FINAL

Application for Jordan Lake Water Supply Allocation

Submitted By

The City Of Durham North Carolina

Submitted to

North Carolina Division of Water Resources

April 2001

Prepared by

CH2MHILL

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Raleigh, NC 27604

DURHAM

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CITY OF MEDICINE

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April 30, 2001

Mr. John Morris, Director
Division of Water Resources
P.O. Box 27687
Raleigh NC 27604

Subject: Jordan Lake Water Supply Storage Allocation Application – Round 3

Dear Mr. Morris:

To meet long-term potable water demands, the City of Durham is requesting a water supply allocation from Jordan Lake. The City of Durham is prepared to enter into the required financial agreement with the State of North Carolina for reimbursement of the construction and operation and maintenance costs associated with the water supply pool of Jordan Lake to the U.S. Army Corps of Engineers.

Allocation Request

With this application, the City of Durham is requesting approval of the following water supply allocations:

Level I: 16 mgd
Level II: 4 mgd

Along conservation, reuse, and 3 MGD from the conversion of Teer Quarry, these water supply storage allocations will allow the City to meet average day demands through 2050, as shown below, while maintaining demand at 80 percent of available supply.

Year	Total Average Day Demand Including Conservation and Reuse (MGD)	Water Supply Required to Maintain Demand at 80% of Available Supply
2000	31.1	38.8
2010	35.9	44.9
2020	41.2	51.5

Year	Total Average Day Demand Including Conservation and Reuse (MGD)	Water Supply Required to Maintain Demand at 80% of Available Supply
2030	44.4	55.5
2040	46.5	58.2
2050	48.6	60.7

The safe yield (50-year) of Durham's existing water supplies is 37 MGD. Therefore, the City needs to develop a new raw water supply source immediately. The attached application demonstrates that Jordan Lake is the most economical, environmentally compatible and expeditious alternative available to the City of Durham. The City of Durham would return the water directly to Jordan Lake and the Cape Fear Basin through the South Durham Water Reclamation Facility and the County's Triangle Wastewater Treatment Plant. Therefore, a water supply allocation from Jordan Lake would result in essentially "no net loss" of water quantity and availability downstream of Jordan Lake, and would offset an existing interbasin transfer from the Neuse River Basin.

If the City of Durham is granted a Jordan Lake Water Supply Allocation, the City will commit to the following terms and conditions of the Allocation:

- The City will work to limit the City's interbasin transfer between the Neuse River and the Cape Fear River.
- The City will agree to work collaboratively with local governments in funding, planning, designing, and constructing a new, regional water supply and treatment system on the west bank of Jordan Lake.
- The City further agrees that any local government that is issued a Jordan Lake Water Supply Allocation will have reasonable access to the new regional raw water supply and treatment system.
- The City further agrees to continue to strongly support, and participate in, water quality monitoring, modeling, and watershed protection programs applicable to Jordan Lake.

Regional Cooperation

Beginning during the Round 2 Water Supply Allocation process, the City of Durham has participated in meetings with representatives from OWASA and Chatham County to consider the formation of a Jordan Water Agency (JWA). Representatives from the Triangle J Council of Governments and the UNC Institute of Government have organized and led these meetings. The JWA would own, operate, and manage a new raw water intake and treatment facility on Jordan Lake. Durham, OWASA, and Chatham County have held preliminary discussions, but any holder of a water supply allocation from Jordan Lake would be invited to participate in the JWA.

The consensus during these initial meetings is that the City of Durham is an essential partner. If a water supply allocation is granted to the City of Durham, the formation of an JWA could proceed. Once the JWA is formed, planning, design, and construction of a raw water intake and pump station on the west side of Jordan Lake would commence. A water treatment facility, potentially located on OWASA-owned property, is also being considered. Currently, staff representatives from the potential partners have developed a draft agreement and have submitted this agreement to their governing boards for review and approval.

In addition, the City of Durham supports other regional initiatives including the Triangle Area Water Supply Monitoring Project and the Cape Fear River Assembly. The City of Durham has supported the Triangle Area Water Supply Monitoring Project since 1988 and contributes more than any other local government. The City has invested in these initiatives because of its commitment to protecting water quality in the region and because Jordan Lake has been considered a potential future water supply source for Durham since it was filled in 1981.

I appreciate your consideration of this application and would like to thank your staff for their assistance in preparation of this application. If you have any questions, or require additional information, please contact me at 919/560-4381, or Kathryn Kalb, Public Works Director, at 919/560-4326.

Sincerely,

CITY OF DURHAM

A. T. Rolan
Director
Department of Environmental Resources

Cc: Mayor Nichloas Tennyson, City of Durham
Durham City Council
Marcia Conner, City of Durham
Gregory A. Bethea, City of Durham
John Pederson, City of Durham
Kathryn Kalb, City of Durham

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1. Water Demand Forecast

1.1 Methodology

Water demand forecasts and projections of growth and development for the City of Durham service area through 2050 were developed as part of the *City of Durham Water and Sewer Strategic Plan* (CH2M HILL, 2000). Projections of growth and development were based on socioeconomic data provided by the Durham City-County Planning Department that was used by the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (MPO) to develop the 2025 Transportation Plan. The growth and development projections assume that no growth outside of the Urban Growth Area (UGA) will be supported by urban services such as municipal water and sewer service. The UGA was developed by the City Council and County Commissioners in Durham to control development and urban sprawl. Durham's growth policy prohibits extension of water and sewer services outside of the UGA except for schools, industries, and certain properties with potential health hazards due to failing well and septic systems. The City of Durham and Durham County can modify the UGA, but only during an update of the Durham Comprehensive Plan.

Projections of population and single-family and multi-family housing units were provided by the City-County Planning Department for each Transportation Analysis Zone (TAZ) within Durham County from 1995 to 2025 in 5-year increments. Only the TAZs within the UGA were used to develop water demand forecasts. The City-County Planning Department has also determined buildout values for each TAZ. To extrapolate projections to 2050, it was assumed that each TAZ would reach buildout by 2050 and thus, growth was assumed to grow linearly until buildout is achieved.

Water demand forecasts were developed for the following water use sectors:

- Single-family residential
- Multi-family residential
- Commercial
- Industrial
- Institutional
- Bulk Sales
- Process Water
- Unaccounted-for water

Demands for the single-family and multi-family water use sectors were forecasted based on the housing unit projections discussed above. Demands for other water use sectors were forecasted assuming that the relative distribution of water use among the sectors would remain consistent through the planning period. Table 1 shows that the relative distribution of water demands by sector has been consistent during the period 1996 through 2000. The greatest variation in the distribution occurs in 2000. This is a result of the City of Durham reviewing its water and sewer accounts and reclassifying some accounts that were classified inaccurately when the account was created. Therefore, the average distribution of water use sector

TABLE 1.
Distribution of Water Use by Sector

Year	Residential	Commercial	Industrial	Institutional
1996	56%	22%	10%	13%
1997	57%	22%	9%	12%
1998	57%	22%	9%	11%
1999	58%	21%	9%	13%
2000	58%	24%	6%	12%

Source: City of Durham Environmental Resources Dept.

1.1.1 Residential

Residential water demand forecasts were developed based on projections of single-family and multi-family housing units and unit water use factors. The City of Durham monitors total residential water usage and does not track single-family and multi-family usage. Estimates of the total number of residential units served by the City of Durham were obtained from the Environmental Resources Department. The City-County Planning Department tracks the number of single-family and multi-family dwelling units within the City of Durham and Durham County on an annual basis. Since 1998, single-family housing units have averaged 60 percent and multi-family housing units have averaged 40 percent of the total number of housing units in the City of Durham and. This breakdown was applied to the City's estimate of the housing units it serves to obtain the number of single-family and multi-family housing units served each year. Water usage for the single-family and multi-family sectors shown in Tables 2 and 3 were also estimated based on a detailed review of account records for fiscal year 2000. The data suggest that the single-family sector accounts for 75 percent and the multi-family sector accounts for 25 percent of the total residential water use. Therefore, the number of housing units and the annual water use for both the single-family and multi-family residential sectors were estimated. The unit water use factors presented in Tables 2 and 3 are estimates and may not reflect actual water use for each sector.

Table 2 shows the estimated water use by the single-family residential sector from 1996 through 2000. The unit water usage for the single-family residential sector over the period averaged 243 gallons per day (gpd) per single-family residential housing unit. This unit use is within industry standards for residential water use. According to the American Water Works Research Foundation (AWWARF) publication *Residential End Uses of Water* (1999), average day water use for a typical residence is 311 gpd.

TABLE 2
Historical Single-Family Residential Water Usage

Year	Single-family Residential Housing Units	Single-family Residential Water Use (MG)	Unit Water Use (gpd/SFR unit)
1996	34,000	3,150	253.8
1997	38,997	3,366	236.5
1998	36,935	3,474	257.7
1999	42,828	3,569	228.3
2000	43,463	3,764	237.3
		Average	243

Source: City of Durham Environmental Resources Dept., City-County Planning Dept.

Water use by the multi-family residential sector from 1996 through 2000 is summarized in Table 3. The average unit water use for the multi-family residential sector during the period was 121 gpd per housing unit. This unit use is within industry standards for residential water use.

TABLE 3
Historical Multi-Family Residential Water Usage

Year	Multi-family Residential Housing Units	Multi-family Residential Water Use (MG)	Unit Water Use (gpd/MFR unit)
1996	22,667	1,050	126.9
1997	25,998	1,122	118.2
1998	24,623	1,158	128.8
1999	28,552	1,190	114.2
	28,976	1,255	118.6
		Average	121

Source: City of Durham Environmental Resources Dept., City-County Planning Dept.

1.1.2 Commercial

The commercial sector includes water use by retail businesses. Growth in the commercial sector is closely linked with growth in the housing sector since population growth is the driver for additional commercial goods and services. Water demands for the commercial sector were forecasted assuming that the relative mix of commercial demands to total system demands would remain relatively constant through the planning period. From 1996 to 2000, commercial sector demands accounted for 21 to 24 percent of the total system demand. The average for the period was 22 percent, which was selected for projecting future commercial sector demands.

TABLE 4
Historical Commercial Water Use

Year	Commercial Sector Demand (MG)	Total System Demand (MG)	Commercial Demand/ Total Demand
1996	1,635	7,551	22%
1997	1,685	7,835	22%
1998	1,783	8,086	22%
1999	1,713	8,254	21%
2000	2,092	8,619	24%
Average			22%

Source: City of Durham Environmental Resources Dept.

1.1.3 Industrial

Water demand forecasts for the industrial sector were developed assuming that the relative contribution of industrial sector demands to the total system demand would remain constant through the planning period. Historical water use by the industrial sector is summarized in Table 5. Industrial water use has accounted for 6 to 10 percent of the total system demand from 1996 to 1999. The average contribution of the industrial sector was 9 percent. Industrial water use in declined from 722 MG in 1999 to 501 MG in 2000. This is due to the loss of a few industries such as Liggett & Myers and Mitsubishi Semiconductor as well as re-classification of some industrial and commercial users.

TABLE 5
Historical Industrial Water Use

Year	Industrial Sector Demand (MG)	Total System Demand (MG)	Industrial Demand/Total Demand
1996	734	7,551	10%
1997	719	7,835	9%
1998	756	8,086	9%
1999	722	8,254	9%
2000	501	8,619	6%
Average			9%

Source: City of Durham Environmental Resources Dept.

1.1.4 Institutional

Institutional water use includes all water use from governmental or municipal facilities including Duke University and Duke Medical Center, North Carolina Central University, and the Durham Regional Hospital. Some of the end uses in this sector range from water main flushing, indoor use, cooling tower make up water, and water use by laboratory and research facilities. Water use by the institutional sector was forecasted assuming that the growth in the institutional sector would be similar to the growth in the residential sector. Therefore, institutional water use is projected to increase from 3.56 mgd in 2000 to 5.76 mgd in 2050, representing an increase of 2.2 mgd over the 50-year period. This growth seems reasonable since the institutional sector includes several large research facilities (US EPA and NIEHS), universities, and hospitals. Eight of Durham's top-ten highest water users are in the institutional sector (see Attachment 1: Local Water Supply Plan) including :

- Duke University and Medical Center
- Durham Regional Hospital
- Durham Public Schools
- U.S. Environmental Protection Agency (US EPA)
- Durham County
- NC Central University
- National Institute of Environmental Heath Sciences (NIEHS)
- VA Hospital

Water use for Durham County, Durham County Public Schools, and the City of Durham will increase at a similar rate to the residential sector since the City and County will expand public services to keep pace with a larger population.

The specific growth plans for US EPA and NIEHS are not known. However, US EPA is constructing a new campus in Research Triangle Park that will be EPA's major center for air pollution research and regulation. The new campus will have approximately 1.2 million square feet and has space for 2,200 employees.

According to the *Facilities Profile and 10-Year Capital Plan* (Eva Klein & Associates, 1999), North Carolina Central University (NCCU) plans to increase its student population by 49 percent over the next 10 years. In November 2000, the Higher Education Improvement Bond was passed by North Carolina voters, which will provide approximately $118.7 million for expansion and improvement of facilities at NCCU.

Duke University and the Duke University Medical Center (DUMC) represent the largest customer in the City of Durham service area. Therefore, Duke is separated out as a subsector of the institutional sector. The historical and projected growth trends for Duke University and Duke University Medical Center are shown in Table 6. Duke University and DUMC currently occupies approximately 10.9 million gross square feet (GSF) of building space. Facilities Management projects that another 2.2 million GSF will be added over the next 20 years. Currently, construction projects totaling 1.1 million GSF are in various planning stages so this projection may be conservative. Beyond 2020, building space was projected linearly to 2050.

TABLE 6
Historical and Projected Building Space for Duke University and the Duke Medical Center

Year	Gross Square Footage Added During Period	Cumulative Gross Square Footage
pre 1940	1,500,000	1,500,000
1941 – 1960	1,200,000	2,700,000
1961 – 1980	4,400,000	7,100,000
1981 – 2000	3,800,000	10,900,000
2001 – 2020	2,500,000	13,400,000
2020 - 2030	1,720,000	15,120,000
2030 - 2040	1,600,000	16,720,000
2040 – 2050	1,600,000	18,320,000

Source: Facilities Planning, Duke University

Duke University has grown at an average rate of 1.57 million GSF per decade. This trend is expected to continue given the pressure for institutions of higher education to expand. The UNC system is expected to expand by 48,000 students over the next decade. Therefore, Duke University and the DUMC are expected to continue to grow at an aggressive pace since:

- Duke University owns nearly 3,000 acres within Durham County
- Duke University's endowment is currently $2.66 billion
- Campaign for Duke has raised $1.46 billion of its $2.0 billion goal
- Duke University is ranked 3rd best Medical School by U.S. News and World Report for 2002

If the long-term historical growth rate continues, Duke University and DUMC will increase to approximately 18.75 million GSF by 2050, representing a 72 percent increase. The total water demand for Duke University and DUMC was 1.72 mgd in 1999. Therefore, its unit water use was 158 gpd per 1,000 GSF. This unit water use compares well with the unit use for the University of North Carolina at Chapel Hill of 180 gpd per 1,000 GSF (*Technical Memorandum 3.2: OWASA Water and Sewer Master Plan Baseline and Alternative Water Demand Forecasts*, CH2MHILL, 1999). If water use continues at this unit rate, then water demand for Duke's facilities in 2050 could reach 3.0 mgd. This would account for 1.28 mgd (or 58 percent) of the 2.20-mgd increase in water demand projected for the institutional sector over the 50-year planning horizon.

Water demand forecasts for the institutional sector were developed assuming that the relative contribution of institutional sector demands to the total system demand would remain constant through the planning period. Historical water use by the institutional sector is summarized in Table 7. Institutional water use has accounted for 11 to 13 percent of the total system demand from 1996 to 2000. The average contribution of the institutional sector was 12 percent, so this percentage was used to forecast future demands for the institutional sector through 2050.

TABLE 7
Historical Institutional Water Use

Year	Institutional Sector Demand (MG)	Total System Demand (MG)	Percentage of Institutional Demand to Total Demand
1996	981	7,551	13%
1997	942	7,835	12%
1998	915	8,086	11%
1999	1,060	8,254	13%
2000	1,007	8,619	12%
Average			12%

Source: City of Durham Environmental Resources Dept.

RTP is located within Durham and Wake Counties. Approximately, 5,400 acres of the total 7,000 acres are located within Durham County, and the City of Durham serves this portion of RTP with finished water. RTP is a major employment center in the Triangle area with approximately 42,000 employees. RTP includes industrial, commercial, and institutional water users. Demand forecasts for RTP were recently completed by CH2M HILL for the RTP Water and Sewer Facilities Plan and are included here for reference. Table 8 summarizes the demand forecasts for the Durham County portion of RTP and all of the non-residential sectors served by the City of Durham. Water demands for RTP were developed based on existing and expected building square footage. Many of the companies in RTP have plans to expand operations or acquire additional property in RTP within the next 25 years, so growth and development in RTP is expected to continue at a steady rate.

Water demands in the Durham County portion of RTP are expected to increase to 9.3 million gallons per day (MGD) by 2030 and 12.2 MGD by 2050. Water demands in RTP are expected to account for a larger portion of the non-residential demand in the City of Durham in the future with RTP accounting for up to 48% of total non-residential demand by 2050.

TABLE 8
Demand Forecasts for Industrial and Institutional Users in RTP (Durham County)

Year	Building Square Footage	ADD in Durham County RTP (MGD)	ADD for Non-Residential Sectors Served by City (MGD)	RTP Demand/Total Non-Residential Demand (%)
2000	16,762,000	4.9	15.8	31%
2005	19,291,000	5.6	17.1	33%
2010	21,821,000	6.3	18.6	34%
2015	24,350,000	7.1	19.9	35%
2020	26,880,000	7.8	21.4	36%
2025	29,409,000	8.5	22.6	38%
2030	31,939,000	9.3	23.2	40%
2035	34,468,000	10.0	23.8	42%
2040	36,998,000	10.7	24.3	44%
2045	39,528,000	11.5	24.9	46%
2050	42,057,000	12.2	25.5	48%

Source: *Research Triangle Park South Water and Sewer Facilities Planning Study*, CH2M HILL, April 2001.

1.1.5 Bulk Sales

The City of Durham has a contract to provide up to 5.0 MGD of finished water to the Towns of Cary and Morrisville through May 2002 and up to 0.2 MGD to Chatham County through September 2005. The guaranteed purchase amount or the minimum purchase is 80 percent of the contract amount, so the City is committed to provide at least 4.16 MGD through 2002 and 0.16 MGD through 2005 to local water systems. Beyond 2005, there is no committed amount of finished water, and these contracts will be to supply water during emergencies only. The City also has sale-purchase agreements to supply finished water to local utilities including OWASA, the Town of Hillsborough, and the Orange-Alamance Water System, only during emergencies.

1.1.6 System Processes

A portion of the raw water withdrawn is used during the water treatment process for filter backwashing or is lost through treatment residuals. Table 9 summarizes the amount of process water used at Durham's water treatment facilities from January 1999 through October 2000. The average amount of process water used during the period was 8% of the raw water treated. This percentage was applied to the subtotal of the water demands for each of the above water use sectors.

1.1.7 Unaccounted-for Water

Unaccounted-for water in the City of Durham water system is summarized in Table 10. Unaccounted-for water has exceeded industry standards in recent years. However, the City of Durham is taking proactive steps to reduce the amount of unaccounted-for water through the following:

- Enhanced meter testing, calibration, and replacement program
- Improved accounting and metering of unbilled water use by City facilities
- Upgraded customer accounting and billing system

TABLE 9
Historical Process Water Production

Date	Raw Water Treated (MG)	Total Finished Water Pumped (MG)	Process Water (MG)	Process Water (%)
Jan-99	887	851	36	4%
Feb-99	781	738	43	5%
Mar-99	902	856	46	5%
Apr-99	931	856	75	8%
May-99	1,041	991	50	5%
Jun-99	1,117	1,091	27	2%
Jul-99	1,169	1,119	50	4%
Aug-99	1,301	1,098	203	16%
Sep-99	1,100	942	157	14%
Oct-99	1,102	956	146	13%
Nov-99	1,038	939	99	9%
Dec-99	962	915	47	5%
Jan-00	990	917	74	7%
Feb-00	977	860	117	12%
Mar-00	1,009	951	58	6%
Apr-00	1,008	909	98	10%
May-00	1,224	1,109	115	9%
Jun-00	1,217	1,103	114	9%
Jul-00	1,212	1,102	111	9%
Aug-00	1,139	1,014	125	11%
Sep-00	1,006	879	127	13%
Oct-00	1,095	1,005	90	8%
		Average	91	8%

Source: City of Durham Environmental Resources Dept.

