FINAL

Jordan Lake Partnership Western Intake Feasibility Study

Technical Memorandum

October 2014

31118-102

HAZEN AND SAWYER
Environmental Engineers & Scientists

Final

Jordan Lake Partnership Western Intake Feasibility Study

October 2014

HAZEN AND SAWYER
Environmental Engineers & Scientists

4011 WestChase Blvd., Suite 500
Raleigh, NC 27607

31118-102

Table of Contents

1.0 Introduction 1
1.1 Purpose and Authorization 1
1.2 Scope 1
1.3 Background 2
1.3.1 Jordan Lake Partnership 2
1.3.2 Jordan Lake Allocations 2
1.3.3 Western Intake Site and OWASA Property 3
2.0 Basis of Conceptual Design and Analysis 10
2.1 Basis for Facility Sizing 10
2.2 Cost Basis and Assumptions 11
3.0 Alternatives Analysis 14
3.1 Alternative 1: Regional Water Treatment Facility 14
3.2 Alternative 2: South Durham and Jordan Lake Water Treatment Facilities 15
3.3 Alternative 3: Raw Water Only Facilities 16
3.4 Alternatives Cost Comparison 17
4.0 Other Project Considerations 20
4.1 Advantages / Disadvantages to Receiving Raw Versus Finished Water 20
4.1.1 Raw Water 20
4.1.2 Finished Water 21
4.2 Pipeline Routing and Easement Acquisition Considerations 22
4.3 Water Quality Issues 23
4.4 Interbasin Transfers 25
5.0 Project Implementation Considerations 29
5.1 Anticipated Permits and Approvals 29
5.2 Draft Project Schedule and Implementation 30
5.3 Funding the Next Major Step: Cost-Loaded Schedule for Engineering Services 30
6.0 Potential Partnership Structures and Interim Planning 33
6.1 Interlocal Agreement Model 33
6.1.1 Sales and Purchase Model 33

6.1.2 Joint Agency Model 34
6.2 Special Purpose District/Authority Model 34
6.2.1 Water Authority 35
6.2.2 Metropolitan Water Districts 37
6.3 Application of Organizational Models 39
6.3.1 Lead Agency Responsible for Service Delivery 39
6.3.2 Scope of Service Delivery 41
6.3.3 Costs for Service Delivery 41
6.3.4 Schedule for Service Delivery 42
6.4 Partnership Structure Comparison 42
7.0 Conclusions and Recommendations 45
7.1 Conclusions 45
7.2 Recommendations 46
8.0 References 48

Appendix A: Regional Water Treatment Facilities – Detailed Cost Summary

Appendix B: South Durham and Jordan Lake Regional Water Treatment Facilities – Detailed Cost Summary

Appendix C: Raw Water Only Facilities Alternative – Detailed Cost Summary

Appendix D: Jordan Lake Water Quality Data Summary

Executive Summary

Introduction

The purpose of this report is to support a focus group of the Jordan Lake Partners (JLP), referred to hereinafter as the Western Intake Partners (WIPs), in planning for the potential collaborative development of water withdrawal, treatment, and transmission facilities on the western side of B. Everett Jordan Lake. The WIP, which includes the City of Durham (Durham), Chatham County, the Orange Water and Sewer Authority (OWASA), and the Town of Pittsboro (Pittsboro), retained Hazen and Sawyer, P.C. to complete the services addressed in this report. This study was funded by Durham.

The project scope consists of two main tasks: (1) at a conceptual level, develop and evaluate regional Jordan Lake water supply alternatives to assist the WIP in determining the most favorable alternative to meet the water supply needs of the individual members as well as the group as a whole, and (2) review institutional models under which the WIP could potentially organize to develop the selected water supply alternative.

The report reviews the three conceptual water supply alternatives listed below. An element common to all three is a regional raw water intake and pumping station at a site identified by OWASA near its 125-acre Jordan Lake property and known as the Vista Point western intake site. It should be noted that this study does not consider alternative intake locations and assumes use of OWASA's property at Jordan Lake for construction of a regional water treatment facility (RWTF) regardless of whether or not OWASA decides to participate in the RWTF. In future studies, the WIP may wish to consider alternative locations for one or both of these facilities. It should also be noted that, although Orange County is not a WIP, for purposes of this study it is assumed Durham would provide wholesale water service to Orange County directly from its distribution system. Orange County is therefore included in facility planning. At the WIP's request, Orange County is also identified in facility cost sharing as a separate entity, as well as jointly with Durham.

> **Alternative 1 - Regional Water Treatment Facility**: Construct a RWTF on the OWASA Jordan Lake property, and extend new finished water pipelines from this facility to each WIP system as shown in **Figure E-1**.
>
> **Alternative 2 - South Durham and Jordan Lake Water Treatment Facilities**: As shown in **Figure E-2**, construct a WTF on the OWASA property to serve Chatham County and Pittsboro; construct a second WTF located adjacent to the South Durham Water Reclamation Facility in southwestern Durham County to serve Durham, OWASA and Orange County; and extend new raw water and finished water pipelines as shown in **Figure E-2**.
>
> **Alternative 3 - Raw Water Only Facilities**: construct a WTF on the OWASA property to serve Chatham and Pittsboro; extend raw water pipelines to OWASA's Jones Ferry Road Water Treatment Plant (WTP) and Durham's Williams WTP (to serve Orange County as well as Durham); and extend finished water pipelines as shown in **Figure E-3**.

Basis of Conceptual Design and Analysis

The sizing of potential water infrastructure components presented in this report was based on water demand projections provided by each of the WIPs, with the assistance of the Triangle J Council of Governments (TJCOG), and refined in a collaborative process over several iterations. The maximum day demands summarized in **Table E-1** were used as the basis for facility sizing.

With year 2060 as a planning horizon, water treatment and pumping facilities are initially sized to meet maximum day demands in the year 2040, with construction completion assumed to occur in year 2021, and with subsequent expansion in year 2040 to meet year 2060 maximum day demands. Pipelines, which are costly to expand (via the installation of parallel piping), and the regional intake are sized to meet ultimate, year 2060 maximum day demands.

In light of current and potential Jordan Lake drinking water quality considerations, capital costs for the construction of new WTFs, and improvements to existing WTFs facilities in the case of Alternative 3, assume advanced water treatment technology will be needed to meet current and anticipated regulatory requirements and to provide high quality finished water to the WIPs. The treatment processes assumed are similar to the existing Cary/Apex WTF but include ultraviolet disinfection (UV) as an additional process. These processes would:

- provide for the removal of organics for total organic carbon (TOC) and disinfection byproduct (DBP) control;
- use ozone, UV, and chlorine to provide multiple barriers for disinfection and oxidation for pathogens, taste and odor, emerging contaminants, and algal toxins; and,
- utilize chloramines as a residual disinfectant to minimize DBP formation as currently practiced in the region.

Raw water terminal storage is not included in the cost analysis; however, the partners may wish to evaluate that option during more detailed future studies. The final process selection should be evaluated in the preliminary engineering phase based on site-specific source water quality monitoring at the intake site, and finished water quality goals established by the WIP.

Cost estimates were prepared in current, 2014 dollars, based on planning-level information and appropriate simplifying assumptions and contingency allowances. Final costs of the selected project will depend on a range of factors to be considered during more detailed design-level studies.

Table E-1: Demand Basis of Facility Design

Partner	Year 2040 Demand Basis for Initial Facilities Capacity (mgd)			Year 2060 Demand Basis for Ultimate Facilities Capacity (mgd)		
	Avg. Day	Max. Day	% of Total Capacity	Avg. Day	Max. Day	% of Total Capacity
Chatham County	6.5	10.0	30.3%	10.5	16.0	29.6%
Durham	16.5	17.0	51.5%	16.5	21.0	38.9%
Orange County	1.0	1.0	3.0%	2.0	3.0	5.6%
OWASA	2.0	2.0	6.1%	5.0	5.0	9.3%
Pittsboro	2.0	3.0	9.1%	6.0	9.0	16.7%
Total	**28.0**	**33.0**	**100%**	**40.0**	**54.0**	**100%**

Alternatives Analysis

Costs for the three Jordan Lake water supply alternatives studied are summarized in **Tables E-2, E-3** and **E-4**. The Regional Water Treatment Facility (Alternative 1) is the most economical alternative for all of the partners as illustrated in **Figure E-4**. Alternative 2 – South Durham and Jordan Lake WTFs was 9% higher on a capital cost basis and 8% higher on a life cycle cost basis than Alternative 1. Alternative 3 – Raw Water Only Facilities was 30% higher on a capital cost basis and 51% higher on a life cycle cost basis than Alternative 1.

The Regional Water Treatment Facility alternative is expected to provide the optimum use of resources while also minimizing implementation issues. It also requires the least linear footage of pipeline, which would minimize impacts to the environment and the public. The Regional Water Treatment Facility alternative also offers economies and efficiencies of scale from the perspective of operation, maintenance, staffing, monitoring, reporting, etc.

