources include surface water and the Castle Hayne aquifer.

To address the water supply issues described above the Division of Water Resources recommends that the Ground Water Committee send the Central Coastal Plain Capacity Use Area issue to the Environmental Management Commission in February 1999 and take the following action:

Direct the Division of Water Resources to proceed with the capacity use area rule making process. This includes rules to:

1. declare and delineate the Central Coastal Plain Capacity Use Area as the area encompassed by the following 15 North Carolina counties: Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne and Wilson; and
2. set procedures to be applied to that area.



Central Coastal Plain

Crosshatched counties not included in proposed CUA
Heavy Dashed Line - Existing CUA #1

LEGEND

- Drawdown Area
- Sub-Basin Boundary
- Aquifer Dewatering
- Existing CUA #1

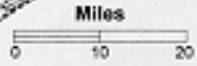


Figure 1
 Division of Water Resources
 Date Prepared: 11/12/1998

Central Coastal Plain Capacity Use Investigation Report

I. Introduction

Ground water is the predominant source of water for communities and self-supplied users in the coastal plain of North Carolina. Ground water in many parts of this area can be used for domestic uses with minimal treatment. The availability of high quality water means water can be supplied relatively cheaply compared to other sources. Data maintained by the Division of Water Resources indicate that water levels in the Black Creek and Upper Cape Fear aquifers have been declining since the late 1960s. The Division has anecdotal information from the 1920s that water freely flowed from artesian wells at the time they were constructed. This change, from free-flowing wells to water levels as much as 195 feet below land surface, indicates that current withdrawals of water from these aquifers exceed the available supply that can be used on a sustainable basis. Growth in demand and the physical limits of the hydrogeologic system have resulted in the present situation. The Water Use Act mandates action to protect the long range usefulness of water resources in conditions such as now present in the Central Coastal Plain.

The Water Use Act of 1967 allows for the Environmental Management Commission to “declare and delineate from time to time, and may modify, capacity use areas of the State where it finds that the use of groundwater or surface water or both require coordination and limited regulation for protection of the interests and rights of residents or property owners of such areas or of the public interest.” The Act further states that a capacity use area “is one where the Commission finds that the aggregate uses of groundwater or surface water, or both, in or affecting said area (i) have developed or threatened to develop to a degree which requires coordination and regulation, or (ii) exceed or threaten to exceed, or otherwise threaten or impair, the renewal or replenishment of such waters or any part of them.”

The documented declines in water levels indicate a clear impairment to “renewal or replenishment” of the waters of the Black Creek and Upper Cape Fear aquifers. The most threatened portions of the Black Creek and Upper Cape Fear aquifers lie beneath the following North Carolina counties: Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pitt, Wayne and Wilson. The Division recommends that water withdrawals be regulated in these counties. In addition, because of the complex nature of the aquifer systems in this region, the Division recommends regulating withdrawals in Beaufort, Carteret, Pamlico, and Washington Counties also to prevent damage to the aquifers underlying these counties as alternative sources are developed.

The Division’s recommendation is based on the following concerns:

- a. Water level drawdowns. Monitoring wells specifically designed to track water levels in the Black Creek and Upper Cape Fear aquifers show water level drawdown trends ranging from declines of one to eight feet per year. These monitoring wells are distributed throughout an 8000 square mile portion of the coastal plain.
- b. Dewatering. The term dewatering describes the process where water levels are drawn down below the top of an aquifer. Dewatering is known to cause irreparable harm to the aquifer’s ability to yield water. Among other problems, as water is drained from the pore spaces in the aquifer the pores can collapse, reducing the space available to hold water. Water levels from water supply systems in several of these counties show drawdowns below the top of the aquifer by as much as 150 feet.
- c. Current and projected water use. Current and projected water use reported through the

Local Water Supply Planning process {G.S. 143-355(l) & (m)} plus water use by other users have been compared to the estimated safe yield from the Black Creek and Upper Cape Fear aquifers. Projections through the year 2020 indicate a growing deficit in water supply. It is clear that other sources of water must be developed to make up this deficit.

- d. Alternate water sources. Alternative sources of water in this area need more extensive treatment to meet drinking water standards. The location and nature of alternate water supply sources for this region of North Carolina, including surface water and the Castle Hayne aquifer, make solutions to this problem more complex and extend the area affected by the problem. These other sources of water are limited due to water quality concerns in the lower Neuse River basin and Pamlico River basin and lack of access to the Castle Hayne aquifer for many of the affected water systems.

Section II of this document contains descriptions of the water resources affected in this problem area and how the scope of the problem has been determined. Section III includes discussion of the alternative solutions to the problem. Section IV contains conceptual rules for the Central Coastal Plain Capacity Use Area, and Section V examines the economic impact of these proposed rules. The appendices are maps and tables for reference.

II. Water Resources Affected

The Black Creek and Upper Cape Fear confined aquifers of the Central Coastal Plain are the primary concern in this proposed capacity use area. These aquifers are composed of many distinct layers of sand and other porous material that stretch across large portions of the North Carolina coastal plain.

In this central coastal plain area, the individual sand layers are hydraulically connected so they behave as regional aquifers. As a result, pumping at one site affects water levels tens of miles away. A vertical slice