Unaccounted-for water in the City of Durham has exceeded 10%, the maximum level allowed by DWR for forecasting water demands for this application, in recent years. However, the City of Durham initiated a program to reduce accounted-for water in 1999 by modifying and improving its meter testing and replacement program. The City has also improved its accounting of unbilled water use through installation of meters or better estimates of water use. The implementation of these steps has resulted in lower unaccounted-for water with this percentage dropping from 25% in 1998 to 13% so far in 2000. The City of Durham is committed to lowering unaccounted-for water to below 10%, the widely accepted industry standard. Therefore, 10% was used to estimate unaccounted-for water in the demand forecasts.

TABLE 10
Historical Unaccounted-for Water

Year	Total Finished Water Pumped to System (MG)	Total Water Sales (MG)	Total Unbilled Water Usage (MG)	Unaccounted-for Water (%)
1996	9,897	7,662	110	21%
1997	10,650	7,950	143	24%
1998	11,209	8,277	98	25%
1999	11,351	9,049	84	20%
2000	6,951	5,908	109	13%

Source: City of Durham Environmental Resources Dept.

1.2 Population and Housing Unit Projections

As discussed in Section 1.1, the City-County Planning Department developed projections of housing units and population through 2025. These data were modified to forecast the number of housing units served by the City of Durham through 2050 by assuming that the existing Urban Growth Area (UGA) would not change in the future and that the UGA would reach buildout by 2050 (Table 11). The number of housing units served by the City of Durham service area is expected to increase from 82,659 in 2000 to 133,853 in 2050. This represents an increase of approximately 62% in the number of housing units or an average annual rate of increase of 1.0%.

The service area population for Durham was estimated using the City-County Planning Department's assumption of 2.46 people per household. Recently, data for Census 2000 was released which indicates that the population for the City of Durham was 187,035 and the population for Durham County was 223,314. Based on this new census information, the service area population projections presented here seem reasonable.

TABLE 11
Population and Housing Unit Forecasts for the City of Durham Service Area[1]

Year	Population	Total Housing Units	Single-Family Residential Units	Multi-Family Residential Units
2000	203,341	82,659	50,505	32,154
2005	221,030	89,849	54,898	34,951
2010	240,530	97,776	59,741	38,035
2015	257,166	104,539	63,873	40,666
2020	276,403	112,359	68,651	43,708
2025	291,397	118,454	72,376	46,079
2030	298,974	121,534	74,257	47,277
2035	306,550	124,614	76,139	48,475
2040	314,127	127,694	78,021	49,673
2045	321,703	130,774	79,903	50,871
2050	329,280	133,853	81,784	52,069

1. Based on data provided by Durham City-County Planning Dept.

1.3 Water Demand Forecasts

Average day water demand forecasts are based on the methodology presented in Section 1.1 and are summarized in Table 12. Average day water demands for the City of Durham service area, excluding committed sales to other utilities, are expected to increase from 49.2 MGD in 2000 to 54.2 MGD in 2050. The City of Durham expects that unit water use will be reduced by 6 percent by 2050 based on its Water Conservation Program outlined in Section 2. Also, the City plans to initiate a water reuse program within its service area. Mlore information on the impact of conservation and reuse is included in Section 2.

The water demand forecasts do not include committed sales to local utilities. The City of Durham is committed to supply at least 4.0 MGD to the Towns of Cary and Morrisville through May 2002. The City also has a contract to supply Chatham County with a minimum of 0.16 MGD through September 2005.

TABLE 12
Projected Average Daily Service Area Demand[1,2]

	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Residential											
Single-family	10.28	13.3	14.5	15.5	16.7	17.6	18.0	18.5	19.0	19.4	19.9
Multi-family	3.43	4.2	4.6	4.9	5.3	5.6	5.7	5.9	6.0	6.2	6.3
Commercial	5.72	6.7	7.3	7.8	8.3	8.8	9.0	9.3	9.5	9.7	9.9
Industrial	1.37	2.8	3.1	3.3	3.5	3.7	3.8	3.9	4.0	4.1	4.2
Institutional	1.41	1.98	2.22	2.41	2.65	2.75	2.73	2.76	2.79	2.77	2.75
Duke University and Med. Ctr.	1.72	1.82	1.91	2.01	2.10	2.25	2.40	2.50	2.60	2.75	2.90
System Processes[3]	2.54	2.5	2.7	2.9	3.1	3.3	3.3	3.4	3.5	3.6	3.7
Unaccounted-for water	4.48	3.1	3.4	3.6	3.9	4.1	4.2	4.3	4.4	4.5	4.6
Total Service Area Demand	30.95	36.4	39.6	42.4	45.5	48.0	49.2	50.5	51.7	53.0	54.2

1. all data in million gallons per day
2. Does not include sales to other systems
3. System processes includes main flushing and process losses during treatment.

2. Conservation and Demand Management

The City of Durham is committed to water conservation and reuse to reduce water demands and to increase the efficient utilization and protection of existing natural resources. The City of Durham has formed a Water Conservation Program within the Environmental Resources Department. The Water Conservation Program advocates water conservation and demand management within Durham and manages the City's water conservation initiatives and policies (see Attachment 2 – Water Conservation Ordinance). Since creation of the Water Conservation Program, the City has implemented the following actions, which were recommended in a Water Resources Research Institute study entitled *Water Conservation in Durham: Economic and Financial Impacts of Selected Programs*:

- Creating a Water Conservation Program within the Environmental Resources Department and hiring two staff members
- Initiating a public education campaign within the City to inform the public of water conservation measures through brochures, a web page, and presence at community events
- Lobbying the North Carolina Building Code Council to amend the State Building Code to require low-flow toilets in new construction
- Developing a Showerhead Exchange Program to distribute low-flow, water-conserving showerheads
- Conducting water use assessments for residential and commercial customers to determine water use patterns and recommend options for reducing water use

The Water Conservation Program is responsible for promoting water conservation in the City of Durham and administering public education and information programs for the Environmental Resources Department. These personnel coordinate tours of reservoirs and water treatment and reclamation facilities and participate in community events. In addition to interactive public outreach, this division maintains an active City-linked web site that highlights various aspects of the division's functions, including the new Water Quality Report, water conservation techniques, and a calendar of events.

In addition to sharing information about water quality and conservation, the Water Conservation Division conducts a Showerhead Exchange Program that allows customers to exchange older showerheads for low-flow heads that are designed to conserve water. Staff also conduct water use assessments (by request only) in homes and businesses to determine if and where leaks exist and to determine water use patterns. Then staff recommend ways to use water more efficiently and reduce water and sewer bills. There is a $10 charge for this service.

The City of Durham has also converted its water rate structure from a declining block rate to a single-block rate. This change will promote water conservation among City of Durham customers since higher water use results in higher water charges compared to the declining block rate structure. The City of Durham anticipates that the water conservation measures outlined above along with the impacts of low-flow plumbing fixtures will reduce overall demands by 6 percent by 2030. The City plans to reduce non-residential water demands through non-potable water reuse as outlined below.

The City is also committed to developing a non-potable reuse program within the service area. The City has upgraded and improved both of its wastewater treatment plants to include tertiary treatment. These upgrades allow the City to utilize its plants as water reclamation facilities and supply reuse water to its customers for non-potable uses. The City conducted an evaluation of water reuse opportunities throughout its service area as part of the *Water and Sewer Strategic Plan* (CH2M HILL, 2000) to determine areas within the service area where water reuse could effectively be implemented.

The potential for water reuse was estimated by evaluating the water use patterns within the Durham service area and examining long-term climatological records. Water consumption records for Durham's non-residential customers were examined to determine the distribution of non-potable demands throughout the service area.

The evaluation identified the three key areas within the service area where there is a concentration of potential users with high non-potable demands that could sustain a water reuse program. A phased approach was recommended to allow Durham to target those areas with the highest potential for water reuse, provide for public acceptance of reclaimed water, and minimize the initial capital costs of implementing a reclaimed water program. The water reuse program would be implemented in three phases:

Phase I: Research Triangle Park and Southeast Durham
Phase II: North Durham and Treyburn
Phase III: West and Central Durham

This approach was determined by evaluating and comparing the potential for water reuse among various sectors in the City of Durham. Capital costs for constructing a reclaimed water distribution system were also considered. These costs are affected by the proximity of potential reclaimed water customers to one another, and the to the wastewater treatment facilities. However, a detailed economic analysis was not conducted to evaluate the rates and fees for reclaimed water.

RTP was selected as the preferred location for implementation of a water reuse program. Based on 1998 water demands, the reuse potential for RTP was estimated at 1.38 MGD (Table 13). Implementation of a water reuse program for RTP is considered feasible due to:

- Close proximity of the potential reuse customers within RTP
- Close proximity of a source for reclaimed water (South Durham WRF or Triangle WWTP)
- High non-potable demands, particularly non-seasonal demands
- Support of water reuse by some customers in RTP

TABLE 13
Overall Water Reuse Potential in RTP

Customer Type	Number of Customers	Total Reuse Potential (MG)
Commercial	21	106.0
Institutional	10	117.6
Industrial	19	280.8
Total Average Day Demand (mgd)		1.38

Therefore, the City is planning to pursue water reuse in RTP. The feasibility of implementing water reuse within other areas of the Durham service area is uncertain since a detailed economic analysis has not been conducted and the City has not obtained widespread support for reuse in other areas of the service area. Therefore, each of the water supply alternatives presented in Section 5 includes water reuse based on the implementation of a reclaimed water program in RTP only. The total reuse potential for RTP was estimated at 1.38 mgd, however, a water reuse program for RTP would have a target demand of approximately 1 mgd since not all of the potential non-potable demand may be suitable for reuse due to:

- Reclaimed water may not be suitable for some industrial process uses
- Participation in the reuse program may not be 100 percent
- A portion of the total potential demand is represented by many smaller users and it may not be economically feasible to supply reclaimed water to all potential users initially.

The total water average day demand for all users in the Durham County portion of RTP was 4.9 mgd in 2000. Assuming that the a water reuse program could be implemented with a total demand of 1 mgd, then reuse would meet approximately 20 percent of the total demand in the Durham portion of RTP. Reuse demands were projected assuming that reclaimed water would meet 20 percent of the total demand in RTP and that a reuse program would be implemented by 2005. Reuse demand could reach 1.86 by 2030 and 2.44 mgd by 2050 based on the water demand projections for RTP presented in Table 8.

Table 14 summarizes the projected impact of water conservation and reuse on potable demands through 2050. Conservation is expected to reduce demands by 2.9 mgd or 6 percent by 2030. Reuse demand is expected to reach 1.9 MGD by 2030. Therefore, conservation and reuse are expected to have a combined impact of reducing potable demands by 4.8 MGD by 2030 or approximately 10 percent.

TABLE 14
Impact of Conservation and Reuse on Potable Demand Forecasts for City of Durham

Year	Projected ADD[1] (MGD)	Projected Demands with Conservation[2] (MGD)	Projected Reuse Demand
2000	31.0	31.0	N/A
2005	36.4	34.2	1.1
2010	39.6	37.2	1.3
2015	42.4	39.8	1.4
2020	45.5	42.8	1.6
2025	48.0	45.1	1.7
2030	49.2	46.3	1.9
2035	50.5	47.5	2.0
2040	51.7	48.6	2.1
2045	53.0	49.8	2.3
2050	54.2	51.0	2.4

1. Projected demands for City of Durham (from Table 8)
2. Demands assuming 6% reduction in total demands due to conservation

3. Current Water Supply

The City of Durham obtains its raw water from two protected reservoirs, Lake Michie and the Little River Reservoir. Both reservoirs are located within the Neuse River basin in northern Durham County. Information on these two water supply sources is summarized in Table 15. Lake Michie was impounded on the Flat River in 1926 and has a total storage volume of 4 billion gallons (BG). The 50-year safe yield of Lake Michie is 19 MGD based on a 1988 study *Evaluation of Alternative Reservoirs on the Flat River and Little River* (Hazen and Sawyer). The Little River Reservoir was impounded on the Little River in the late 1980s. This reservoir has a total storage volume of 4.9 BG. The 50-year safe yield of the Little River Reservoir is 18 MGD. Therefore, the total capacity of the City of Durham's raw water supplies is 37 MGD on a 50-year safe yield basis.

TABLE 15
Current Water Supply Sources for the City of Durham

Source	County	Basin	Source Type	Safe Yield (50-year)	Water Quality
Lake Michie	Durham	Neuse	surface	19	good[1]
Little River Reservoir	Durham	Neuse	surface	18	good[1]

1. Reservoir is in a protected watershed

4. Future Water Supply Needs

Based on the water demand forecasts presented in Section 1 and the current water supply capacity of 37 MGD, the future water supply needs for the City of Durham service area are summarized in Table 16. Currently, the City of Durham has a water supply deficit of 3.8 MGD. The City of Durham has contracts with three neighboring water systems to sell or purchase water on an emergency basis. Typically, Durham provides other systems with finished water and has not purchased water from a neighboring system since 1995. However, the City has wholesale contracts guaranteeing the Towns of Cary and Morrisville with up to 5 MGD of finished water and a contract guaranteeing Chatham County with up to 0.2 MGD. However, the City is not committed to provide any guaranteed amount beyond 2005. All of Durham's contracts are on an emergency basis only by the end of 2005 when the City's excess water supply will be only 2.6 MGD.

Due to continued growth within the Urban Growth Area of Durham, water demands are projected to increase to approximately 46.3 MGD by 2030 and 51.0 MGD by 2050. Although the City of Durham is pursuing several alternatives for expanding its water supply capacity, no projects have been completed or permitted. The water supply deficit based on the existing water supply capacity is estimated to be 9.3 MGD by 2030 and 14.0 MGD by 2050. Therefore, the long-term water supply needs for the City of Durham are projected to be approximately 14.0 MGD just to meet service area demands through 2050. In order to maintain water demands at less than 80 percent of water supply capacity, an additional 27 MGD of water supply capacity will need to be secured by 2050.

TABLE 16
Future Water Supply Needs

	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Available Supply											
(1) Existing Surface Water Supply	37	37	37	37	37	37	37	37	37	37	37
(2) Existing Ground Water Supply	0	0	0	0	0	0	0	0	0	0	0
(3) Existing Purchase Contracts	0	0	0	0	0	0	0	0	0	0	0
(4) Future Supplies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5) Total Available Supply	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
Average Daily Demand											
(6) Service Area Demand[a]	31.0	34.2	37.2	39.8	42.8	45.1	46.3	47.5	48.6	49.8	51.0
(7) Existing Sales Contracts	5.0	0.2	0	0	0	0	0	0	0	0	0
(8) Future Sales Contracts	0	0	0	0	0	0	0	0	0	0	0
(9) Total Average Daily Demand[a]	36.0	34.4	37.2	39.8	42.8	45.1	46.3	47.5	48.6	49.8	51.0
(10) Demand as Percent of Supply	97%	93%	101%	108%	116%	122%	125%	128%	131%	135%	138%
(11) Supply Needed to maintain 80%	45.0	43.0	46.5	49.8	53.5	56.4	57.9	59.3	60.8	62.3	63.7
Additional Information for Jordan Lake Allocation											
(12) Sales Under Existing Contracts	5	0.2	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
(14) Demand in each planning period	36.0	34.4	37.2	39.8	42.8	45.1	46.3	47.5	48.6	49.8	51.0
(15) Supply minus Demand	1.0	2.6	-0.2	-2.8	-5.8	-8.1	-9.3	-10.5	-11.6	-12.8	-14.0

[a.] Includes water conservation. Water reuse is not included but is considered as a future water source (see Section 5).

5. Alternative Water Supplies

The City of Durham has considered several alternatives to meet its long-term water supply needs to 2050 and to support projected growth in the service area. These water supply sources were evaluated in the *City of Durham Water and Sewer Utility Strategic Plan* (CH2M HILL, 2000) and are summarized below. To the extent possible, all water supply alternatives were developed such that the water demands do not exceed 80% of the available supply.

Water Supply Alternative	Description
1	a) Obtain 20-MGD allocation from Jordan Lake b) Convert Teer Quarry to water supply storage c) Implement non-potable reuse program
2a	a) Raise WSE of Lake Michie to 365 ft. b) Convert Teer Quarry to water supply storage c) Implement non-potable reuse program
2b	a) Convert Teer Quarry to water supply storage b) Raise WSE of Lake Michie to 365 ft. c) Transfer Wastewater from SDWRF to NDWRF
3a	a) Convert Teer Quarry to water supply storage b) New reservoir on the Flat River c) Implement non-potable reuse program
3b	a) Convert Teer Quarry to water supply storage b) New reservoir on the Flat River c) Implement non-potable reuse program d) Transfer Wastewater from SDWRF to NDWRF
4a	a) Convert Teer Quarry to water supply storage b) Utilize water supply in Kerr Lake c) Implement non-potable reuse program
4b	a) Convert Teer Quarry to water supply storage b) Utilize water supply in Kerr Lake c) Implement non-potable reuse program d) Transfer Wastewater from NDWRF to Kerr Lake e) Transfer Wastewater from SDWRF to NDWRF
5	a) Obtain 16-MGD water supply allocation from Jordan Lake b) Convert Teer Quarry to water supply storage d) Raise WSE of Lake Michie to 365 ft. c) Implement non-potable reuse program

Each water supply alternative was evaluated using the criteria listed below:

- Environmental impacts (compared to the Jordan Lake alternative)
- Water quality classification
- Timeliness of implementation
- Interbasin transfers
- Potential for regional partnerships
- Technical complexity
- Institutional complexity
- Political complexity
- Public benefits such as recreation
- Consistency with local plans
- Capital and Operation/Maintenance Cost

A summary of the results of the evaluation of each water supply alternative is shown in Table 17. Each alternative is discussed in further detail in the following sections. Alternatives 2, 3, and 4 would require interbasin (IBT) certificates since these alternatives represent an increase over a grandfathered IBT amount or a new IBT. Therefore, two options are presented for each alternative that results in an increased IBT with one option returning wastewater to the source basin to eliminate the IBT or maintain the IBT at the grandfathered amount.

TABLE 17
Summary of Water Supply Alternatives

	Alternatives							
	1	**2a**	**2b**	**3a**	**3b**	**4a**	**4b**	**5**
Total Supply (MGD)	62	60	60	65	65	67	67	76
Environmental Impacts	same	worse	worse	worse	worse	worse	worse	same
Water Quality Classification	WS-IV	WS-III	WS-III	WS-III, WS-II	WS-III, WS-II	WS-III	WS-III	WS-II
Interbasin Transfer (MGD)[1]	30[2]	40[3]	30[4]	40[3]	30[4]	29[4]	0[5]	30[2]
Regional Partnerships	yes	yes	yes	no	no	yes	yes	yes
Technical Complexity	complex	very complex	very complex	very complex	very complex	complex	complex	complex
Institutional Complexity	complex	very complex	very complex	very complex	very complex	very complex	very complex	very complex
Political Complexity	complex	very complex	very complex	very complex	very complex	very complex	very complex	very complex
Public Benefits	none	few	few	few	few	few	few	none
Consistency with Local Plans	yes	yes	yes	yes	yes	yes	yes	yes
Net Present Value ($ Millions)	$168.6	$200.5	$227.8	$226.1	$253.4	$130.6	$226.1	$207.4
Unit Cost ($/gallon)[6]	$6.74	$8.72	$9.90	$8.08	$9.05	$4.35	$7.54	$5.32

1. *Maximum IBT amount that occurs during 2000 to 2050 (on a maximum day basis)*
2. *IBT from Neuse River Basin to Cape Fear Basin. IBT increases to approximately 30 MGD until Jordan Lake facilities are online (2006). Once a Jordan Lake supply is online, IBT amount would decrease and could be managed to remain below grandfathered amount.*
3. *IBT from Neuse River Basin to Cape Fear Basin. Maximum IBT amount occurs in 2050.*
4. *IBT from Neuse River Basin to Cape Fear Basin. Maximum IBT amount occurs in 2030 until facilities are online to transfer wastewater back to source basin.*
5. *IBT is from Roanoke River Basin to Neuse/Cape Fear Basins. Maximum IBT amount occurs in 2050.*
6. *Unit cost equals the net present value divided by the incremental increase in safe yield (above 37 mgd).*

5.1 Alternative 1 – Obtain 20-MGD Jordan Lake Allocation

In this alternative, the City of Durham would secure a 16-MGD Level I and a 4-MGD Level II water supply allocation for Jordan Lake. The City of Durham would also implement a non-potable reuse program, and convert Teer Quarry into an offline raw water storage reservoir. The non-potable reuse program would be implemented to meet a projected demand of approximately 1.9 MGD in 2030. The City is also considering converting a rock quarry into an offline storage reservoir that would be filled using Eno River and excess flow from Lake Michie and the Little River Reservoir. Preliminary estimates indicate that the 50-year safe yield of Teer Quarry could be approximately 3 MGD. However, studies are ongoing to verify the storage volume of Teer Quarry and its 50-year safe yield. This alternative would increase total water supply capacity to approximately 62 MGD. This alternative ensures that projected water demands through 2050 do not exceed 80% of the available water supply.