Table E-2: Conceptual-Level Cost Summary – Regional Water Treatment Facility

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs Per 1,000 gallons (2014 $)	
	Initial Facilities	Ultimate Facilities	Total		Usage	Level I Allocation Purchased
Chatham County	$65.9 M	$21.4 M	$87.3 M	$183.4 M	$1.7	$0.6
Durham and Orange County	$132.9 M	$20.5 M	$153.4 M	$418.7 M	--	--
Durham	$120.1 M	$12.8 M	$132.9 M	$388.2 M	$1.5	$1.5
Orange County	$12.8 M	$7.7 M	$20.5 M	$30.5 M	$1.5	$1.0
OWASA	$15.0 M	$9.6 M	$24.6 M	$31.0 M	$4.1	$0.4
Pittsboro	$29.5 M	$22.0 M	$51.5 M	$61.3 M	$1.5	$0.7
Total	**$243.3 M**	**$73.5 M**	**$316.8 M**	**$694.3 M**	**--**	**--**

Table E-3: Conceptual-Level Cost Summary: South Durham and Jordan Lake Water Treatment Facilities

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs Per 1,000 gallons (2014 $)	
	Initial Facilities	Ultimate Facilities	Total		Usage	Level I Allocation Purchased
Chatham County	$74.7 M	$21.5 M	$96.2 M	$194.2 M	$2.0	$0.7
Durham and Orange County	$142.8 M	$22.0 M	$164.8 M	$451.2 M	--	--
Durham	$128.2 M	$13.8 M	$142.0 M	$417.4 M	$1.7	$1.7
Orange County	$14.6 M	$8.2 M	$22.8 M	$33.8 M	$1.8	$1.1
OWASA	$22.6 M	$10.4 M	$33.0 M	$42.4 M	$8.9	$0.6
Pittsboro	$29.5 M	$21.5 M	$51.0 M	$64.6 M	$1.7	$0.7
Total	**$269.6 M**	**$75.4 M**	**$345.0 M**	**$752.4 M**	--	--

Table E-4: Conceptual-Level Cost Summary – Raw Water Only Facilities

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs Per 1,000 gallons (2014 $)	
	Initial Facilities	Ultimate Facilities	Total		Usage	Level I Allocation Purchased
Chatham County	$74.7 M	$21.5 M	$96.2 M	$193.2 M	$1.9	$0.7
Durham and Orange County	$208.6 M	$20.9 M	$229.5 M	$730.6 M	--	--
Durham	$189.9 M	$13.1 M	$203.0 M	$690.6 M	$2.8	$2.8
Orange County	$18.7 M	$7.8 M	$26.5 M	$40.0 M	$2.1	$1.3
OWASA	$27.8 M	$7.1 M	$34.9 M	$47.7 M	$10.0	$0.6
Pittsboro	$29.5 M	$21.5 M	$51.0 M	$78.7 M	$2.1	$0.9
Total	**$340.6 M**	**$71.0 M**	**$411.6 M**	**$1,050.2 M**	**--**	**--**

Other Project Considerations

Other project considerations are reviewed in report Section 4. In summary, these include the following:

- Advantages and disadvantages to the individual WIPs of pumping raw versus finished water, which on balance favor finished water delivery.
- Pipeline routing and easement acquisition includes a discussion of benefits of routing pipelines along existing transportation corridors, related routing challenges including easement acquisition, environmental impacts, and cultural and historic resources impacts.
- Potential water quality issues, including: source water quality degradation and actions by the state to address this issue; evaluations that will be necessary to inform final decisions regarding the intake location and configuration; provisions for the addition of chemicals at the intake to address the quality of raw water as it is transported via pipelines for treatment; additional measures that must be taken to address water quality degradation in raw water that must be transported over long distances, particularly on an intermittent rather than continuous basis; and concerns about the age (or residence time) and disinfection issues associated with the transportation of finished water to and within the WIPs' distribution systems.

Project Implementation Considerations

Report Section 5 addresses project implementation considerations, including project permitting, financing, and schedule. It includes a cost-loaded schedule to assist the WIP in overall project planning, with a focus on financing and implementation issues in the near term.

There is not a specific proposed date for completion and start-up of the regional facilities; however, the project implementation schedule presented in this report anticipates that at least 87 months would be required for project planning, preliminary engineering design, final design, and construction. Consequently, mid-2021 is the estimated earliest date that the proposed facilities could be placed into service assuming that preliminary engineering studies would begin in the summer of 2014. If the partners desire to evaluate

additional sites for regional water treatment facilities, then the schedule would have to be extended to accommodate that evaluation and subsequent purchase actions. Furthermore, the timeframe in the schedule for the completion of required inter-local agreements relating to the authorization and funding of subsequent engineering and permitting phases of this regional project is judged to be optimistic.

In consideration of the project schedule requirements and the water supply needs and infrastructure investment decisions that some partners face, the WIPs should proceed without delay to implement a plan to obtain water from Jordan Lake.

Potential Partnership Structures and Interim Planning

Section 6 reviews a number of institutional models under which the WIP could potentially organize to collaboratively develop the Jordan Lake Regional Water Supply Project and focuses on the following three, which are considered to be most applicable: interlocal agreement, Water Authority, and Metropolitan Water District. Example applications of each model are provided as well as basic issues the institutional model would have to address.

The complexity of organizational issues that the partners must deal with include differing levels of water supply capacity, water supply risk levels, financial capacity, need for upgrades/expansions to existing water supply, treatment, and distribution systems, and so on. This complexity will present substantial challenges—and require a significant time commitment—to arrive at a suitable agreement that aligns the partners' individual needs with the project's organizational and implementation requirements. In consideration thereof, the partners will want to consider interim interlocal agreements and related infrastructure improvements as a bridge between near- and long-term planning. A primary information source for planning interim arrangements is the Phase 2 Potable Water Interconnection Study–Hydraulic Modeling, which is currently in progress for the Jordan Lake Partnership (JLP) and scheduled to be completed in 2015. The JLP, including members of the WIP, commissioned Hazen and Sawyer to complete this study in order to develop a regional approach for planning interconnections that could increase the reliability and sustainability of drinking water sources and infrastructure by allowing the Partners to use their water resources cooperatively and thus defer construction of new facilities (on Jordan Lake or elsewhere).

In view of this complexity, one approach for advancing the regional project would be for one partner to take the lead in financing and arranging for the next phase of project engineering and design services, with the understanding that other partners would participate in the review process and would reimburse the lead partner for a proportionate share of the expenses incurred at such time as they formally decide to become a partner in the regional facilities.

Conclusions and Recommendations

The following are the report's conclusions and recommendations.

Conclusions

1. Of the three Jordan Lake water supply alternatives that have been developed and evaluated collaboratively with the WIP to meet the individual partner and group water supply needs, Alternative 1 - Regional Water Treatment Facility appears to be the overall optimal alternative to be carried forward for facilities planning and potential implementation.

2. As summarized in **Table E-5**, Alternative 1 has the lowest capital as well as life cycle costs, followed by Alternative 2 - South Durham and Jordan Lake Water Treatment Facilities. Alternative 3 - Raw Water Only Facilities has the highest overall costs.

3. Alternative 1 is also estimated to provide the overall optimum use of resources and have the lowest environmental impacts. It is thus expected to be the easiest alternative to implement. Although the present study involved only conceptual design and did not include a detailed assessment of potential environmental impacts, a single RWTF at Jordan Lake would likely minimize environmental impacts. As noted in **Table E-5,** Alternative 1 is estimated to have the lowest wetland and stream impacts. This is largely because this alternative has the lowest overall linear footage of water pipeline. An added advantage is that it maximizes the footage of finished water main and thus the potential for meeting customer demands along the identified pipeline routes.

4. At this conceptual level of study, cost estimates were prepared based on planning-level conceptual designs, desktop site evaluations, and simplifying assumptions. The processes assumed for the WTF assume advanced treatment processes that address multiple water quality concerns, and should be further evaluated following a site specific water quality monitoring study. No physical site evaluations or surveys were performed. Final costs of the project will depend on the concepts and capacity assumptions that are carried forward and developed during final design, and a wide range of factors to be determined during the design process.

5. The DWR and the USACE expect regional participation in any Jordan Lake water supply project and are likely to approve only one more publicly owned water supply intake on Jordan Lake. With the existing Cary-Apex intake located on the east side of the lake north of US Highway 64, the new intake would logically be located at a site on the western side of the lake to serve communities on the west side.

6. This study assumes the development of a regional water intake at a location north of the Vista Point Recreation Area and use of OWASA's property at Jordan Lake for construction of either a RWTF or a smaller facility to serve Chatham County and Pittsboro. In future studies the WIP may wish to consider alternative locations for the intake and/or RWTF.

7. Report Section 4 reviews a number of Other Project Considerations. Of these, evaluation of source water quality, with a focus on evaluations related to the configuration of the selected regional intake location and selection of appropriate water treatment plant processes, is judged to merit consideration for further study in the near term.

8. Report Section 5 includes a number of project implementation items that merit considerations for action by the WIP.

9. As discussed in Section 6, there are a number of institutional models under which the WIP could organize to collaboratively develop the Jordan Lake Regional Water Supply Project.

10. Based on our experience with other institutional frameworks for regional collaboration involving multiple water systems, Hazen and Sawyer believes the interlocal agreement model may be the most appropriate for the WIP to facilitate implementation, operation, and management of the Jordan Lake west regional intake, treatment, and major transmission facilities and services. Such an approach would likely be the easiest to implement and support, while still being capable of ensuring that the needs of all project partners can be met in an equitable and timely manner.

11. The local governments should begin the process to obtain governing board approval to proceed with additional work on the western intake and/or RWTF.

12. In advance of construction for the first phase of facilities, it will be necessary for a lead WIP agency to complete a number of activities, including preliminary engineering and design, land acquisition, environmental permitting, and final design.

Table E-5: Alternatives Comparison

Alternative	Capital Costs (2014 Million $)			Total Life Cycle Costs (2014 Million $)	Total Pipeline Length (ft)	Relative Wetland and Stream Impacts
	Initial Facilities	Ultimate Facilities	Total			
Alternative 1 – Regional Water Treatment Facility	$243.3	$73.5	$316.8	$694.3	~151,000	Lowest
Alternative 2 – South Durham and Jordan Lake Water Treatment Facilities	$296.6	$75.4	$345.0	$752.4	~200,000	Greater than Alt 1
Alternative 3 – Raw Water Only Facilities	$340.6	$71.0	$411.6	$1050.2	~271,000	Greatest

Recommendations

1. Based on the foregoing, Hazen and Sawyer recommends that the WIP select Alternative 1 - RWTF as the preferred alternative for planning for the potential collaborative development of a regional Jordan Lake Supply. This recommendation was presented to and concurred with by technical staff of the WIPs at meetings held on May 9, 2014, and June 27, 2014.