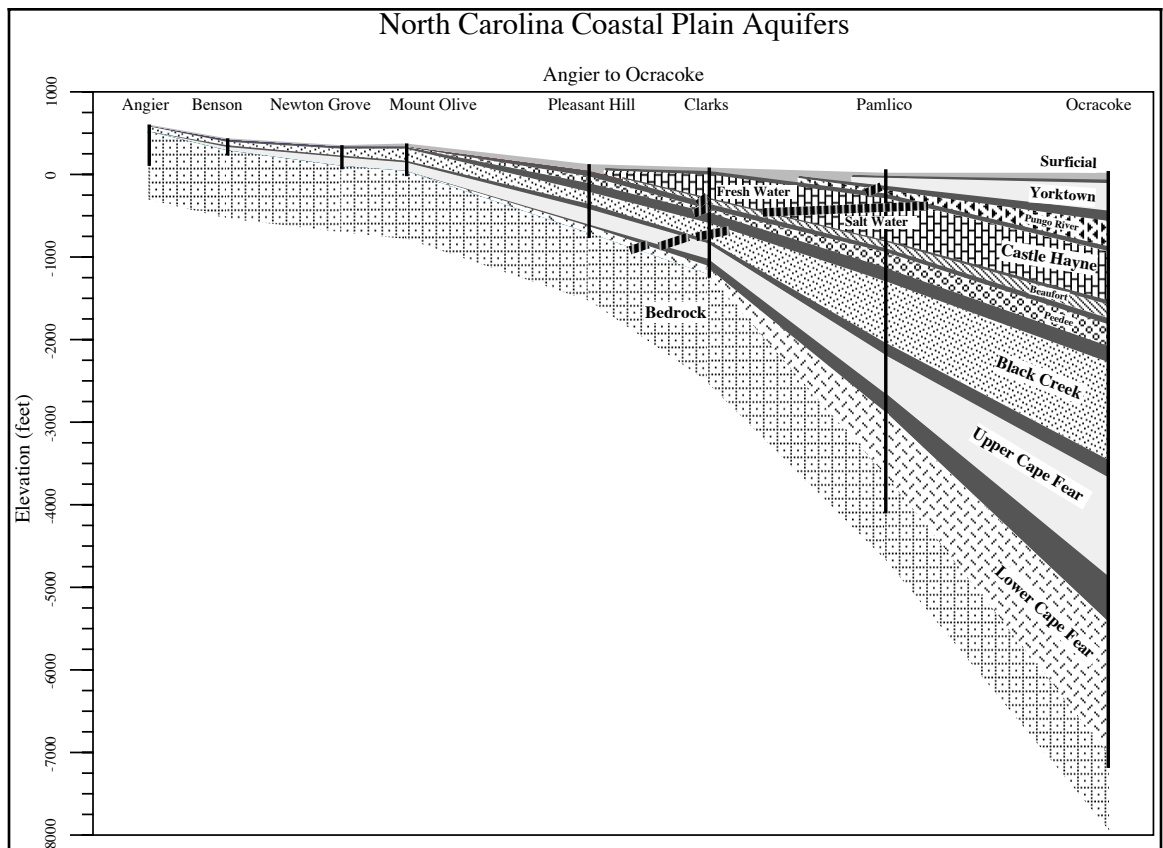


Figure 2. Hydrogeological cross-section of the Central Coastal Plain

through the sedimentary sequence in the central coastal plain reveals many sets of alternating layers of sands and clays that form aquifers and confining units. Confining units inhibit but do not completely prevent the flow of water between the more permeable aquifers. Figure 2 illustrates a simplified cross-section of this hydrogeologic system along a line from Angier to Ocracoke. Generally, the sedimentary layers thicken and more aquifers and confining units are present toward the east. The Castle Hayne aquifer only exists in the eastern portion of this cross-section, east of Pleasant Hill. The encroachment of salt water limits the availability of fresh water from the aquifers in different places along westward dipping boundaries. As fresh water is withdrawn faster than it is replenished, salt water moves further inland, filling the space formally occupied by fresh water.

Combining this cross-section with the map views of these aquifers, information presented in Figure 1 & 2 and Appendices A-C, allows one to understand the three-dimensional nature of this hydrogeologic system. The multi-dimensional, conceptual model of these aquifers and confining units is known as the hydrogeological framework. As is shown on the cross-section, the deeper confined aquifers receive recharge from the surface and surficial aquifer primarily along their western boundaries where they merge with the surficial aquifer (to the west of the area where they are used for water supply). Zones of surficial recharge are land surface areas where infiltration of rainfall can move into the deeper confined aquifers. The deeper confined aquifers also receive recharge through leakage across their confining units. Zones of leakage recharge are estimated by comparing water levels in different aquifers shown in Appendices A-C. The total recharge to the Black Creek and Upper Cape Fear aquifers is determined by estimating the areas of surficial recharge and extent of leakage recharge. If aquifers recharge and discharge at the same rates, they are said to be in equilibrium and water levels remain stable. Currently the discharge, including pumping, from the Black Creek and Upper Cape Fear aquifers exceeds the recharge as evidenced by the declining water levels -- they are out of equilibrium. Therefore, ground water in these aquifers is being used in an unsustainable way.

Water Level Drawdowns

As stated in the introduction, water level declines measured using monitoring wells screened in these aquifers have been tracked since the late 1960s. Data from 13 Upper Cape Fear aquifer wells, 21 Black Creek aquifer wells, and 20 Peedee aquifer wells document both the decline of water levels over time and the breadth of the drawdown area (see Figure 1 and Appendices A-C). Figures 3, 4, and 5 are examples of hydrographs from wells depicted in Appendices B & C. These hydrographs are typical of those used to gauge the extent and rates of drawdown. Water levels dramatically decrease over time with little fluctuation in these examples. These types of curves show the highly confined nature of the aquifers. The lack of seasonal change in water levels indicates that these aquifers do not experience increased recharge in winter months as is typical of a shallower aquifer. The variations in Figure 5 are due to nearby pumping in the Kinston water system.

Declines in water levels impact all aquifer users. Well yields decrease as water levels decline, requiring them to lower well pump intakes or drill new wells to maintain existing withdrawals. Also, aquifer material is compacted as water levels decline, permanently reducing storage capacity. The declines affect all users, even though individual users may be taking action to limit their own rate of withdrawal. The observed declines are the cumulative effect of all withdrawals from the

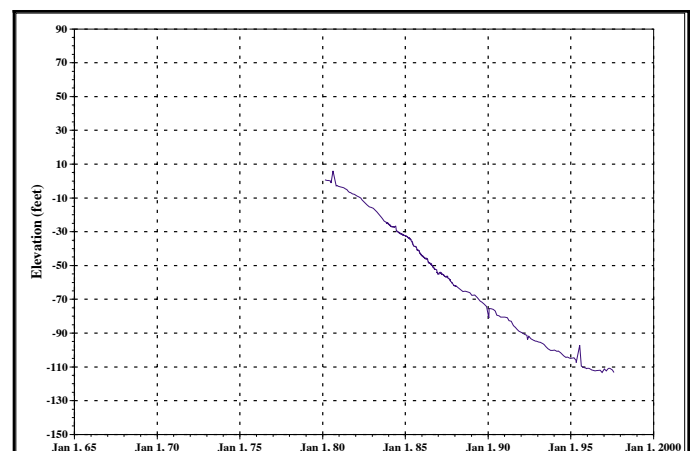


Figure 3. Hydrograph of Black Creek aquifer well near Comfort, NC.

Black Creek and Upper Cape Fear aquifers in this area. The regional extent of the declines in water levels can not be attributed to any one or a few large ground water user(s). In appendix E, 1992 public water suppliers are listed to illustrate the number of known withdrawal points and the degree to which water use is distributed. This contrasts with Castle Hayne aquifer ground water users in Capacity Use Area No. 1, as listed in appendix F.

It is useful to describe typical water supply situations in the Central Coastal Plain. Richlands is a small town situated between Jacksonville and Kinston in northwestern Onslow County. Another example is Kinston, located in the heart of Lenoir County. It is one of the larger water systems and is completely surrounded by other systems.

Richlands is supplied with water from the Black Creek aquifer from two wells. The town has withdrawn water at a rate that has remained stable since 1980 -- about 200,000 gallons per day. Yet, water levels in these wells have declined at seven to eight feet per year from 1980 to the present. These water level declines are caused by regional demand on the aquifer. Hydrologic characteristics of the Black Creek aquifer indicate the aquifer should be able to meet Richlands water supply needs if the regional drawdown of the aquifer were not occurring. Recently, the Town lowered one pump intake by about 20 feet to extend the life of that well by two or three years. Richlands has the option of purchasing water from Onslow County or continuing the expensive upkeep on their wells and inevitable construction of new wells (at an estimated \$200,000 to \$300,000 per new well) if the town decides to maintain its own sources of water.

Kinston's water supply comes from over 20 wells screened in the Black Creek and Upper Cape Fear aquifers to supply about five million gallons per day. The number of wells has increased since the 1920s, but more dramatically in the last ten years. Kinston has replaced wells that no longer yield enough water and separated these new wells from existing wells by as much distance as possible. Even wells just a few years old now yield 50 percent less water than when originally constructed, caused by the regional decline in ground water pressure. Kinston is surrounded by other water system wells from neighboring communities and left with little space to expand. The City currently has plans to construct a surface water intake on the Neuse River to compensate for their loss in capacity from existing ground water sources and to meet demands from projected growth in water use. In the meantime additional well construction will be required to meet current demands. There is no requirement that individual communities coordinate plans with other neighboring users of the same aquifers as they compete to meet demand.

Dewatering

As noted above, aquifer dewatering results from reducing water levels below the top of an

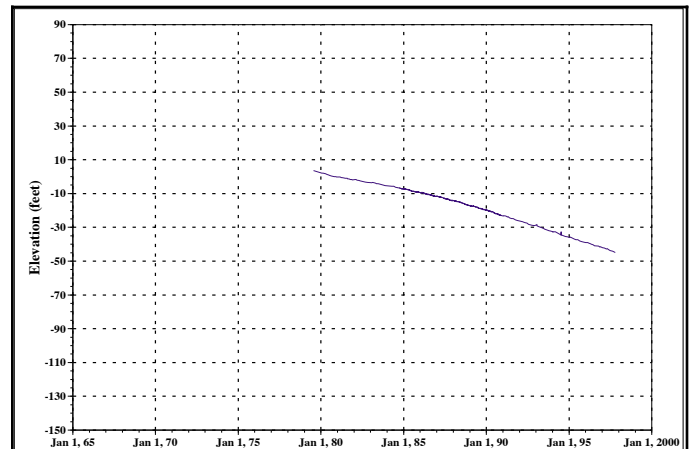


Figure 4. Hydrograph of Black Creek aquifer well near Clarks, NC.



Figure 5. Hydrograph of Upper Cape Fear aquifer well near Kinston, NC.

aquifer. When water level data from the monitoring wells are combined with pumping water levels taken from water system wells and the hydrogeological framework, areas of aquifer dewatering can be delineated (see Figure 1). The contours of the dewatered areas on the map show up to 150 feet of water level decline below the top of the aquifer. As shown on the map, dewatering is occurring in Greene, Lenoir and Pitt counties. Dewatering is known to cause irreparable damage to the structure of the aquifer by inducing compaction and reducing the capacity of the aquifer to store water. Dewatering also reduces the yield of wells and slows the rate of recharge to the aquifers by introducing air into the pore spaces of the aquifer.

The dewatered areas shown in Figure 1 represent the minimum amount of dewatering occurring at this time, as many of the water users have not or could not report water level information to the Division. Staff feel that these areas will double or triple in size within ten years if the historical rate of drawdown continues into the future. This projected damage to a valuable resource can be avoided by effective resource management.

Current and Projected Water Use

Demand for ground water in the proposed capacity use area has increased without interruption for the past seven decades. According to Local Water Supply Plans, population and water demands for industry and agriculture will continue to increase. The primary purpose of the proposed capacity use area is to assure that withdrawals to meet this demand do not exceed the safe yield of the ground water system. Figure 6 illustrates this growing deficit in water supply. It is extremely difficult to know precisely how much water is available from these aquifers.

However, using an generous estimate of 56,000 gallons per day per square mile¹ for the recharge rate to the Black Creek and Upper Cape Fear aquifers, demand for that ground water began to exceed the sustainable supply of 90 million gallons per day in 1992. Estimated recharge areas of 1,100 and 500 square miles were assigned to the Black Creek and Upper Cape Fear aquifers, respectively. This deficit must be met with other water sources to avoid further damage to these aquifers.

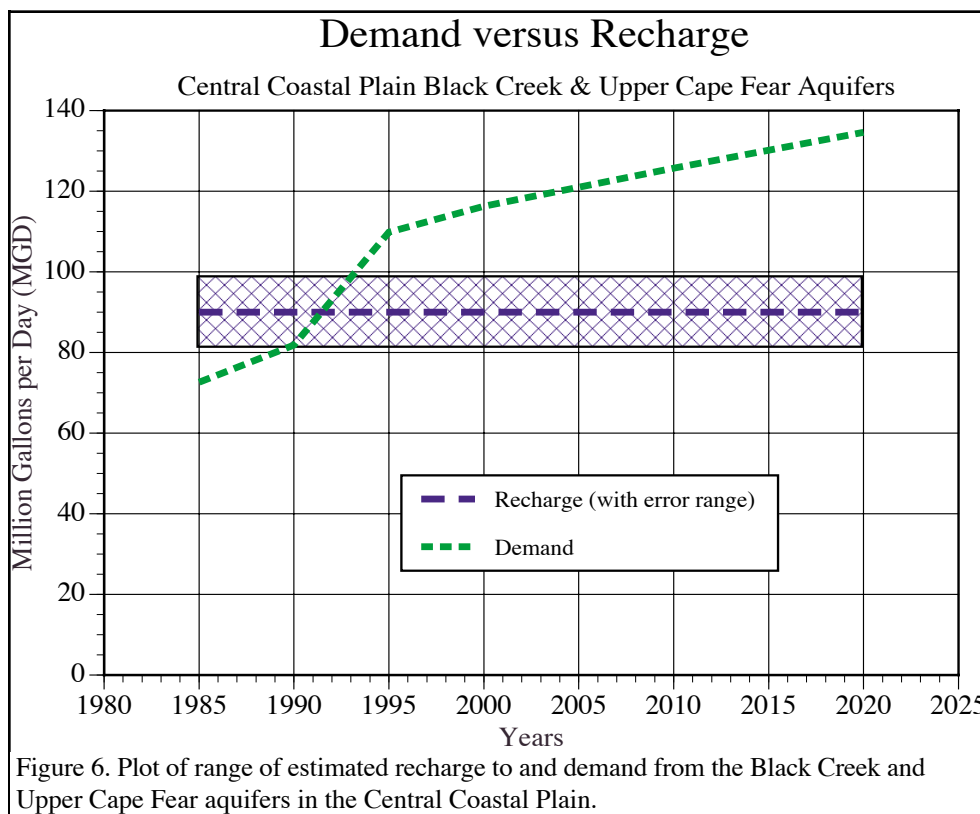


Figure 6. Plot of range of estimated recharge to and demand from the Black Creek and Upper Cape Fear aquifers in the Central Coastal Plain.

¹ Robison, T.M. and Mann Jr., L.T., 1977, Public Water Supplies of North Carolina, Part 5 Southern Coastal Plain, US Geological Survey and the NC Department of Natural Resources and Community Development, 333 p.

Alternate Water Sources

Currently, ground water supplies are of primary concern in the area proposed for the Central Coastal Plain Capacity Use Area. As ground water withdrawals from the Black Creek and Upper Cape Fear aquifers reach capacity, increased use of surface water and of other aquifers is sure to occur. Providing water to citizens is a local government and private issue and there is no requirement that neighboring communities coordinate water supply plans. The Division, therefore, recommends that surface water use also be regulated in this proposed capacity use area. Existing water quality problems in the Neuse and Pamlico Estuaries will make it important to analyze the effects of increased surface water use in these river basins. Capacity use area designation provides a crucial regulatory tool for protecting these water bodies. The eastern portion of the proposed Central Coastal Plain Capacity Use Area would most likely tap the Castle Hayne aquifer to meet current and future needs. It is important that this aquifer is also not stressed beyond its limits. The Division hopes to avoid over-pumping the other sources of water in the region.

Establishment of the Central Coastal Plain Capacity Use Area and public recognition of the deteriorating water supply will encourage cooperation among the many users in the region. All water users will be made aware of the seriousness of the issue at the same time instead of waiting for their individual wells to fail. The current condition is the result of the sum total of a set of uncoordinated individual users' decisions. Coordinated planning provides the opportunity to develop regional water supply options that meet demands and protect the sustainability of the regions' water resources.

III. Alternatives Including Regulation of Water Use

There is only one real choice for water resource management in the affected area although other alternatives exist:

1. **Do Nothing:** The Commission could choose not to intervene. Users would generally remain unaware of water supply problems looming in their near future and would not be able to adequately plan for shortfalls in supply. Water supply development will continue as a series of individual decisions by individual water users. Systems with readily available alternative sources of water will take advantage of those sources as the Black Creek and Upper Cape Fear aquifers fail to provide enough water. Water levels will continue to decline and water supplies will be permanently reduced.
2. **Actively Encourage Conservation:** Any effort to accomplish the same tasks using less water is worthwhile. However, the Division estimates that even with aggressive water conservation programs, realistic rates of water savings decrease water use by ten percent. Changes in local water use policies and water rates could help manage the demand for water and should be considered by all systems. Even with a ten percent savings factored into the demand curve in Figure 6, the Central Coastal Plain still remains in a water deficit situation.
3. **Voluntary Capacity Use Area:** Over fifteen years of technical assistance to and communication with the water systems in the Central Coastal Plain have failed to bring about substantive voluntary water restrictions or coordination. Efforts toward this end began with a cooperative agreement between the USGS, the Division, and 14 Central Coastal Plain local governments in 1980s to study the aquifers and model their use. Other Division attempts to deal with the Central Coastal Plain since that agreement are described in Appendix D. Although technical assistance continues, there is little hope of convincing water users to voluntarily work together and adopt better water use policy. A recent study by the North Carolina League of Municipalities and the North

Carolina Association of County Commissioners² identified desire for local control and apprehension about regionalism as major impediments to “effective local intergovernmental cooperation in the provision of water and sewer services.” These factors encourage inefficient development of water resources as communities compete with each other for water and invest in projects designed to maximize local gains regardless of effects on the resource. Given the historical experience of the Division and the clear recognition of local officials as to the impediments to cooperation it is unlikely significant changes can be expected prior to the point where aquifer damage has affected widespread areas of the Central Coastal Plain.

4. **Capacity Use Area Designation:** The Division recommends that the Commission authorize the associated rulemaking to designate the Central Coastal Plain Capacity Use Area. This option will institute a regulatory mechanism that encourages cooperation between users and helps users plan for future sources of water, including implementation of water conservation measures. These regulations would also preserve the Black Creek and Upper Cape Fear aquifers so they can be used as a dependable water source.

Whether regulation of the areas is implemented or not, other sources of drinking water will be required to meet existing and future demands. There is simply no way these aquifers can support the current demand, much less an increase in water use. The present use of the resource has been dictated by each entity seeking to obtain water at minimal current costs for extraction, treatment and delivery. Development of other ground or surface water sources combined with demand management and water conservation methods are absolutely necessary to rectify the current situation. Without regulation, individual users will continue to minimize short term costs, resulting in damage to the resource and large capital costs in the future. Establishing a capacity use area throughout the Central Coastal Plain will allow the Division to protect the resource and promote development of new sources of water at reasonable costs that are equitably distributed.

² Gregory, Lyman J., 1996, Water and Sewer Policy Survey Results, North Carolina League of Municipalities and the North Carolina Association of County Commissioners, 29 p.

IV. Conceptual Central Coastal Plain Capacity Use Area Rule

- **Declaration and delineation of Central Coastal Plain Capacity Use Area**

The Environmental Management Commission on _____, declared and delineated all the area encompassed by the following 15 North Carolina counties as the Central Coastal Plain Capacity Use Area: Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne and Wilson.

- **General permitting requirements**

- No person shall, after _____, (as designated by the Commission) withdraw, obtain or utilize surface waters or ground waters, or both, in excess of 100,000 gallons per day for any purpose unless such person shall first obtain a water use permit from the Director.
- Water usage and water level reports will be required.
- There shall not be increases in water usage beyond a maximum permitted level or addition of wells or surface water intakes without prior approval.
- Construction of monitoring stations may be required.
- Where permitted withdrawals will be less than the amount requested, the following factors will be considered in determining the amount of the permitted withdrawal: availability of alternate supply; costs; other permitting requirements; practicability; conservation measures that have been implemented or proposed by the applicant; the proposed use of the water, and the benefits to be provided by that use.
- Guidelines for resource protection will be a part of the Central Coastal Plain Strategic Management Plan which will be written at intervals not exceeding 10 years. The resource protection requirements specified in the Strategic Management Plan shall extend to all water users in the Central Coastal Plain Capacity Use Area including those not required to secure a permit, but will not be extended to individual domestic withdrawals. The Strategic Management Plan shall include delineations and descriptions of regions within Central Coastal Plain Capacity Use Area where problems associated with ground or surface water use are occurring and the resource protection requirements to mitigate those problems.
- An annual status report for the Central Coastal Plain Capacity Use Area will be prepared.

- **Specific criteria used for permitting ground water use**

- Withdrawal rates will not be permitted that have or will likely cause adverse impacts on the resource. Adverse impacts include, but are not limited to: dewatering of aquifers; encroachment of salt water; and land subsidence or sinkhole development.
- Maximum well withdrawal rates and total use limits will be determined using available methods of hydrogeologic analysis, including, but not limited to, computer ground water flow modeling.
- Maximum allowable drawdown levels will be determined based on the Division's

hydrogeological framework for the Central Coastal Plain.

- Withdrawals of water that cause lower quality water to displace higher quality water such that the available uses of the resource are impacted will not be permitted.
- **Specific criteria used for permitting surface water use**
 - Surface water withdrawal permits will specify limits that maintain instream flows downstream of the intake.
 - The cumulative impact of surface water withdrawals shall not result in a violation of the statewide antidegradation policy.

V. Economic Analysis of Proposed Rule

Regulated Community

The regulated community includes public and private water systems, self-supplied industry, agriculture, and other major withdrawers in the proposed 15-county area. Currently, withdrawals in Beaufort, Pamlico, Washington, and portions of Carteret, Craven and Martin counties are subject to similar permitting requirements under Capacity Use Area No. 1. The additional economic impact would be minor for this area, such as new reporting requirements. Withdrawals in the remaining area (Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pitt, Wayne, Wilson, and portions of Carteret, Craven, and Martin counties) are currently unregulated. For that area, the proposed rule will have a significant economic impact.

Water users in the Central Coastal Plain have traditionally relied on the Black Creek and Upper Cape Fear aquifers. The high quality water from these aquifers requires minimal treatment to meet drinking water standards. Consequently, this resource has been pumped at a rate exceeding its natural recharge rate. The Division estimates that current use exceeds the sustainable yield by 26 MGD. Without regulation, this deficit could exceed 45 MGD by 2020. To alleviate demand on the Black Creek and Upper Cape Fear aquifers, regulated parties would be required to invest in alternate water supplies.

Alternate water sources include surface water, shallower wells, aquifer storage and recovery (ASR), and conservation. All of these options with the exception of conservation are more costly than the Black Creek and Upper Cape Fear aquifers due to higher treatment costs. Table 1 below compares the average cost of different alternatives. The choice of alternatives would be highly dependent on site-specific costs and environmental considerations. A likely distribution of sources is shown in the right-hand column of Table 1.

Table 1. Cost of Water Supply Alternatives

Supply Alternative	Capital Cost (\$/MGD)	Operating Cost (\$/000 Gal)	Distribution of Future Sources
Baseline (BC/UCF)	\$300,000	\$0.40	N/A
Surface Water	\$2,250,000	\$0.73	0.60
Shallow Aquifers	\$2,500,000	\$0.73	0.20
ASR*	\$400,000	\$15,000/MGD/YR	0.10
Conservation	minimal	Unknown	0.10

* Due to seasonal operation, ASR operating costs are best represented as an annual cost per MGD peaking capacity.

Based on unit cost estimates, capital expenditures would range between \$40 and \$75 million, spread over the next 20 years. Operating costs would also be higher, costing an additional \$2 million per year by 2000 and \$4.5 million per year by 2020. Additional costs to withdrawers would include preparation of permit applications and monthly withdrawal reports. These costs, though, are minor compared with overall operating costs. In some cases, the Division could require a permit holder to establish additional monitoring stations.

Higher long-term costs will be incurred without regulation. Absent regulation, withdrawers will continue to exploit the cheap high quality water in the Black Creek and Upper Cape Fear aquifers. As water levels drop, pumping costs will increase while, at the same time, yields will decline. Many water systems are already struggling to keep wells online. Withdrawers

will eventually have no choice but to develop new sources to meet existing demands, often as an emergency response to a failing well system.

Continued over-pumping leads to an even more serious problem: compaction of the aquifer structure and permanent loss of water storage. Loss of storage jeopardizes the Black Creek and Upper Cape Fear aquifers as a sustainable peaking source by reducing the available short-term yield. Replacing this storage with surface water storage would be extremely costly from both an economic and ecological standpoint.

A secondary impact of unregulated water use is reduced economic growth. New industry is unlikely to locate in the Central Coastal Plain unless dependable water supplies are available. Without regulation, the safe yield of water supplies will be in question as users compete for the same sources.

In contrast to an unregulated scenario, the proposed rule offers a coordinated approach to managing existing and future water supplies. Costs associated with deliberately planned water supply development are lower than emergency responses to unplanned water shortages. The proposed rule also encourages regional solutions that offer improved economies of scale.

Agency Costs

Designation of a Central Coastal Plain capacity use area will primarily affect the Division of Water Resources. Compared with the existing capacity use program, the proposed rule will substantially increase the number of permit reviews, inspections, enforcement and other associated tasks. See Table 2 and Table 3. A major ongoing task would be development of an aquifer framework model to assist permit decision-making. A new requirement under the proposed rule is completion of a strategic management plan every 5 to 10 years. Plan preparation would be of a scope similar to the Neuse River Basinwide Water Quality Management Plan. The plan would require at least one staff-year to complete.

Table 2. Staffing Requirements of Current Capacity Use Program

Position	Full-time Equivalent					
	Regulatory Development	Monitoring & Recordkeeping	Permitting	Inspection & Enforcement	Modeling	Total
Hydrologist	0.15	0.20	0.50	0.10	0.20	1.15
Hydro Tech		0.10				0.10
Office Asst.		0.25	0.10			0.35
Total	0.15	0.55	0.60	0.10	0.20	1.60

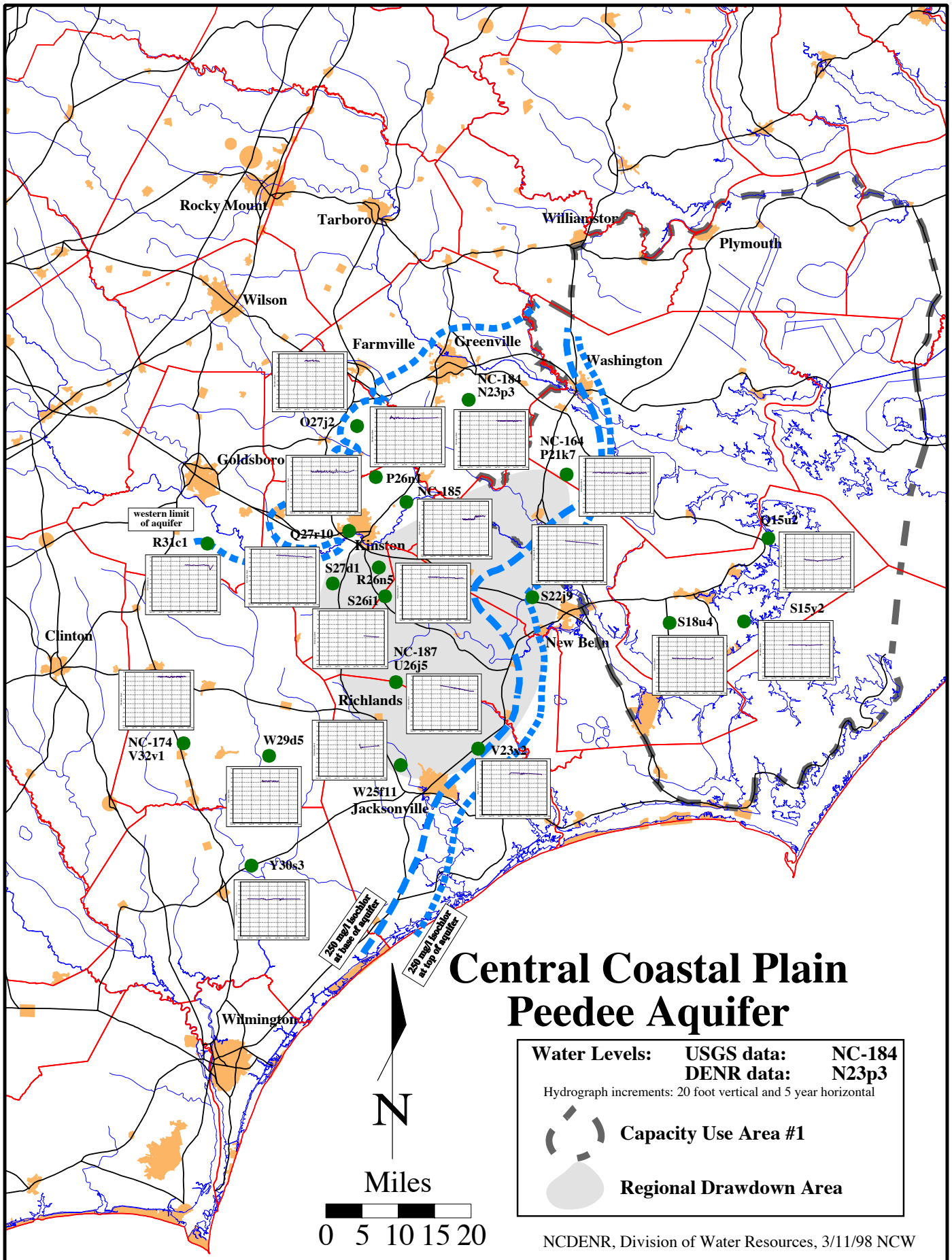
Table 3. Staffing Requirements of Proposed Capacity Use Program

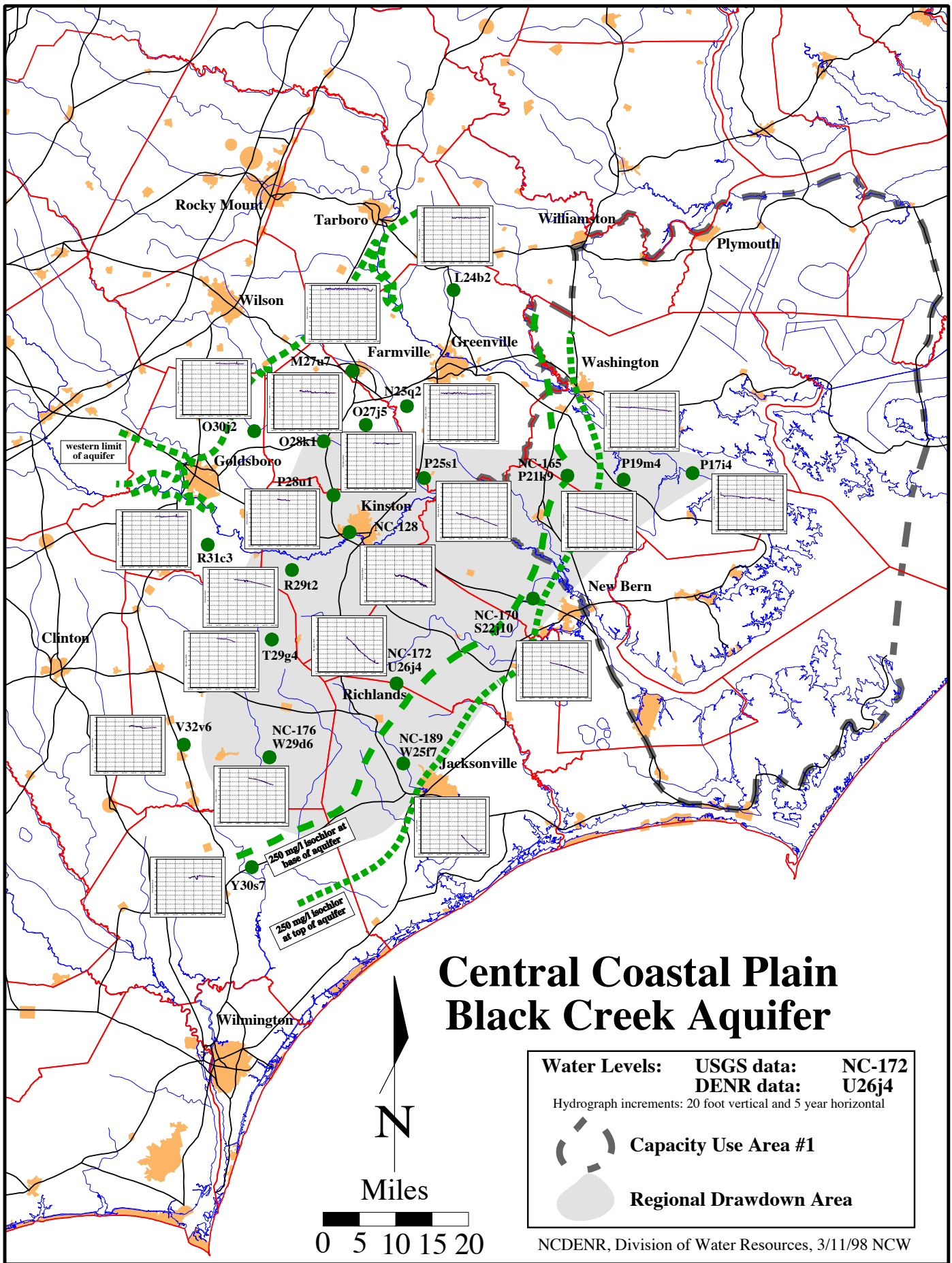
Position	Full-time Equivalent					
	Regulatory Development	Monitoring & Recordkeeping	Permitting	Inspection & Enforcement	Modeling	Total
Hydrologist	0.60	0.25	1.60	0.25	0.40	3.10
Hydro Tech	0.05	0.10	0.10	0.10		0.35
Office Asst.		0.75	0.25			1.00
Total	0.65	1.10	1.95	0.35	0.40	4.45

Currently, about 1.6 full-time equivalents (FTE) of staff are devoted to the Division's capacity use program. Under the proposed rule, estimated staffing needs would increase to 4.45 FTE's. The Division estimates an increase of \$150,000 in salary and benefits.



Appendices

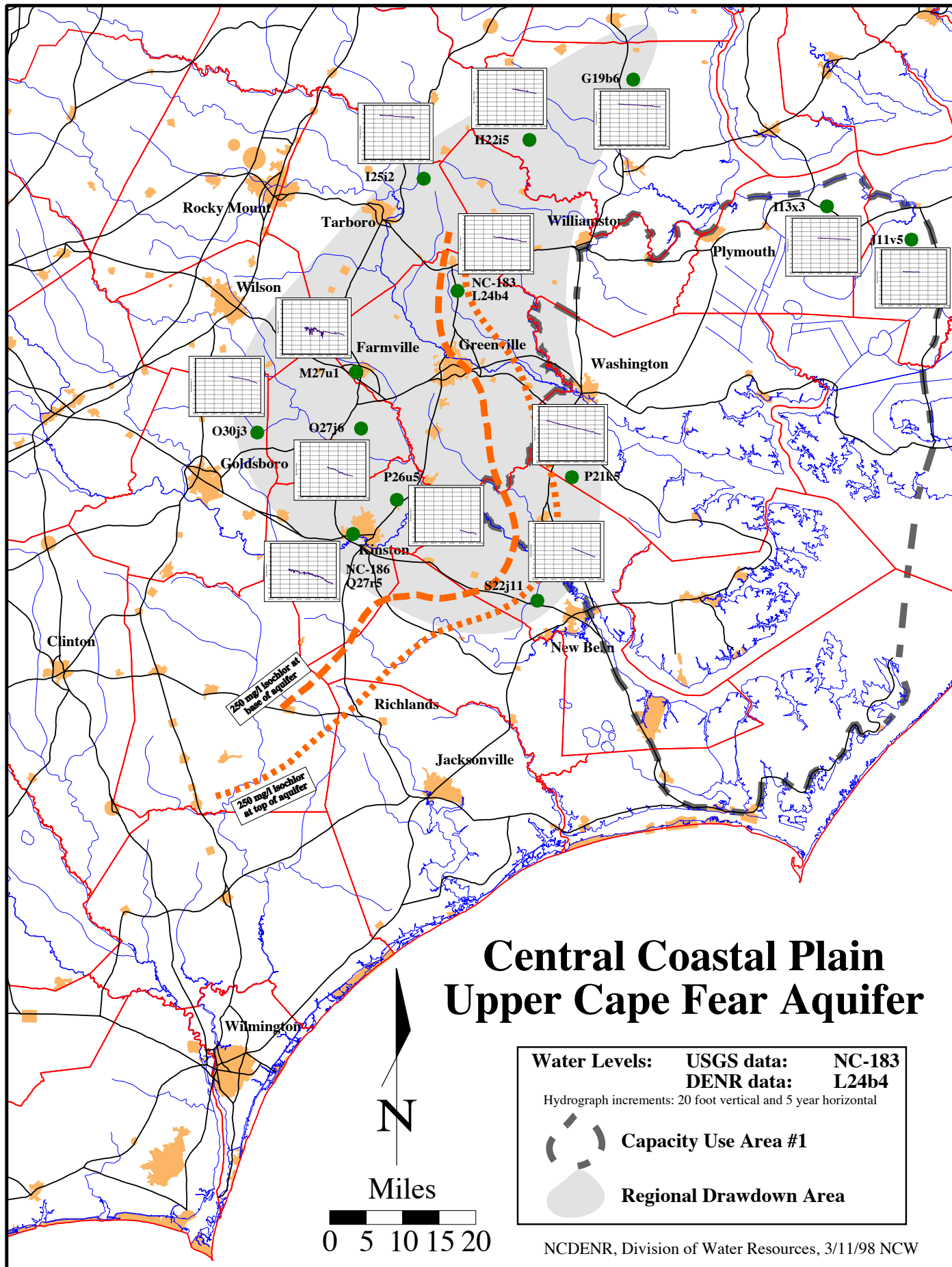
- A. Central Coastal Plain Peedee Aquifer
- B. Central Coastal Plain Black Creek Aquifer
- C. Central Coastal Plain Upper Cape Fear Aquifer
- D. Table of Central Coastal Plain Water System Technical Assistance
- E. List of Known Black Creek and Upper Cape Fear Aquifer Users
- F. List of Known Castle Hayne Aquifer Users







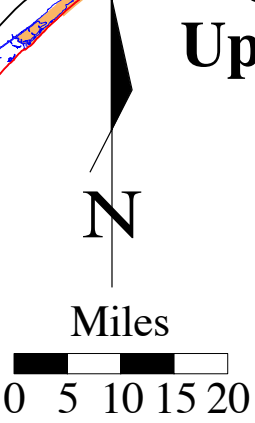
Central Coastal Plain Black Creek Aquifer

Water Levels:	USGS data:	NC-172
	DENR data:	U26j4
Hydrograph increments: 20 foot vertical and 5 year horizontal		
	Capacity Use Area #1	
	Regional Drawdown Area	



Central Coastal Plain Upper Cape Fear Aquifer

Water Levels:	USGS data:	NC-183
	DENR data:	L24b4
Hydrograph increments: 20 foot vertical and 5 year horizontal		
		Capacity Use Area #1
		Regional Drawdown Area



Appendix D: Central Coastal Plain Water System Technical Assistance

Water System	Population Served	Situation	Outcome
Kinston	25,295	Kinston has been looking for new wells and dealing with lost yield from existing wells - they are surrounded by other systems using the Black Creek and Upper Cape Fear aquifers -- Kinston will supply the Global Transpark	over the years (since 1992) DWR has recommended that Kinston find a new source of water -- namely the Neuse -- DWQ has signed off on a 24 mgd intake on the Neuse -- in the interim they construct new wells as far east as possible
New Bern	24,225	concerned about the status of the CCP aquifers and their source of water to meet future demands	began conversations with them and their consultants in 1992
Jacksonville	32,795	concerned about the status of the CCP aquifers especially with salt water intrusion	began conversations with them and their consultants in 1992
Onslow County	61,390	concerned about the status of the CCP aquifers and their source of water to meet future demands -- began using the Castle Hayne aquifer near Holly Ridge in 1996 to supplement supply	began conversations with them and their consultants in 1992
Richlands	1,250	town is only using one well, there are water level concerns with other well because water level is below pump intake	on 1/30/97 presented at commissioner meeting about CCP and their particular situation, brought other well on line and lowered both pump intakes
Craven County	19,809	concerns with potential CUA on their water source -- wanted to supply eastern subdivisions with Black Creek aquifer source instead of Castle Hayne aquifer	on 3/13/97 explained how CUA might work and that we couldn't force them to use the Castle Hayne, but regulations for use in CUA # 1 are less restrictive than "CCPCUA"
Jones County	8,223	concerned with declining water levels and the effect of animal farms on source	on 4/23/97 presented at public health meeting about CCP
Pitt County	~52,000	many water systems (11? using ground water) in the county -- there seem to be conflicts developing (political as well) among the users -- some of the problems stem from high levels of fluoride	on 8/27/97 DWR met with McGill Associates who represented Pitt County and spoke about the CCP situation -- spoke about Pitt being a ground water management pilot project for CCP
Walnut Creek	624	looking for new well to replace badly constructed well, all three wells are showing water level declines	on 12/3/97 reviewed our database and geophysical logs of their new borehole to help pick best zone
Southern Wayne Sanitary District	6,245	need additional water source, looking for 2 new wells	on 3/13/98 reported in letter about TDEM survey -- found good zone for source and cautioned them about drilling in certain areas due to less productive (lower resistivity) areas
Fork Township	7,112	they are anxious to have some supply wells closer to the geographic center of the Township in Wayne County	on 5/22/98 began work with Fork Township to find sites for wells in Wayne County -- should ease stress on the Black Creek aquifer in Lenoir County
	238,968		

Appendix E: Known Central Coastal Plain Black Creek and Upper Cape Fear Aquifer Users

1992 Local Water Supply Plan System Name	County	Average Demand (MGD)
Craven Co W&S	Craven	1.799
Dover	Craven	0.021
New Bern	Craven	3.430
Vanceboro Wtr Sys	Craven	0.127
Albertson Utility Sys	Duplin	0.084
Beulaville	Duplin	0.116
Calypso	Duplin	0.061
Chinquapin Wtr Assoc	Duplin	0.243
Faison	Duplin	0.409
Greenevers	Duplin	0.078
Kenansville	Duplin	0.189
Magnolia	Duplin	0.070
Rose Hill	Duplin	0.225
Teachey	Duplin	0.035
Wallace	Duplin	2.810
Warsaw	Duplin	0.351
Macclesfield	Edgecombe	0.067
Pinetops	Edgecombe	0.236
Greene Co RWS	Greene	0.680
Hookerton	Greene	0.048
Snow Hill	Greene	0.573
South Greene	Greene	0.222
Walstonburg	Greene	0.033
Jones Co Wtr Sys	Jones	0.521
Maysville	Jones	0.102
Pollocksville	Jones	0.061
Deep Run Water Corp	Lenoir	0.867
Kinston	Lenoir	4.800
La Grange	Lenoir	0.378
North Lenoir Wtr Corp	Lenoir	0.810
Pink Hill	Lenoir	0.100

Bear Grass	Martin	0.008
Hamilton	Martin	0.045
Jamesville	Martin	0.054
Oak City	Martin	0.071
Robersonville	Martin	1.419
Williamston	Martin	0.805
Jacksonville	Onslow	3.570
Northwest Onslow Co	Onslow	0.096
Onslow Co W&S	Onslow	4.503
Richlands	Onslow	0.168
Ayden	Pitt	0.549
Bethel	Pitt	0.167
Farmville	Pitt	1.712
Greenville WTP	Pitt	0.930
Grimesland	Pitt	0.123
Stokes Region Wtr Corp	Pitt	0.047
Winterville	Pitt	0.320
Grifton	Pitt/Lenoir	0.213
Fork Township Sanitary Dist	Wayne	0.774
Mount Olive	Wayne	1.099
Southern Wayne Sanitary Dist	Wayne	0.331
Walnut Creek	Wayne	0.105
Wayne Water Districts	Wayne	1.260
Black Creek	Wilson	0.160
Lucama	Wilson	0.095
Sims	Wilson	0.022
Stantonsburg	Wilson	0.095
	Average	0.760
	Minimum	0.008
	Maximum	4.800
	Total	38.290

Appendix F: Known Central Coastal Plain Castle Hayne Aquifer Users

Name of User	County	Current Permitted Use (MGD)
Calvin L Rowe Sr	Beaufort	0.864
Carolina Fisheries	Beaufort	2.500
Castle Hayne Fisheries	Beaufort	2.160
City of Washington	Beaufort	4.200
Cypress Swamp Fisheries	Beaufort	0.760
David C Austin	Beaufort	2.160
David W Waters	Beaufort	1.296
Down East Fisheries	Beaufort	0.720
GHW Weyerhaeuser Nursery	Beaufort	1.000
NCSU Pamlico Aquaculture Field Lab	Beaufort	2.360
National Spinning Co	Beaufort	2.000
North State Fisheries	Beaufort	1.728
PCS Phosphate Co	Beaufort	78.000
Richland Township W&S Beaufort County #VII	Beaufort	0.515
Swindell Fish Farms	Beaufort	0.576
Town of Chocowinity	Beaufort	0.250
Weyerhaeuser Real Estate Company	Beaufort	0.520
Town of Beaufort	Carteret	1.000
Town of Morehead City	Carteret	2.500
Town of Newport	Carteret	0.923
CWS Systems Inc	Craven	1.000
City of Havelock	Craven	1.140
Fairfield Harbour	Craven	0.300
Town of Vanceboro	Craven	0.412
US Marine Corps Cherry Point	Craven	8.000
Vanguard Farms Inc	Craven	2.000
Weyerhaeuser Company	Craven	0.200
White Rock Fish Farm Inc	Craven	0.432
Weyerhaeuser Plymouth Plant	Martin	3.540
Woodridge Timber Inc	Martin	0.144
Alston Spruill Farms	Pamlico	0.720

Harrison's Aquafarm Inc	Pamlico	1.728
Island Fisheries	Pamlico	1.296
McCotter Farms	Pamlico	3.500
Minnesott Golf and Country Club	Pamlico	0.300
Pamlico County Water System	Pamlico	2.210
Pamlico Packing Co Inc	Pamlico	0.517
Paul Farms Inc	Pamlico	1.440
Town of Oriental	Pamlico	0.150
Bray Inc of the Albemarle	Tyrrell	4.000
John Hancock Farmland Management	Tyrrell	0.010
Tyson Foods Inc	Tyrrell	3.797
AgResource Ltd Dannenberg Farms	Washington	1.000
AgResource Ltd Grace Farms	Washington	0.384
Bernard F Kornegay	Washington	0.504
Country Club of Plymouth Inc	Washington	0.200
H L Respass Farms	Washington	0.300
Manning Farms Inc	Washington	1.296
NCDA Tidewater Research Center	Washington	3.673
T L Harris Jr	Washington	1.440
Town of Creswell	Washington	0.288
Town of Plymouth	Washington	0.735
Town of Roper	Washington	0.300
Tyson Foods Inc	Washington	0.153
Average		2.840
Minimum		0.010
Maximum		78.000
Total		153.140