Environmental Impacts

This alternative represents the baseline alternative in which a Jordan Lake water supply allocation is secured to meet long-term water demands. The environmental impacts of other alternatives will be compared to this one.

Water Quality Classification

Jordan Lake is classified as a public water supply (WS-IV). The water quality of Jordan Lake is considered good although the watershed is becoming more developed and there are several discharges into the upper reaches of Jordan Lake. A Comprehensive Management Plan for Jordan Lake has been considered to ensure that future water quality in Jordan Lake is suitable for drinking water supply. The City currently has more stringent buffer requirements than the State for the portion of the watershed located in Durham.

Timeliness

The City of Durham has been involved in discussions with OWASA and Chatham County since 1999 regarding the potential for regional cooperation in developing Jordan Lake as a water supply. OWASA currently owns approximately 125 acres of land on the west side of Jordan Lake that may be used for a new water treatment plant. OWASA also commissioned a study in 1991 to evaluate alternatives for siting a new raw water intake on the west side of Jordan Lake. With much of the preliminary work completed, the City of Durham could potentially construct the necessary facilities to utilize Jordan Lake and have them online by 2006. The phasing of the projects in this alternative is illustrated in Attachment 3.

Interbasin Transfers

Since Durham withdraws all of its raw water from the Neuse River Basin and discharges a portion of its treated wastewater in the Cape Fear Basin, there is currently an IBT from the Neuse River Basin to the Cape Fear River Basin. If the City of Durham is granted an allocation from Jordan Lake, this IBT would be reduced and 100 percent of the raw water withdrawn would be returned to the Cape Fear Basin through the City's South Durham WRF and the County's Triangle WWTP. The IBT from the Neuse River Basin to the Cape Fear Basin is approximately 26 MGD and would increase to approximately 30 MGD until facilities to utilize Jordan Lake are online. Once Jordan Lake facilities are online, the IBT would decrease. The IBT amount would depend upon how the City of Durham manages withdrawals from its supplies in the Neuse basin and Jordan Lake. However, it is assumed that the IBT could be managed to remain below the City's grandfathered IBT amount.

Regional Partnerships

Since 1999, the City of Durham has been involved in discussions with OWASA and Chatham County regarding the potential for forming a Jordan Water Agency (JWA). The JWA would construct, operate, and manage a new raw water intake and water treatment facility located on the west side of Jordan Lake. The three parties have developed a draft agreement and are currently reviewing this agreement.

Technical Complexity

This alternative is considered complex since it would require the design and construction of a new raw water intake and pumping station on the west side of Jordan Lake. A new water treatment facility may also be constructed although options are available to utilize existing treatment facilities in the area in the short-term. Some existing water transmission mains could be used to convey finished water to the Durham service area. A 16-inch water main was recently installed along Farrington Road to connect the City of Durham and Chatham County water systems. Additional transmission mains and interconnections would be needed as demand increases.

Institutional Complexity

This alternative is considered complex since environmental review and permitting of a new raw water intake, water treatment facility, and transmission mains would be required. However, Jordan Lake is an existing water supply reservoir and a water supply allocation would reduce an existing IBT and would not result in one.

Political Complexity

This alternative is considered complex since the City of Durham is pursuing a regional partnership for the implementation of this alternative. Participation by OWASA and Chatham County is not guaranteed. Staff from both OWASA and Chatham County have participated in recent meetings and are currently presenting this option to their governing boards. However, the City of Durham could potentially implement this project without a regional partnership although this would increase the overall costs to Durham. Since Durham discharges treated wastewater into Jordan Lake, the City would need to address public concerns over water quality in Jordan Lake.

Public Benefits

There are no secondary benefits to the public in this alternative since Jordan Lake is an existing multi-purpose reservoir and the City is requesting a water supply allocation only.

Consistency with Local Plans

This alternative is consistent with local plans and was presented as the preferred option in the City of Durham Water and Sewer Strategic Plan (CH2MHILL, 2000). This option was also discussed in a 1988 study, *Evaluation of Alternative Reservoirs on the Flat River and Little River* (Hazen and Sawyer).

Cost

The total Net Present Value for this alternative is $168.6 million. The unit cost is $6.78 per gallon of additional water supply. Costs include capital and O&M costs for the construction of an intake and pump station at Teer Quarry and transmission main to tie into existing raw water mains. Costs associated with the implementation of a non-potable reuse program in RTP using the South Durham WRF are also included. Costs for construction of facilities at Jordan Lake are shared between potential partners based on expected demands. More detailed estimates of capital costs and annual costs in five-year increments are presented in Attachment 4.

5.2 Alternative 2 – Expand Lake Michie

In this alternative, the City of Durham would raise the water surface elevation of Lake Michie from 341 ft to 365 ft by constructing a new dam downstream of the existing dam. This would increase the 50-year safe yield of Lake Michie by approximately 18 MGD. This alternative also includes conversion of Teer Quarry into an offline raw water storage reservoir with an expected safe yield of 3 MGD, and implementation of a non-potable reuse program with a projected demand of 1.9 MGD by 2030. This alternative could potentially increase the City's available water supply to 60 MGD on a 50-yr safe yield basis, including water reuse. However, this Alternative does not provide sufficient water supply to ensure that projected water demands do not exceed 80% of the available water supply in 2050.

This alternative would result in increased IBT from the Neuse River Basin to the Cape Fear River Basin. Therefore, there are two options under this alternative:

- Alternative 2A: discharge treated wastewater into Neuse and Cape Fear Basins.
- Alternative 2B: return treated wastewater to Neuse Basin to maintain IBT below grandfathered amount.

Environmental Impacts

The environmental impacts of this alternative may be greater than those resulting from the utilization of Jordan Lake as a water supply since the expansion of Lake Michie would inundate approximately 440 additional acres. Expansion of Lake Michie may impact existing wetlands, archaeological and historic sites, and endangered species. There may also be environmental impacts from the construction of the new dam. The environmental impacts of converting Teer Quarry into an offline water storage reservoir are considered to be minimal.

There may be environmental impacts due to the increased IBT from the Neuse River Basin to the Cape Fear River Basin in Alternative 2A. Since there is no increase in the IBT above the grandfathered amount, there would be no negative environmental impacts related to IBT under Alternative 2B.

Water Quality Classification

Lake Michie is classified as a public water supply (WS-III). The water quality of Lake Michie is considered good. Lake Michie is located in rural Durham County and is protected by a buffer.

Timeliness

Expansion of Lake Michie is estimated to require a minimum of 15 years for environmental review, permitting, land acquisition and clearing, and construction. In 2015, the City's water demands are projected to be over 46 MGD resulting in a water supply deficit of almost 10 MGD. Therefore, conversion of Teer Quarry into a raw water storage reservoir would be required to offset some of the water supply deficit until the expanded reservoir could be online in 2015. It is estimated that Teer Quarry could be operational by 2004 or 2005 and could increase the City's available water supply by approximately 3 MGD. The phasing of the projects in this alternative is illustrated in Attachment 3.

Interbasin Transfers

In Alternative 2A, increasing the available water supply in the Neuse River Basin would increase the IBT from the Neuse River Basin to the Cape Fear River Basin. The IBT is estimated at 50 MGD by 2050.

In Alternative 2B, treated wastewater would be returned to the Neuse River Basin to maintain the IBT at the grandfathered amount.

Regional Partnerships

No regional partnerships have been discussed between the City of Durham and other utilities. However, the Town of Cary is including this alternative in its application for additional water supply allocations from Jordan Lake. Although there have been no formal discussions of a joint venture, there is a potential for regional cooperation, which should reduce the project cost to each participant.

Technical Complexity

This alternative is considered very complex since it would require the design and construction of a new dam, raw water intake, and modifications to the existing pumping station at Lake Michie. Existing raw water transmissions mains could be used to convey raw water to the Brown WTP. Conversion of Teer Quarry into a storage reservoir would require the design and construction of an intake structure and pumping station that would allow the City to access much of the storage volume of the quarry.

Alternative 2B would also require the design and construction of pumping stations and force mains to transfer a portion of the wastewater from the Cape Fear River Basin to the Neuse River Basin.

Institutional Complexity

This alternative is considered very complex due to the environmental review and permitting of an expanded reservoir that inundates an additional 440 acres. Environmental review, permitting, and inspection of a new dam and raw water intake at Lake Michie and a inatke and pumping station at Teer Quarry would be required.

Alternative 2A would increase the interbasin transfer from the Neuse River Basin to the Cape Fear River Basin would require an IBT certificate from the North Carolina Environmental Management Commission (EMC).

Alternative 2B would not require an IBT certificate, but would require environmental review and permitting of pumping stations and force mains to transfer a portion of the wastewater from the Cape Fear River Basin to the Neuse River Basin.

Political Complexity

This alternative is considered very complex since approximately 67 residences and other structures that would need to be relocated. Also, the City would need to relocate over 5,000 feet of road. There may be public opposition to this project and difficulty in acquiring the necessary property to expand Lake Michie. Also, the City has received some opposition to converting Teer Quarry into an offline storage reservoir. A study is currently underway to examine the feasibility of the Teer Quarry option.

Public Benefits

The expansion of Lake Michie may result in secondary benefits to the public through improved recreational opportunities.

Consistency with Local Plans

This alternative is consistent with local plans and was presented as an option in the City of Durham Water and Sewer Strategic Plan (CH2MHILL, 2000). This option was also the recommended option in the 1988 study, *Evaluation of Alternative Reservoirs on the Flat River and Little River* (Hazen and Sawyer).

Cost

The total Net Present Value for Alternative 2a is $200.5 million. The unit cost is $8.72 per gallon of additional water supply. Costs include capital and O&M costs for the construction of an intake and pump station at Teer Quarry and transmission main to tie into existing raw water mains. Costs associated with the implementation of a non-potable reuse program in RTP using the South Durham WRF are also included. Costs for expanding Lake Michie to a water surface elevation of 365 ft are also included.

The Net Present Value of Alternative 2b is $227.8 million. The unit cost is $9.90 per gallon of additional water supply. Costs for this alternative include all facilities in Alternative 2a as well as pump station and force main to transfer treated effluent from the South Durham WRF to the Neuse Basin.

More detailed estimates of capital costs and annual costs in five-year increments are presented in Attachment 4.

5.3 Alternative 3 – New Reservoir on the Flat River

In this alternative, the City of Durham would impound a new reservoir on the Flat River upstream of Lake Michie. Options for locating a new reservoir were evaluated in a 1988 study, *Evaluation of Alternative Reservoirs on the Flat River and Little River* (Hazen and Sawyer). In this study, it was determined that a new reservoir on the Little River would be infeasible since approximately 80 residences would need to be relocated at the site evaluated. A new reservoir on either the Flat River could increase the available water supply by up to 23 MGD (50-year safe yield). Conversion of Teer Quarry into an offline raw water storage reservoir with an expected safe yield of 3 MGD, and implementation of a non-potable reuse program with a projected demand of 1.9 MGD by 2030 are also included in this alternative. This alternative could potentially increase the 50-year safe yield of the Durham water supply system to 65 MGD, including water reuse. This alternative does not provide sufficient water supply to ensure that projected 2050 demands do not exceed 80% of the available supply.

This alternative would result in increased IBT from the Neuse River Basin to the Cape Fear River Basin. Therefore, there are two options under this alternative:

- Alternative 3A: discharge treated wastewater into Neuse and Cape Fear Basins.
- Alternative 3B: return treated wastewater to Neuse Basin to maintain IBT below grandfathered amount.

Environmental Impacts

The environmental impacts of this alternative may be greater than those from using Jordan Lake as a water supply since a new reservoir would flood up to 1,370 acres depending on the final site selection. Construction of a new reservoir may impact existing wetlands, archaeological and historic sites, and endangered species. There may also be environmental impacts from the construction of the dam at the new reservoir. The environmental impacts of converting Teer Quarry into an offline water storage reservoir are considered to be minimal.

Alternative 3A may also result in direct environmental impacts due to the increased interbasin transfer from the Neuse River Basin to the Haw River Basin.

Water Quality Classification

The Flat River near the sites evaluated for a new reservoir is classified as a public water supply (WS-III). Water quality in the Flat River is considered good although this water sources is designated as a nutrient sensitive water.

Timeliness

Construction of a new reservoir is estimated to require 15 to 20 years for environmental review, permitting, land acquisition and clearing, and construction. In 2015, the City's water demands are projected to be over 46 MGD resulting in a water supply deficit of almost 10 MGD. Therefore, conversion of Teer Quarry into a raw water storage reservoir would be required to offset some of the water supply deficit until the new reservoir is online. It is estimated that Teer Quarry could be operational by 2004 or 2005 and could increase the City's available water supply by approximately 3 MGD. However, a water supply deficit would remain from 2010 until the new reservoir is completed in about 2015. The phasing of the projects in this alternative is illustrated in Attachment 3.

Interbasin Transfers

In Alternative 3A, increasing the available water supply in the Neuse River Basin would increase the IBT from the Neuse River Basin to the Cape Fear River Basin. The IBT is estimated at 50 MGD by 2050.

Future IBT would be maintained at the grandfathered amount in Alternative 3B.

Regional Partnerships

No regional partnerships have been discussed between the City of Durham and other utilities to develop a new reservoir on the Flat River.

Technical complexity

This alternative is considered very complex since it would require the development of a new reservoir. This project would include the design and construction of a new dam, raw water intake, pumping station, and raw water transmission mains as well as acquisition and clearing of up to 1,370 acres. Conversion of Teer Quarry into a storage reservoir would require the design and construction of an intake structure and pumping station that would allow the City to access most of the storage volume of the quarry.

Also, Alternative 3B would require the design and construction of pumping stations and force mains to transfer a portion of the wastewater from the Cape Fear River Basin to the Neuse River Basin.

Institutional Complexity

This alternative is considered very complex due to the environmental review and permitting of a new reservoir that inundates over 1,000 acres. Environmental review, permitting, and inspection of a new dam, raw water intake, pumping station, and transmission mains at the new reservoir and an intake and pumping station at Teer Quarry would be required.

Alternative 3A would increase the interbasin transfer from the Neuse River Basin to the Cape Fear River Basin would require an IBT certificate from the North Carolina Environmental Management Commission (EMC).

Alternative 3B would not require an IBT certificate, but would require environmental review and permitting of pumping stations and force mains to transfer a portion of the wastewater from the Cape Fear River Basin to the Neuse River Basin.

Political Complexity

This alternative is considered very complex since residences, roads, and other structures would need to be relocated. There may be public opposition to this project and difficulty in acquiring the necessary property for an new reservoir. Several of the sites for a new reservoir on the Flat River would result in flooding of a portion of Hill Forest, a research foreast owned by North Carolina State University (NC State). During the 1988 study, NC State has indicated that it was willing to discuss the concept of a new reservoir that floods a portion of Hill Forest.

Also, the City has received some opposition to converting Teer Quarry into an offline storage reservoir. A study is currently underway to examine the feasibility of the Teer Quarry option.

Public Benefits

A new reservoir could provide secondary benefits through additional recreational opportunities for the public if the City were to allow fishing, boating, and swimming on the new reservoir.

Consistency with Local Plans

This alternative is consistent with local plans and was presented as an option in the City of Durham Water and Sewer Strategic Plan (CH2MHILL, 2000). This option was also evaluated in the 1988 study, *Evaluation of Alternative Reservoirs on the Flat River and Little River* (Hazen and Sawyer).

Cost

The total Net Present Value for Alternative 3a is $226.1 million. The unit cost is $8.08 per gallon of additional water supply. Costs include capital and O&M costs for the construction of an intake and pump station at Teer Quarry and transmission main to tie into existing raw water mains. Costs associated with the implementation of a non-potable reuse program in RTP using the South Durham WRF are also included. For the development of a new reservoir on the Flat River, costs include land acquisition and clearing, construction of a dam, spillway, intake, and pump station, and relocation of roads and structures.

The Net Present Value of Alternative 3b is $253.4 million. The unit cost is $9.05 per gallon of additional water supply. Costs for this alternative include all facilities in Alternative 3a as well as pump station and force main to transfer treated effluent from the South Durham WRF to the Neuse Basin.

More detailed estimates of capital costs and annual costs in five-year increments are presented in Attachment 4.

5.4 Alternative 4 – Utilize Kerr Lake as a Water Supply

In this alternative, the City of Durham would utilize existing the water supply in John H. Kerr Reservoir (Kerr Lake). Although the available water supply that the City could obtain from Kerr Lake is not known, the City is currently participating in a feasibility study along with the City of Raleigh, the Town of Cary, and Granville County to evaluate the feasibility of using Kerr Lake as a raw water supply. It is assumed that the City of Durham could obtain at least 25 MGD (50-yr safe yield) of water supply from Kerr Lake. This alternative also includes the construction of a water treatment facility near Kerr Lake. Conversion of Teer Quarry into an offline raw water storage reservoir with an expected safe yield of 3 MGD, and implementation of a non-potable reuse program with a projected demand of 1.9 MGD by 2030 are also included in this alternative. This alternative could potentially increase the 50-year safe yield of the Durham water supply system to 67 MGD, including water reuse. This alternative does not provide sufficient water supply to ensure that projected 2050 demands do not exceed 80 % of the available supply.

This alternative would result in an IBT from the Roanoke River Basin to the Neuse and Cape Fear River Basins. Therefore, there are two options under this alternative:

- Alternative 4A: discharge treated wastewater into Neuse and Cape Fear Basins.
- Alternative 4B: return treated wastewater to the Roanoke River Basin to maintain IBT of zero.

Environmental Impacts

The direct environmental impacts of this alternative may be greater than those resulting from the utilization of Jordan Lake as a water supply source. There may be direct environmental impacts associated with the construction of a new raw water intake on Kerr Lake, a water treatment facility near Kerr Lake, and transmission and pumping facilities to convey finished water approximately 55 miles to the Durham service area. However, the environmental impacts of converting Teer Quarry into an offline water storage reservoir are considered to be minimal.

In Alternative 4A, there may be direct environmental impacts related to the IBT from the Roanoke River Basin to the Neuse and Haw River Basins. This is in addition to the increase in IBT from the Neuse River Basin to the Haw River Basin. Thus, this alternative results in an additional IBT instead of reducing an existing as in Alternative 1.

Water Quality Classification

Several sites have been considered for a raw water intake on Kerr Lake in the Island Creek area. Anderson Swamp Creek has been classified as WS-III. This is the only stream tributary to John H. Kerr Reservoir that is currently classified for water supply.

Timeliness

Environmental review, permitting, design, and construction of a new intake on Kerr Lake as well as associated transmission and pumping facilities are estimated to require 15 to 20 years to complete. In 2015, the City's water demands are projected to be approximately 40 MGD resulting in a water supply deficit of nearly 2.8 MGD. Therefore, conversion of Teer Quarry into a raw water storage reservoir would be required to offset some of the water supply deficit until water supply at Kerr Lake is available to Durham. It is estimated that Teer Quarry could be operational by 2004 or 2005 and could increase the City's available water supply by approximately 3 MGD. The phasing of the projects in this alternative is illustrated in Attachment 3.

Interbasin Transfers

In Alternative 4A, there would be an IBT from the Roanoake River Basin to the Neuse and Cape Fear River Basins as a result of the withdrawal of raw water from Kerr Lake. The IBT from the Roanoke River Basin to the Neuse and Cape Fear River Basins is estimated to be 29 MGD by 2050.

There would be no net IBT under Alternative 4B.

Regional Partnerships

The City of Durham is coordinating with the City of Raleigh, the Town of Cary, and Granville County to evaluate the feasibility of using Kerr Lake as a water supply source. The potential for a regional partnership to implement this project is not yet known.

Technical Complexity

This alternative is considered complex since it would require the design and construction of a raw water intake, water treatment facility, and pumping and transmission facilities. If a regional partnership is not reached, the City could potentially convey raw water to its Brown WTP for treatment prior to distribution. Conversion of Teer Quarry into a storage reservoir would require the design and construction of an intake structure and pumping station that would allow the City to access most of the storage volume of the quarry.

Also, Alternative 4B would require the design and construction of pumping facilities and approximately 50 miles of force main to transfer treated wastewater back to the Roanoke River Basin.

Institutional Complexity

This alternative is considered very complex due to the environmental review and permitting requirements. The City would need to obtain a water supply allocation from the US Army Corps of Engineers (USACE). This alternative may also involve additional permitting and review due to inter-state transfer issues. Environmental review, permitting, and inspection would be required for the new raw water intake, pumping stations, and transmission mains as well as for the new facilities at Teer Quarry.

Alternative 4A would also require the City to obtain an IBT certificate from the NC EMC.

Political Complexity

This alternative is considered very complex since this alternative results in an IBT and potentially inter-state transfer issues. There may be considerable opposition from the public, environmental groups, and the State of Virginia to granting the City an allocation from Kerr Lake similar to the process that Virginia Beach went through to obtain water supply from Lake Gaston.

Public Benefits

Obtaining a water supply allocation from Kerr Lake would not have any secondary benefits to the public. However, another option being considered for this project would be to convey raw water to Lake Michie to increase the available supply for Durham and Raleigh. If this option is implemented, additional benefits could be realized through the generation of hydropower at Lake Michie.

Consistency with Local Plans

This alternative was presented as an option in the City of Durham Water and Sewer Strategic Plan (CH2MHILL, 2000).

Cost

The total Net Present Value for Alternative 4a is $130.6 million. The unit cost is $4.35 per gallon of additional water supply. This assumes that the City of Durham can acquire an allocation of 25 MGD from Kerr Lake. For the development of a new reservoir on the Flat River, costs include land acquisition and clearing, construction of a dam, spillway, intake, and pump station, and relocation of roads and structures. Costs for implementation of a non-potable reuse program and conversion of Teer Quarry into an offline raw water storage reservoir are included.

The Net Present Value of Alternative 3b is $226.1 million. The unit cost is $7.54 per gallon of additional water supply. Costs for this alternative include all facilities in Alternative 4a as well as pump station and force main to transfer treated effluent from the North Durham WRF to Kerr Lake to eliminate any IBT from the Roanoke basin. Costs also include a pump station and force main to transfer up to 11 MGD of treated effluent from the South Durham WRF to the Neuse Basin to maintain an IBT at the grandfathered amount..

More detailed estimates of capital costs and annual costs in five-year increments are presented in Attachment 4.

5.5 Alternative 5 – Obtain 16-MGD Allocation from Jordan Lake and Expand Lake Michie

In this alternative, the City of Durham would obtain a smaller (16-MGD) water supply allocation for Jordan Lake. To fulfill its long-term water demands, the City would also convert Teer Quarry into an offline storage reservoir (3 MGD), implement a non-potable water reuse program (1.9 MGD), and expand Lake Michie (18 MGD). This alternative could potentially increase the 50-year safe yield of the Durham water supply system to 75 MGD, including water reuse. Water demands do not exceed 80% of the available supply once Jordan Lake facilities are online.

Environmental Impacts

The environmental impacts of this alternative may be greater than those resulting from utilization of Jordan Lake as a water supply source. There may be direct impacts from the flooding of 440 additional acres as well as the construction of a new dam at Lake Michie

The environmental impacts of converting Teer Quarry into an offline water storage reservoir are considered to be minimal. There are no environmental impacts related to IBT since withdrawal of raw water from Jordan Lake would maintain future IBT amounts near the grandfathered amount.

Water Quality Classification

Jordan Lake is classified as a public water supply (WSIV). The water quality of Jordan Lake is considered good. The Towns of Cary and Apex utilize Jordan Lake as their only raw water source. A Comprehensive Management Plan for Jordan Lake has been considered to ensure that future water quality in Jordan Lake is suitable for drinking water supply.

Lake Michie is classified as a public water supply (WS-III). The water quality of Lake Michie is considered good. Lake Michie is located in rural Durham County and is protected by a buffer.

Timeliness

A non-potable direct reuse program could potentially be implemented by 2006 to reduce the potable water demands and the water supply deficit that would exist until Jordan Lake facilities are online. Conversion of Teer Quarry into a storage reservoir could be implemented by 2005. It is estimated that the City of Durham could construct the necessary facilities to utilize Jordan Lake and have them online by 2006 assuming an allocation is granted in 2001. Expansion of Lake Michie is expected to require 15 to 20 years due to environmental review, permitting, and land acquisition. The phasing of the projects in this alternative is illustrated in Attachment 3.

Interbasin Transfers

Withdrawing raw water from Jordan Lake would offset an existing IBT from the Neuse River Basin to the Cape Fear River Basin. The IBT from the Neuse Basin to the Cape Fear Basin is estimated at 26 MGD currently. The IBT would increase to approximately 30 MGD until facilities to utilize Jordan Lake are online. Once Jordan Lake facilities are online, the IBT would decrease. The IBT amount would depend upon how the City of Durham manages withdrawals from its supplies in the Neuse basin and Jordan Lake. However, it is assumed that the IBT could be managed to remain below the City's grandfathered IBT amount.

Regional Partnerships

The City of Durham is interested in participating in a regional partnership with other local utilities to form a JWA. The JWA would construct, operate, and manage a new raw water intake and water treatment facility located on the west side of Jordan Lake. The three parties have developed a draft agreement and are currently reviewing this agreement.

Technical Complexity

This alternative is considered very complex since it would require the design and construction of a raw water intake, water treatment facility, and pumping and transmission facilities near Jordan Lake. Conversion of Teer Quarry into a storage reservoir would require the design and construction of an intake structure and pumping station that would allow the City to access most of the storage volume of the quarry. Expansion of Lake Michie would require design and construction of a new dam, spillway, and intake.

Institutional Complexity

This alternative is considered very complex. It is anticipated that future IBT amounts could be maintained such that an IBT certificate from the NC EMC would not be required. However, the environmental review and permitting for the expanded Lake Michie would require considerable staff time and effort.

Political Complexity

This alternative is considered very complex since the City of Durham is pursuing a regional partnership for creation of a JWA to construct, own, and operate the facilities at Jordan Lake. Participation by likely partners is not guaranteed. The City would also need to address public concerns over future water quality in Jordan Lake.

Public opposition to expanding Lake Michie is likely since several residences will need to be located. The environmental impacts of the reservoir expansion would potentially dictate the level of public concern.

Also, the City has received some opposition to converting Teer Quarry into an offline storage reservoir. A study is currently underway to examine the feasibility of the Teer Quarry option.

Public Benefits

The expansion of Lake Michie may result in secondary benefits to the public through improved recreational opportunities.

Consistency with Local Plans

This alternative was presented as an option in the City of Durham Water and Sewer Strategic Plan (CH2MHILL, 2000).

Cost

The total Net Present Value for Alternative 5 is $207.4 million. The unit cost is $5.32 per gallon of additional water supply. Facilities to utilize a 12-MGD allocation from Jordan Lake, including intake, raw water pump station, water treatment plant, and finished water transmission to Durham service area are included in costs. Costs to expand Lake Michie (similar to Alternative 2a) are included. Costs for implementation of a non-potable reuse program and conversion of Teer Quarry into an offline raw water storage reservoir are also included.

More detailed estimates of capital costs and annual costs in five-year increments is presented in Attachment 4.

6. Plans to Use Jordan Lake

6.1 Allocation Request

The City of Durham is applying for a **16-MGD Level I** and **4-MGD Level II** allocation from the Jordan Lake water supply pool. The City of Durham needs additional water supply capacity immediately since its average day water demands, including wholesale contracts, are expected to exceed the 50-year safe yield of its existing water supplies in the next few years. Some existing wholesale contracts with Morrisville and Cary expire in 2002 while a sales contract with Chatham County is in effect to 2005. In 2005, after existing all sales contracts expire, the City will have only 2.8 MGD of excess water supply above projected demands. Therefore, the City needs to secure additional water supply soon, and Jordan Lake represents the most cost-effective, environmentally-friendly option to meet the City's water supply needs. All other water supply alternatives do not provide sufficient water supply such as Teer Quarry, or will require 15 to 20 years to implement such as a Lake Michie expansion, a new reservoir on the Flat River, or utilization of Kerr Lake for water supply. The City of Durham has begun planning for other water supply sources such as land acquisition around Lake Michie and conducting a feasibility study of the Kerr Lake option. However, political, environmental, legal, and regulatory issues may present obstacles that will delay or possibly prevent implementation of any of these options.

6.2 Jordan Water Agency

The City of Durham has participated in meetings with representatives from OWASA and Chatham County to consider the formation of a JWA to own, operate, and manage a new raw water intake and treatment facility on Jordan Lake. The consensus during these meetings is that the City of Durham is an essential component of the regional partnership. Therefore, for the regional partnership to be successful, the City of Durham needs to secure a Level I water supply allocation for Jordan Lake. A copy of the draft agreement between the City of Durham, OWASA, and Chatham County is included in Attachment 5.

If a water supply allocation is granted, the City of Durham would proceed with the formation of a water agency with its regional partners and with the planning, design, and construction of a raw water intake and pump station on the west side of Jordan Lake (see attached figure). The City is also considering the construction of a water treatment facility near Jordan Lake (potentially on OWASA-owned property) and would convey finished water to its distribution system.

6.3 Water Quality Monitoring Plan

The proposed monitoring program for raw water withdrawn from the B. Everett Jordan Lake and finished water from a proposed water treatment facility located near Jordan Lake is summarized below in Tables 18 and 19. Table 18 summarizes the monitoring program for the finished water and Table 19 summarizes the monitoring program for the raw water. The monitoring program is similar to the City's existing monitoring program for its existing raw water supplies and is based on current regulations of the North Carolina Rules Governing Public Water Supplies and the U.S. Environmental Protection Agency. The proposed monitoring program includes monitoring required by state and federal regulations as well as additional monitoring to provide more information about water quality in Jordan Lake and improve operation and performance of the treatment facility. In addition, the City supports the Triangle Area Water Supply Monitoring Project which monitors water quality at 4 sites within the lake proper that would be near or upstream of the proposed intake location. Samples are collected for nitrogen, phosphorus, ammonia, nitrate, metals, pesticides, semivolatile and volatile organic compounds. The City has supported this monitoring program since 1988 in anticipation that Jordan Lake might become a future water supply for the City of Durham.

TABLE 18
Proposed Finished Water Monitoring Program for Jordan Lake Facilities

Contaminant		Monitoring Frequency	Sample Location
MICROBIOLOGY AND TURBIDITY			
Total coliforms		based on population	DS
Turbidity		Continuously	FW
Turbidity		Daily	RW
CORROSITIVITY			
Alkalinity		Daily	RW and FW
Calcium		Monthly	FW
Total dissolved solids		Weekly	FW
Temperature		Daily	RW and FW
pH		Daily	RW and FW
INORGANIC			
Iron		Daily	RW and FW
Manganese		Daily	RW and FW
Fluoride		Daily	FW
Nitrate (as Nitrogen)		Monthly	RW and FW
Nitrite		Monthly	RW and FW
Orthophosphate		Daily	FW
Total Phosphorus		Monthly	RW
Aluminum	Mercury	Annually	RW and FW
Antimony	Molybdenum		
Arsenic	Nickel		

TABLE 18
Proposed Finished Water Monitoring Program for Jordan Lake Facilities

Asbestos	Selenium		
Barium	Silver		
Beryllium	Sodium		
Cadmium	Sulfate		
Chromium	Thallium		
Copper	Vanadium		
Cyanide	Zinc		
Lead			
TRIHALOMETHANES/HALOACETIC ACIDS			
Chloroform	Bromodichloromethane		
Bromoform	Chlorodibromomethane		
Monochloroacetic acid	Trichloroacetic acid	Quarterly	FW and DS
Monobromoacetic acid	Dibromoacetic acid		
Dichloroacetic acid	Bromochloroacetic acid		
VOLATILE ORGANIC COMPOUNDS			
Benzene	1,1-Dichloroethylene		
Carbon tetrachloride	Ethylbenzene		
Chlorobenzene	Tetrachloroethylene		
1,2-Dichlorobenzene	1,1,1-Trichloroethane	First Year: 4/year	
1,4-Dichlorobenzene	Trichloroethylene	Subsequent Years:	FW
1,2-Dichloroethane	1,2,4-Trichlorobenzene	Annually	
cis-1,2-Dichloroethylene	Vinyl chloride		
trans-1,2-Dichloroethylene			
ORGANIC COMPOUNDS			
1,1,2-Trichloroethane	Ethylene dibromide (EDB)	First Year: 4/year	FW
1,2-Dichloropropane	Glyphosate	Subsequent years:	
2,3,7,8-TCDD (Dioxin)	Heptachlor	Quarterly at 3-yr intervals	
2,4,5-TP	Heptachlor epoxide		
2,4-D	Hexachlorobenzene		
Adipates	Hexachlorocyclopentadiene		
Alachlor	Lindane		

TABLE 18
Proposed Finished Water Monitoring Program for Jordan Lake Facilities

Atrazine	Methoxchlor		
Benzo(a)pyrene	Oxamyl (vydate)		
Carbofuran	PAHs		
Chlordane	PCBs		
Dalapon	Phthalates		
Dibromochloropropane (DBCP)	Picloram		
Dichloromethane	Simazine		
Dinoseb	Styrene		
Diquat	Toluene		
Endothall	Toxaphene		
Endrin	Xylene		
RADIONUCLIDES			
Radium 226 and 228	Gross alpha particle activity		
Beta particle and photon radioactivity	Radon	Quarterly at 4-yr intervals	FW
Uranium			

FW = finished water from the Jordan Lake water treatment facility at the point of entry into the distribution system
DS = throughout the distribution system (actual sites may be determined by regulations)

TABLE 19
Proposed Raw Water Monitoring Program for Jordan Lake Facilities[1]

Contaminant		Monitoring Frequency
PHYSICAL		
Alkalinity	pH	
Dissolved Oxygen	Temperature	Daily
Conductivity	Turbidity	
Color	Treshold Odor	Weekly
Hardness		
INORGANIC		
Iron		Daily
Manganese		Daily
Nitrate (as Nitrogen)		Monthly
Nitrite		Monthly
Total Phosphorus		Monthly
Aluminum	Mercury	
Antimony	Molybdenum	
Arsenic	Nickel	
Asbestos	Selenium	
Barium	Silver	
Beryllium	Sodium	Annually
Cadmium	Sulfate	
Chromium	Thallium	
Copper	Vanadium	
Cyanide	Zinc	
Lead		
ORGANIC		
Total Organic Carbon		Daily
Dissolved Organic Carbon		

1. Samples collected at raw water intake

Attachment 1:

Local Water Supply Plan Update

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

LOCAL WATER SUPPLY PLAN for JORDAN LAKE ALLOCATION APPLICATION 2000-2001
Part 1: Water Supply System Report for Calendar Year 2000

Completed By: CH2M HILL Date: 4/30/2001

SECTION 1: GENERAL INFORMATION

1-A. Water System: City of Durham, NC 1-B. PWS Identification #: 03-32-010

1-C. River Sub-Basin(s): Neuse River (10-1) sub-basin & Haw River (2-1) sub-basin

1-D. County(s): Durham County , parts of Orange & Wake Counties

1-E. Contact Person: A.T. Rolan Title: Environmental Resources Director, City of Durham, NC

1-F. Mailing Address: 101 City Hall Plaza City: Durham ZIP: 27701

1-G. Phone: 919.560.4381 1-H. Fax: 919.560-4479 1-I. E-mail: trolan@ci.durham.nc.us

1-J. Type of Ownership (Check One): ☒ Municipality F County F Authority F District F Non-Profit Association F For-Profit Business
F State F Federal F Other__________

SECTION 2: WATER USE INFORMATION

2-A. Population Served in 2000 Year-Round 203,341
Seasonal (if applicable) N/A For Months of N/A

2-B. Total Water Use for 2000 including all purchased water: 11662.82 Million Gallons (MG)

2-C. Average Annual Daily Water Use in 2000: 34.41 Million Gallons per Day (MGD)

2-D. List 2000 Average Annual Daily Water Use by Type in Million Gallons per Day (MGD):

	Metered Connections		Non-Metered Connections		Total
Type of Use	Number	Average Use (MGD)	Number	Estimated Average Use (MGD)	Average Use (MGD)
(1) Residential	58,358	13.71			13.71
(2) Commercial	3,666	5.72			5.72
(3) Industrial	104	1.37			1.37
(4) Institutional	772	2.75	unknown	0.09	2.84
(5) Sales to other Systems					3.46
(6) System Processes					2.83*
(7) Subtotal [sum (1) thru (6)]					29.93
(8) Average Annual Daily Water Use [Item 2-C]					34.41
(9) Unaccounted-for water [(8) – (7)]					4.48

* System processes includes main flushing and process losses during treatment.

2-E. List the Average Daily and Maximum Day Water Use by Month for 2000 in Million Gallons per Day (MGD):

	Average Daily Use	Maximum Day Use	Max/Ave Ratio		Average Daily Use	Maximum Day Use	Max/Ave Ratio		Average Daily Use	Maximum Day Use	Max/Ave Ratio
Jan	29.57	31.99	1.08	May	35.77	42.69	1.19	Sep	29.30	32.40	1.11
Feb	29.67	32.24	1.05	Jun	36.78	43.09	1.17	Oct	32.41	36.21	1.12
Mar	30.68	33.93	1.10	Jul	35.53	42.96	1.21	Nov	28.83	34.19	1.19
Apr	30.31	34.76	1.15	Aug	33.62	39.52	1.18	Dec	29.24	33.81	1.16

2-F. List the system's 10 Largest Water Users and their Average Annual Daily Use in Million Gallons per Day (MGD) for 2000: (include sales to other systems)

Water User	Average Daily Use	Water User	Average Daily Use
Duke University and Medical Center	1.72	EPA	0.15
Glaxo Wellcome	0.73	Durham County Government	0.14
IBM	0.31	NC Central University	0.13
Durham Regional Hospital	0.27	NIEHS	0.12
Durham County Public Schools	0.22	VA Hospital	0.12

2-G. WATER SALES TO OTHER WATER SYSTEMS IN 2000 List all systems that can be supplied water through existing interconnections (regular and emergency). Mark the locations of connections on the System Map.

1 Water supplied to:		2 Average Daily Amount		3 Contract Amount		4 Pipe Size(s)	5*
Water System	PWSID	MGD	# of Days	MGD	Expiration Date	Inches	R or E
Town of Hillsborough	03-68-015	0.05	30	2.0	2003	16	E
OWASA	03-68-010	0.0	0	4.0	1998	12 (2)	E
Town of Cary	03-92-020	3.4	323	3.5	2008	16	R[1]
Town of Morrisville	03-92-075	0	0	1.5	2008	through Cary	R[1]
Orange Alamance Water System	03-92-020	0	0	0.387	2003	through Hillsborough	E
Chatham County		0	0	0.2	2010	16	R[2]

***NOTE** Column 5 **R=**Regular Use, **E=**Emergency Use

1. **Regular until 2003, emergency from 2003 to 2008.**
2. **Regular until 2005, emergency from 2005 to 2010.**

2-H. What is the Total Amount of Sales Contracts for Regular Use? 5.2 MGD

SYSTEM NAME City of Durham PWSID 03-32-010

SECTION 3: WATER SUPPLY SOURCES

3-A. SURFACE WATER List surface water source information. Mark and label locations of intakes on the System Map.

1 Name of Stream and/or Reservoir	2 Drainage Area Square Miles	3 Is Withdrawal Metered? Y / N	4 Sub-Basin	5 Average Daily Withdrawal for days used		6 Maximum Day Withdrawal	7* Available Supply		8* System Component Limiting Daily Output		9 Useable On-Stream Raw Water Supply Storage Million Gallons	10* R or E
				MGD	# of Days	MGD	MGD	Qualifier	Capacity MGD	System Component		
Flat River/Lake Michie	168	Yes	Neuse River (10-1)				19	SY50	32	R	4,000	R
Little River/Little River Lake	97	Yes	Neuse River (10-1)				18	SY50	48	R	4,900	R
								Totals				

*NOTES Column 7 Supply Qualifiers: **C=**Contract amount, **SY20=2**0-year Safe Yield, **SY50=**50-year Safe Yield, **F=**20% of 7Q10 or other instream flow requirement, **T=**Treatment plant capacity, O=Other
Column 8 Component: **R=**Raw water pumps, **T=**Treatment facilities, **M=**Transmission main, **D=**Distribution system, **O=**Other (specify)____________________
Column 10 **R=**Regular Use, **E=**Emergency Use

3-B. What is the Total Surface Water Supply available for Regular Use? ___37___ MGD

3-C. Does this system have off-stream raw water supply storage? ☒ No F Yes Useable Capacity ____________ Million Gallons

3-D. WATER PURCHASES FROM OTHER WATER SYSTEMS IN 2000
List all systems that can supply water to this system through existing interconnections (regular and emergency). Mark the locations of the connections on the System Map.

1 Water supplied by:		2 Average Daily Amount		3 Contract Amount		4 Pipe Size(s)	5* R or E
Water System	PWSID	MGD	# of Days	MGD	Expiration Date	Inches	
Town of Hillsborough, NC	03-68-015	0	0	2.0	2003	16	E
Orange Water & Sewer Authority	03-68-010	0	0	4.0	1998	12 (2)	E
Town of Cary, NC	03-92-020	0	0	3.5	2008	16	E
Town of Morrisville, NC	03-92-075	0	0	1.5	2008	through Cary	E
Orange Alamance Water System	03-68-020	0	0	0.387	2003	through Hillsborough	E
Chatham County		0	0	0.2	2010	16	E

*NOTE Column 5 **R=**Regular Use, **E=**Emergency Use

3-E. What is the Total Amount of Purchase Contracts available for Regular Use? _____0____MGD (Do not include emergency use connections in total)

SYSTEM NAME City of Durham PWSID 03-32-010

3-F. GROUND WATER List well information. ***Mark and label the location of all wells on the System Map.***

1 Name or Number of Well	2 Well Depth	3 Casing Depth	4 Screen Depth		5 Well Diameter	6 Pump Intake Depth	7 Is Well Metered?	8 Average Daily Withdrawal for Days Used		9 Maximum Day Withdrawal	10 12-Hour Supply	11* System Component Limiting Daily Output		12* R or E
	Feet	Feet	Top Feet	Bottom Feet	Inches	Feet	Y / N	MGD	# of Days	MGD	Million Gallons	Capacity MGD	System Component	

***NOTES** Column 11 Component: **R=**Raw water pumps, **T=**Treatment facilities, **M=**Transmission main, **D=**Distribution system, **O=**Other (specify)____________________
Column 12 **R=**Regular Use, **E=**Emergency Use

3-G. What is the Total <u>12-Hour</u> Supply of all wells available for Regular Use? ______0_______ million gallons

3-H. Are ground water levels monitored? X No F Yes How often? ____________________

3-I. Does this system have a wellhead protection program X No F Yes F Under development

SYSTEM NAME City of Durham PWSID 03-32-010

3-J. WATER TREATMENT PLANTS List all WTPs, including any under construction, as of 12/31/2000. ***Mark and label locations on the System Map***.

Water Treatment Plant Name	Permitted Capacity MGD	Source(s)
Wade G. Brown Water Treatment Plant	30	Lake Michie & Little River Lake
Williams Water Treatment Plant	22	Lake Michie & Little River Lake

3-K. What is the system's finished water storage capacity? 20 Million Gallons

SECTION 4: WASTEWATER INFORMATION

4-A. List Average Daily Wastewater Discharges by Month for 2000 in Million Gallons per Day (MGD)

	Average Daily Discharge		Average Daily Discharge		Average Daily Discharge		Average Daily Discharge
Jan	25.27	Apr	24.06	Jul	21.63	Oct	19.87
Feb	28.07	May	20.29	Aug	24.05	Nov	20.08
Mar	22.41	Jun	19.73	Sep	23.00	Dec	20.38

4-B. List all Wastewater Discharge and/or Land Application Permits held by the system. ***Mark and label points of discharge and land application sites on the System Map***.

1 NPDES or Land Application Permit Number	2 Permitted Capacity Dec. 31,2000 MGD	3 Design Capacity MGD	4 Average Annual Daily Discharge MGD	5 Name of Receiving Stream	6 Sub-Basin	7 Maximum Daily Discharge MGD
NC0023841	20	20	9.00	Ellerbee Creek	Neuse River (10-1)	
NC0047597	20	20	9.95	New Hope Creek	Haw River (2-1)	

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4-C. List all Wastewater Discharge Connections with other systems. Mark and label the locations of connections on the System Map.

1 Wastewater Discharger		2 Wastewater Receiver		3 Average Daily Amount Discharged or Received		4 Contract Maximum
Name	PWSID	Name	PWSID	MGD	# of Days	MGD
City of Durham, NC	03-32-010	County of Durham WWTP (NC0026051)	03-32-010-D03	3.46	365	---

4-D. Number of sewer service connections: 56,385

4-E. Number of water service connections with septic systems: 90 (Number in Sub-basin 1 ____ Number in Sub-basin 2 ____ Number in Sub-basin 3 ____)

4-F. Are there plans to build or expand wastewater treatment facilities in the next 10 years? X No F Yes Please explain. ____

SECTION 5: WATER CONSERVATION and DEMAND MANAGEMENT ACTIVITIES

5-A. What is the estimated total miles of distribution system lines? 961 miles

5-B. List the primary types and sizes of distribution lines:

	Asbestos Cement (AC)	Cast Iron (CI)	Ductile Iron (DI)	Galvanized Iron (GI)	Polyvinyl Chloride(PVC)	Other
Size Range	6-12 inch	6-24 inch	6-42 inch			36-54
Estimated % of lines	<1%	46%	50%			3%

5-C. Were any lines replaced in 2000? F No ☒ Yes 4,416 linear feet

5-D. Were any new water mains added in 2000? F No ☒ Yes 190,000 linear feet

5-E. Does this system have a program to work or flush hydrants? F No ☒ Yes How often? 1 x per year – main feeder lines, others as needed

5-F. Does this system have a valve exercise program? F No ☒Yes How often? 1 x per year – all valves

SYSTEM NAME City of Durham PWSID 03-32-010

5-G. Does this system have a cross-connection control program? F No ☒ Yes

5-H. Has water pressure been inadequate in any part of the system? ☒ No F Yes Please explain. ____________________

5-I. Does this system have a leak detection program? ☒ No F Yes What type of equipment or methods are used? ____________________

5-J. Has water use ever been restricted since 1992? ☒ No F Yes Please explain. ____________________

5-K. Does this system have a water conservation plan? F No ☒ Yes Please attach a copy.

5-L. Did this system distribute water conservation information in 2000? F No ☒ Yes

5-M. Are there any local requirements on plumbing fixture water use which are stricter than the NC State Building Code? ☒ No F Yes Please explain. ____________________

5-N. Does this system have a program to encourage replacement or retrofit of older, higher water-use plumbing fixtures? F No ☒ Yes

5-O. Does this system have a water shortage or drought response plan? F No ☒ Yes Please attach a copy.

5-P. Is raw water metered? F No ☒ Yes

5-Q. Is finished water output metered? F No ☒ Yes

5-R. Do you have a meter replacement program? F No ☒ Yes

5-S. How many meters were replaced in 2000? 2,303 meters

5-T. How old are the oldest meters in the system? 26 years

5-U. What type of rate structure is used? F Decreasing Block ☒ Flat Rate F Increasing Block F Seasonally Adjusted F Other____________

Attach a detailed description of the rate structure to this document.

5-V. Are there meters for outdoor water use, such as irrigation, which are not billed for sewer services? F No ☒ Yes # of meters not available

5-W. Does this system use reclaimed water or plan to use it within the next five years? F No ☒ Yes # of connections ____________ MGD

SECTION 6: SYSTEM MAP

Review, correct, and return the enclosed system map Check Plot to show the present boundaries of the water distribution system service area, points of intake and discharge, wells, water and wastewater treatment facilities, and water and wastewater interconnections with other systems. Also, show any proposed points of intake or discharge, wells, water and wastewater facilities, water and wastewater interconnections, and future service area extensions. Use symbols shown on the attached map.

SYSTEM NAME City of Durham PWSID 03-32-010

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

Completed By: CH2MHILL Date: 12-8-2000

WATER SYSTEM: City of Durham PWSID: 03-32-010

SECTION 7: WATER DEMAND PROJECTIONS

7-A. Population to be Served	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Year-Round	203,341	221,030	240,530	257,166	276,403	291,397	298,974	306,550	314,127	321,703	329,280
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											
Single Family	10.3	13.3	14.5	15.5	16.7	17.6	18.0	18.5	19.0	19.4	19.9
Multi-family	3.4	4.2	4.6	4.9	5.3	5.6	5.7	5.9	6.0	6.2	6.3
(2) Commercial	5.72	6.7	7.3	7.8	8.3	8.8	9.0	9.3	9.5	9.7	9.9
(3) Industrial	1.37	2.8	3.1	3.3	3.5	3.7	3.8	3.9	4.0	4.1	4.2
(4) Institutional	1.12	1.98	2.22	2.41	2.65	2.75	2.73	2.76	2.79	2.77	2.75
	1.72	1.82	1.91	2.01	2.10	2.25	2.40	2.50	2.60	2.75	2.90
(5) System Processes	2.83	2.5	2.7	2.9	3.1	3.3	3.3	3.4	3.5	3.6	3.7
(6) Unaccounted-for water	4.48	3.1	3.4	3.6	3.9	4.1	4.2	4.3	4.4	4.5	4.6
(7) Total Service Area Demand [sum (1) thru (6)]	30.95	36.4	39.6	42.4	45.5	48.0	49.2	50.5	51.7	53.0	54.2

7-C. Is non-residential water use expected to change significantly through 2050 from current levels of use? F No ☒ Yes
If yes, please explain: A larger industry locating in the Durham service area could dramatically change industrial demand projections.

SYSTEM NAME City of Durham PWSID 03-32-010

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

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

7-E. What is the Total Amount of Future Supplies available for Regular Use? ____0_____ 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		
Chatham County		0.20[A]	2000	2010	16 inch	E

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

A. The City has committed to a regular sale of 0.2 MGD through 2005. The minimum purchase amount is 0.16 MGD. The contract is for emergency use only from 2005 to 2010.

SYSTEM NAME City of Durham PWSID 03-32-010

7-G. What is the total amount of existing Future Sales Contracts for Regular Use? ____0.16_____ 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)	37	37	37	37	37	37	37	37	37	37	37
(2) Existing Ground Water Supply (Item 3-G)	0	0	0	0	0	0	0	0	0	0	0
(3) Existing Purchase Contracts (Item 3-E)	0	0	0	0	0	0	0	0	0	0	0
(4) Future Supplies (Item 7-E)	0	0	0	0	0	0	0	0	0	0	0
(5) **Total Available Supply** [sum (1) thru (4)]	37	37	37	37	37	37	37	37	37	37	37
Average Daily Demand, MGD											
(6) Service Area Demand (Item 7-B, Line 7)	31.0	34.2	37.2	39.8	42.8	45.1	46.3	47.5	48.6	49.8	51.0
(7) Existing Sales Contracts (Item 2-H)	5.0	0.2	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
(9) **Total Average Daily Demand** [sum (6) thru (8)]	36.0	34.4	37.2	39.8	42.8	45.1	46.3	47.5	48.6	49.8	51.0
(10) Demand as Percent of Supply [(9) / (5)] x 100	97%	93%	101%	108%	116%	122%	125%	128%	131%	135%	138%
(11) **Supply Needed to maintain 80% [(9) / 0.8] – (5)**	45.0	43.0	46.5	49.8	53.5	56.4	57.9	59.3	60.8	62.3	63.7
Additional Information for Jordan Lake Allocation											
(12) Sales Under Existing Contracts	5	0.2	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
(14) Demand in each planning period [(6)+(12)+(13)]	36.0	34.4	37.2	39.8	42.8	45.1	46.3	47.5	48.6	49.8	51.0
(15) Supply minus Demand [(5) – (14)]	1.0	2.6	-0.2	-2.8	-5.8	-8.1	-9.3	-10.5	-11.6	-12.8	-14.0

SYSTEM NAME City of Durham PWSID 03-32-010

8-B. Does Line 10 above indicate that demand will exceed 80% of available supply before the year 2030? F 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 #1 List the components of each alternative scenario including the planning period when each component will come online.

(#1)	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-A "Existing Supply – Demand"	1.0	2.6	-0.2	-2.8	-5.8	-8.1	-9.3	-10.5	-11.6	-12.8	-14.0
(2) Available supply from Project 1 (Teer Quarry)	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Available supply from Project 2 (Reuse)	0.0	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.4
Available supply from Project 3 (Jordan Lake)	0.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
(3) Supply available for future needs [(1) + (2)]	1.0	6.7	24.1	21.6	18.8	16.6	15.6	14.5	13.5	12.5	11.4
(4)..................Withdrawal from Source Basin (Neuse)*	47.9	49.7	46.4	44.1	43.8	44.1	44.1	44.3	44.3	44.3	44.4
(5) Total discharge to Source Basin (Neuse)*	13.3	14.0	16.0	17.5	19.3	20.8	21.3	21.8	22.3	22.8	23.4
(6) Consumptive Use in Source Basin (Neuse)*	5.6	6.1	6.8	7.4	8.1	8.6	8.9	9.1	9.3	9.5	9.8
(7) Total discharge to Receiving Basin (Haw)*	20.0	20.1	21.2	22.3	23.6	24.4	25.0	25.6	26.2	26.8	27.4
(8) Consumptive Use in Receiving Basin (Haw)*	7.5	8.9	9.4	9.8	10.4	10.7	10.9	11.1	11.4	11.6	11.8
(9) Interbasin Transfer [(4) – (5–) - (6)]*	28.9	29.5	23.6	19.1	16.4	14.7	13.9	13.3	12.6	11.9	11.3

* maximum day basis

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
Jordan Lake		Surface	Haw	WS-IV	20	6	2006
Teer Quarry[A]		Surface	Neuse	[1]	3	5	2005
Water Reuse					1.9 (by 2030)	5	2005

A. Teer Quarry would be developed as an offline storage reservoir filled by raw water from Lake Michie, Little River Reservoir, and the Eno River

SYSTEM NAME City of Durham PWSID 03-32-010

Future Supply Alternative #2 List the components of each alternative scenario including the planning period when each component will come online.

(#2)	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-" "Existing Supp–y - Demand"	1.0	2.6	-0.2	-2.8	-5.8	-8.1	-9.3	-10.5	-11.6	-12.8	-14.0
(2) Available supply from Project 1 (Teer Quarry)	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Available supply from Project 2 (Water Reuse)	0.0	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.4
Available supply from Project 3 (Expand Lake Michie)	0.0	0.0	0.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
(3) Supply available for future needs [(1) + (2)]	1.0	6.7	4.1	19.6	16.8	14.6	13.6	12.5	11.5	10.5	9.4
(4)......................Withdrawal from Source Basin (Neuse)*	48.5	49.7	53.9	57.6	61.8	65.1	66.6	68.3	69.8	71.3	72.9
(5) Total discharge to Source Basin (Neuse)*	13.3	14.0	16.0	17.5	19.3	20.8	21.3	21.8	22.3	22.8	23.4
(6) Consumptive Use in Source Basin (Neuse)*	5.8	6.1	6.8	7.4	8.1	8.6	8.9	9.1	9.3	9.5	9.8
(7) Total discharge to Receiving Basin (Haw)*	20.0	20.1	21.2	22.3	23.6	24.4	25.0	25.6	26.2	26.8	27.4
(8) Consumptive Use in Receiving Basin (Haw)*	7.9	8.9	9.4	9.8	10.4	10.7	10.9	11.1	11.4	11.6	11.8
(9) Interbasin Transfer [(4) – (5) - (6)]*	29.3	29.5	31.1	32.6	34.4	35.7	36.4	37.3	38.1	38.9	39.8

*maximum day basis

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
Lake Michie		Surface	Neuse	WS-III	18	15	2015
Teer Quarry		Surface	Neuse	[1]	3	5	2005
Water Reuse					1.9 (by 2030)	5	2005

1. Teer Quarry would be developed as an offline storage reservoir filled by raw water from Lake Michie, Little River Reservoir, and the Eno River

SYSTEM NAME City of Durham PWSID 03-32-010

Future Supply Alternative #3 List the components of each alternative scenario including the planning period when each component will come online.

(#3)	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-A "Existing Supply – Demand"	1.0	2.6	-0.2	-2.8	-5.8	-8.1	-9.3	-10.5	-11.6	-12.8	-14.0
(2) Available supply from Project 1 (Teer Quarry)	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Available supply from Project 2 (Water Reuse)	0.0	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.4
Available supply from Project 3 (New Reservoir on Flat River)	0.0	0.0	0.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
(3) Supply available for future needs [(1) + (2)]	1.0	6.7	4.1	24.6	21.8	19.6	18.6	17.5	16.5	15.5	14.4
(4)......................Withdrawal from Source Basin (Neuse)*	48.5	49.7	53.9	57.6	61.8	65.1	66.6	68.3	69.8	71.3	72.9
(5) Total discharge to Source Basin (Neuse)*	13.3	14.0	16.0	17.5	19.3	20.8	21.3	21.8	22.3	22.8	23.4
(6) Consumptive Use in Source Basin (Neuse)*	5.8	6.1	6.8	7.4	8.1	8.6	8.9	9.1	9.3	9.5	9.8
(7) Total discharge to Receiving Basin (Haw)*	20.0	20.1	21.2	22.3	23.6	24.4	25.0	25.6	26.2	26.8	27.4
(8) Consumptive Use in Receiving Basin (Haw)*	7.9	8.9	9.4	9.8	10.4	10.7	10.9	11.1	11.4	11.6	11.8
(9) Interbasin Transfer [(4) – (5) - (6)]*	29.3	29.5	31.1	32.6	34.4	35.7	36.4	37.3	38.1	38.9	39.8

*maximum day basis

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
New Reservoir on Flat River		Surface	Neuse	WS-III	23	15	2015
Teer Quarry		Surface	Neuse	[1]	3	5	2005
Water Reuse					1.9 (by 2030)	5	2005

SYSTEM NAME City of Durham PWSID 03-32-010

1. Teer Quarry would be developed as an offline storage reservoir filled by raw water from Lake Michie, Little River Reservoir, and the Eno River

Future Supply Alternative #4 List the components of each alternative scenario including the planning period when each component will come online.

(#4)	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-A "Existing Supply - Demand"	1.0	2.6	-0.2	-2.8	-5.8	-8.1	-9.3	-10.5	-11.6	-12.8	-14.0
(2) Available supply from Project 1 (Teer Quarry)	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Available supply from Project 2 (Water Reuse)	0.0	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.4
Available supply from Project 3 (Kerr Lake)	0.0	0.0	0.0	0.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
(3) Supply available for future needs [(1) + (2)]	1.0	6.7	4.1	1.6	23.8	21.6	20.6	19.5	18.5	17.5	16.4
(4).........Total Withdrawal from Source Basin (Roanoke)*	0.0	0.0	0.0	0.0	18.0	22.5	24.0	25.5	27.0	30.0	31.5
(5) Total Discharge to Source Basin (Roanoke)*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(6) Consumptive Use in Source Basin (Roanoke)*	0.0	0.0	0.0	0.0	1.4	1.8	1.9	2.0	2.2	2.4	2.5
(7) ....Interbasin Transfer [(4) – (5) - (6)]*	0.0	0.0	0.0	0.0	16.6	20.7	22.1	23.5	24.8	27.6	29.0

*maximum day basis

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
Kerr Lake		Surface	Roanoke	WS-III	25	20	2020
Teer Quarry		Surface	Neuse	[1]	3	5	2005
Water Reuse					1.9 (by 2030)	5	2005

1. Teer Quarry would be developed as an offline storage reservoir filled by raw water from Lake Michie, Little River Reservoir, and the Eno River

Future Supply Alternative #5 List the components of each alternative scenario including the planning period when each component will come online.

(#5)	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
(1) Line (15) from Table 8-A "Existing Supply - Demand"	1.0	2.6	-0.2	-2.8	-5.8	-8.1	-9.3	-10.5	-11.6	-12.8	-14.0
(2) Available supply from Project 1 (Teer Quarry)	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Available supply from Project 2 (Water Reuse)	0.0	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.4
Available supply from Project 3 (16-MGD Allocation from Jordan Lake)	0.0	0.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Available supply from Project 4 (Expand Lake Michie)	0.0	0.0	0.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
(3) Supply available for future needs [(1) + (2)]	1.0	6.7	20.1	35.6	32.8	30.6	29.6	28.5	27.5	26.5	25.4
(4)......................Withdrawal from Source Basin (Neuse)*	46.5	49.7	46.4	44.1	43.8	44.1	44.1	44.3	45.8	47.3	48.9
(5) Total discharge to Source Basin (Neuse)*	13.3	14.0	16.0	17.5	19.3	20.8	21.3	21.8	22.3	22.8	23.4
(6) Consumptive Use in Source Basin (Neuse)*	5.6	6.1	6.8	7.4	8.1	8.6	8.9	9.1	9.3	9.5	9.8
(7) Total discharge to Receiving Basin (Haw)*	20.0	20.1	21.2	22.3	23.6	24.4	25.0	25.6	26.2	26.8	27.4
(8) Consumptive Use in Receiving Basin (Haw)*	7.5	8.9	9.4	9.8	10.4	10.7	10.9	11.1	11.4	11.6	11.8
(9) Interbasin Transfer [(4) – (5) - (6)]*	27.6	29.5	23.6	19.1	16.4	14.7	13.9	13.3	14.1	14.9	15.8

*maximum day basis

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
Lake Michie		Surface	Neuse	WS-III	18	15	2015
Teer Quarry		Surface	Neuse	[1]	3	5	2005
Jordan Lake		Surface	Haw	[1]	16	6	2006
Water Reuse					1.9 (by 2030)	5	2005

1. Teer Quarry would be developed as an offline storage reservoir filled by raw water from Lake Michie, Little River Reservoir, and the Eno River

8-C. Are peak day demands expected to exceed the water treatment plant capacity by 2010? F No ☒ Yes
If yes, what are your plans for increasing water treatment capacity?
The City of Durham is currently undergoing a pilot study to re-rate the filters at the Brown WTP. This should increase total treatment capacity to 61 MGD. An additional expansion of the Brown WTP may also be required by 2010.

8-D. Does this system have an interconnection with another system capable of providing water in an emergency? F No ☒ Yes If not, what are your plans for interconnecting (or please explain why an interconnection is not feasible or not necessary).
The City of Durham has interconnections with the Town of Cary, the Town of Morrisville, OWASA, the Town of Hillsborough, the Orange-Alamance Water System, and Chatham County. The City is planning to construct an interconnection with the City of Raleigh.

8-E. Has this system participated in regional water supply or water use planning? F No ☒ Yes Please describe.
The City of Durham is currently participating in a study along with the City of Raleigh, the Town of Cary, and Granville County evaluating the feasibility of utilizing Kerr Lake as a water supply source

8-F. List the major water supply reports or studies used for planning.

City of Durham Water and Sewer Strategic Plan (CH2M HILL, 2000)

City of Durham Local Water Supply Plan (1994, updated 1997 and 2000)

Jordan Lake Allocation Application - Round 2 (1997)

Evaluation of Alternative Reservoirs on the Flat and Little Rivers (Hazen and Sawyer, 1988)

Little River Reservoir at Orange Factory, USACOE Section 404 Permit, Environmental Assessment (1982)

Report of Water Supply for the City of Durham (1974)

SYSTEM NAME City of Durham PWSID 03-32-010

SECTION 9: TECHNICAL ASSISTANCE NEEDS

Is technical assistance needed:

9-A. to develop a local water supply plan? ☒ No F Yes

9-B. with a leak detection program? ☒ No F 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? F No ☒ Yes

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

9-G. with a wellhead or source water protection plan? ☒ No F Yes

9-H. with water system compliance or operational problems? ☒ No F Yes

9-I. with Consumer Confidence Reports? ☒ No F 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.

A Water Distribution System Master Plan is currently underway to evaluate system improvements needed to maintain capacity and water quality. A feasibility study to evaluate the efficacy of converting Teer Quarry into an offline raw water storage reservoir is also currently underway. The City has included several projects in its Capital Improvements Plan including additional elevated storage in southern Durham, and upgrades and renovations at the City's water treatment plants.

SYSTEM NAME City of Durham PWSID 03-32-010

Attachment 2:

Water Conservation Ordinance

ARTICLE VI. WATER CONSERVATION*

Sec. 23-163. Purpose and intent; statutory construction.

It is the purpose and intent of this article to assure that available water resources are put to reasonable beneficial uses to avoid depletion of the city water supply during a water shortage. This article shall be liberally construed to effectuate such purpose and intent. (Ord. No. 7028, 1, 7-28-86)

Sec. 23-164. Definitions.

The following terms, phrases, words and their derivation shall have the meaning given herein. The word "shall" is always mandatory and never directory.

- **a)** *City*: The term "city" means the City of Durham a North Carolina municipal corporation.
- **b)** *Customer*: The term "customer" refers to any person who is an owner, occupant, or user of real property to which water is supplied by the city. The term shall also refer to any person who uses water supplied by the city, or to any person who is billed for the supply of water from the city, or to any person who is responsible for or otherwise has the right or permission to utilize the supply of water provided by the city.
- **c)** *Person*: The term "person" means any natural person, any group of persons, any firm, partnership, association, corporation, company, or any other organization or entity.
- **d)** *Water*: The term "water" refers to all water, except wastewater, supplied by the city to any customer.
- **e)** *Water shortage*: A "water shortage" shall be deemed to exist when the ordinary demands and requirements of water customers served by the city cannot be satisfied without depleting the water supply to of below a critical level, the level at which the continued availability of water for human consumption, sanitation and fire protection is jeopardized. (Ord. No 7028, 1 7-28-86)

Sec. 23-165. Response to water shortage.

It shall be the duty of the director of water resources to report to the city manager conditions adversely affecting the city water supply. The manager shall review all relevant and available information, and if deemed necessary, shall recommend that the city council declare water conservation measures contained herein to be in full force and effect as necessary. (Ord. No 7028, 1, 7-28-86).

Sec. 23-166. Violation of article prohibited; enforcement.

- **a)** *Violation*. In the event that the city council shall declare one or more stages of water conservation as set forth herein, it shall be unlawful for any person to use or permit user of water supplied by the city in violation of any mandatory restrictions instituted.

b) *Enforcement*. It shall be the duty of the director of water resources to investigate violations of the mandatory restriction and issue orders consistent with the purpose and intent of this article. All customers shall cease any violation of the mandatory restrictions upon the order of the director of water resources. Any customer who violates any provision of the article , or who shall violate or fail to comply with any order made hereunder shall be subject to penalty or a combination of the penalties as follows:

1) *Discontinuance of service*. The city man discontinue water service to any structure(s) or parcel(s) when the city manager upon recommendation of the director of water resources gives written notice of any violation of mandatory restrictions and intent to discontinue service. Water service shall be discontinued within twenty-four (24) hours unless the violation shall cease voluntarily.

   When service is discontinued pursuant to the provisions of this section, service shall not be reinstated unless and until the city manager upon recommendation of the director of water resources determines that the risk to the city water supply has been alleviated.

   The customers shall have a right of appeal to the city council, upon serving written notice of appeal on the city manager within five (5) days after receiving notice of any violation and intent to discontinue service. The appellant will be notified by the city manager of the time and place for the hearing of the appeal. The city council shall act on the appeal as expeditiously as possible and shall notify the appellant in writing not later than two (2) days after the final decision.

Equitable relief. The provisions of this article may be enforced by an appropriate remedy, including a mandatory or prohibitory injunction, issuing from a court of competent jurisdiction.

c) *Penalty not a substitute remedy*. The imposition of one or more penalties for any violation shall not excuse any violation or permit t to continue. (Ord. No. 7028, 1, 7-28-86)

Sec. 23-167. Water conservation stages; recommendations; mandatory measures.

Stage I - Continuing Voluntary Conservation Practices. Customers shall be encouraged to observe water conservation measures to reduce the wasting of water as follows:

a) Check plumbing and toilets for leaks annually, and if necessary repair.
b) Repair leaking faucets whenever they develop
c) Store drinking water in the refrigerator to avoid trying to run it cool at the tap.
d) Use shower for bathing purposes or reduce the depth of water used for but baths. Limit showers to four (4) minutes where possible.
e) Refrain from running faucets while shaving, rinsing dishes or brushing teeth.
f) Install water flow restrictive devices in shower heads.
g) Install water-saving devices such as plastic bottles or commercial units in toilet tanks.
h) Wash full loads in clothes washers and dishwashers.

i) Review water uses and where feasible install recycle systems, particularly commercial and industrial customers.

Stage II. Voluntary Conservation. Customers shall be encouraged to observe the recommendations of Stage I and to increase the level of conservation effort as follows:

a) Limit the use of clothes washers and dishwashers, and when used, to operate full loads.
b) Reduce the flushing of toilets to the minimum whenever practical.
c) Limit lawn watering to only when grass shows signs of withering and apply water as slow as possible to achieve deep penetration.
d) Limit shrubbery watering to the minimum reusing household water when possible.
e) Limit car washing to the minimum.
f) Limit wash downs of outside areas such as sidewalks, patios, driveways, or other similar purposes.
g) Limit hours of operation of water-cooled air conditioners possible.
h) Use disposable dishes and utensils, bother for residential and commercial purposes, where feasible.

Stage III. Moderate Mandatory Conservation. Customers shall be encouraged to observe the recommendations of Stage I and II, and the level of the conservation effort shall be increased to require the following mandatory measures. No person shall:

a) Water lawns, grass, trees, shrubbery, flowers, golf greens or vegetable gardens except between 5:00 p.m. and 12:00 midnight on Wednesday and Saturday.
b) Introduce water into wading pools or swimming pools except to the extent necessary to replenish losses due to evaporation of spillage, and maintain operation of chemical feed equipment.
c) Use water to wash down outside areas such as sidewalks, patios, driveways, or for other similar purposes.
d) Introduce water into any decorative fountain, pool or pond except where the water is recycled.
e) Serve water in a restaurant or similar establishment except upon request.
f) Use water for any unnecessary purpose or intentionally waste water.
g) Wash the exterior of a motor vehicle except where fifty (50) percent or more of the water is recycled, or where a private well water system is used.

Provided, however, any customer may secure a written license from the city manger or his designee to use water contrary to the Stage III mandatory conservation measures where it can be shown to the manager's satisfaction that use of water pursuant to conditions prescribed by the city manager in the license will result in a thirty (30) percent of greater saving of water. Any license issued pursuant to this provision: (1) must be in the possession of the licensee whenever water is used contrary to the Stage Iii mandatory conservation measures; and (2) is subject to amendment or revocation by the city manager at any time for good cause.

Stage IV. Severe Mandatory Conservation. Customers shall be encouraged to observe the conservation measures in Stages I and II and required to continue observing the mandatory requirements in Stage III. The level of the conservation effort shall increase to require the following additional mandatory measures. No person shall:

a) Water or sprinkle any lawn, grass, trees, or golf greens.
b) Water any vegetable garden or ornamental shrubs except during the hours of 5:00 p.m. and 9:00 p.m. on Saturday.
c) Fill any wading pool or swimming pool or replenish any filled pool except to the minimum essential for operation of chemical feed equipment.
d) Make nonessential use of water for commercial or public use.
e) Operate water-cooled air conditioners or other equipment that do not recycle cooling water, except when health and safety are adversely affected.

Stage V. Stringent Mandatory Conservation. Customers hall be encouraged to observe the conservation measures in Stages I and II and required to continue observing the mandatory requirements in Stages III and IV. The level of the conservation effort shall increase to require the following **additional** mandatory measures. No person shall:

a) Use water outside a structure except in an emergency involving fire.
b) Operate evaporative air conditioning units which recycle water except during the operating hours of the business.
c) Use any swimming pool or wading pool.
d) Wash any motor vehicle, including commercial washing unless a private well is used.

In addition to the conservation measures enumerated above, customer shall use plates, glasses, cups and eating utensils that are disposable.

Stage VI. Rationing. Customers shall be encouraged to observe the conservation measures in Stages I and II and require to continue observing the mandatory requirements of Stages III, IV and V. the level of the conservation effort shall increase to require the following mandatory measures:

a) Fire protection will be maintained, but where possible, tank trucks shall use raw water.
b) All industrial uses of water shall be prohibited.
c) All other uses of water will be limited to those necessary to meet minimum health and safety needs of the customers as determined by the city manager upon consultation with the director of water resources in light of conditions present.

Failure to act in accordance therewith or use of water in any manner or attempt to evade or avoid water rationing restrictions, shall be unlawful. (Ord. No.7028, 1, 7-28-86)

Sec. 23-168. Scope and duration; effect of invalidity.

a) *Scope and duration*. In the event that the city council shall declare one or more stages of water conservation to be in effect, said proclamation shall be applicable to all persons using water supplied by the city. Pursuant to the provision of section 23-80 (4), and policies adopted in accordance with this article shall also apply to extensions of city water service outside the city limits.

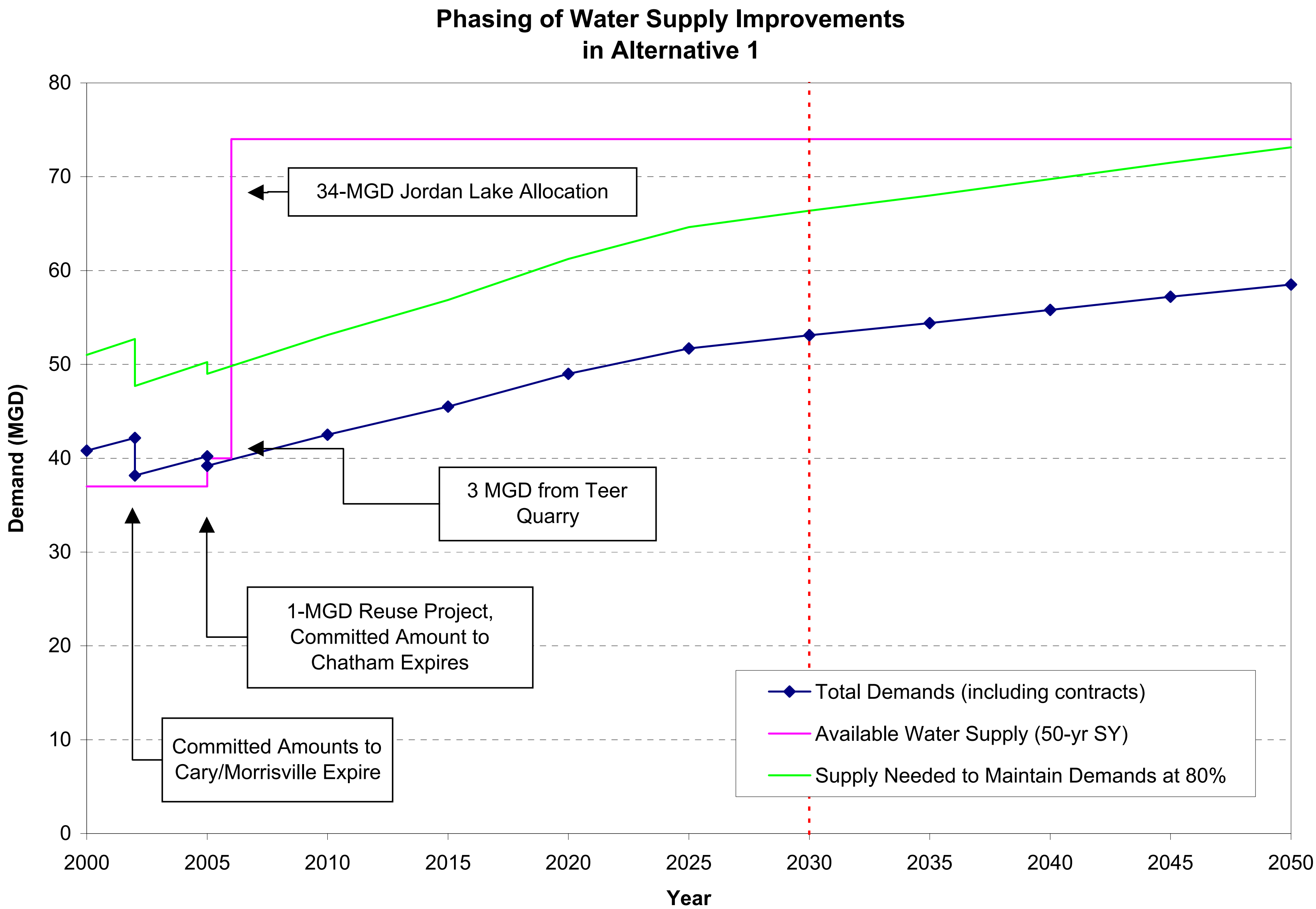
   Stage I of the water conservation measures shall remain in full force and effect at all times or until such time as this article is amended or repealed. Whenever Stages II, III, IV, V, VI or the water conservation measures are declared, they shall remain in full force and effect until the mayor by proclamation declares that the particular stage of the water shortage is over and the measures applicable to it are no longer in effect.

b) *Effect of invalidity*. Should any section or provision of this article be declared by the courts to be unconstitutional or invalid such decision shall not affect the validity of this article as a whole or any part other than the part so held unconstitutional or invalid. (Ord. No. 7028, 1, 7-28-86)

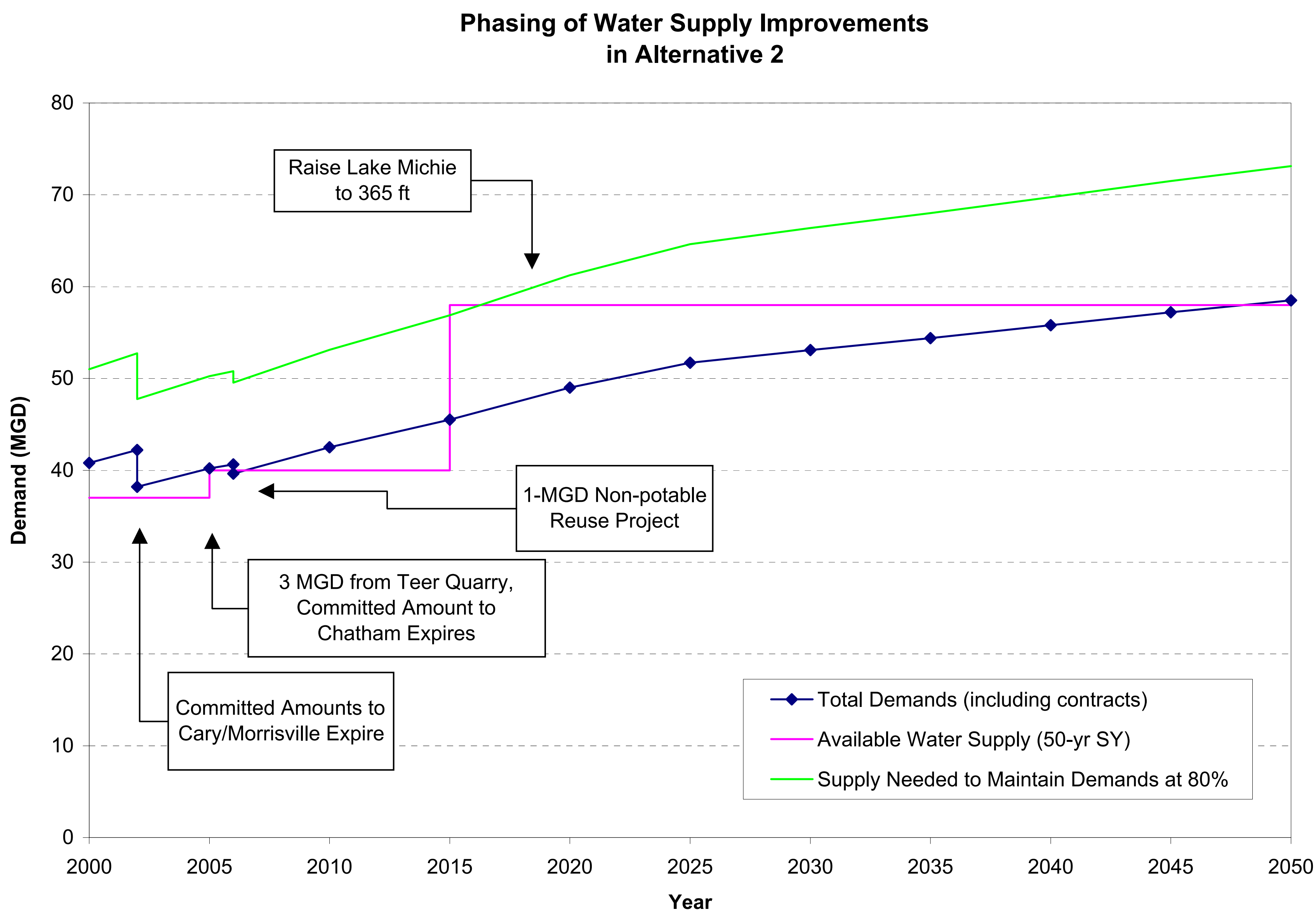
Sec. 23-169. Reserved.

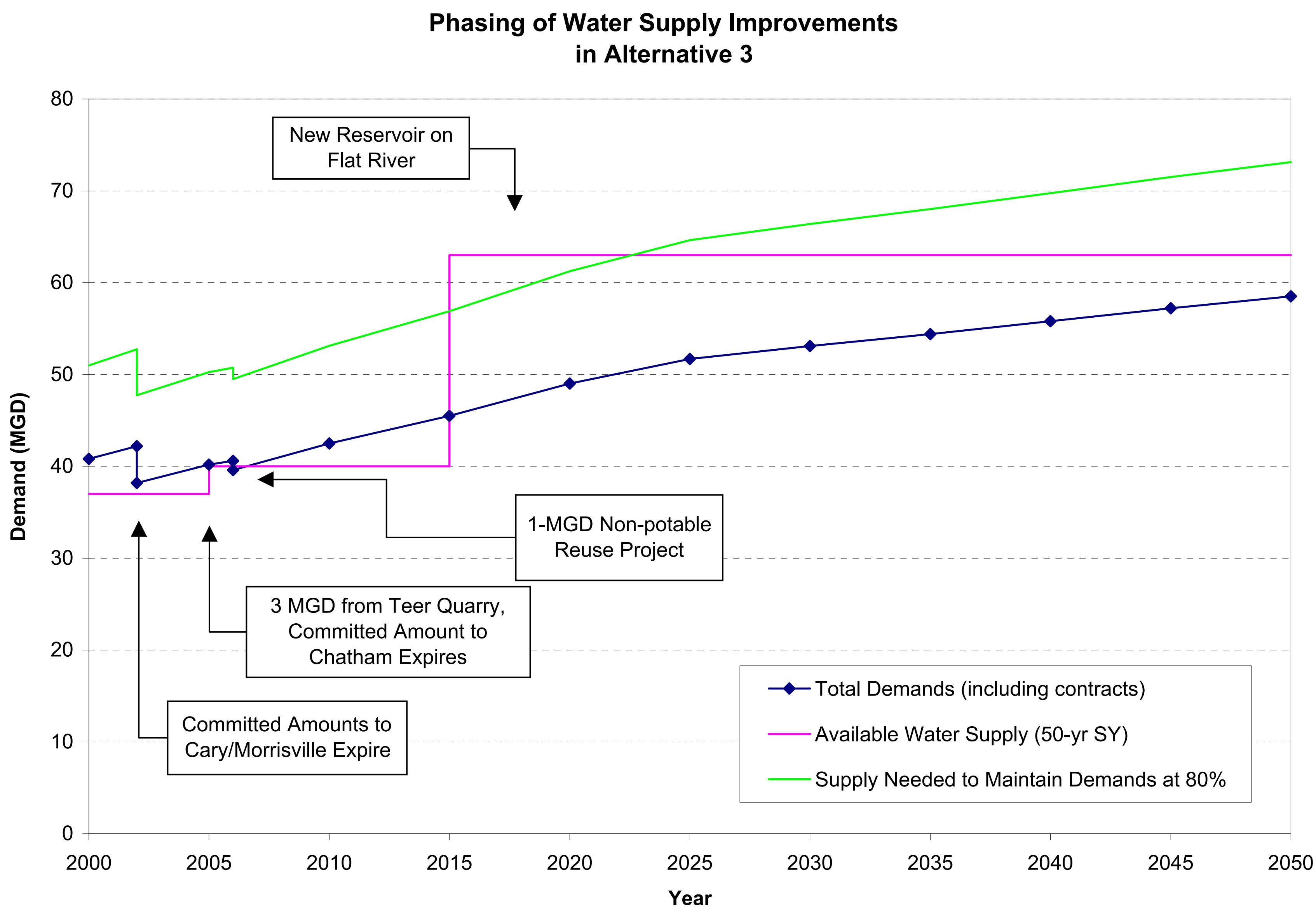
Attachment 3:

Phasing of Water Supply Improvements

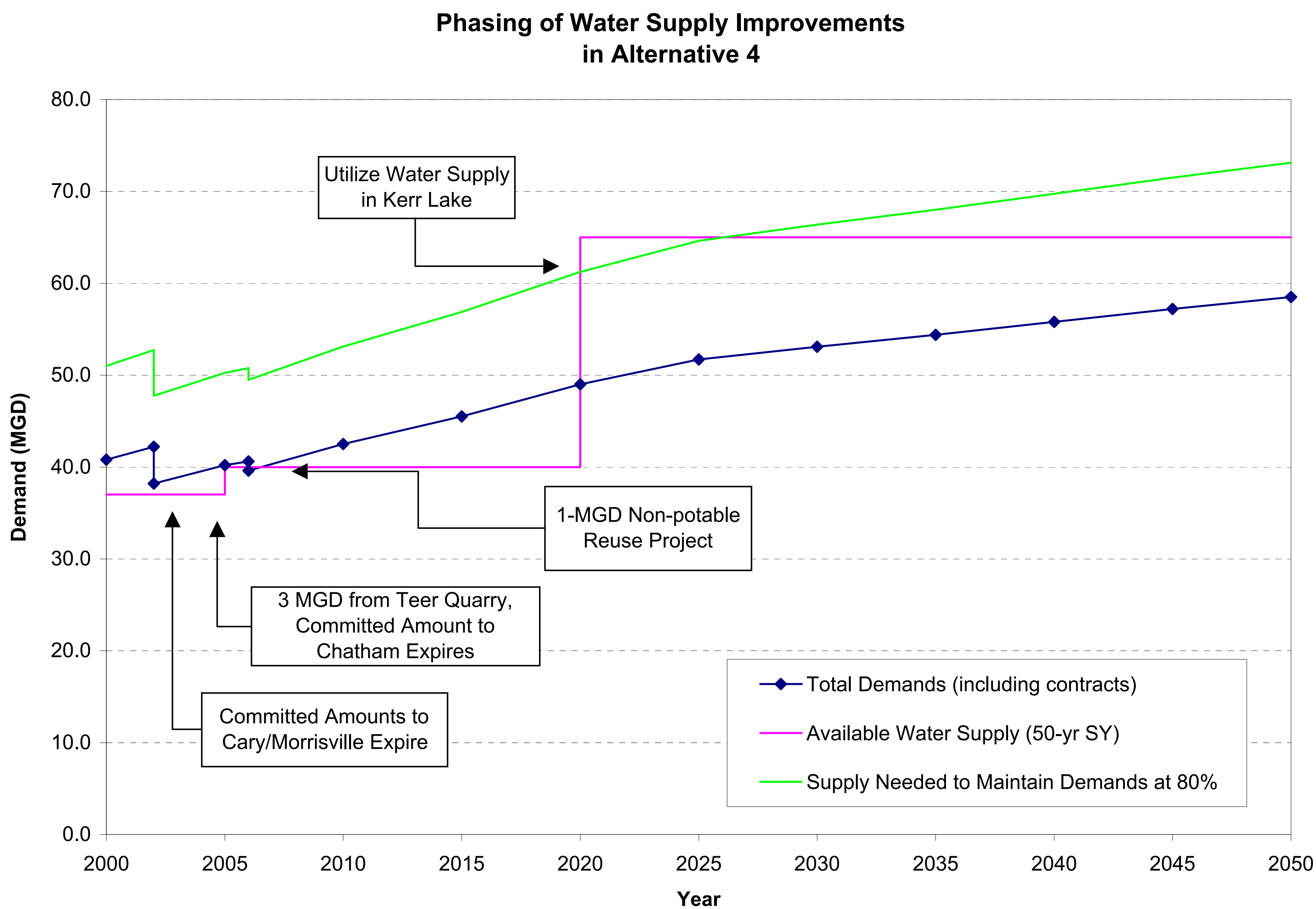


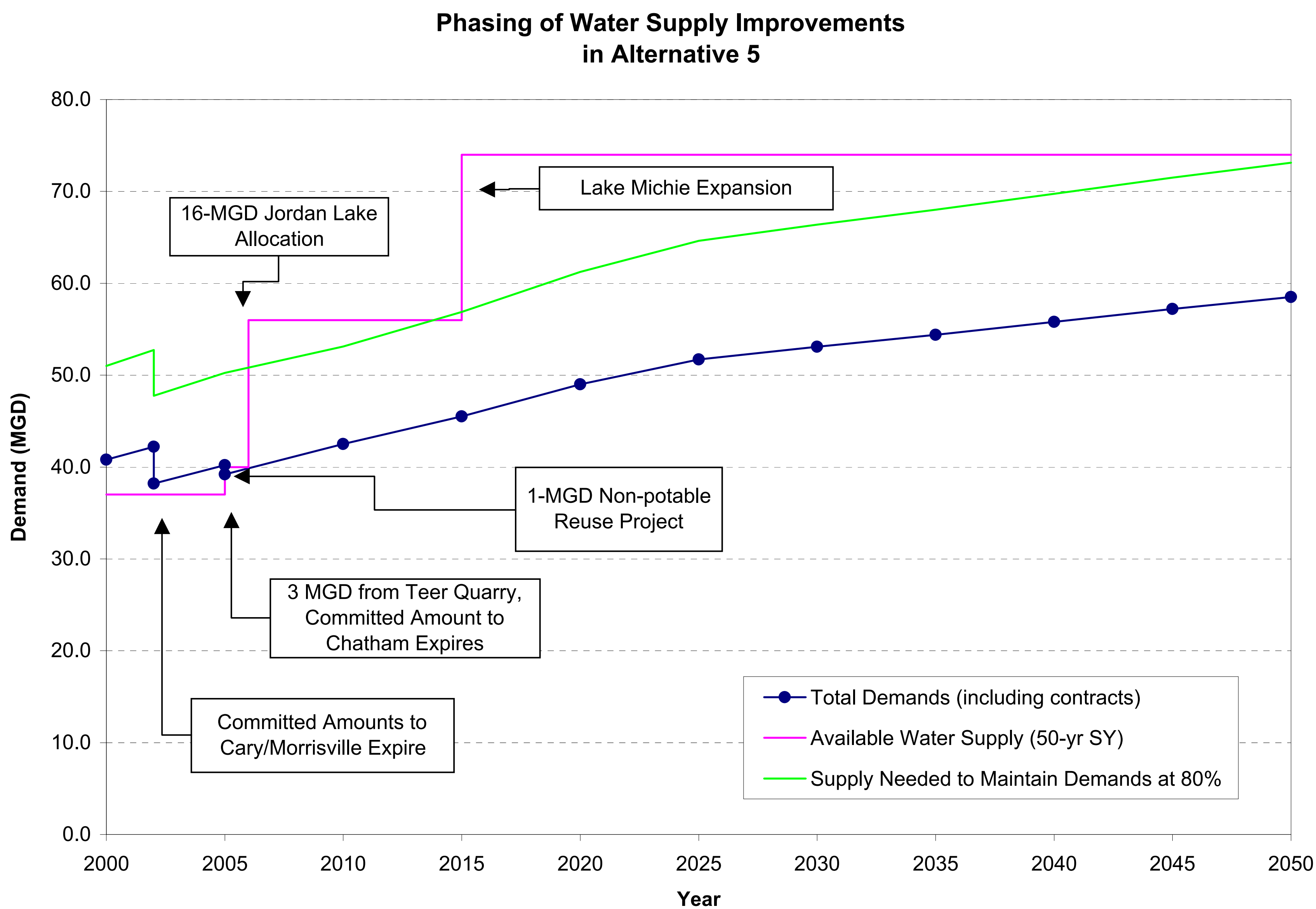
Phasing of Water Supply Improvements
in Alternative 1
80
70
60
50
40
30
20
10
0
Demand (MGD)
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
34-MGD Jordan Lake Allocation
3 MGD from Teer Quarry
1-MGD Reuse Project, Committed Amount to Chatham Expires
Committed Amounts to Cary/Morrisville Expire
Total Demands (including contracts)
Available Water Supply (50-yr SY)
Supply Needed to Maintain Demands at 80%


Phasing of Water Supply Improvements
in Alternative 2
Demand (MGD)
Year
0
10
20
30
40
50
60
70
80
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Raise Lake Michie
to 365 ft
1-MGD Non-potable
Reuse Project
3 MGD from Teer Quarry,
Committed Amount to
Chatham Expires
Committed Amounts to
Cary/Morrisville Expire
Total Demands (including contracts)
Available Water Supply (50-yr SY)
Supply Needed to Maintain Demands at 80%



Phasing of Water Supply Improvements
in Alternative 3
Demand (MGD)
Year
New Reservoir on Flat River
1-MGD Non-potable Reuse Project
3 MGD from Teer Quarry, Committed Amount to Chatham Expires
Committed Amounts to Cary/Morrisville Expire
Total Demands (including contracts)
Available Water Supply (50-yr SY)
Supply Needed to Maintain Demands at 80%
0
10
20
30
40
50
60
70
80
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050


Phasing of Water Supply Improvements
in Alternative 4
Demand (MGD)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Utilize Water Supply
in Kerr Lake
1-MGD Non-potable
Reuse Project
3 MGD from Teer Quarry,
Committed Amount to
Chatham Expires
Committed Amounts to
Cary/Morrisville Expire
Total Demands (including contracts)
Available Water Supply (50-yr SY)
Supply Needed to Maintain Demands at 80%



Phasing of Water Supply Improvements
in Alternative 5
Demand (MGD)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
16-MGD Jordan Lake Allocation
Lake Michie Expansion
1-MGD Non-potable Reuse Project
3 MGD from Teer Quarry, Committed Amount to Chatham Expires
Committed Amounts to Cary/Morrisville Expire
Total Demands (including contracts)
Available Water Supply (50-yr SY)
Supply Needed to Maintain Demands at 80%

Attachment 4:

Cost Estimates of Water Supply Improvements

Alternative 1
20-MGD Jordan Lake Allocation

Jordan Water Agency	Unit	Quantity	Unit Cost	Item Cost
RW Intake (55 MGD)	LS	1	$1,850,000	$ 1,850,000
RW Pump Station (54 MGD)	MGD	54	$ 130,000	$ 7,020,000
RW Transmission Line (42-inch)	LF	1,000	$ 400	$ 400,000
WTP (54 MGD)	MGD	54	$1,250,000	$ 67,500,000
Durham's share		**56%**		$42,991,200
Finished Water Transmission	LF	100,000	$168	$ 16,800,000
Booster Pump Station	MGD	34	$120,000	$ 4,080,000
Durham's share		**75%**		$15,660,000
			Subtotal	$58,651,200
Mobilization/Demobilization		7%		$4,105,584
Contingency		10%		$5,865,120
Contractor's OH and Profit		15%		$8,797,680
			Construction Cost	$77,419,584
Engineering Design and Administration		10%		$7,741,958
Legal and Administrative Costs		5%		$3,870,979
Cost of Regulatory Requirements		5%		$3,870,979
DWR Allocation Payment	EA	1	$1,500,000	$1,500,000
			Jordan Lake Capital Cost	$94,403,501
			Net Present Value of O&M Costs	$43,093,109
			Total Jordan Lake Costs	$137,496,610
Teer Quarry				
Raw Water Pump Station	mgd	6	$130,000	$780,000
Intake	mgd	6	$125,000	$750,000
Raw Water Main (24")	LF	1500	$200	$300,000
			Capital subtotal	$1,830,000
Mobilization/Demobilization		7%		$128,100
Contingency		10%		$183,000
Contractor's OH and Profit		15%		$274,500
			Construction subtotal	$14,500,000
Engineering Design and Administration		20%		$2,900,000
Legal and Administrative Costs		10%		$1,450,000
Cost of Regulatory Requirements		5%		$725,000
			Teer Quarry Capital Cost	$19,575,000
			Net Present Value of O&M Costs	$1,679,702
			Total Teer Quarry Costs	$21,254,702
Non-potable Reuse Project				
Reuse pumping and storage	LS	1	$ 350,000	$350,000
Reuse distribution system	LF	80000	$ 48	$3,840,000
			Subtotal	$4,190,000
Mobilization/Demobilization		7%		$293,300
Contingency		10%		$419,000
Contractor's OH and Profit		15%		$628,500
			Construction subtotal	$ 5,530,800
Engineering Design and Administration		20%		$1,106,160
Legal and Administrative Costs		10%		$553,080
Cost of Regulatory Requirements		10%		$553,080
			Reuse Capital Cost	$7,743,120
			Net Present Value of O&M Costs	$2,112,596
			Total Reuse Costs	$9,855,716
			Total Net Present Value	$168,607,028
			Incremental Supply (MGD)	25
			Unit Cost ($/gallon)	$ 6.74

Alternative 2a
Expansion of Lake Michie Reservoir

	Unit	Quantity	Unit Cost	Item Cost
Lake Michie				
Dam Site Preparation	EA	1	$1,324,000	$1,324,000
Dam Embankment	EA	1	$5,460,000	$5,460,000
Principal Spillway	EA	1	$16,112,000	$16,112,000
Diversion Conduit	EA	1	$4,714,000	$4,714,000
Intake Tower	EA	1	$2,484,000	$2,484,000
Pumping Station	EA	1	$3,712,000	$3,712,000
Decommissioning of Existing Facility	EA	1	$275,000	$275,000
Access Roads	EA	1	$564,000	$564,000
Site Work	EA	1	$711,000	$711,000
Electrical	EA	1	$1,351,000	$1,351,000
Reservoir Clearing	EA	1	$647,000	$647,000
Road Relocations	EA	1	$5,700,000	$5,700,000
Modifications to Existing Utilities	EA	1	$594,000	$594,000
Raw Water Main to Brown and Williams WTP (30")	LF	60,000	$120	$7,200,000
			Capital Total	$50,848,000
Mobilization/Demobilization		7%		$3,559,360
Contingency		10%		$5,084,800
Contractor's OH and Profit		15%		$7,627,200
			Construction Total	$67,119,000
Engineering Design and Administration		20%		$13,423,800
Legal and Administrative Costs		10%		$6,711,900
Cost of Regulatory Requirements		10%		$6,711,900
Land/Easement Acquisition	acres	1070	$ 10,000	$10,700,000
			Lake Michie Capital Cost	$104,666,600
			NPV of O&M	$8,352,173
			Total Lake Michie Cost	$113,018,773
Teer Quarry				
Raw Water Pump Station	mgd	6	$130,000	$780,000
Intake	mgd	6	$125,000	$750,000
Raw Water Main (24")	LF	1500	$200	$300,000
			Capital subtotal	$1,830,000
Mobilization/Demobilization		7%		$128,100
Contingency		10%		$183,000
Contractor's OH and Profit		15%		$274,500
			Construction subtotal	$2,415,600
Engineering Design and Administration		20%		$483,120
Legal and Administrative Costs		10%		$241,560
Cost of Regulatory Requirements		5%		$120,780
			Teer Quarry Capital Cost	$3,261,060
			NPV of O&M Cost	$ 1,679,702
			Total Teer Quarry Cost	$4,940,762
Non-potable Reuse Project				
Reuse pumping and storage	LS	1	$ 350,000	$350,000
Reuse distribution system	LF	80000	$ 48	$3,840,000
			Subtotal	$4,190,000
Mobilization/Demobilization		7%		$293,300
Contingency		10%		$419,000
Contractor's OH and Profit		15%		$628,500
			Construction subtotal	$ 5,530,800
Engineering Design and Administration		20%		$1,106,160
Legal and Administrative Costs		10%		$553,080
Cost of Regulatory Requirements		10%		$553,080
			Reuse Capital Cost	$7,743,120
			NPV of O&M Cost	$ 2,112,596
			Total Reuse Cost	$9,855,716
Expand Brown WTP				
25-MGD expansion	MGD	25	$ 1,250,000	$31,250,000
Mobilization/Demobilization		7%		$2,187,500
Contingency		10%		$3,125,000
Contractor's OH and Profit		15%		$4,687,500
			Construction subtotal	$ 41,250,000
Engineering Design and Administration		20%		$8,250,000
Legal and Administrative Costs		10%		$4,125,000
Cost of Regulatory Requirements		5%		$2,062,500
			Brown WTP Capital Cost	$55,687,500
			NPV of O&M Cost	$17,002,724
			Total Brown WTP Cost	$72,690,224
			Total Net Present Value	$200,505,475
			Incremental Supply (MGD)	23
			Unit Cost ($/gallon)	$ 8.72

Alternative 2b
Expansion of Lake Michie Reservoir
w/ Transfer of WW to NDWRF

	Unit	Quantity	Unit Cost	Item Cost
Lake Michie				
Dam Site Preparation	EA	1	$1,324,000	$1,324,000
Dam Embankment	EA	1	$5,460,000	$5,460,000
Principal Spillway	EA	1	$16,112,000	$16,112,000
Diversion Conduit	EA	1	$4,714,000	$4,714,000
Intake Tower	EA	1	$2,484,000	$2,484,000
Pumping Station	EA	1	$3,712,000	$3,712,000
Decommissioning of Existing Facility	EA	1	$275,000	$275,000
Access Roads	EA	1	$564,000	$564,000
Site Work	EA	1	$711,000	$711,000
Electrical	EA	1	$1,351,000	$1,351,000
Reservoir Clearing	EA	1	$647,000	$647,000
Road Relocations	EA	1	$5,700,000	$5,700,000
Modifications to Existing Utilities	EA	1	$594,000	$594,000
Raw Water Main to Brown and Williams WTP (30")	LF	60,000	$120	$7,200,000
			Capital Total	$50,848,000
Mobilization/Demobilization		7%		$3,559,360
Contingency		10%		$5,084,800
Contractor's OH and Profit		15%		$7,627,200
			Construction Total	$67,119,000
Engineering Design and Administration		20%		$13,423,800
Legal and Administrative Costs		10%		$6,711,900
Cost of Regulatory Requirements		10%		$6,711,900
Land/Easement Acquisition	acres	1070	$ 10,000	$10,700,000
			Lake Michie Capital Cost	$104,666,600
			NPV of O&M	$8,352,173
			Total Lake Michie Cost	$113,018,773
Teer Quarry				
Raw Water Pump Station	mgd	6	$130,000	$780,000
Intake	mgd	6	$125,000	$750,000
Raw Water Main (24")	LF	1500	$200	$300,000
			Capital subtotal	$1,830,000
Mobilization/Demobilization		7%		$128,100
Contingency		10%		$183,000
Contractor's OH and Profit		15%		$274,500
			Construction subtotal	$2,415,600
Engineering Design and Administration		20%		$483,120
Legal and Administrative Costs		10%		$241,560
Cost of Regulatory Requirements		5%		$120,780
			Teer Quarry Capital Cost	$3,261,060
			NPV of O&M Cost	$ 1,679,702
			Total Teer Quarry Cost	$4,940,762
Non-potable Reuse Project				
Reuse pumping and storage	LS	1	$ 350,000	$350,000
Reuse distribution system	LF	80000	$ 48	$3,840,000
			Subtotal	$4,190,000
Mobilization/Demobilization		7%		$293,300
Contingency		10%		$419,000
Contractor's OH and Profit		15%		$628,500
			Construction subtotal	$ 5,530,800
Engineering Design and Administration		20%		$1,106,160
Legal and Administrative Costs		10%		$553,080
Cost of Regulatory Requirements		10%		$553,080
			Reuse Capital Cost	$7,743,120
			NPV of O&M Cost	$ 2,112,596
			Total Reuse Cost	$9,855,716
Expand Brown WTP				
25-MGD expansion	MGD	25	$ 1,250,000	$31,250,000
Mobilization/Demobilization		7%		$2,187,500
Contingency		10%		$3,125,000
Contractor's OH and Profit		15%		$4,687,500
			Construction subtotal	$ 41,250,000
Engineering Design and Administration		20%		$8,250,000
Legal and Administrative Costs		10%		$4,125,000
Cost of Regulatory Requirements		5%		$2,062,500
			Brown WTP Capital Cost	$55,687,500
			NPV of O&M Cost	$17,002,724
			Total Brown WTP Cost	$72,690,224
Transfer WW from SDWRF to NDWRF				
WW Pump Station	MGD	21	$ 130,000	$2,730,000
Force Main	LF	61000	$ 144	$8,784,000
			Subtotal	$11,514,000
Mobilization/Demobilization		7%		$805,980
Contingency		10%		$1,151,400
Contractor's OH and Profit		15%		$1,727,100
			Construction subtotal	$ 15,198,480
Engineering Design and Administration		20%		$3,039,696
Legal and Administrative Costs		10%		$1,519,848
Cost of Regulatory Requirements		5%		$759,924
			Transfer Capital Cost	$20,517,948
			NPV of O&M Cost	$6,753,894
			Total Transfer Cost	$ 27,271,842
			Total Net Present Value	$227,777,318
			Incremental Supply (MGD)	23
			Unit Cost ($/gallon)	$ 9.90

Alternative 3a
New Reservoir on Flat or Little River

	Unit	Quantity	Unit Cost	Item Cost
New Reservoir				
Dam Site Preparation	EA	1	$2,100,000	$2,100,000
Dam Embankment	EA	1	$7,131,742	$7,131,742
Principal Spillway	EA	1	$10,717,000	$10,717,000
Diversion Conduit	EA	1	$3,670,000	$3,670,000
Intake Tower	EA	1	$2,105,155	$2,105,155
Pumping Station	EA	1	$973,000	$973,000
Decommissioning of Existing Facility	EA	1	$0	$0
Access Roads	EA	1	$1,137,000	$1,137,000
Site Work	EA	1	$864,000	$864,000
Electrical	EA	1	$378,000	$378,000
Reservoir Clearing	EA	1	$2,057,000	$2,057,000
Road Relocations	EA	1	$16,032,677	$16,032,677
Modifications to Existing Utilities	EA	1	$2,552,000	$2,552,000
Raw Water Transmission Main	LF	100000	$144	$14,400,000
			Capital Total	$64,117,574
Mobilization/Demobilization		7%		$4,488,230
Contingency		10%		$6,411,757
Contractor's OH and Profit		15%		$9,617,636
			Construction Total	$84,635,000
Engineering Design and Administration		20%		$16,927,000
Legal and Administrative Costs		10%		$8,463,500
Cost of Regulatory Requirements		10%		$8,463,500
Land/Easement Acquisition	acres	1070	$ 10,000	$10,700,000
			Reservoir Capital Cost	$129,189,000
			NPV of O&M Cost	$9,473,854
			Total Reservoir Cost	$138,662,854
Teer Quarry				
Raw Water Pump Station	mgd	6	$130,000	$780,000
Intake	mgd	6	$125,000	$750,000
Raw Water Main (24")	LF	1500	$200	$300,000
			Capital subtotal	$1,830,000
Mobilization/Demobilization		7%		$128,100
Contingency		10%		$183,000
Contractor's OH and Profit		15%		$274,500
			Construction subtotal	$2,415,600
Engineering Design and Administration		20%		$483,120
Legal and Administrative Costs		10%		$241,560
Cost of Regulatory Requirements		5%		$120,780
			Teer Quarry Capital Cost	$3,261,060
			NPV of O&M Cost	$ 1,679,702
			Total Teer Quarry Cost	$4,940,762
Non-potable Reuse Project				
Reuse pumping and storage	LS	1	$ 350,000	$350,000
Reuse distribution system	LF	80000	$ 48	$3,840,000
			Subtotal	$4,190,000
Mobilization/Demobilization		7%		$293,300.00
Contingency		10%		$419,000
Contractor's OH and Profit		15%		$628,500
			Construction subtotal	$ 5,530,800
Engineering Design and Administration		20%		$1,106,160
Legal and Administrative Costs		10%		$553,080
Cost of Regulatory Requirements		10%		$553,080
			Reuse Capital Cost	$7,743,120
			NPV of O&M Cost	$ 2,112,596
			Total Reuse Cost	$9,855,716
Expand Brown WTP				
25-MGD expansion	MGD	25	$ 1,250,000	$31,250,000
Mobilization/Demobilization		7%		$2,187,500
Contingency		10%		$3,125,000
Contractor's OH and Profit		15%		$4,687,500
			Construction subtotal	$ 41,250,000
Engineering Design and Administration		20%		$8,250,000
Legal and Administrative Costs		10%		$4,125,000
Cost of Regulatory Requirements		5%		$2,062,500
			Brown WTP Capital Cost	$55,687,500
			NPV of O&M Cost	$17,002,724
			Total Brown WTP Cost	$72,690,224
			Total Net Present Value	$226,149,556
			Incremental Supply (MGD)	28
			Unit Cost ($/gallon)	$ 8.08

Alternative 3b
New Reservoir on Flat or Little River

New Reservoir					
	Unit	Quantity	Unit Cost		Item Cost
Dam Site Preparation	EA	1	$2,100,000		$2,100,000
Dam Embankment	EA	1	$7,131,742		$7,131,742
Principal Spillway	EA	1	$10,717,000		$10,717,000
Diversion Conduit	EA	1	$3,670,000		$3,670,000
Intake Tower	EA	1	$2,105,155		$2,105,155
Pumping Station	EA	1	$973,000		$973,000
Decommissioning of Existing Facility	EA	1	$0		$0
Access Roads	EA	1	$1,137,000		$1,137,000
Site Work	EA	1	$864,000		$864,000
Electrical	EA	1	$378,000		$378,000
Reservoir Clearing	EA	1	$2,057,000		$2,057,000
Road Relocations	EA	1	$16,032,677		$16,032,677
Modifications to Existing Utilities	EA	1	$2,552,000		$2,552,000
Raw Water Transmission Main	LF	100000	$144		$14,400,000
			Capital Total		$64,117,574
Mobilization/Demobilization		7%			$4,488,230
Contingency		10%			$6,411,757
Contractor's OH and Profit		15%			$9,617,636
			Construction Total		$84,635,000
Engineering Design and Administration		20%			$16,927,000
Legal and Administrative Costs		10%			$8,463,500
Cost of Regulatory Requirements		10%			$8,463,500
Land/Easement Acquisition	acres	1070	$ 10,000		$10,700,000
			Reservoir Capital Cost		$129,189,000
			NPV of O&M Cost		$9,473,854
			Total Reservoir Cost		$138,662,854
Teer Quarry					
Raw Water Pump Station	mgd	6	$130,000		$780,000
Intake	mgd	6	$125,000		$750,000
Raw Water Main (24")	LF	1500	$200		$300,000
			Capital subtotal		$1,830,000
Mobilization/Demobilization		7%			$128,100
Contingency		10%			$183,000
Contractor's OH and Profit		15%			$274,500
			Construction subtotal		$2,415,600
Engineering Design and Administration		20%			$483,120
Legal and Administrative Costs		10%			$241,560
Cost of Regulatory Requirements		5%			$120,780
			Teer Quarry Capital Cost		$3,261,060
			NPV of O&M Cost	$	1,679,702
			Total Teer Quarry Cost		$4,940,762
Non-potable Reuse Project					
Reuse pumping and storage	LS	1	$ 350,000		$350,000
Reuse distribution system	LF	80000	$ 48		$3,840,000
			Subtotal		$4,190,000
Mobilization/Demobilization		7%			$293,300.00
Contingency		10%			$419,000
Contractor's OH and Profit		15%			$628,500
			Construction subtotal	$	5,530,800
Engineering Design and Administration		20%			$1,106,160
Legal and Administrative Costs		10%			$553,080
Cost of Regulatory Requirements		10%			$553,080
			Reuse Capital Cost		$7,743,120
			NPV of O&M Cost	$	2,112,596
			Total Reuse Cost		$9,855,716
Expand Brown WTP					
25-MGD expansion	MGD	25	$ 1,250,000		$31,250,000
Mobilization/Demobilization		7%			$2,187,500
Contingency		10%			$3,125,000
Contractor's OH and Profit		15%			$4,687,500
			Construction subtotal	$	41,250,000
Engineering Design and Administration		20%			$8,250,000
Legal and Administrative Costs		10%			$4,125,000
Cost of Regulatory Requirements		5%			$2,062,500
			Brown WTP Capital Cost		$55,687,500
			NPV of O&M Cost		$17,002,724
			Total Brown WTP Cost		$72,690,224
Transfer WW from SDWRF to NDWRF					
WW Pump Station	MGD	21	$ 130,000		$2,730,000
Force Main	LF	61000	$ 144		$8,784,000
			Subtotal		$11,514,000
Mobilization/Demobilization		7%			$805,980
Contingency		10%			$1,151,400
Contractor's OH and Profit		15%			$1,727,100
			Construction subtotal	$	15,198,480
Engineering Design and Administration		20%			$3,039,696
Legal and Administrative Costs		10%			$1,519,848
Cost of Regulatory Requirements		5%			$759,924
			Transfer Capital Cost		$20,517,948
			NPV of O&M Cost		$6,753,894
			Total Transfer Cost		$27,271,842
			Total Net Present Value		$253,421,399
			Incremental Supply (MGD)		28
			Unit Cost ($/gallon)	$	9.05

Alternative 4a
Utilize Kerr Lake as Water Supply Resource

KERR LAKE					
Pipeline Construction	Unit	Quantity	Unit Cost		Item Cost
Open-Cut Pipe	LF	**306,000**	$245		$75,106,094
Open-Cut Pipe	LF	**5,000**	$172		$859,057
Pump/Booster Station Pump Systems					
Raw Water Intake	EA	1	$2,045,373		$2,045,373
Raw Water Pump Station	/mgd	50	$71,588		$3,579,403
Finished Water Booster Pump Station	/mgd	3*50	$71,588		$5,369,104
New Water Treatment Plant (50 mgd)	EA	1	$43,658,485	$	21,829,243
FW Transmission Piping for Kerr Lake (30" line)	LF	16,000	$120		$1,920,000
			Subtotal		$110,708,273
			Durham's Share (50%)		$55,354,137
Mobilization/Demobilization		7%			$3,874,790
Contingency		10%			$5,535,414
Contractor's OH and Profit		15%			$8,303,120
			Durham Share of Construction Costs (total)		$73,067,460
Engineering Design and Administration		20%			$14,613,492
Legal and Administrative Costs		10%			$7,306,746
Cost of Regulatory Requirements		10%			$7,306,746
Land/Easement Acquisition	acres	300	$ 10,000		$1,500,000
			Kerr Lake Capital Cost (Durham's share)		$103,794,444
			NPV of O&M Cost		$11,972,870
			Total Kerr Lake Cost		$115,767,315
Teer Quarry					
Raw Water Pump Station	mgd	6	$130,000		$780,000
Intake	mgd	6	$125,000		$750,000
Raw Water Main (24")	LF	1500	$200		$300,000
			Capital subtotal		$1,830,000
Mobilization/Demobilization		7%			$128,100
Contingency		10%			$183,000
Contractor's OH and Profit		15%			$274,500
			Construction subtotal		$2,415,600
Engineering Design and Administration		20%			$483,120
Legal and Administrative Costs		10%			$241,560
Cost of Regulatory Requirements		5%			$120,780
			Teer Quarry Capital Cost		$3,261,060
			NPV of O&M Cost	$	1,679,702
			Total Teer Quarry Cost		$4,940,762
Non-potable Reuse Project					
Reuse pumping and storage	LS	1	$ 350,000		$350,000
Reuse distribution system	LF	80000	$ 48		$3,840,000
			Subtotal		$4,190,000
Mobilization/Demobilization		7%			$293,300.00
Contingency		10%			$419,000
Contractor's OH and Profit		15%			$628,500
			Construction subtotal	$	5,530,800
Engineering Design and Administration		20%			$1,106,160
Legal and Administrative Costs		10%			$553,080
Cost of Regulatory Requirements		10%			$553,080
			Reuse Capital Cost		$7,743,120
			NPV of O&M Cost	$	2,112,596
			Total Reuse Cost		$9,855,716
			Total Net Present Value		$130,563,793
			Incremental Supply (MGD)		30
			Unit Cost ($/gallon)	$	4.35

Alternative 4b
Utilize Kerr Lake as Water Supply Resource

KERR LAKE				
Pipeline Construction	Unit	Quantity	Unit Cost	Item Cost
Open-Cut Pipe	LF	**306,000**	$245	$75,106,094
Open-Cut Pipe	LF	**5,000**	$172	$859,057
Pump/Booster Station Pump Systems				
Raw Water Intake	EA	1	$2,045,373	$2,045,373
Raw Water Pump Station	/mgd	50	$71,588	$3,579,403
Finished Water Booster Pump Station	/mgd	3*50	$71,588	$5,369,104
New Water Treatment Plant (50 mgd)	EA	1	$43,658,485	$ 21,829,243
FW Transmission Piping for Kerr Lake (30" line)	LF	16,000	$120	$1,920,000
			Subtotal	$110,708,273
			Durham's Share (50%)	$55,354,137
Mobilization/Demobilization		7%		$3,874,790
Contingency		10%		$5,535,414
Contractor's OH and Profit		15%		$8,303,120
			Durham Share of Construction Costs (total)	$73,067,460
Engineering Design and Administration		20%		$14,613,492
Legal and Administrative Costs		10%		$7,306,746
Cost of Regulatory Requirements		10%		$7,306,746
Land/Easement Acquisition	acres	300	$ 10,000	$1,500,000
			Kerr Lake Capital Cost (Durham's share)	$103,794,444
			NPV of O&M Cost	$11,972,870
			Total Kerr Lake Cost	$115,767,315
Teer Quarry				
Raw Water Pump Station	mgd	6	$130,000	$780,000
Intake	mgd	6	$125,000	$750,000
Raw Water Main (24")	LF	1500	$200	$300,000
			Capital subtotal	$1,830,000
Mobilization/Demobilization		7%		$128,100
Contingency		10%		$183,000
Contractor's OH and Profit		15%		$274,500
			Construction subtotal	$2,415,600
Engineering Design and Administration		20%		$483,120
Legal and Administrative Costs		10%		$241,560
Cost of Regulatory Requirements		5%		$120,780
			Teer Quarry Capital Cost	$3,261,060
			NPV of O&M Cost	$ 1,679,702
			Total Teer Quarry Cost	$4,940,762
Non-potable Reuse Project				
Reuse pumping and storage	LS	1	$ 350,000	$350,000
Reuse distribution system	LF	80000	$ 48	$3,840,000
			Subtotal	$4,190,000
Mobilization/Demobilization		7%		$293,300.00
Contingency		10%		$419,000
Contractor's OH and Profit		15%		$628,500
			Construction subtotal	$ 5,530,800
Engineering Design and Administration		20%		$1,106,160
Legal and Administrative Costs		10%		$553,080
Cost of Regulatory Requirements		10%		$553,080
			Reuse Capital Cost	$7,743,120
			NPV of O&M Cost	$ 2,112,596
			Total Reuse Cost	$9,855,716
Transfer WW				
WW Pump Station (SDWRF to NDWRF)	MGD	11	$ 130,000	$1,430,000
Force Main	LF	61000	$ 96	$5,856,000
WW Pump Station (NDWRF to Kerr)	MGD	20	$ 130,000	$2,600,000
Force Main	LF	225000	$ 144	$32,400,000
			Subtotal	$42,286,000
Mobilization/Demobilization		7%		$2,960,020
Contingency		10%		$4,228,600
Contractor's OH and Profit		15%		$6,342,900
			Construction subtotal	$ 55,817,520
Engineering Design and Administration		20%		$11,163,504
Legal and Administrative Costs		10%		$5,581,752
Cost of Regulatory Requirements		5%		$2,790,876
			SDWRF to NDWRF Transfer Capital Cost	$75,353,652
			NPV of O&M Cost	$20,192,950
			Total SDWRF to NDWRF Transfer Cost	$95,546,602
			Total Net Present Value	$226,110,395
			Incremental Supply (MGD)	30
			Unit Cost ($/gallon)	$ 7.54

Alternative 5
16-MGD Jordan Lake Allocation and Lake Michie Expansion

Alternative 5
Capital Cost Summary

	Unit	Quantity	Unit Cost	Item Cost
Jordan Water Agency	Unit	Quantity	Unit Cost	Item Cost
RW Intake (50 MGD)	LS	1	$1,850,000	$ 1,850,000
RW Pump Station (48 MGD)	MGD	48	$ 130,000	$ 6,240,000
RW Transmission Line (42-inch)	LF	1,000	$ 400	$ 400,000
WTP (48 MGD)	MGD	48	$1,250,000	$ 60,000,000
Durham's share		**50%**		$34,245,000
Finished Water Transmission	LF	100,000	$144	$ 14,400,000
Booster Pump Station	MGD	1	$120,000	$ 120,000
Durham's share		**55%**		$7,986,000
			Subtotal	$42,231,000
Mobilization/Demobilization		7%		$2,956,170
Contingency		10%		$4,223,100
Contractor's OH and Profit		15%		$6,334,650
			Construction Cost	$55,744,920
Engineering Design and Administration		10%		$5,574,492.00
Legal and Administrative Costs		5%		$2,787,246
Cost of Regulatory Requirements		5%		$2,787,246
DWR Allocation Payment	EA	1	$640,000	$640,000
			Jordan Lake Capital Cost	$67,533,904
			NPV of O&M Cost	$25,393,936
			Total Jordan Lake Cost	$92,927,840
Teer Quarry				
Raw Water Pump Station	mgd	6	$130,000	$780,000
Intake	mgd	6	$125,000	$750,000
Raw Water Main (24")	LF	1500	$200	$300,000
			Capital subtotal	$1,830,000
Mobilization/Demobilization		7%		$128,100
Contingency		10%		$183,000
Contractor's OH and Profit		15%		$274,500
			Construction subtotal	$2,415,600
Engineering Design and Administration		20%		$483,120
Legal and Administrative Costs		10%		$241,560
Cost of Regulatory Requirements		5%		$120,780
			Teer Quarry Capital Cost	$3,261,060
			NPV of O&M Cost	$ 1,679,702
			Total Teer Quarry Cost	$4,940,762
Non-potable Reuse Project				
Reuse pumping and storage	LS	1	$ 350,000	$350,000
Reuse distribution system	LF	80000	$ 48	$3,840,000
			Subtotal	$4,190,000
Mobilization/Demobilization		7%		$293,300
Contingency		10%		$419,000
Contractor's OH and Profit		15%		$628,500
			Construction subtotal	$ 5,530,800
Engineering Design and Administration		20%		$1,106,160
Legal and Administrative Costs		10%		$553,080
Cost of Regulatory Requirements		10%		$553,080
			Reuse Capital Cost	$7,743,120
			NPV of O&M Cost	$ 2,112,596
			Total Reuse Cost	$9,855,716
Lake Michie Expansion				
Dam Site Preparation	EA	1	$1,324,000	$1,324,000
Dam Embankment	EA	1	$5,460,000	$5,460,000
Principal Spillway	EA	1	$16,112,000	$16,112,000
Diversion Conduit	EA	1	$4,714,000	$4,714,000
Intake Tower	EA	1	$2,484,000	$2,484,000
Pumping Station	EA	1	$3,712,000	$3,712,000
Decommissioning of Existing Facility	EA	1	$275,000	$275,000
Access Roads	EA	1	$564,000	$564,000
Site Work	EA	1	$711,000	$711,000
Electrical	EA	1	$1,351,000	$1,351,000
Reservoir Clearing	EA	1	$647,000	$647,000
Road Relocations	EA	1	$5,700,000	$5,700,000
Modifications to Existing Utilities	EA	1	$594,000	$594,000
			Capital Total	$43,648,000
Mobilization/Demobilization		7%		$3,055,360
Contingency		10%		$4,364,800
Contractor's OH and Profit		15%		$6,547,200
			Construction Total	$57,615,000
Engineering Design and Administration		20%		$11,523,000
Legal and Administrative Costs		10%		$5,761,500
Cost of Regulatory Requirements		10%		$5,761,500
Land/Easement Acquisition	acres	1070	$ 10,000	$10,700,000
			Lake Michie Capital Cost	$91,361,000
			NPV of O&M	$8,352,173
			Total Lake Michie Cost	$99,713,173
			Total Net Present Value	$207,437,491
			Incremental Supply (MGD)	39
			Unit Cost ($/gallon)	$ 5.32

Attachment 5:

Draft Agreement for Jordan Water Agency