2. Hazen and Sawyer has developed a list of anticipated permits, a draft schedule, and a cost-loaded schedule for the RWTF to assist the WIPs with continued discussions and planning efforts as they work to develop a shared intake and related facilities at Jordan Lake. Several actions are recommended to be completed by the WIPs in the following weeks and months to facilitate timely completion of the proposed facilities to meet the needs of the partners. These include the following:

    - Present the study and findings to each local governing Board;
    - Initiate a water quality monitoring study for the intake site on Jordan Lake to establish a baseline and to inform subsequent intake and treatment plant design decisions;
    - Obtain approval of the governing Boards to proceed with additional work, including the interlocal agreement(s) necessary to initiate policy planning, preliminary engineering and design, and related consulting services;
    - Establish a Technical Advisory Committee (TAC) to guide the technical aspects of the Regional Facilities Preliminary Engineering and Design Process; and,
    - Form a Policy Advisory Committee (PAC) to review and provide guidance to the TAC.

3. In light of current and potential water quality conditions at Jordan Lake, it is recommended that future drinking water treatment facilities using water from Jordan Lake include advanced treatment processes to address taste and odor challenges, disinfection by-product formation, algal toxins and other issues. Therefore, the cost estimates in this report assume that drinking water treatment facilities receiving water from Jordan Lake would include the following minimum processes: conventional treatment processes plus ozone and ultraviolet light disinfection and granular activated carbon treatment. Alternative 3 (which includes delivery of raw water to Durham's and OWASA's existing water treatment plants) includes estimated costs for construction and operation of major process improvements at those two existing facilities.

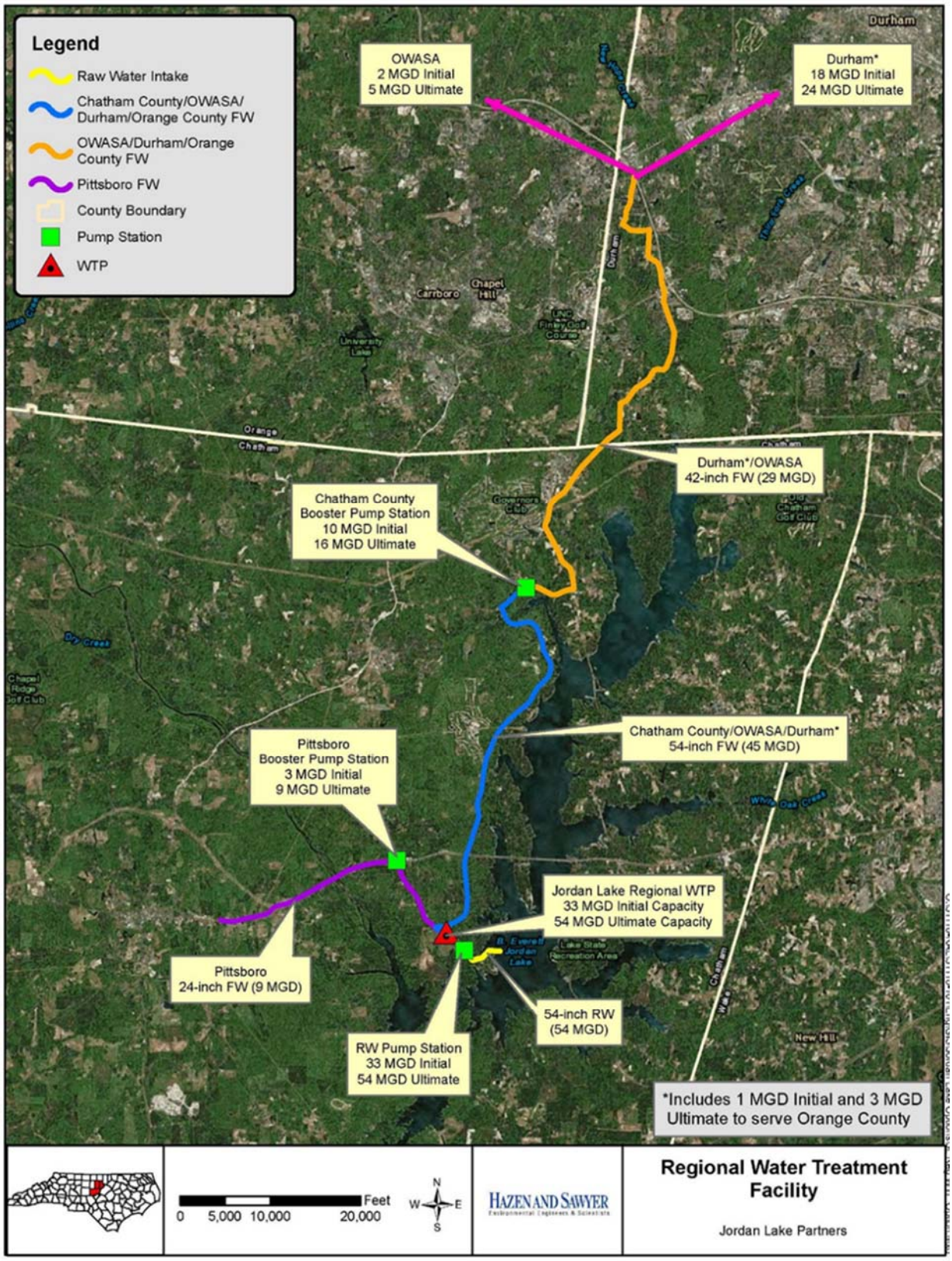


Figure E-1: Alternative 1 - Regional Water Treatment Facility

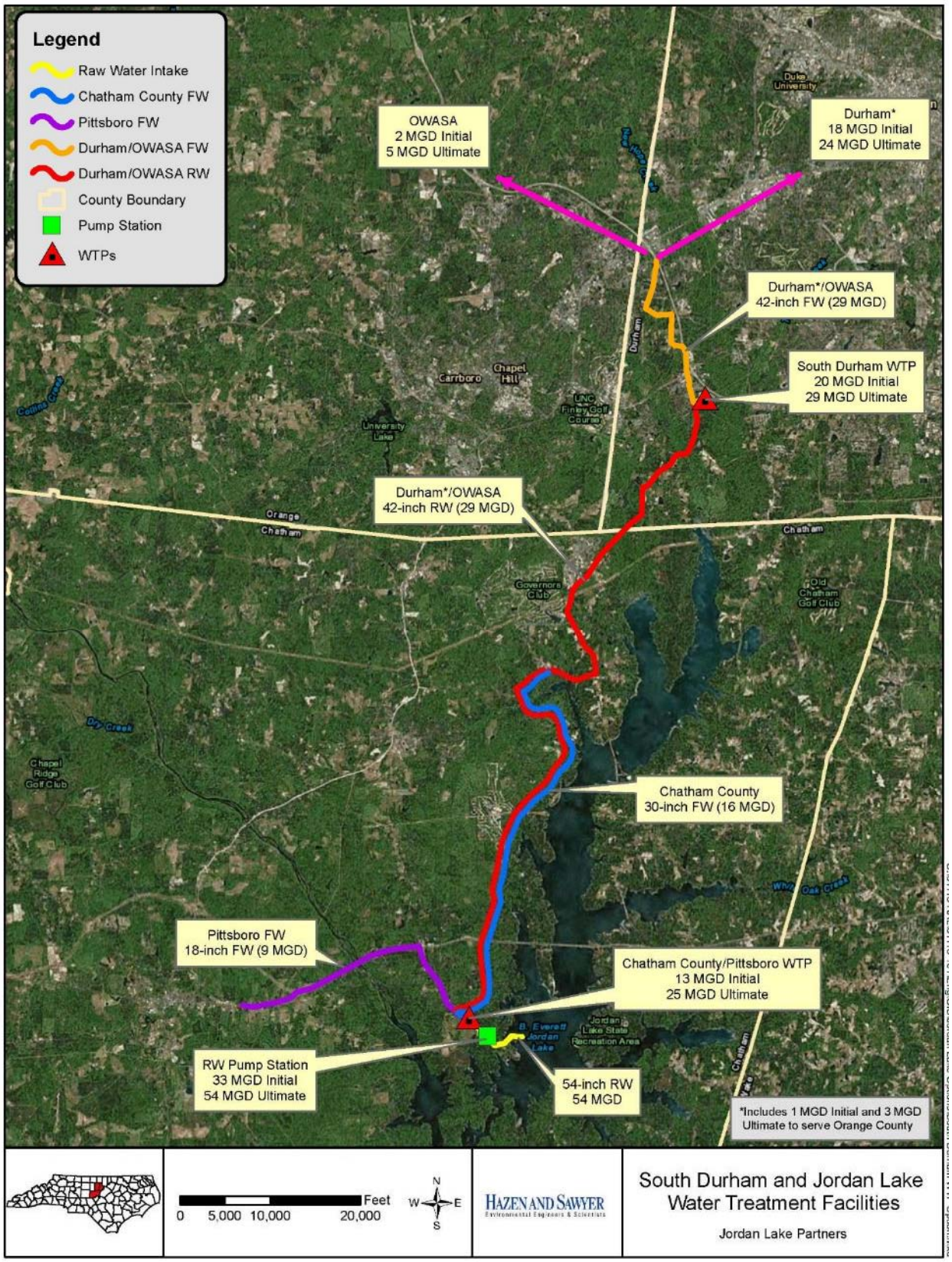


Figure E-2: Alternative 2 - South Durham and Jordan Lake WTFs

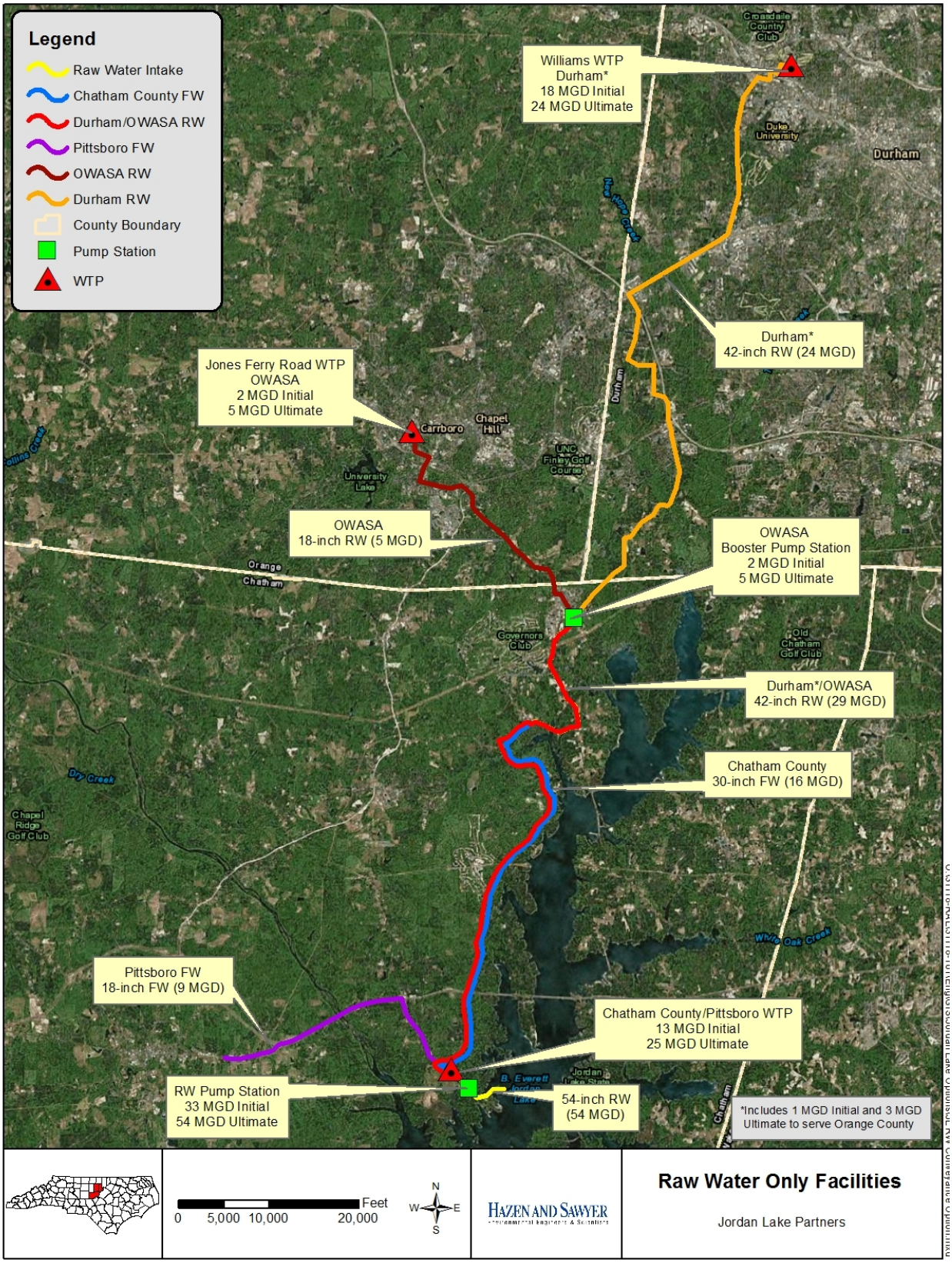


Figure E-3: Alternative 3 - Raw Water Only Facilities

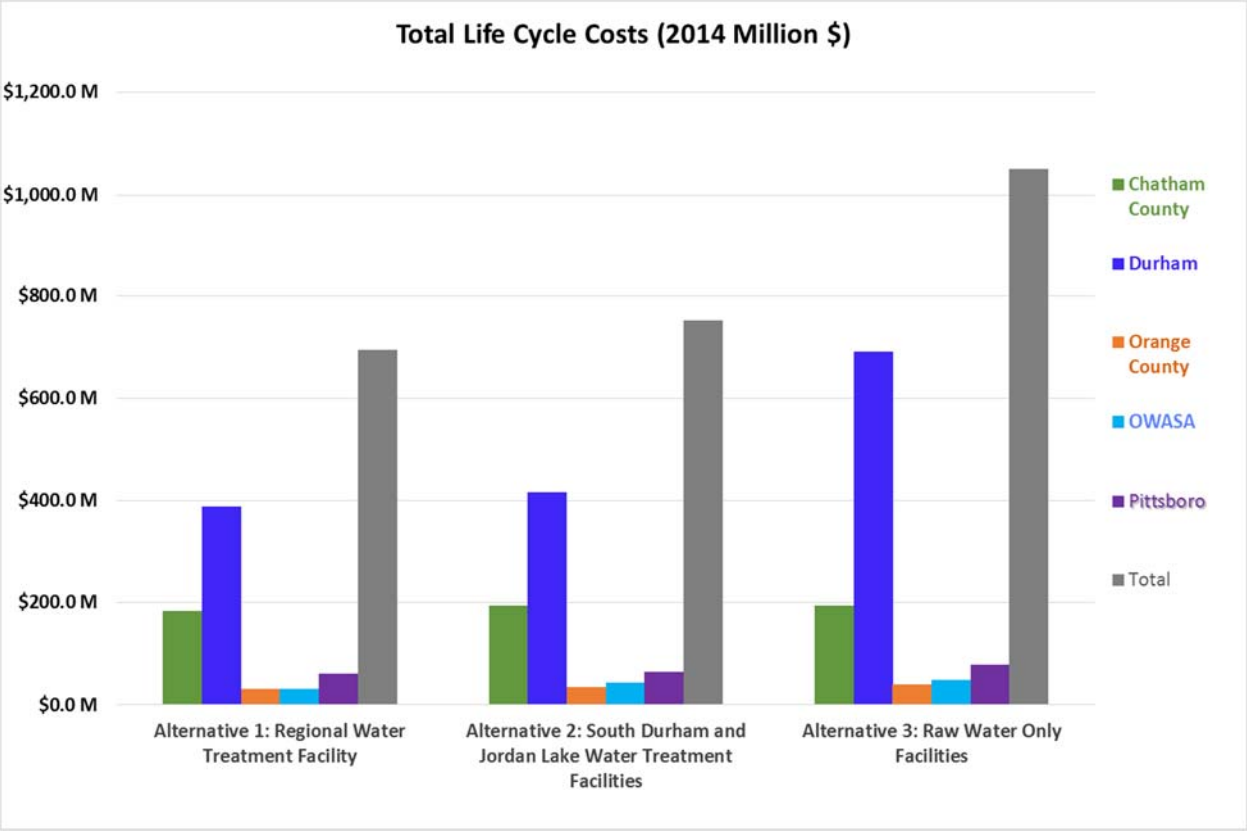


Figure E-4: Life Cycle Cost Comparison

1.0 Introduction

1.1 Purpose and Authorization

The purpose of this report is to support a focus group of the Jordan Lake Partners (JLP), referred to hereinafter as the Western Intake Partners (WIPs), in planning for the potential collaborative development of water withdrawal, treatment, and transmission facilities on the western side of B. Everett Jordan Lake. The WIP, which includes the City of Durham (Durham), the Orange Water and Sewer Authority (OWASA), Chatham County, and the Town of Pittsboro (Pittsboro), retained Hazen and Sawyer, P.C. to complete the services addressed in this report. This study was funded by Durham.

1.2 Scope

The project scope consists of two main tasks: (1) at a conceptual level, develop and evaluate regional Jordan Lake water supply alternatives to serve the WIP, and (2) review institutional models under which the WIP could potentially implement the preferred water supply alternative.

The alternatives analysis in Section 3 of this report reviews the three conceptual water supply alternatives listed below. An element common to all three alternatives is a regional raw water intake and pumping station at a site identified by OWASA near its Jordan Lake property and known as the Vista Point western intake site. It should be noted that this study does not consider alternative intake locations and assumes use of OWASA's property at Jordan Lake for construction of a regional water treatment facility whether or not OWASA decides to participate in the regional facilities. In future studies, the WIP may wish to consider alternative locations for one or both of these facilities. It should also be noted that, although Orange County is not a WIP, for purposes of this study it is assumed that Durham would provide wholesale water service to Orange County directly from its distribution system. Orange County is therefore included in facility planning. At the WIP's request, Orange County is also identified in facility cost sharing as a separate entity as well as jointly with Durham.

Alternative 1 - Regional Water Treatment Facility: As shown in **Figure 1-1**, construct a regional water treatment facility (RWTF) on the OWASA Jordan Lake property, and extend new finished water pipelines from this facility to each WIP system.

Alternative 2 - South Durham and Jordan Lake Water Treatment Facilities: construct a WTF on the OWASA property to serve Chatham County and Pittsboro; construct a second WTF located adjacent to the South Durham Water Reclamation Facility in southwestern Durham County to serve the Durham, OWASA and Orange County; and extend new raw water and finished water pipelines as shown in **Figure 1-2**.

Alternative 3 - Raw Water Only Facilities: As shown in **Figure 1-3**, construct a WTF on the OWASA property to serve Chatham and Pittsboro; extend raw water pipelines to OWASA's Jones Ferry Road WTP and Durham's Williams WTP (to serve Orange County as well as Durham); and extend finished water pipelines as shown.

1.3 Background

1.3.1 Jordan Lake Partnership

The JLP was created in 2009 by local jurisdictions and water systems in the Research Triangle Region of North Carolina to "jointly plan for sustainable and secure water supplies for the Region." The JLP includes the four members of the WIP focus group and the following nine additional partners: Town of Apex, Town of Cary, Town of Hillsborough, Town of Holly Springs, Town of Morrisville, Orange County, City of Raleigh, City of Sanford, and Wake County (for the RTP South service area). The JLP receives administrative and technical support from Fountainworks, LLC and the Triangle J Council of Governments (TJCOG). The City of Durham serves as the lead fiscal and contracting agent for the JLP and contracted with Hazen and Sawyer, P.C. to complete this report.

The JLP worked collaboratively to develop the Triangle Regional Water Supply Plan (TRWSP). The TRWSP is divided into two volumes. *Volume I: Regional Needs Assessment*, identified each partners long term water supply demands, examined their current water supply sources and estimated yields, and identified potential future water supply needs (TJCOG, 2012). *Volume II: Regional Supply Options*, evaluated multiple strategies to address those needs (TJCOG, 2014).

The result of the TRWSP effort was the establishment of a preferred regional alternative that was strongly supported by all members of the JLP. The preferred regional alternative was compared with numerous other alternatives and was found to be the most economical and represent the least environmental impacts. Details of the preferred alternative are available in TRWSP *Volume II* (2014) and are not reiterated herein, except to note that the preferred regional alternative involves continued use of and additional allocations from Jordan Lake for most of the Jordan Lake Partners, and assumes development of a Western Intake and Water Treatment Facility to serve the four WIPs plus Orange County. This approach would provide more regional reliability and redundancy. While Orange County is not a member of the WIP, they have been included as part of the Western Intake Feasibility Study as it is assumed they will receive their Jordan Lake water supply storage allocation through an interconnection with the City of Durham.

1.3.2 Jordan Lake Allocations

The B. Everett Jordan Lake is a U.S. Army Corps of Engineers (USACE) multi-purpose reservoir located in Chatham County, in central North Carolina. The project was authorized by the United States Congress for flood control, water supply, water quality control, recreation, and wildlife conservation. Impounded in 1981, the lake's storage volume is divided into three operational pools as shown in **Figure 1-4**. The conservation pool is subdivided into 45,800 acre-feet (approximately 15 billion gallons) that is reserved for water supply and 94,600 acre-feet that is reserved for downstream flow augmentation. The State of North Carolina has authority over the water supply pool and can allocate this storage to local governments having a need for water supply capacity. The State, acting through the Environmental Management Commission (EMC) under NCAC Title 15A 02G.05000, as administered by the Department of Environment and Natural Resources, Division of Water Resources (NCDENR, DWR), issues two levels of water allocations: "Level I" allocations are made based on 20-year water need projections with withdrawals planned to begin within five years of the allocation; "Level II" allocations are made based on longer term needs of up to 30 years.

During the conclusion of Allocation Round 3 in July 2002, the EMC allocated a total of 63 percent of Jordan Lake's storage capacity (equivalent to 63 mgd of water supply capacity) to local utilities in the Triangle. **Table 1-1** summarizes the existing allocations approved by the EMC. The DWR has estimated that the

water supply pool has a supply capacity of 100 million gallons per day (mgd) and thus, for convenience, refers to each one percent of storage interchangeably by its equivalent safe yield of approximately 1 mgd.[1]

Table 1-1: Current Jordan Lake Water Supply Storage Allocations

Allocation Holder	Level I	Level II	Total
Towns of Cary and Apex	32	0	32
Chatham County	6	0	6
City of Durham	10	0	10
Town of Holly Springs	0	2	2
Town of Morrisville	3.5	0	3.5
Orange County	0	1	1
OWASA	5	0	5
Wake County – RTP South	3.5	0	3.5
Total	**55**	**8**	**63**

Acting on a November 2009 request by the JLP, the EMC formally initiated the process for the fourth allocation round in January 2010. On June 4, 2013, the DWR published the *Jordan Lake Water Supply Storage Allocation Application Guidelines, Round Four*. As discussed hereinafter, each of the WIPs has submitted a Round 4 Level I Allocation draft application to the DWR, with a draft version of Alternative 1 - Regional Water Treatment Facility being identified as the preferred alternative.

Table 1-2 (TJCOG, 2012) summarizes each WIP's current total Jordan Lake allocation, Round 4 Level I Allocation Request, and projected year 2060 demands. As discussed hereinafter, the Round 4 Allocation Request and the projected year 2060 demands served as the basis for the conceptual water supply alternatives.

Table 1-2: WIP Jordan Lake Current, Requested, and Projected Storage Allocations

Partner	Current Allocation (mgd)	Round 4 Allocation Request (mgd)	Projected Year 2060 Demand
Chatham County	6	13	18
Durham	10	16.5	16.5
Orange County	1	1.5	2
OWASA	5	5	5
Pittsboro	0	6	6
Total	**22**	**42**	**47.5**

1.3.3 Western Intake Site and OWASA Property

Cary and Apex jointly own and operate an existing municipal water supply intake on Jordan Lake as well as a nearby water treatment facility. Located on the eastern shore of the lake just north of US Highway 64, this is the only publicly owned water supply intake on Jordan Lake (**Figure 1-5**). For many years, Triangle Area communities have recognized the need for one or more additional publicly owned intakes on Jordan

[1] Although the yield of Jordan Lake's water supply pool has not been confirmed independently in connection with this report, recent modeling of future Cape Fear Basin water use scenarios using the OASIS hydrologic model indicate that 100 mgd is probably a conservative estimate of its operational water supply yield.

Lake. DWR and the USACE expect regional participation in any future Jordan Lake water supply projects, and are likely to approve only one more intake, which would logically be located at a site on the west side of the lake to serve communities on the west side. In the late 1980s, recognizing the need to preserve a potential site for a future regional water treatment plant on the west side of the lake, OWASA acquired approximately 125 acres of land in Chatham County at a location off of Seaforth Road (SR 1941) near Vista Point, as shown in **Figure 1-5**. A preliminary engineering study completed for OWASA in 1991 (1991 Intake Study[2]) identified four options for constructing an intake and raw water (RW) pumping facilities in the vicinity of the OWASA property. A potential intake location labeled as Option 1 was recommended as the optimal site based on available information, but further study was recommended to define design details. The recommended site is located on USACE property directly north of the Vista Point recreational area.

As a part of the OWASA 2010 Long-Range Water Supply Plan, Hazen and Sawyer assisted OWASA in developing two options for these assets: (a) Develop Jordan Independently by OWASA, and (b) Develop Jordan Lake in Partnership with Others.[3] The latter option served as a starting point for the Alternative 1 - Regional Water Treatment Facility presented in this report.

[2] Water Intake Site Investigation, B. Everett Jordan Lake, prepared for the Orange Water and Sewer Authority, Carrboro, North Carolina, by CH2MHILL, September 1991.

[3] Appendix V11, Hazen and Sawyer Technical Memorandum, Option 3: Develop Jordan Lake in Partnership with Others, http://www.owasa.org/Data/Sites/1/media/whatwedo/appendix%20vii.pdf

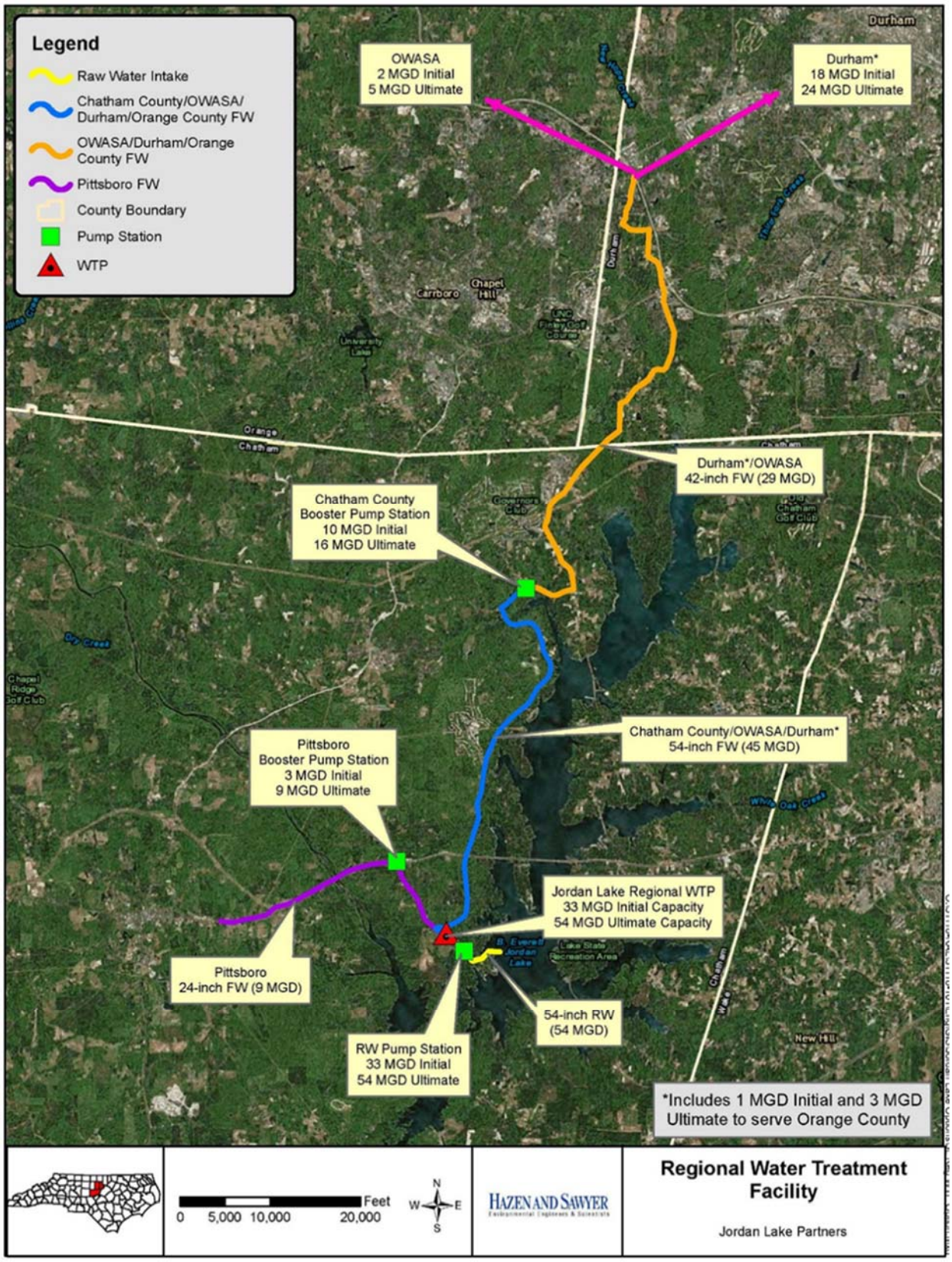


Figure 1-1: Alternative 1 - Regional Water Treatment Facility

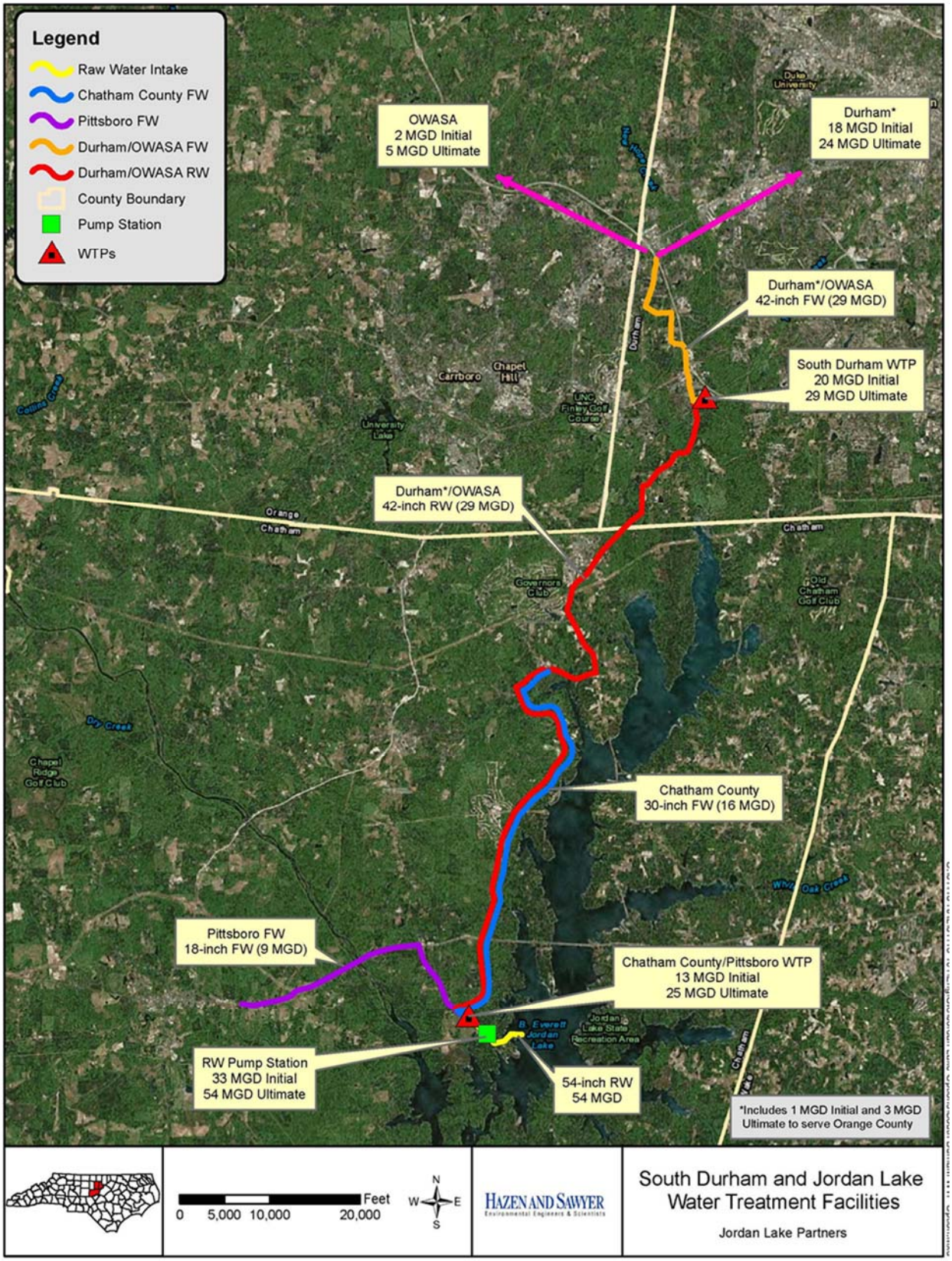


Figure 1-2: Alternative 2 - South Durham and Jordan Lake WTFs

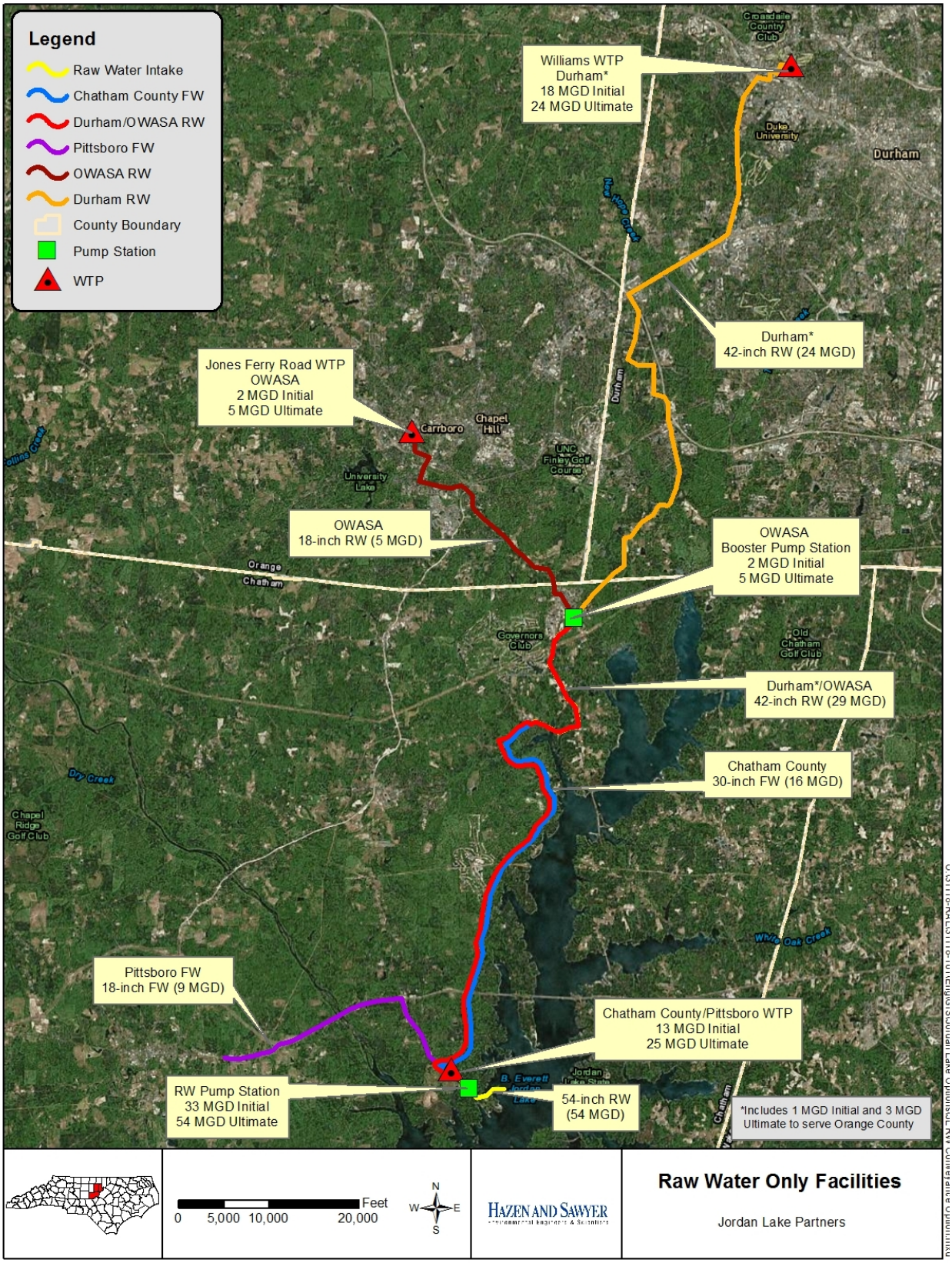


Figure 1-3: Alternative 3 - Raw Water Only Facilities

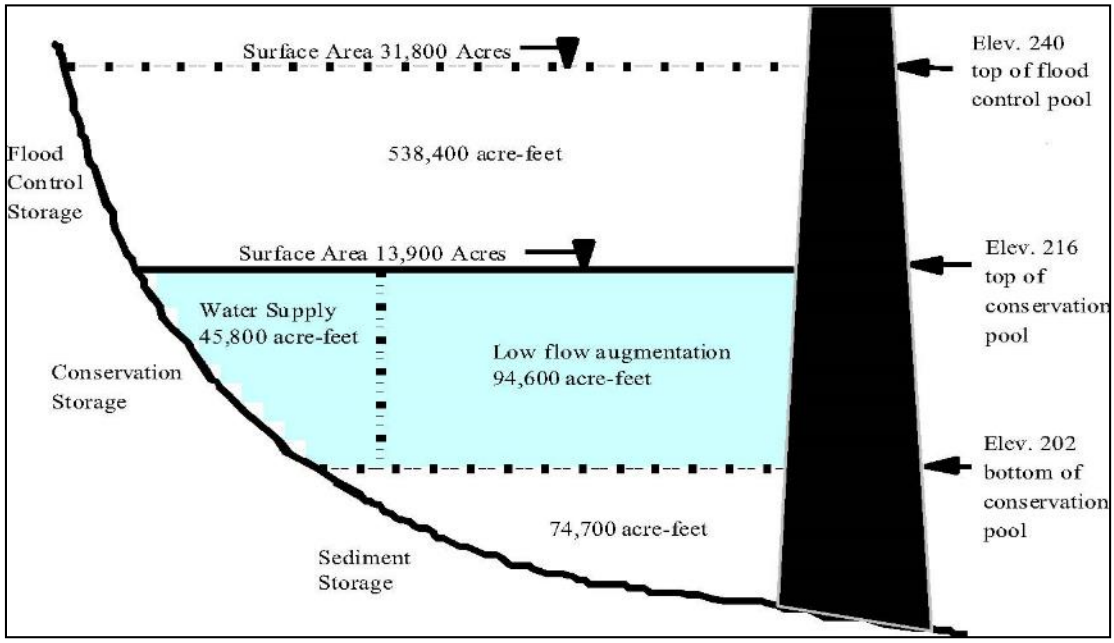


Figure 1-4: Jordan Lake Operational Pools

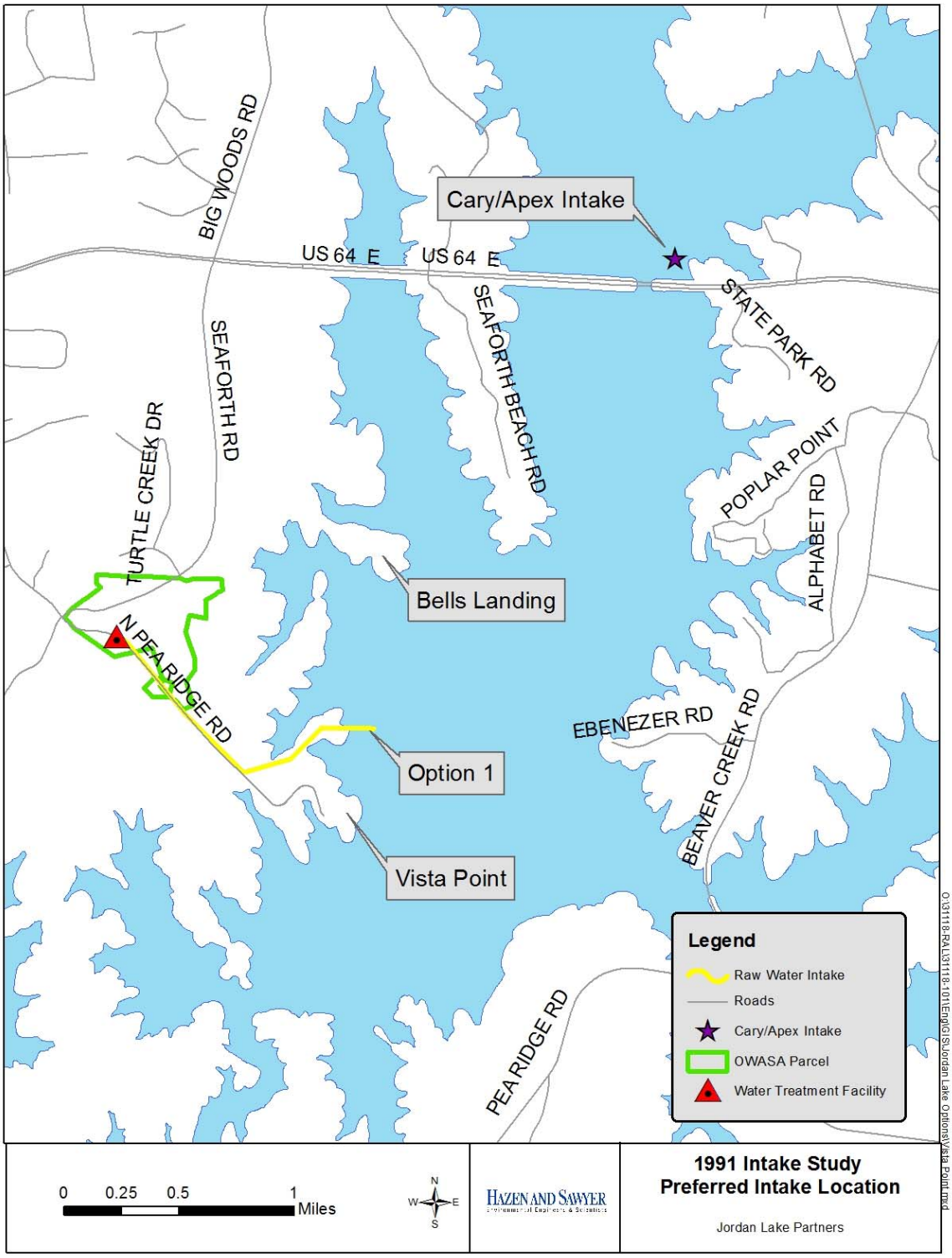


Figure 1-5: Western Intake Site Location

2.0 Basis of Conceptual Design and Analysis

The development of a regional intake, pump station, and water treatment facility on the west side of Jordan Lake has been discussed for several decades and, as noted above, was included as the preferred alternative by each of the WIPs in their Jordan Lake Water Supply Storage Allocation - Round 4 Level I Allocation draft applications. Report Section 3 discusses the three Jordan Lake Western Intake alternatives identified in Section 1. The present section discusses the basis for the conceptual design analysis of these alternatives.

2.1 Basis for Facility Sizing

In this report, the sizing of infrastructure components is based on water demand projections provided by the respective WIPs, as refined in a collaborative process over several iterations. **Table 2-1** summarizes the water demands that the WIPs have agreed to use for facility sizing in this report. In general, demands are consistent with the Round 4 Level I draft allocation requests, with the exception of Chatham County, whose demand projections have been adjusted to reflect their assumed desired capacity in the new regional facilities. Participation by Chatham County reflects its option to continue to utilize its existing 3 mgd WTF on the east side of Jordan Lake, and the potential for the County to realize reduced water demands as a result of recently implemented rate increases and/or other measures.

The following summarize the key bases for facility sizing and operation:

- Year 2060 is the planning horizon for facility sizing and life cycle cost analyses.
- The intake and pipelines, which are costly to expand, are sized to meet ultimate, year 2060 maximum day demands.
- Water treatment and pumping facilities are initially sized to meet maximum day demands in the year 2040, and are assumed to be expanded in year 2040 to meet year 2060 maximum day demands. The following assumptions apply:
    - Except for OWASA, it is assumed that daily water usage from Jordan Lake facilities will be in accordance with the demands summarized in **Table 2-1**, notwithstanding that practical economic considerations might eventually favor an alternative operating protocol. OWASA's stated policy is to use Jordan Lake water only during extended droughts or operational emergencies; therefore, for the purpose of this study, it is assumed that OWASA would pump water on average only once every five years rather than on a daily basis as assumed for the other partners.
    - The maximum pumping rate does not exceed twice the allocation (equivalent to a maximum day peaking factor of 2.0), which is the case for all of the WIPs. For higher pumping rates, DWR may limit the annual volume pumped to the actual storage allocated (150 MG = 1% of the water supply pool storage) instead of the equivalent yield, which includes streamflow (1 mgd = 365 MG/year). This potential limitation would address a concern that an allocation holder might wish to pump the total allocated volume at a high rate over a short period during the peak of a drought, in which case the streamflow component of the allocation could be negligible.

Table 2-1: Demand Basis of Facility Design

Partner	Year 2020 Demand Basis for Initial Water Production (mgd)			Year 2040 Demand Basis for Initial Facilities Capacity (mgd)			Year 2060 Demand Basis for Ultimate Facilities Capacity (mgd)		
	Avg. Day	**Max. Day**	**%**	**Avg. Day**	**Max. Day**	**%**	**Avg. Day**	**Max. Day**	**%**
Chatham County	3.0	5	21.7%	6.5	10.0	30.3%	10.5	16.0	29.6%
Durham	16.5	17	73.9%	16.5	17.0	51.5%	16.5	21.0	38.9%
Orange County	1.0	1	4.3%	1.0	1.0	3.0%	2.0	3.0	5.6%
OWASA	0.0	0	0.0%	2.0	2.0	6.1%	5.0	5.0	9.3%
Pittsboro	0.0	0	0.0%	2.0	3.0	9.1%	6.0	9.0	16.7%
Total	**20.5**	**23**	**100%**	**28.0**	**33.0**	**100%**	**40.0**	**54.0**	**100%**

2.2 Cost Basis and Assumptions

Cost estimates were prepared based on planning-level conceptual designs, desktop site evaluations, and simplifying assumptions. No physical site evaluations or surveys were performed. Facility and water line layouts were based on Geographic Information System analysis. All costs are presented in 2014 dollars. Final costs of the project will depend on the concepts that are carried forward to and developed during final design, and a range of factors, such as actual labor and material costs, competitive market conditions, final project scope, treatment process selection, implementation schedule, and other variable conditions unknown at this time. Consistent with the actual Round 4 Allocation draft requests, the present study also assumes that each partner will obtain and maintain a Level I Jordan Lake allocation. No costs are included for Level II Allocations. Capital costs were calculated for all required project infrastructure components to include: the regional intake, regional raw water piping, regional raw water pump station, water treatment facilities, raw and finished water transmission piping and booster pumping stations (where needed), payment by WIPs to OWASA for purchase of its Jordan Lake WTF site property, purchase of required additional land/easements, environmental mitigation, and Jordan Lake allocation costs. An overall goal is to make the comparison of alternatives an “apples-to-apples” comparison.

For each infrastructure component, capital costs were assigned to each partner based on the partner’s respective share of the facility capacity/ownership. Thus, for the regional intake and pumping station and the ultimate expansion phase of construction, each WIP was assigned a capital cost share equal to the percentage listed in the last column in **Table 2-1**. Likewise, for the initial phase, costs were assigned based on percentages in the eighth column of **Table 2-1**. For non-shared components, the full costs were assigned to the respective partner.

Capital costs and operation and maintenance costs for the infrastructure components were estimated using both published and in-house Hazen and Sawyer databases and cost curves. The base treatment plant costs developed are preliminary concept level costs and used for comparison of alternatives. In light of

current and potential Jordan Lake drinking water quality considerations, capital costs for the construction of new WTFs, and improvements to existing WTFs facilities in the case of Alternative 3, assume advanced water treatment technology—including conventional treatment processes, plus ozone and ultraviolet (UV) disinfection, deep bed filters with activated (GAC) or biologically activated (BAC) carbon, chlorine disinfection followed by chloramine residual disinfection, along with residuals handling—will be needed to meet current and anticipated regulatory requirements and to provide high quality finished water to the WIPs.

The treatment processes assumed are similar to the existing Cary/Apex WTF but include ultraviolet disinfection (UV) as an additional process. These processes would:

- provide for the removal of organics for total organic carbon (TOC) and disinfection byproduct (DBP) control;
- use ozone, UV, and chlorine to provide multiple barriers for disinfection and oxidation for pathogens, taste and odor, emerging contaminants, and algal toxins; and,
- utilize chloramines as a residual disinfectant to minimize DBP formation as currently practiced in the region.

Raw water terminal storage is not included in the cost analysis; however, the partners may wish to evaluate that option during more detailed future studies. The final process selection should be evaluated in the preliminary engineering phase based on site-specific source water quality monitoring at the intake site, and finished water quality goals established by the WIP.

Capital cost financing was assumed to begin in the year 2015 for the design and construction of the initial phase infrastructure components, and in year 2035 for design and construction of infrastructure components assumed to be expanded by year 2040. Capital costs have been assumed to be debt-financed for 25 years, at an annual interest rate of 3.225%.

For the life cycle cost analysis, annual costs include annual operation and maintenance costs (including variable costs such as energy and chemicals; and fixed costs, such as staffing, equipment maintenance and replacement, etc.), capital cost debt service payments; and Jordan Lake allocation costs. The assumed lifespan of equipment is 25 years, and the assumed lifespan of the remainder of the infrastructure is 50 years. As noted, all capital and life cycle costs discussed in Section 3 are presented in 2014 dollars, unless otherwise indicated. Additional key assumptions are listed below.

<u>Calculation of Capital Costs*</u>

Current ENR CCI:	9795.92
Contractor Mobilization, Overhead, and Profit:	15%
Engineering Studies, Design, and Construction Services:	15%
Legal Fees, Permits, and Approvals:	5%
Contingency**:	25%
Raw and Finished Water Main - Rural:	$9.00 per inch-diameter/ft
Raw and Finished Water Main - Urban:	$15.00 per inch-diameter/ft
Land Acquisition:	$10,000 per acre

Calculation of Life Cycle Costs

Discount Rate:	1.295%
Capital Recovery Interest Rate:	3.225%
Financing Term:	25 years
Equipment Replacement as % of Total Construction Cost:	15%
Number of Years Replacement Equipment Defrayed Over:	5 years
Annual O&M Costs as Percentage of Construction Costs:	10%
Fixed O&M Costs as Percentage of Total O&M Costs:	70%
Variable O&M Costs as Percentage of Total O&M Costs:	30%
Energy Cost:	$0.092 per kW-hr

The Following items are per the DWR's instructions for the Jordan Lake Round 4 Allocation requests:

Level I Allocation Total Purchase Cost:	$91,040.76 per mgd
Level I Allocation Annual Cost for Subsequent Years:	$2,218.85 per mgd/year
Level I Allocation Additional Fixed Administration Cost:	$250 per year

*All estimates were prepared in accordance with the guidelines of the Association for the Advancement of Cost Engineering (AACE) International for a Class 4 level of estimation (conceptual estimate of +50% to -30%).
**Contingency costs for the expansion of Durham's Williams WTF are assumed to be 40% due to the uncertainties associated with repurposing this historic facility and site constraints for the new facilities.

3.0 Alternatives Analysis

The following three water supply alternatives were developed and evaluated at a conceptual level to assist the WIPs in determining the most favorable alternative to meet the water supply needs of the individual WIP as well as the group as a whole, and to provide an estimate of capital and other costs to assist in the facilities planning and development process.

As noted in report Section 1.2, all three alternatives reviewed hereinafter involve the construction of a regional raw water intake and pumping station on USACE property at or near the Vista Point recreation area and near the OWASA Jordan Lake property (**Figure 1-5**). Based on the projected total maximum day demand for the WIP in year 2060, as summarized in **Table 2-1**, and the foregoing discussion, these facilities would have an ultimate design capacity of 54 mgd, except for the treatment facilities and pumping stations, which would have an initial capacity of 33 mgd and a footprint designed for the ultimate 54 mgd facility capacity.

3.1 Alternative 1: Regional Water Treatment Facility

Alternative 1 involves the construction of the Regional WTF on the OWASA Jordan Lake property, which, as discussed above would have an initial capacity of 33 mgd and an ultimate capacity of 54 mgd and would treat raw water pumped from the regional intake and pumping facility.

Finished water would be conveyed to the WIPs' distribution systems through two pipelines, one routed north and the other west as shown on **Figure 1-1**. The north pipeline would serve all of the WIP partners except Pittsboro. It extends northward from the OWASA site along Seaforth/Big Woods Road to Jack Bennett Road and west to its intersection with Lystra Road, where finished water would be delivered to the Chatham County North distribution system. It would continue west along Lystra Road and turns north onto Farrington Point Road eventually to a point near the crossing of Old Chapel Hill Road and I-40 in Durham, where finished water would be delivered to the OWASA-Durham distribution system interconnection. It is assumed Orange County would be served via the existing Durham-Hillsborough water system interconnection. The Pittsboro pipeline would run west along Mt. Gilead Church Road to US 64/Business 64 to a connection with its distribution system. Based on a preliminary hydraulic evaluation, finished water booster pumping stations are estimated to be required for Chatham County, Orange County, and Pittsboro.

Conceptual level costs for the Regional Water Treatment Facility alternative are summarized in **Table 3-1**. The grand total of capital costs is estimated at $317 million, with $243 million going to the initial construction and $74 to the facility expansion. Capital costs for the individual partners range, based on the respective percentage share of costs (refer to **Table 2-1**) from a grand total of $21 million for Orange County to $133 million for Durham. Because it is assumed that Durham would provide wholesale water service to Orange County directly from its distribution system, the costs shown in **Table 3-1** for Durham and Orange County are presented both as a combined cost and as separate costs. The same applies to cost summaries for the other two alternatives discussed hereinafter. **Table 3-1** also lists estimated life cycle costs, which total $694 million, and unit life cycle costs based both on water usage and the amount of the Level I allocation held by each partner. It should be noted that the usage unit cost for OWASA is considerably higher than for the other partners because, for the purposes of this study, it is assumed OWASA would use Jordan Lake water on average only once every five years rather than on a daily basis as assumed for the other partners.

Table 3-1: **Conceptual-Level Cost Summary – Alternative 1: Regional Water Treatment Facility**

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs Per 1,000 gallons (2014 $)	
	Initial Facilities	Ultimate Facilities	Total		Usage	Level I Allocation Purchased
Chatham County	$65.9 M	$21.4 M	$87.3 M	$183.4 M	$1.7	$0.6
Durham and Orange County	$132.9 M	$20.5 M	$153.4 M	$418.7 M	--	--
Durham	$120.1 M	$12.8 M	$132.9 M	$388.2 M	$1.5	$1.5
Orange County	$12.8 M	$7.7 M	$20.5 M	$30.5 M	$1.5	$1.0
OWASA	$15.0 M	$9.6 M	$24.6 M	$31.0 M	$4.1	$0.4
Pittsboro	$29.5 M	$22.0 M	$51.5 M	$61.3 M	$1.5	$0.7
Total	**$243.3 M**	**$73.5 M**	**$316.8 M**	**$694.3 M**	**--**	**--**

3.2 Alternative 2: South Durham and Jordan Lake Water Treatment Facilities

This alternative involves the construction of two WTFs: (i) the Jordan Lake WTF, located on the OWASA Jordan Lake property and serving Chatham County and Pittsboro; and (ii) the South Durham WTF, located on the site of the South Durham Water Reclamation Facility owned by Durham, to serve Durham, OWASA, and Orange County.

The conceptual design for this alternative envisions that raw water would be pumped from the regional intake and pumping facility to each WTF via a separate pipeline. Consequently, the conceptual design assumes two sets of pumps would be installed at the regional raw water pumping facility. Raw water pumping facility costs have been adjusted to account for the additional mechanical equipment and larger required footprint. As shown in **Figure 1-2**, the northern shared raw water pipeline would be routed north from the OWASA site along the same general route as the Alternative 1 northern finished water pipeline, except, in this case, all water would be delivered to the South Durham WTF site, which is located east off of Farrington Road and south of Interstate 40. Finished water from this WTF would be delivered to the OWASA-Durham distribution system interconnection generally following the northern section of the route described under Alternative 1. Finished water from the Jordan Lake WTF would be conveyed to Chatham County and Pittsboro through separate pipelines, which as shown in **Figure 1-2** would generally follow the routes described above for Alternative 1.

Conceptual level costs for Alternative 2 are summarized in **Table 3-2**. As discussed hereinafter, capital and life cycle costs for this alternative are generally higher than those for Alternative 1.

Table 3-2: **Conceptual-Level Cost Summary**
Alternative 2 - South Durham and Jordan Lake Water Treatment Facilities

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs Per 1,000 gallons (2014 $)	
	Initial Facilities	Ultimate Facilities	Total		Usage	Level I Allocation Purchased
Chatham County	$74.7 M	$21.5 M	$96.2 M	$194.2 M	$2.0	$0.7
Durham and Orange County	$142.8 M	$22.0 M	$164.8 M	$451.2 M	--	--
Durham	$128.2 M	$13.8 M	$142.0 M	$417.4 M	$1.7	$1.7
Orange County	$14.6 M	$8.2 M	$22.8 M	$33.8 M	$1.8	$1.1
OWASA	$22.6 M	$10.4 M	$33.0 M	$42.4 M	$8.9	$0.6
Pittsboro	$29.5 M	$21.5 M	$51.0 M	$64.6 M	$1.7	$0.7
Total	**$269.6 M**	**$75.4 M**	**$345.0 M**	**$752.4 M**	--	--

3.3 Alternative 3: Raw Water Only Facilities

The Raw Water Only Facilities alternative was selected for evaluation because it maximizes use of existing water treatment facilities owned by Durham and OWASA. It involves the following WTF improvements: (i) construction of the same Jordan Lake WTF described above under Alternative 2 to serve Chatham County and Pittsboro, (ii) the addition of advanced treatment at OWASA's Jones Ferry Road WTP, consistent with the general assumptions and recommendations in this report for treating Jordan Lake water, and (iii) major renovations and upgrades to Durham's existing Williams WTP to provide advanced treatment.

In this case, raw water would be pumped to all three WTF locations as shown in **Figure 1-3**. The regional raw water pumping facility would be furnished with two sets of pumps as described above under Alternative 2. Durham and OWASA would jointly own and use a raw water pipeline from Jordan Lake to the Jones Ferry Road WTP branch pipeline connection at the intersection of Farrington Point Road and Mt. Carmel Church Road. A raw water booster pump station would be installed on OWASA's section of the Jordan Lake raw water line. The Durham raw water pipeline would continue north along Old Farrington Point Road/Farrington Mill Road to Farrington Road north into Durham to the Williams Water Treatment Plant located on Hillandale Road (As previously noted, