June 12, 2001

Syd Miller
NC DENR - DWR
1601 Mail Service Center
Raleigh, NC 27699-1601

RE: Chatham County Round Three Water Allocation Application

Dear Mr. Miller:

Chatham County hereby respectfully submits our Water Supply Allocation Application for Round Three. Chatham County commits to the financial obligation that the granting of increased allocation would entail. We are asking for a total Level I allocation increase of 2 MGD and a total Level II allocation increase of 2.5 MGD. Chatham County currently holds a Level I allocation of 4.0 MGD and a Level II allocation of 2 MGD. If granted its request Chatham County would hold a total Level I allocation of 6.0 MGD and a total level II allocation of 4.5 MGD.

Chatham County currently participates in regional partnerships through our inclusion in the Triangle "J" Mutual Aid Compact and discussions with the City of Durham and the Orange Water and Sewer Authority regarding the formation of a regional water entity currently dubbed the Jordan Water Authority.

The attached application package is Chatham County's best attempt at providing the information requested in your application instructions. In reviewing our application please keep in mind that Chatham County is a much different system than what you will be analyzing in other application packages such as the ones from Cary/Apex and the City of Durham. We are mainly a rural system with only a very limited history. Until a little over a year ago our account billing system provide very little useful information. Until last October our Jordan WTP was operated by a contract operator whose records are suspect at best. On top of that is the fact that the County is beginning to see some instances of medium to high density development that will

have a huge impact on our system over the next few years. In short we have done the best we could do with the information we had to work with.

We are only asking for an additional 4.5 MGD of capacity over the next 30 years. Frankly we think our needs will be much more than that but there is not sufficient information at this time to substantiate that hypothesis. Chatham County has faith that DWR will keep abreast of changes in allocations as referenced in **North Carolina Administrative Code Section T15A:02G.0500 Allocation of Jordan Lake Water Supply Storage** and make adjustments in the future as needed.

Sincerely,

Ronald D. Singleton, PE
Director of Public Works
Chatham County

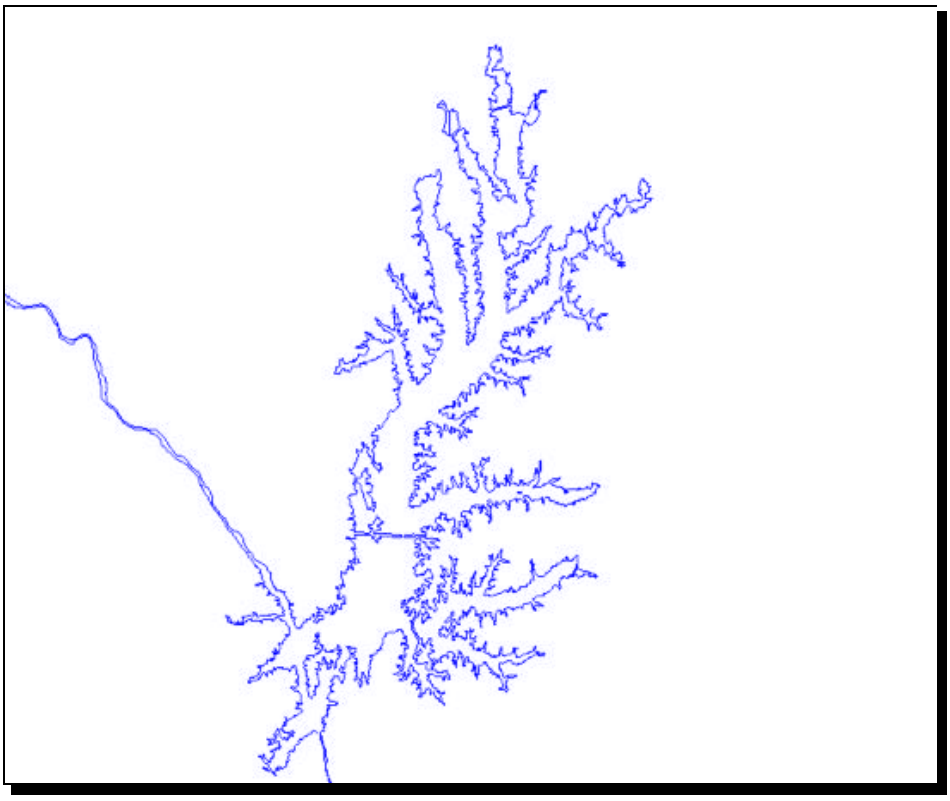
RDS

Enclosures

B. Everett Jordan Lake
Water Supply Allocation Request
Round Three

For

The County of Chatham



May 31, 2001

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Introduction

Chatham County is located in the central Piedmont Region of North Carolina and lies completely within the Cape Fear River Basin. Chatham owns and operates approximately 222 miles of water mains and a 3.0 MGD water plant. The County's distribution network is split into three separate and independent systems. The North Chatham system is served mainly by the Chatham County Water Treatment Plant and extends from the plant north to the County Line. This system is also able to purchase water from the Town of Pittsboro, the City of Durham, and the Orange Water and Sewer Authority (OWASA). The East Chatham system includes the townships of Moncure, Haywood, Asbury, Merry Oaks and Corinth. This system is supplied totally at this point from water purchases from the City of Sanford. The Southwest Chatham system includes the townships of Bear Creek, Bonlee, Bennett, and Carbonton. The Southwest system is supplied totally at this point by purchases from Siler City and Goldston-Gulf Sanitary District.

Chatham County has exploded in terms of population, increasing from 38,979 in 1990 to 49329 in 2000, an increase of 26.6%. This growth has been primarily overflow from Wake, Durham, and Orange Counties. The number of Chatham water customers rose 23.46% in a five-year period. The North Carolina Department of Transportation is currently expanding US 64 and US 15-501 to four-lane highways that will further encourage growth. The economy, while slowing down a bit, still recorded a 2% growth rate in the first quarter of 2001. Given these factors, Chatham is expected to experience a moderately rapid rate of growth in the coming years.

At the present time, Chatham County has an allocation of 6.0 MGD from Jordan Lake. The safe yield from the Lake is 100 MGD; 35 MGD have been allocated to various governments in the first round of allocations. Another 9 MGD request is pending approval by the Environmental Management Commission. Chatham is requesting a 2.0 MGD Level One and a 2.5 MGD Level Two water supply allocation from Jordan Lake.

Jordan Lake represents a common sense, cost-effective, and environmentally friendly option available to Chatham County in the foreseeable future. Any other alternatives to using Jordan Lake will require years to develop and will be significantly more expensive. The benefits of increasing Chatham's water supply allocation from Jordan Lake include:

1. Jordan Lake is located almost wholly within the County. It is only natural that Chatham look to Jordan Lake to fulfill its future needs. Chatham County is planning to connect the three separate systems that it maintains in the near future, thereby making Jordan Lake water available to the entire County, including Siler City, Pittsboro, and the Goldston-Gulf Sanitary District.

2. There will be no interbasin transfers of water if the County receives an increased allocation.

3. The County will have a greater incentive to promote and enforce its land use plan.

Population, Water Use and the Future

Chatham County is looking ahead to a time of population expansion that could easily equal the growth spurt of the decade just past. Cheaper land, new four-lane highways, business incentive programs, immigration (both foreign and domestic) and a steadily growing economy are all signs that point towards a bright future for Chatham County. Along with the predicted population growth will be an increasing demand for that most basic of commodities: water.

Methodology

Population and water demand projections were developed using data from the 2000 Census in conjunction with predictions from the North Carolina Office of State Planning (OSP). Population projections from the OSP were not available for the years past 2020. To estimate population out to 2050, an annual average rate of increase was obtained from the OSP data and the number of residents was extrapolated to 2050. For a full accounting of the methodology used, please refer to Appendix A.

Sector Projections

The water system was divided into three distinct sectors: residential, commercial, and industrial. Houses, mobile homes, and multi-family dwellings such as apartment buildings are classified as residential customers. Commercial customers are typically small businesses, churches, restaurants and other such small users. Industrial users are typically large consumers of water, such as poultry operations and brick plants. Usages rates are expressed below in the following table.

Table 1: Sector Usage Rates

Customer Classification	Usage Rate	# of 5/8" meter equivalents
Residential	65.3 gallons/day/person 161.29 gallons/day/household	4030
Commercial	360.5 gallons/ 5/8" meter equivalents	416
Industrial	1070.2 gallons/ 5/8" meter equivalent	149.5

Growth Projections

Projections of County population, number of water customers, and the percentage of the county population served are summarized in Table 1. The population of the County has grown at a 26.6% rate, from 38,979 in 1990, to 49,329 in 2000. The population of the County in 2050 is projected to be 114,742 people. Of that number, 65, 873 people will be served by the County, in addition to possible bulk sales to Siler City and Pittsboro. Both Siler City and Pittsboro are developing plans to supplement their existing water sources. Any speculation regarding future bulk sales to those cities is based on the premise that, long term, Jordan Lake will be the most viable water source and Chatham County will have the infrastructure in place to supplement other water systems in the County. The population in the area serviced by the County is expected to increase at a moderate pace, while other areas in the region will approach their particular buildout capacities far sooner than will Chatham. The Goldston-Gulf Sanitary District recorded a slight negative growth rate from 1990 to 2000, and its population has been assumed to be stable for the purposes of the allocation request.

Table 2: Growth Projections for Chatham County from 2000-2050.

	Total County Population	Population served by County Water	Percentage of County Population Served	Siler City Population	Pittsboro Population	Goldston-Gulf Population
2000	49,329	11,351	23.01%	8,645	2,491	1,200
2005	54,651	15,824	28.95%	9,639	2,725	1,200
2010	59,336	20,542	34.62%	10,754	3,023	1,200
2015	64,492	23,412	36.30%	12,001	3,554	1,200
2020	69,137	26,796	38.76%	13,381	4,233	1,200
2025	75,228	30,805	40.95%	14,722	5,066	1,200
2030	81,856	35,579	43.47%	16,204	6,186	1,200
2035	89,067	41,288	46.36%	17,843	7,717	1,200
2040	96,914	48,146	49.68%	19,658	9,843	1,200
2045	105,452	56,420	53.50%	21,667	12,827	1,200
2050	114,742	66,441	57.90%	23,893	17,060	1,200

Historical Water Use

In 2000, the average daily demand (ADD) for all of Chatham County's customers was 1.25 MGD. The maximum daily demand (MDD) was 1.549 MGD, which yields a peaking factor of 1.24. Since FY 96-97 the ADD has increased by 0.71 MGD, or 131 percent. Chatham County at this time does not sell water to other water systems.

Chatham has relied heavily upon and will continue to rely upon in the near future bulk purchase contracts from the City of Durham, the City of Sanford, the Goldston-Gulf Sanitary District, the Town of Pittsboro and the Town of Siler City. Two of the three separate distribution systems are entirely dependent upon this source of water. In the future it is likely that contracts will be renegotiated at higher prices and/or limited (shrinking) allocations as the systems Chatham County purchases from will need all they can supply for their own citizens. Projections have Siler City and Pittsboro needing additional water supply beginning in 2035, if needed improvements to each town's water treatment plants are implemented. If no improvements are implemented, then the date of needing additional supply will be much sooner, perhaps as soon as 2020.

Per capita demand in Chatham County has increased in the past 5 years. In FY 96-97 it was 70.45 gpcd. In 2000 it was 110.12 gpcd, an increase of 56.31 percent. Compared to Pittsboro, with a demand of 437.5 gpcd, and Siler City, with a demand of 328.25 gpcd, Chatham County's demand seems low. However, the municipalities' high rates of demands are explained by their large industrial users, mainly the various poultry processing facilities located in both towns. Chatham's per capita demand is predicted to increase to 293.56 gpcd in 2050, in good part to the poultry farms in the County proper that are not connected to County water as of yet.

The Future

Chatham County is projected to have an average daily water demand of 19.50 MGD in the year 2050. In the year 2015, the County is projected to consume more than its current allocation of 6.0 MGD, with an average daily demand of 6.65 MGD and a maximum daily demand of 8.24 MGD. Below is a table of the predicted average daily water demands in the County.

Table 3: County Water Demand Projections

Year	County Average Water Demand (MGD)	Siler City Average Water Demand (MGD)	Pittsboro Average Water Demand (MGD)	County Water Demand & Possible Bulk Sales (MGD)	Peak County Water Demand and Bulk Sales (MGD)	Goldston-Gulf Average Water Demand (MGD)
2000	1.25	3.10	1.20	1.25	1.55	0.14
2005	2.87	3.46	1.69	2.87	3.56	0.14
2010	5.81	3.53	1.82	5.81	7.20	0.14
2015	6.65	3.94	1.99	6.65	8.24	0.14
2020	7.64	4.39	2.26	7.64	9.48	0.14
2025	8.83	4.83	2.58	8.83	10.94	0.14
2030	10.24	5.32	2.97	10.24	12.70	0.14
2035	11.94	5.86	3.39	11.80	14.63	0.14
2040	14.00	6.45	3.94	14.39	17.85	0.14
2045	16.48	7.11	4.67	18.26	22.65	0.14
2050	19.50	7.84	5.62	22.97	28.48	0.14

Water Conservation

Water conservation is of prime importance to Chatham County. Given the current rates of use and projected increases in water demand, Chatham could be adversely affected by situations in which a chronic shortage of supply occurs, such as a prolonged drought. To ensure that all of the potable water produced is available to the customers and citizenry of Chatham, the Board of Commissioners and County staff have acted upon the elements of the following water conservation program.

1. Water Conservation Ordinance: In 1991 the Chatham Board of Commissioners enacted a water conservation ordinance that would take effect in times of severe water shortage. It provided instructions to follow in the event of four progressively more severe stages of a water shortage. The full ordinance is contained in Appendix B.
2. On January 1, 1999, Chatham adopted an increasing block rate structure to encourage water conservation, especially among residential customers. The rate structure is included in Appendix B.
3. Chatham County has had an ongoing water audit program since FY 96-97. The necessary data is entered into a MS Excel worksheet that yields the percentage of unaccounted-for water. Annual purchase meter calibration is part of this program.
4. In 2000, Chatham purchased a leak correlation device in order to track down leaks in older pipes and places where the water audit points to a problem with unaccounted-for water.
5. Chatham County has an ongoing public education program for the purpose of water conservation. At the Chatham County Public Works office, where customers come to pay their water bills, there are no less than five pamphlets that relate different ways to conserve water, from fixing leaky faucets to the proper time and manner of lawn irrigation. A free irrigation water gauge is also available for distribution at the office. On May 14, 2001, Chatham County held a cookout for their water customers as part of celebrating National Water Week. Staff and vendors were on site to demonstrate various tools and equipment.
6. Currently the only policy of retrofitting older plumbing to improve water conservation through newer fixtures is to replace non-conserving water fixtures in County facilities when necessary.
7. A joint Chatham County – Pittsboro project is being developed that would utilize effluent from the Pittsboro WWTP to supply all the process water for the 3M facility that is currently under construction south of Town. The facility will use up to 0.26 MGD of water. Currently the facility site is proposed to be supplied from Asbury Township, for which the County purchases water from the City of Sanford. If the reuse project becomes a reality the 3M demand for potable water would drop to about 12,000 gallons per day.

Water conservation is an ongoing program with Chatham County. The County recognizes and respects the importance of water conservation and the role that it can and will play in the education of the citizens of Chatham.

Current Sources of Water

Chatham County obtains its water from a variety of sources. There are three distribution systems in the County: the North Chatham system, the East Chatham system, and the Southwest Chatham system. At the present time, these three systems are independent of one another, and each has its own sources of water. Chatham does not at this time sell water to other systems.

The North Chatham system stretches from Jordan Lake north to the border with Orange and Durham counties and then back to the Town of Pittsboro and uses no less than three distinct sources of water on a regular basis. First and foremost is the 3 MGD Chatham County Water Plant that is located on the eastern shore of Jordan Lake. Chatham also buys water from the City of Durham, with a contracted amount of 0.2 MGD, and from the Town of Pittsboro, with a contracted amount equal to 25% of the functional capacity of the 2.0 MGD WTP or approximately 0.5 MGD. Chatham also has a mutual-aid agreement with the Orange Water And Sewer Authority for transfer of water in either direction during an emergency.

The East Chatham system is comprised of the townships of Moncure, Haywood, Asbury, Merry Oaks and Corinth. Water for this system is purchased exclusively from the City of Sanford under a contract that is currently being renegotiated. There are plans to connect this system to the North Chatham system in the near future, supplying the people of this area with water from Jordan Lake.

The Southwest Chatham system includes the townships of Bear Creek, Bonlee, Bennett, and Carbonton. Water for this system is purchased from the Town of Siler City, with a contracted amount of 0.3 MGD that is due for re-negotiation in 2007, and from the Goldston-Gulf Sanitary District, with a contracted amount of 0.16 MGD that is due for re-negotiation in 2007.

Chatham County has a 4.0 MGD Level One and a 2.0 MGD Level Two allocation for a total allocation of 6 MGD from Round One of the Jordan Lake allocation. In 1997, during Round Two of the allocation process, the County applied for an additional 7 MGD, but was refused because the NC Division of Water Resources did not agree with the County's forecasts for population and water demand. However, Chatham's average daily demands have increased to 1.25 MGD from 0.54 MGD in FY 96-97. Projected average daily demands will exceed the 6 MGD allocation by 2015, with the assumption that current levels of bulk purchases will not increase. This assumption is a fair one considering that all of the other systems that Chatham purchases from are experiencing rapid growth as well. Chatham County's sources of water are summarized in Table 3, below.

Table 4: Chatham County Sources of Water.

Source	Source Type	Amount Available (MGD)
Town of Pittsboro	Surface	0.5
Town of Siler City	Surface	0.3
Goldston-Gulf San. District	Surface	0.16
City of Sanford	Surface	0.3
City of Durham	Surface	0.2
Lake Jordan	Surface	3.0
OWASA	Surface	Emergency

Plans to use Jordan Lake

Chatham County has a 4.0 MGD Level I and a 2.0 MGD Level II allocation from the first round of the Jordan Lake allocation process. At present, the capability exists to withdraw 3.0 MGD from the lake to be treated at the Chatham County Water Treatment Plant. The plant was designed with an expansion to 6.0 MGD in mind, with stub-outs for the necessary piping and wiring. According to staff's projections, the plant will need to be expanded by the end of 2005.

In this third round, Chatham is requesting for a total additional 4.5 MGD allocation, consisting of a Level I allocation of 2.0 MGD and a Level II allocation of 2.5 MGD. If Chatham's request is granted, a total of 10.5 MGD will be available for the County to withdraw from Jordan Lake.

Jordan Lake lies almost entirely within Chatham County. Being dependent upon Jordan Lake for its drinking water supply will give the County a great incentive for actively pursuing and enforcing its land use plan. This increased impetus for responsible stewardship of the Jordan Lake watershed will not only benefit Chatham County, but will also provide for the water quality for other water utilities and also for those who simply love the waters of the lake for recreational purposes.

Monitoring of raw and finished water withdrawn from Jordan Lake will be in accordance with the requirements of the North Carolina Department of Environment and Natural Resources, Division of Environmental Health, and the United States Environmental Protection Agency.

Chatham County is planning to connect its three distribution systems into one, and supply the needs of its customers mainly from Jordan Lake. With this connection, Chatham will also make water from Jordan Lake available to Siler City, Pittsboro, and the Goldston-Gulf Sanitary District. County staff has projected that Siler City and Pittsboro will need to develop alternate supplies of water around 2040. Bulk purchases from Chatham County would be an option for both towns. If both towns do not implement necessary improvements to their water treatment plants and reservoirs, the date of 2040 comes much closer, in 2015.

Alternative Water Supply Sources

Chatham County utilizes a variety of sources to meet the needs of its three existing distribution systems. The North Chatham system is primarily supplied by the Chatham County Water Treatment Plant at Jordan Lake. Water is also purchased for the system from the City of Durham and the Town of Pittsboro. The East Chatham system's water supply is purchased solely from the City of Sanford. The Southwest Chatham system's water supply is purchased from the Goldston-Gulf Sanitary District and the Town of Siler City.

With these disparate sources and widespread systems come various alternatives for assuring a future supply of water that would be sufficient to the demands of the population. Much of the data for these alternatives can be found in the Chatham County Water Utility Master Plan. Each of the following alternatives was weighed in the allocation process. Only three alternatives have been identified as viable. The economic analyses for these three alternatives can be found in Appendix E.

Jordan Lake

One alternative for Jordan Lake that is being discussed at this time is a regional partnership with the City of Durham in building a raw water intake on the western side of the lake. Preliminarily this is being called the Jordan Water Authority although no decisions have been made to this point as the structure of the organization. An intake on that side would require a water treatment plant there as well, but in the long run decreases considerably the transmission costs to other parts of the County.

The current plant on the eastern side, the Chatham County Jordan Water Treatment Plant, was designed to be readily expanded to 6.0 MGD in the future. This expansion has a high probability of happening within the next five years, thereby exhausting Chatham's current allocation. For this joint intake project to work, it would require that Chatham County receive an additional allocation.

This project is technically very complex, with building a new water plant, a raw water intake and new transmission lines in an environmentally sensitive area. The political complexity is also high for roughly the same reason; there will be a public backlash against construction in this area. The public benefits of such a project would be a cheaper source of water that Chatham County would control to some degree through both joint ownership and the County's Land Use Plan. The environmental impact on Jordan Lake would be similar to any other water utility's construction of facilities by the lake.

Haw River

The Haw River is one of the two major tributaries that form Jordan Lake. It begins north of the City of Greensboro and extends through Chatham County where it merges with the Deep River to form the Cape Fear River. The Town of Pittsboro's water treatment plant

intake is located on the Haw just southeast of Highway 15-501 near Bynum Mill Village. It has a permitted withdrawal of 2.0 MGD. There is a significant amount of wastewater discharged into the Haw by the Cities of Greensboro and Burlington upstream of Chatham County. Because of these discharges, there are concerns that the water quality in the Haw River has been seriously degraded. The river has been assigned the following classifications by the NC Division of Environmental Management.

- Haw River from Burlington to Bynum: Class C NSW
- Haw River from Bynum to below U.S. 64: Class WS-IV NSW
- Haw River from U.S. 64 to Jordan Dam: Class WS-IV
- Haw River from Jordan Dam to Old U.S. 1: Class WS-IV
- Haw River from Old U.S. 1 to Cape Fear River: Class C

The following table yields the summer 7Q10 along with the recommended maximum withdrawal rate (20% of 7Q10) for various points along the Haw River:

Location	Summer 7Q10 (in CFS)	Maximum Withdrawal Rate (MGD)
Bynum	59.2	7.65
Jordan Dam	75.6	9.77
Moncure	77.1	9.96

Despite the relatively central location of the Haw River in Chatham County, the portion of the Haw River between Bynum and Jordan Lake should not be considered a viable water source for the County. The logical service area for a water treatment plant located at this point on the Haw would be the area already served by the North Chatham system, the primary source for which is the Chatham County Water Treatment Plant at Jordan Lake. It would be more cost effective to expand the Chatham County Jordan WTP than to construct a similarly sized plant on the Haw. In addition, Chatham County owns 0.5 MGD of the total capacity of Pittsboro's water plant.

Another potential treatment plant site on the Haw River is south of Jordan Lake. This location has a sufficient allowable withdrawal to meet the projected residential and commercial needs of the Eastern Chatham system. However, it would be more cost efficient to either purchase more capacity from the City of Sanford or to install transmission lines from the North Chatham system than to build a treatment plant at this location. Another factor to consider is at this point the flow of the river is now affected by the water quality discharge from Lake Jordan and any withdrawal from this section of the river would be under increased scrutiny. There would be no enhanced benefit to the public with either project.

Cape Fear River

The Cape Fear River is formed at the confluence of the Haw and Deep Rivers just south of Jordan Lake. There are a large number of existing industrial water supply intakes and

wastewater discharges in this stretch of water. The water supply within the Chatham County section of the river is classified as WS-IV indicating that it is available for use as a water source. The following table shows the 7Q10 and recommended maximum withdrawal rate (20% of 7Q10) for various points along the Cape Fear River in Chatham County.

Location	Summer 7Q10 (in CFS)	Maximum Withdrawal Rate (MGD)
Cape Fear River @ Moncure	142.0	18.35
Cape Fear River @ Corinth	74.0	9.56

Although the stream flow data for the Cape Fear River indicates that the river has more than adequate flow to serve the needs of the County, it is not considered a viable source. The river is located in the extreme southeast portion of the County, well away from the more highly populated areas of the northeastern and southwestern areas of the County, with a consequently highly cost of construction and maintenance of transmission mains. This section of the Cape Fear is also influenced by the water quality releases from Jordan Lake and would therefore undergo more scrutiny from a regulatory standpoint. The City of Sanford currently has a raw water intake near where NC 42 crosses the Cape Fear River. This site has been proposed in the recent past as the possible site for a regional water and wastewater treatment complex.

There is an existing industrial area in the Moncure area near where the Cape Fear River is formed. This area is targeted in the land use plan for future industrial growth. A Chatham County WTP in this location would enhance the marketability of this area for industrial growth and provide a second source of supply that could easily service the southern and western portions of the county.

Deep River

The Deep River is one of the two headwater tributaries of the Cape Fear River. It begins west of the City of Greensboro and flows to the southeast through Guilford, Randolph, Moore, Chatham, and Lee counties until it meets the Haw River near Moncure Township. The Deep River lies within Carolina Slate Belt geology, and as such, the low-flow rate of the river and its tributaries is very low. There are currently seventeen different dams on the Deep River, all of which slow the flow rate and trap pollutants. The most significant of these dams to Chatham County is the Carbonton Dam. It was constructed to create an impoundment for use by a hydroelectric facility, part of which is still in use today. According to the "Cape Fear River Basinwide Water Quality Management Plan" prepared by NC DEM, the Deep River has reached its assimilative capacity from Carbonton Dam to the Haw River. As a result, DEM has recommended that no new wastewater discharges be permitted in this area. According to DEM, the Deep River has the following surface water classifications:

- Deep River from NC 22 to NC 42: Class WS-IV
- Deep River from NC 42 to SR 1007: Class WS-IV
- Deep River from SR 1007 to NC 87: Class WS-IV
- Deep River from NC 87 to Moncure: Class WS-IV

The following table shows the 7Q10 and recommended maximum withdrawal rate (20% of 7Q10) for various points along the Deep River:

Location	Summer 7Q10 (in CFS)	Maximum Withdrawal Rate (MGD)
High Falls	17	2.20
Gulf	16	2.07

As long as the proposed withdrawal rate is less than 2.0 MGD, these sites are acceptable. However, the capacity probably could not be increased because the large number of existing impoundments on the river would give pause to any new impoundments being permitted. Because of these limits, the best site for a proposed water treatment facility on the Deep River would be at the Carbonton Dam. Estimates for this impoundment vary greatly, from 5 to 20 MGD.

There are two issues to consider when analyzing the political complexity of the Carbonton Dam as a potential source of water. One is that the hydroelectric facility at the dam is still operational, and would probably have to be purchased, since it is on the Lee County side of the dam, Lee County's permission would be required before it could condemned or otherwise shut down by Chatham County. The other issue, and the more important one, is the City of Greensboro's Randleman Dam project. Once constructed, the average flow rate in the Deep River will be lowered considerably (DWQ, 1996). However, the dam is expected to actually increase the low flow in the river because of its projected 30 cfs minimum release. However, that is a projection and is subject to several variables. For both of these reasons, the project is rated as very complex politically.

The environmental impact of a water treatment plant at Carbonton would be rated as worse than using Jordan Lake, by reducing the flow of water in a river that already has seventeen impoundments on it. Getting the necessary permits and permission from the State would be institutionally complex given the impact on the river. Building a water treatment plant would be technically very complex. Public benefits would be rated as few, by slightly decreasing the price of water to citizens in the Southwest Chatham system by reducing the need for long transmission lines and booster stations versus the construction of a new water treatment plant. For these reasons this site was ruled out as a future supply for Chatham County.

Rocky River

The Rocky River, a major tributary of the Deep River, is approximately 35 miles in length and is located primarily within Chatham County. The Town of Siler City's Water Treatment Plant intake is located on the river to the north of town while the wastewater treatment plant discharges into a tributary of the river at Loves Creek. The portion of the

Rocky River south of Siler City is classified as Class C waters. The river is considered to be a very low flow river by the State. The Town of Siler City is forced to utilize two off-stream reservoirs to obtain its minimum raw water supply. The following table shows the 7Q10 and recommended maximum withdrawal rate (20% of 7Q10) for various points along the Rocky River.

Location	Summer 7Q10 (in CFS)	Maximum Withdrawal Rate (MGD)
U.S. 64	0.28	0.04
Bonlee	0.52	0.07
Asbury	0.70	0.09
Mt. Vernon Springs	0.19	0.02

Because of this data, the Rocky River cannot be considered as either a short-or-long term source to meet future water supply needs. Any proposed water treatment plant constructed on the river will require a large volume of off-stream raw water storage to provide the necessary supply. The construction of sufficient raw water storage involves considerable expense, resulting in a project that is not financially feasible. In addition, a pre-construction requirement would be to petition the Division of Water Resources to reclassify the river for use as a public water source, which could stretch out into a span of years.

Bulk Water Purchases

City of Sanford

The City of Sanford currently supplies Chatham County with an allocation of up to 0.3 MGD, at a rate of $3.20/1000 gallons. The current contract allows for a renegotiation of the maximum daily allocation. However, the limiting factor in this scenario would be the construction of transmission mains, for the main part of the East Chatham system is supplied by one eight-inch main across the Cape Fear River. An eight-inch main also serves the subsystem of Asbury Township. Additional mains would have be to installed from the City of Sanford or a linking main would have to constructed between the main system and Asbury. The second option is on the drawing board for the near future, although no plans have been finalized or approved as of yet. Either option will increase the amount purchased from Sanford, which will in turn increase the overall cost of the water in the future, barring a highly doubtful decrease in Sanford's rates.

The environmental impact of this option would be the same as increasing Chatham County's allocation from Jordan Lake, since there would be no interbasin transfer. Institutionally the project would not be complex. Technically the project would not be complex. Politically, the project would be very complex. Jordan Lake lies almost entirely within Chatham County, with a estimated volume of 15 billion gallons and a 100 MGD safe yield withdrawal rate. It would be very difficult to make the public understand why they would have to pay a higher price for water from another county

when there is a relatively huge body of water located inside Chatham. A public uproar over water prices would likely cause the disapproval of such a project by the Board of Commissioners. There would be no benefit to the public with such a project.

Town of Pittsboro

Chatham County owns a quarter of the 2.0 MGD capacity of the Town of Pittsboro's water treatment plant, which only supplies the North Chatham system. This capacity has not been fully utilized since the Chatham County Water Treatment Plant at Jordan Lake came online in1996. At present, the capacity is being used to service the Bynum Mill Village and to augment the North Chatham supply during periods of peak demand. To meet future demands in the area, Pittsboro's water treatment plant would have to be expanded to 6.0 MGD, with nearly all of the expanded capacity going to Chatham County. The County would also be required to build a new twelve-inch transmission main from the expanded plant to the existing 16" main on Highway 15-501.

This is an unlikely scenario, as the Town commissioned a preliminary study by the Rose Group concerning plant upgrades in the range of 2 MGD, for a total of 4 MGD. This amount would meet Pittsboro's projected needs to 2040. After that date, the Town would have to find another source of water; most probably either purchase from the County or perhaps a raw water intake on Jordan Lake, if all of the 100 MGD safe yield has not been committed to other entities.

The environmental impact on the Haw River would be approximately the same as a withdrawal from Jordan Lake, since the Haw is the main source of water for Jordan Lake. The technical complexity of expanding an existing water treatment plant from 2.0 MGD to 6.0 MGD is complex. The institutional complexity of withdrawing an additional 4.0 MGD from the main tributary for Jordan Lake at a point on the river that is classified as WS-IV, Nutrient Sensitive Waters might be rated at a minimum of complex, and very probably very complex. The political complexity of the intergovernmental interactions during such a project would be classified as very complex. There would be no benefit to the public with such a project.

The City of Durham

In 2001, the City of Durham and Chatham County entered into a contract in which the County is obligated to buy 0.2 MGD from Durham. This contract is set to expire in 2005. The interconnect with Durham is finished, and at the time of this writing, the County has begun purchasing water. The City of Durham is pursuing an allocation as well from Jordan Lake, and is interested in building an intake on the western side of the lake in a joint effort with Chatham County. The Chatham County Water Treatment Plant on the eastern side of the lake was designed to be expanded from 3.0 MGD to 6.0 MGD at some time in the future. When this expansion takes place, the current allocation of 6.0 MGD will be expended. For a joint intake on the western side of the Lake, Chatham's allocation would have to be increased. If it does not, and Durham draws water from the lake, the political complexity of increasing the amount of bulk purchase from Durham

could only be rated as very complex. This rating is in regard to the fact that Jordan Lake is located almost entirely within Chatham County, and the public reaction to an increased purchase *from another government that is withdrawing water from Jordan Lake* would be very unfavorable. In turn, that would make the Board of Commissioners' outlook on such a purchase plan very unfavorable, with a degradation of regional governmental relationships almost certain, and disapproval of such a project inevitable. There would be no benefit to the public with such a project.

OWASA

The Orange Water and Sewer Authority and Chatham County share an interconnect that at this time is designed for emergency use only. Under the current piping configuration with the difference in pressure zones between OWASA and the North Chatham system, OWASA is capable of transferring 0.3 MGD to Chatham. OWASA would need to construct a booster pump station and may need to upsize some of its mains in the area in order to sell additional water to Chatham through this interconnection. Chatham would likely have to bear the cost of such capital improvements to OWASA's infrastructure.

The environmental impact of this project would be less that that of Chatham withdrawing from Jordan Lake, as long as OWASA was not using its Level II allocation of 10 MGD. The technical complexity of constructing new mains and a booster station is not complex. The institutional complexity would not be complex, as long as no interbasin transfer was required. If OWASA was not using its Jordan Lake allocation, the political complexity of the project would be somewhat complex, because using any source of water other than Jordan Lake would be inflammatory to a certain section of the public. If OWASA used its allocation to withdraw from Jordan Lake and sell to Chatham when Chatham could not use the waters of the lake, the situation would be very complex indeed. There would be a public outcry, and the project would very likely not make it past the public hearing stage before the Board of Commissioners would cancel it. There would be no benefit to the public with such a project.

Town of Siler City

Siler City operates a 4.0 MGD water treatment plant that takes raw water from the Rocky River through two reservoirs, which have a current safe yield of 4.0 MGD. A 1997 study by Hobbs, Upchurch & Associates, P.A. identified an economical expansion of the lower reservoir that would increase the potential safe yield to 6.0 MGD. Theoretically, the capacity of the existing plant could be upgraded to 6.0 MGD. Currently, the County's contract with Siler City calls for a maximum of 0.3 MGD. The initial period of the contract expires in 2002 but will be automatically renewed for an additional five years unless either party objects. If Siler City is not able to gain permission to upgrade their reservoir system, it would be likely that Siler City either deny any increases in future bulk purchases or request Chatham County to make other arrangements.

It must also be noted that the Town is now using an average of 3.1 MGD. The Town is in the process of obtaining the necessary permissions and permits to implement this project.

However, even with 6.0 MGD, the Town is projected to run out of water in 2040, at which time the Town will need additional water supply. One alternative would be to purchase from the County.

If the County made the decision to try and obtain a capacity through participating in an upgrade, the project would decrease the amount of water in what the State considers to be a low-flow river. Considering the potential impact of withdrawing 2.0 MGD more from the river on the western side of the County, the environmental impact would be worse than that of withdrawal from Jordan Lake. That might also make the project institutionally complex through the permitting process with the State. The project would be technically complex, with the reservoir expansion and the added capacity for the water treatment plant. The project would be politically complex, because Chatham would have to pay for a large part of the upgrades to another water utility's system. Conceivably the County would own most if not all of the added capacity to Siler City's plant, just as it owns a quarter of the capacity of the Pittsboro treatment plant. Still, all intergovernmental partnerships are by their very nature complex, with many different constituencies pulling in many different ways. There would be no benefit to the public with such a project.

Goldston-Gulf Sanitary District

The Goldston-Gulf water treatment plant has a current capacity of 0.33 MGD, 0.16 MGD of which the County has the ability to purchase on a daily basis. The contract between the County and the District expires in 2003. It can be renegotiated, but County staff does not foresee an increase in the purchase amount.

However, an alternative is for the County and the District to jointly expand the capacity of the plant to 2.0 MGD. That is approximately the limit that the Deep River can support at that point without increasing the impoundment size, which would probably be looked upon with disfavor by the State, making it institutionally very complex. Technically, the project would be complex, upgrading existing facilities. Politically, it would be very hard to justify the cost involved for receiving less than two million gallons a day, and then dealing with the necessary intergovernmental relationships. Environmentally, the project would be worse than drawing out of Jordan Lake because the Deep River is a river whose low-flow rate is very low, which could distress the riparian environment. There would be no benefit to the public with such a project.

Groundwater

A water feasibility study was completed in 1998 for Chatham County by Hobbs, Upchurch & Associates, P.A. Groundwater data, historical well usage patterns, and well flow data were intensely scrutinized. The Chatham County Water Treatment Plant was found to serve the only area of the County with somewhat favorable geological conditions. The historical data also indicated that well yields would continue to decrease, especially with the addition of more users to the various aquifers. As a result of the

analysis, groundwater is not considered to be a feasible source for Chatham County's long-term water supply needs.

Wastewater Reuse

Until the County begins a large-scale wastewater operation, a wastewater reuse system would not be feasible. At present, there is a joint Chatham County-Pittsboro project to supply the under-construction 3M facility with reuse water, reducing potable water needs from 0.26 MGD to 12,000 GPD if the project comes to fruition.

Methodology

Chatham County's population and water demand projections were developed using data from the 2000 Census in conjunction with projections from the North Carolina Office of State Planning (OSP). Population projections from the OSP were not available for the years past 2020. To estimate the County population out to 2050, an annual average rate of increase was obtained from the OSP data and the number of County residents was extrapolated to 2050, yielding a total County population of 114,742.

The number of residents served was arrived at by utilizing the Chatham Land Use Plan, which was developed by County Staff working closely with the Triangle J Council of Governments. This is a draft plan only, and has not been adopted by the County Commissioners. The Chatham Land Use Plan can be accessed via the Internet on Chatham County's website, www.co.chatham.nc.us. Areas of the County were designated as either municipal territories (current Town boundaries and existing ETJs), Compact Community Corridors (areas of expected and current high growth), Resource Protection Areas (areas, mostly along rivers, where growth will be restricted), Economic Development Areas (areas where industry is expected to increase growth), and Agricultural/Rural Residence areas (areas where farming and large lot sizes are predominant).

Several scenarios were formulated using the areas defined above to predict growth of the County's future water customers. Basic assumptions were as follows:

- The average number of people per household is 2.47. This statistic originates from the 2000 Census.

- All population increases in the County areas (i.e. non-municipal areas) are assumed to be supplied water by the County at some time during the planning period.

- Compact Community Corridors:
    1. 60% of the land is able to be built upon. This assumption takes into account streams, low areas, roads, and other such obstacles to construction.
    2. At buildout, the average housing unit density will be 1.5 houses/acre.

- Resource Protection Areas:
    1. 50% of the land is able to be built upon. This assumption takes into account streams, low areas, roads, and other such obstacles to construction.
    2. At buildout, the average housing unit density will be 1house/5 acres.

- Economic Development Areas:
    1. 60% of the land is able to be built upon. This assumption takes into account streams, low areas, roads, and other such obstacles to construction.
    2. At buildout, the average housing unit density will be 1house/4 acres.

- Agricultural/Rural Residence Areas:
    1. 60% of the land is able to be built upon. This assumption takes into account streams, low areas, roads, and other such obstacles to construction.
    2. At buildout, the average housing unit density will be 1house/4 acres.

- Municipal Areas:
    1. The population density within the current Town boundaries will stay relatively constant.
    2. That the Town boundaries will be extended to the current ETJ limits (Annexation of the current ETJs).
    3. That at buildout the ETJ population density will be equal to that of the current Town limits.
    4. That 60% of the land is able to be built upon. This assumption takes into account streams, low areas, roads, and other such obstacles to construction.

With these assumptions in place, four growth scenarios (very aggressive, aggressive, moderate and low) were developed and analyzed. The moderate scenario was selected as the most probable one, which agrees with the NC Office of State Planning's forecast of moderate growth for at least the next two decades. The scenario was based on a 75% buildout in the Compact Community Corridors by 2050, with a 30% buildout in the Agricultural/Rural Residential, Economic Development, and Resource Protection Areas. The customer base for the County is expected to grow rapidly in the first decade, based on the size of two subdivisions. The first, which is in the design phase and should go to the public hearing phase in July, will consist of approximately 2250 houses. The second is already constructing Phase 1 and has submitted for approval plans for Phase 2. This subdivision will consist of approximately 600 houses. According to developer plans, buildout for both of these subdivisions is expected by 2010, and both will be on County water.

County water demand is also expected to increase rapidly until 2010, which is linked to the aforementioned subdivisions and also to historical water demand data. The water demand for combined commercial and industrial users grew at an astronomical 1552.12 percent between FY 96-97 to 2000, from 0.0187 MGD to 0.3084 MGD. Average water demand was calculated using the different growth rates of the various areas. For example, the population in the Compact Community Corridors grew at a much higher rate in the first decade than did the population in the Agricultural/Rural Residence areas. Accordingly, the average water demand's rate of growth in the first areas was higher than that of the second areas. The per capita usage increased from 110.12 gpcd in 2000 to

293.56 gpcd in 2050. This large increase reflects the expectation of a large increase in the number of poultry farmers served by the County. Chatham County is the fourth largest county in terms of poultry production in the state. There are approximately two hundred poultry farms in the County, and only thirty-five at present are provided water by the County. It has been County staff's experience that a poultry farmer will join the system as soon as a water main is laid beside the property.

Municipal water demand was calculated in a different way. For Siler City, the per capita demand of 328.25 gpcd was assumed to be constant for both the residents that would live inside the current boundaries and those who live inside the current ETJ. The current population density for Siler City is 2.294 people/acre. A moderate ETJ population scenario for 2050 was chosen, which is consistent with the County's projected growth. The scenario is one of the ETJ achieving 50% of its buildout population. With this scenario the Town is expected to begin bulk water purchases from somewhere, most likely the County, by 2040. This date assumes that Siler City will be allowed by the State to increase its reservoir capacity to 6.0 MGD. If not, that date is projected to be 2015. County staff used the 2040 date in calculating water demand.

For Pittsboro, the per capita demand of 437.5 gpcd was assumed to smooth out a bit as the residential base increased. Currently, the Townsend chicken processing plant uses between 0.4 and 0.6 MGD. This industrial usage is why the per capita demand is so high. County staff estimates that the per capita demand will decrease to at least 300 gpcd. A similar growth scenario to that of Siler City was chosen, with a 50% ETJ buildout population. The scenario takes into account the current problems Pittsboro is having with its wastewater treatment plant, and assumes that Pittsboro will have the problems solved by 2010. The current population density for Pittsboro is 1.431 people/acre. The high rate of growth for Pittsboro reflects the low number of customers currently in its ETJ. Currently the Town has commissioned a preliminary study by the Rose Group concerning plant upgrades in the range of 2 MGD, for a total of 4 MGD. Assuming this improvement is implemented, and no other sources of water are developed, the Town is projected to begin bulk purchasing by 2045. If the treatment plant is not upgraded, that date comes much earlier, perhaps by 2015. County staff used the 2045 date in calculating water demand.

The area around Goldston-Gulf has actually experienced a small amount of shrinkage according to the Census 2000 data. In 2000 319 lived people in Goldston. In 1990 the population was 338 people. The resulting growth rate was a negative 5.6%. This corresponds to approximately 5% of the meters in the Goldston-Gulf Sanitary District being unused, according to water treatment plant data. In addition, the District is overwhelmingly residential, with no new industries planning at this time to relocate there. For these reasons, the District's population is assumed to be stable, with no net growth in the 50-year planning window for this request.

APPENDIX

B

LOCAL WATER SUPPLY PLAN for JORDAN LAKE ALLOCATION APPLICATION 2000-2001
Part 2: Water Supply Planning Report

Completed By: Ronald D. Singleton, P.E. Date: May 31, 2001

WATER SYSTEM: North Chatham, East Chatham, Southwest Chatham PWSID: 03-19-126, 03-19-045, 03-19-050

SECTION 7: WATER DEMAND PROJECTIONS

7-A. Population to be Served	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Year-Round	11351	15824	20542	23412	26796	30805	35579	41288	48146	56420	66441
Seasonal (if applicable)*											

*Please list the months of seasonal demand: _____ Attach a detailed explanation of how projections were calculated.

Table 7-B. Projected Average Daily Service Area Demand in Million Gallons per Day (MGD). (Does not include sales to other systems)
Sub-divide each water use type as needed for projecting future water demands.

	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Residential	0.65	1.64	4.08	4.65	5.33	6.14	7.11	8.28	9.69	11.41	13.51
(2) Commercial	0.15	0.35	0.72	0.82	0.93	1.06	1.21	1.38	1.57	1.79	2.04
(3) Industrial	0.16	0.28	0.35	0.44	0.55	0.68	0.85	1.07	1.34	1.67	2.09
(4) Institutional	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
(5) System Processes	0.01	0.41	0.84	0.96	1.10	1.27	1.47	1.72	2.02	2.37	2.81
(6) Unaccounted-for water	0.28	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.27	0.28	0.29
(7) Total Service Area Demand [sum (1) thru (6)]	1.25	2.87	5.81	6.65	7.64	8.83	10.24	11.94	14.00	16.48	19.50

7-C. Is non-residential water use expected to change significantly through 2050 from current levels of use? ○ No ● Yes
If yes, please explain; 3M is in process of construction of facility that will use 0.26 MGD to produce colored granules for roofing shingles, & increased poultry

production.

Table 7-D. FUTURE SUPPLIES List all new sources or facilities which were under development as of December 31, 2000 and mark locations on the System Map.

Source or Facility Name	PWSID (if purchase)	Surface water or Ground water	Sub-Basin of Source	Water Quality Classification	Additional Supply MGD	Development Time years	Year Online
City of Durham (Regular Use)	03-32-010	Purchase	Neuse (10-1) Haw (2-1)	WS-IV	0.2	Expires 2005	2001

***NOTE** **R=**Regular Use, **E=**Emergency Use

7-E. What is the Total Amount of Future Supplies available for Regular Use? 0.2 MGD

Table 7-F. FUTURE SALES CONTRACTS that have been already agreed to. List new sales to be made to other systems.

1 Water supplied to:		2 Contract Amount and Duration			3 Pipe Size(s) Inches	4* R or E
System Name	PWSID	MGD	Year Begin	Year End		
NONE						

***NOTE** **R=**Regular Use, **E=**Emergency Use

7-G. What is the total amount of existing Future Sales Contracts for Regular Use? _____0_____ MGD

SECTION 8: FUTURE WATER SUPPLY NEEDS

Local governments should maintain adequate water supplies to ensure that average daily water demands do not exceed 80% of the available supply. Completion of the following table will demonstrate whether existing supplies are adequate to satisfy this requirement and when additional water supply will be needed.

Table 8-A. AVERAGE DAILY DEMAND AS PERCENT OF SUPPLY Show all quantities in MGD.

Available Supply, MGD	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Existing Surface Water Supply (Item 3-B)	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
(2) Existing Ground Water Supply (Item 3-G)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3) Existing Purchase Contracts (Item 3-E)	1.26	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(4) Future Supplies (Item 7-E)	0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5) **Total Available Supply** [sum (1) thru (4)]	4.26	7.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Average Daily Demand, MGD											
(6) Service Area Demand (Item 7-B, Line 7)	1.25	2.87	5.81	6.65	7.64	8.83	10.24	11.94	14.00	16.48	19.50
(7) Existing Sales Contracts (Item 2-H)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(8) Future Sales Contracts (Item 7-G)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(9) **Total Average Daily Demand** [sum (6) thru (8)]	1.25	2.87	5.81	6.65	7.64	8.83	10.24	11.94	14.00	16.48	19.50
(10) Demand as Percent of Supply [(9) / (5)] x 100	29.34%	41.01%	89.35%	102.3%	117.6%	135.8%	157.6%	183.8%	215.3%	253.6%	300.1%
(11) **Supply Needed to maintain 80% [(9) / 0.8] - (5)**	-2.7	-3.41	0.76	1.81	3.05	4.53	6.30	8.43	11.00	14.10	17.88
Additional Information for Jordan Lake Allocation											
(12) Sales Under Existing Contracts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(13) Expected Sales Under Future Contracts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.45	1.78	3.46

Available Supply, MGD	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(14) Demand in each planning period [(6)+(12)+(13)	1.25	2.87	5.81	6.65	7.64	8.83	10.24	11.94	14.45	18.26	22.96
(15) Supply minus Demand [(5) - (14)]	3.01	4.13	0.69	-0.15	-1.14	-2.33	-3.74	-5.30	-7.89	-11.76	-16.47

8-B. Does Line 10 above indicate that demand will exceed 80% of available supply before the year 2030? No ○ Yes ●
If yes, your Jordan Lake Water Supply Storage Allocation Application should include the following items:

(1) Alternatives for obtaining additional water supply to meet future demands. Use the following tables to summarize the various future water supply alternatives available to your system. Attach a detailed description of each water supply project shown in each alternative. The sooner the additional supply will be needed, the more specific your plans need to be.

(2) A demand management program to ensure efficient use of your available water supply. A program should include: conducting water audits at least annually to closely monitor water use; targeting large water customers for increased efficiency; modifying water rate structures; identifying and reducing the amount of leaks and unaccounted-for water; and reusing reclaimed water for non-potable uses.

(3) Restrictive measures to control demand if the additional supply is not available when demand exceeds 80% of available supply, such as placing a moratorium on additional water connections until the additional supply is available or amending or developing your water shortage response ordinance to trigger mandatory water conservation as water demand approaches the available supply.

Future Supply Alternative List the components of each alternative scenario including the planning period when each component will come online.

(#1) Chatham County WTP Expansion & South Chatham Interconnect in 2005.	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-A "Existing Supply – Demand"	3.01	4.13	0.69	-0.15	-1.14	-2.33	-3.74	-5.30	-7.89	-11.76	-16.47
(2) Available supply from Project 1 (describe)	0.0	6.0	9.0	9.0	9.0	12.0	12.0	12.0	24.0	24.0	24.0
Available supply from Project 2 (describe)											
Available supply from Project 3 (describe)											
(3) Supply available for future needs [(1) + (2)]	3.01	10.13	9.69	8.85	7.86	9.67	8.26	6.7	16.11	12.24	7.53
(4) Total discharge to Source Basin	1.25	2.87	5.81	6.65	7.64	8.83	10.24	11.94	14.45	18.26	22.96
(5) Consumptive Use in Source Basin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(6) Total discharge to Receiving Basin											
(7) Consumptive Use in Receiving Basin											
(8) Amount not returned to Source Basin [(6) + (7)]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

List details of the future supply options include in this alternative in the table below.

Future Source or Facility Name	PWSID (if purchase)	Surface water or Ground water	Sub-Basin of Source	Water Quality Classification	Additional Supply (MGD)	Development Time years	Year Online
Chatham WTP Expansion to 6.0 MGD		Surface	Haw (2-1)	WS-IV	3.0		2005
Chatham WTP Expansion to 9.0 MGD		Surface	Haw (2-1)	WS-IV	3.0		2010
Chatham WTP Expansion to 12.0 MGD		Surface	Haw (2-1)	WS-IV	3.0		2025
Chatham WTP Expansion to 12.0 MGD		Surface	Haw (2-1)	WS-IV	12.0		2040

Future Supply Alternative List the components of each alternative scenario including the planning period when each component will come online.

(#2) Chatham County WTP Expansion & South Chatham Interconnect in 2005, Plus Jordan Water Authority Plant on western side of Lake.	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-A "Existing Supply - Demand"	3.01	4.13	0.69	-0.15	-1.14	-2.33	-3.74	-5.30	-7.89	-11.76	-16.47
(2) Available supply from Project 1 (describe)	0.0	6.0	12.0	12.0	12.0	18.0	18.0	18.0	24.0	24.0	24.0
Available supply from Project 2 (describe)											
Available supply from Project 3 (describe)											
(3) Supply available for future needs [(1) + (2)]	3.01	10.13	12.69	11.85	10.86	15.67	14.26	12.7	16.11	12.24	7.53
(4) Total discharge to Source Basin	1.25	2.87	5.81	6.65	7.64	8.83	10.24	11.94	14.45	18.26	22.96
(5) Consumptive Use in Source Basin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(6) Total discharge to Receiving Basin											
(7) Consumptive Use in Receiving Basin											
(8) Amount not returned to Source Basin [(6) + (7)]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

List details of the future supply options include in this alternative in the table below.

Future Supply Sources

Future Source or Facility Name	PWSID (if purchase)	Surface water or Ground water	Sub-Basin of Source	Water Quality Classification	Additional Supply (MGD)	Development Time years	Year Online
Chatham WTP Expansion to 6.0 MGD		Surface	Haw (2-1)	WS-IV	3.0		2005

Jordan Water Authority WTP at 6.0 MGD		Surface	Haw (2-1)	WS-IV	6.0		2010
Jordan Water Authority WTP expand to 12.0 MGD		Surface	Haw (2-1)	WS-IV	6.0		2025
Jordan Water Authority WTP expand to 18.0 MGD		Surface	Haw (2-1)	WS-IV	6.0		2040

Attach additional pages as needed to summarize all alternatives.

Future Supply Alternative List the components of each alternative scenario including the planning period when each component will come online.

(#3) Chatham County WTP Expansion & South Chatham Interconnect in 2005, Plus Cape Fear River WTP	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-A "Existing Supply - Demand"	3.01	4.13	0.69	-0.15	-1.14	-2.33	-3.74	-5.30	-7.89	-11.76	-16.47
(2) Available supply from Project 1 (describe)	0.0	6.0	12.0	12.0	12.0	18.0	18.0	18.0	24.0	24.0	24.0
Available supply from Project 2 (describe)											
Available supply from Project 3 (describe)											
(3) Supply available for future needs [(1) + (2)]	3.01	10.13	12.69	11.85	10.86	15.67	14.26	12.7	16.11	12.24	7.53
(4) Total discharge to Source Basin	1.25	2.87	5.81	6.65	7.64	8.83	10.24	11.94	14.45	18.26	22.96
(5) Consumptive Use in Source Basin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(6) Total discharge to Receiving Basin											
(7) Consumptive Use in Receiving Basin											
(8) Amount not returned to Source Basin [(6) + (7)]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

List details of the future supply options include in this alternative in the table below.

Future Supply Sources

Future Source or Facility Name	PWSID (if purchase)	Surface water or Ground water	Sub-Basin of Source	Water Quality Classification	Additional Supply (MGD)	Development Time years	Year Online
Chatham WTP Expansion to 6.0 MGD		Surface	Haw (2-1)	WS-IV	3.0		2005
Cape Fear River WTP at 6.0 MGD		Surface	Haw (2-1)	WS-IV	6.0		2010
Cape Fear River WTP expand to 12.0 MGD		Surface	Haw (2-1)	WS-IV	6.0		2025
Cape Fear River WTP expand to 18.0 MGD		Surface	Haw (2-1)	WS-IV	6.0		2040

8-C. Are peak day demands expected to exceed the water treatment plant capacity by 2010? ○ No ● Yes
If yes, what are your plans for increasing water treatment capacity?

The Chatham County Water Treatment Plant was designed to be expanded to 6.0 MGD. By 2010, Chatham will have to implement this expansion; as well as construct/develop new sources. Further expansion of the existing plant is one option, construction of a plant on the western bank of Jordan Lake is another.

8-D. Does this system have an interconnection with another system capable of providing water in an emergency? ○ No ● Yes If not, what are your plans for interconnecting (or please explain why an interconnection is not feasible or not necessary).

8-E. Has this system participated in regional water supply or water use planning? ● No ○ Yes Please describe.

8-F. List the major water supply reports or studies used for planning. The Chatham Land Use Plan, the Chatham County Water Feasibility Study, the Chatham County Water System Management Plan.

SECTION 9: TECHNICAL ASSISTANCE NEEDS

Is technical assistance needed:

9-A. to develop a local water supply plan? ● No ○ Yes

9-B. with a leak detection program? ● No ○ Yes

9-C. with a demand management or water conservation program? ● No ○ Yes

9-D. with a water shortage response plan? ● No ○ Yes

9-E. to identify alternative or future water supply sources? ● No ○ Yes

9-F. with a capacity development plan? ● No ○ Yes

9-G. with a wellhead or source water protection plan? ● No ○ Yes

9-H. with water system compliance or operational problems? ● No ○ Yes

9-I. with Consumer Confidence Reports? ● No ○ Yes

9-J. Please describe any other needs or issues regarding your water supply sources, any water system deficiencies or needed improvements (storage, treatment, etc.), or your ability to meet present and future water needs. Include both quantity and quality considerations, as well as financial, technical, managerial, permitting, and compliance issues.

APPENDIX

C

APPENDIX

D

APPENDIX

E

SUMMARY OF ALTERNATIVES

Alternatives	Summary Description
Alternative 1	Jordan WTP Expansion & Utilize Pittsboro and Siler City Expanded Plants as Proposed & South Chatham Interconnect in 2005 1A. – Expand Jordan WTP to 6.0 MGD in 2005 1B. – Expand Jordan WTP to 9.0 MGD in 2010 1C. – Expand Jordan WTP to 18.0 MGD in 2025 1D. – Expand Jordan WTP to 24.0 MGD in 2040
Alternative 2	Jordan WTP Expansion to 6.0 MGD, Utilize Pittsboro and Siler City Expanded Plants As Proposed Plus Jordan Water Authority Plant On West Bank & South Chatham Interconnect in 2005 2A. – Expand Jordan WTP to 6.0 MGD in 2005 2B. – Jordan Water Authority Plant @ 6.0 MGD in 2010 2C. – Expand JWA WTP to 12.0 MGD in 2025 2D. – Expand JWA WTP to 18.0 MGD in 2040
Alternative 3	Jordan WTP Expansion to 6.0 MGD, Utilize Pittsboro and Siler City Expanded Plants as Proposed Plus Cape Fear River WTP, South Chatham Interconnect in 2005 and Moncure Finished WL in 2010 3A. – Expand Jordan WTP to 6.0 MGD in 2005 3B. – Cape Fear River WTP @ 6.0 MGD in 2010 3C. – Cape Fear River to 12.0 MGD in 2025 3D. – Cape Fear River to 18.0 MGD in 2040

ALTERNATIVES ANALYSIS

	1	2	3
Total Supply (MGD)	24	24	24
Environmental Impacts	Least	Worse	Worse
Water Quality Classification	WS-IV	WS-IV	WS-IV
Interbasin Transfer (MGD)	0	0	0
Regional Partnerships	Yes	YES	YES
Technical Complexity	Not Complex	Very Complex	Very Complex
Institutional Complexity	Not Complex	Very Complex	Very Complex
Political Complexity	Very Complex	Very Complex	Very Complex
Public Benefits	Many	Many	Many
Consistency with Local Plans	Yes	Yes	No
Total Cost ($ Millions)	$63,712,000	73,516,000	75,567,000
Unit Cost ($/1000 gallons)	$1.14	$1.25	$1.28

Alternative 1A: Expand Jordan WTP to 6.0 MGD in 2005

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $3,000,000
   PW capital cost = **$3,650,000**
2. Engineering, legal & regulatory costs @ 20% = $600,000
   PW Engineering, legal & regulatory costs = **$730,000**
3. General contingency @ 10% = $300,000
   PW general contingency = **$365,000**
4. Annual O&M costs @ $0.50/1000 gallons = $547,500
   PW O&M costs 3 MGD for 45 years @ 4% = $11,344,000 in 2005
   PW = $9,332,000
5. Equipment replacement: 30% of capital cost = $900,000 in 2030
   PW equipment replacement = **$338,000**
6. South Chatham Interconnect $6,000,000 in 2005
   PW = **$4,932,000**
7. Capital recovery:
   a. WTP expansion $3,900,000 for 20 years begin 2005 =$145,000/yr. PW in 2005 = $ 1,663,138, PW 2000 = **$1,367,000**
   b. South Chatham Interconnect $6,000,000 for 20 years, begin 2005 = $223,107 PW in 2005 = $2,559,000, PW 2000 = **$2,103,000**
8. Allocation Cost: PW @ $5,000/yr/mgd = $310,000 in 2005, PW = **$255,000**

Total PW Cost for 1A = $20,430,000

Unit Cost = ($20,430,000/45 yrs) / (3,000 GPD X 365 Days) = **$0.41/1000 gallons**

Alternative 1B: Expand Jordan WTP to 9.0 MGD in 2010

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $6,000,000
   PW capital cost = **$4,053,000**
2. Engineering, legal & regulatory costs @ 20% = $1,200,000
   PW Engineering, legal & regulatory costs = **$811,000**
3. General contingency @ 10% = $600,000
   PW general contingency = **$405,000**
4. Annual O&M costs @ $0.50/1000 gallons = $547,500/yr
   PW O&M costs 3 MGD for 40 years @ 4% = $10,837,000 in 2010
   PW = $7,321,000
5. Equipment replacement: 30% of capital cost = $1,800,000 in 2035
   PW equipment replacement = **$456,000**
6. Capital recovery:
   a. WTP expansion $8,800,000 for 20 years begin 2010 = $290,000/yr.
   PW in 2020 = $ 3,326,000> PW 2000 = **$2,247,000**

7. Allocation Cost: PW @ $5,000/yr/mgd = $594,000 in 2010, PW = **$401,000**

Total PW Cost for 1B = $15,694,000

Unit Cost = ($15,694,000/40 yrs) / (3,000 GPD X 365 Days) = **$0.36/1000 gallons**

Alternative 1C: Expand Jordan WTP to 18.0 MGD in 2025

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $9,000,000
   PW capital cost = **$3,376,000**
2. Engineering, legal & regulatory costs @ 20% = $1,800,000
   PW Engineering, legal & regulatory costs = **$675,000**
3. General contingency @ 10% = $900,000
   PW general contingency = **$338,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,642,500/yr
   PW O&M costs 6 MGD for 25 years @ 4% = $25,659,000 in 2025
   PW = $9,625,000
5. Capital recovery:
   a. WTP expansion $11,270,000 for 20 years begin 2025 = $435,000/yr.
      PW in 2025 = $5,912,000 => PW 2000 = **$2,218,000**
6. Allocation Cost: PW @ $5,000/yr/mgd = $703,000 in 2025,
   PW = $**264,000**

Total PW Cost for 1C = $16,496,000

Unit Cost = ($16,496,000/25 yrs)/(9,000 TGPD X 365 Days) = **$0.20/1000 gallons**

Alternative 1D: Expand Jordan WTP to 24.0 MGD in 2040

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $6,000,000
   PW capital cost = **$1,250,000**
2. Engineering, legal & regulatory costs @ 20% = $1,200,000
   PW Engineering, legal & regulatory costs = **$250,000**
3. General contingency @ 10% = $600,000
   PW general contingency = **$125,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,095,000/yr
   PW O&M costs 6 MGD for 10 years @ 4% = $8,881,000 in 2040
   PW = $1,850,000
5. Capital recovery:
   a. WTP expansion $8,800,000 for 10 years begin 2040 = $145,000/yr.
      PW in 2040 = $ 1,176,000 > PW 2000 = **$245,000**
7. Allocation Cost: PW @ $5,000/yr/mgd = $243,000 in 2040, PW = **$51,000**

Total PW Cost for 1D = $3,771,000

Unit Cost = ($3,771,000/10 yrs) / (6,000 TGPD X 365 Days) = **$0.17 /1000 gallons**

Alternative 2A: Expand Jordan WTP to 6.0 MGD in 2005

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $3,000,000
   PW capital cost = **$3,650,000**
2. Engineering, legal & regulatory costs @ 20% = $600,000
   PW Engineering, legal & regulatory costs = **$730,000**
3. General contingency @ 10% = $300,000
   PW general contingency = **$365,000**
4. Annual O&M costs @ $0.50/1000 gallons = $547,500
   PW O&M costs 3 MGD for 45 years @ 4% = $11,344,000 in 2005
   PW = $9,332,000
5. Equipment replacement: 30% of capital cost = $900,000 in 2030
   PW equipment replacement = **$338,000**
6. South Chatham Interconnect $6,000,000 in 2005
   PW = **$4,932,000**
7. Capital recovery:
   a. WTP expansion $3,900,000 for 20 years begin 2005 =$145,000/yr. PW in 2005 = $ 1,663,138, PW 2000 = **$1,367,000**
   b. South Chatham Interconnect $6,000,000 for 20 years, begin 2005 = $223,107 PW in 2005 = $2,559,000, PW 2000 = **$2,103,000**
8. Allocation Cost: PW @ $5,000/yr/mgd = $310,000 in 2005, PW = **$255,000**

Total PW Cost for 2A = $20,430,000

Unit Cost = ($20,430,000/45 yrs) / (3,000 GPD X 365 Days) = **$0.41/1000 gallons**

Alternative 2B: Jordan Water Authority Plant @ 6.0 MGD in 2010

1. WTP & Intake new construction capital cost at 2$/1000 gallons in 2000 dollars = $12,000,000 => PW 2000 = **$8,107,000**
2. Engineering, legal & regulatory costs @ 20% = $2,400,000
   PW Engineering, legal & regulatory costs = **$1,621,000**
3. General contingency @ 10% = $1,200,000
   PW general contingency = **$811,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,095,000/yr
   PW O&M costs 6 MGD for 40 years @ 4% = $21,673,000 in 2010
   PW = $14,642,000
5. Equipment replacement: 30% of capital cost = $3,600,000 in 2035
   PW equipment replacement = **$912,000**
6. Capital recovery:
   a. WTP expansion $15,600,000 for 20 years begin 2010 = $580,000/yr.
      PW in 2010 = $ 7882,000 => PW 2000 = **$5,325,000**
7. Allocation Cost: PW @ $5,000/yr/mgd = $594,000 in 2010, PW = **$401,000**

Total PW Cost for 2B = $32,819,000

Unit Cost = ($32,819,000/40 yrs) / (6,000 GPD X 365 Days) = **$0.37/1000 gallons**

Alternative 2C: Expand JWA WTP to 12.0 MGD in 2025

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $9,000,000
   PW capital cost = **$3,376,000**
2. Engineering, legal & regulatory costs @ 20% = $1,800,000
   PW Engineering, legal & regulatory costs = **$675,000**
3. General contingency @ 10% = $900,000
   PW general contingency = **$338,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,642,500/yr
   PW O&M costs 6 MGD for 25 years @ 4% = $25,659,000 in 2025
   PW = $9,625,000
5. Capital recovery:
   a. WTP expansion $11,270,000 for 20 years begin 2025 = $435,000/yr.
      PW in 2025 = $5,912,000 => PW 2000 = **$2,218,000**
6. Allocation Cost: PW @ $5,000/yr/mgd = $703,000 in 2025,
   PW = $**264,000**

Total PW Cost for 2C = $16,496,000

Unit Cost = ($16,496,000/25 yrs)/(6,000 TGPD X 365 Days) = **$0.30/1000 gallons**

Alternative 2D: Expand JWA WTP to 18.0 MGD in 2040

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $6,000,000
   PW capital cost = **$1,250,000**
2. Engineering, legal & regulatory costs @ 20% = $1,200,000
   PW Engineering, legal & regulatory costs = **$250,000**
3. General contingency @ 10% = $600,000
   PW general contingency = **$125,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,095,000/yr
   PW O&M costs 6 MGD for 10 years @ 4% = $8,881,000 in 2040
   PW = $1,850,000
5. Capital recovery:
   a. WTP expansion $8,800,000 for 10 years begin 2040 = $145,000/yr.
      PW in 2040 = $ 1,176,000 > PW 2000 = **$245,000**
6. Allocation Cost: PW @ $5,000/yr/mgd = $243,000 in 2040, PW = **$51,000**

Total PW Cost for 2D = $3,771,000

Unit Cost = ($3,771,000/10 yrs) / (6,000 TGPD X 365 Days) = **$0.17 /1000 gallons**

Alternative 3A: Expand Jordan WTP to 6.0 MGD in 2005

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $3,000,000
   PW capital cost = **$3,650,000**
2. Engineering, legal & regulatory costs @ 20% = $600,000
   PW Engineering, legal & regulatory costs = **$730,000**
3. General contingency @ 10% = $300,000
   PW general contingency = **$365,000**
4. Annual O&M costs @ $0.50/1000 gallons = $547,500
   PW O&M costs 3 MGD for 45 years @ 4% = $11,344,000 in 2005
   PW = $9,332,000
5. Equipment replacement: 30% of capital cost = $900,000 in 2030
   PW equipment replacement = **$338,000**
6. South Chatham Interconnect $6,000,000 in 2005
   PW = **$4,932,000**
7. Capital recovery:
   a. WTP expansion $3,900,000 for 20 years begin 2005 =$145,000/yr. PW in 2005 = $ 1,663,138, PW 2000 = **$1,367,000**
   b. South Chatham Interconnect $6,000,000 for 20 years, begin 2005 = $223,107 PW in 2005 = $2,559,000, PW 2000 = **$2,103,000**
8. Allocation Cost: PW @ $5,000/yr/mgd = $310,000 in 2005, PW = **$255,000**

Total PW Cost for 3A = $20,430,000

Unit Cost = ($20,430,000/45 yrs) / (3,000 GPD X 365 Days) = **$0.41/1000 gallons**

Alternative 3B: Cape Fear River WTP @ 6.0 MGD in 2010

1. WTP & Intake new construction capital cost at 2$/1000 gallons in 2000 dollars = $12,000,000 => PW 2000 = **$8,107,000**
2. Engineering, legal & regulatory costs @ 20% = $2,400,000
   PW Engineering, legal & regulatory costs = **$1,621,000**
3. General contingency @ 10% = $1,200,000
   PW general contingency = **$811,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,095,000/yr
   PW O&M costs 6 MGD for 40 years @ 4% = $21,673,000 in 2010
   PW = $14,642,000
5. Equipment replacement: 30% of capital cost = $3,600,000 in 2035
   PW equipment replacement = **$912,000**
6. Moncure Finished WL $3,000,000 in 2010 => PW 2000 = **$2,027,000**
7. Capital recovery:
   a. WTP expansion $15,600,000 for 20 years begin 2010 = $580,000/yr.
      PW in 2010 = $ 7882,000 => PW 2000 = **$5,325,000**
      i. Moncure WL $3,000,000 for 20 years, begin 2010 = $111,553
         PW in 2010 = $1,516,000 => PW 2000 = **$1,024,000**
8. Allocation Cost: PW @ $5,000/yr/mgd = $594,000 in 2010, PW = **$401,000**

Total PW Cost for 3B = $34,870,000

Unit Cost = ($34,870,000/40 yrs) / (6,000 GPD X 365 Days) = **$0.40/1000 gallons**

Alternative 3C: Expand Cape Fear River WTP to 12.0 MGD in 2025

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $9,000,000
   PW capital cost = **$3,376,000**
2. Engineering, legal & regulatory costs @ 20% = $1,800,000
   PW Engineering, legal & regulatory costs = **$675,000**
3. General contingency @ 10% = $900,000
   PW general contingency = **$338,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,642,500/yr
   PW O&M costs 6 MGD for 25 years @ 4% = $25,659,000 in 2025
   PW = $9,625,000
5. Capital recovery:
   a. WTP expansion $11,270,000 for 20 years begin 2025 = $435,000/yr.
      PW in 2025 = $5,912,000 => PW 2000 = **$2,218,000**
6. Allocation Cost: PW @ $5,000/yr/mgd = $703,000 in 2025,
   PW = $**264,000**

Total PW Cost for 3C = $16,496,000

Unit Cost = ($16,496,000/25 yrs)/(6,000 TGPD X 365 Days) = **$0.30/1000 gallons**

Alternative 3D: Expand Cape Fear River WTP to 18.0 MGD in 2040

1. WTP expansion capital cost at 1$/1000 gallons in 2000 dollars = $6,000,000
   PW capital cost = **$1,250,000**
2. Engineering, legal & regulatory costs @ 20% = $1,200,000
   PW Engineering, legal & regulatory costs = **$250,000**
3. General contingency @ 10% = $600,000
   PW general contingency = **$125,000**
4. Annual O&M costs @ $0.50/1000 gallons = $1,095,000/yr
   PW O&M costs 6 MGD for 10 years @ 4% = $8,881,000 in 2040
   PW = $1,850,000
5. Capital recovery:
   a. WTP expansion $8,800,000 for 10 years begin 2040 = $145,000/yr.
      PW in 2040 = $ 1,176,000 > PW 2000 = **$245,000**
6. Allocation Cost: PW @ $5,000/yr/mgd = $243,000 in 2040, PW = **$51,000**

Total PW Cost for 3D = $3,771,000

Unit Cost = ($3,771,000/10 yrs) / (6,000 TGPD X 365 Days) = **$0.17 /1000 gallons**

APPENDIX

F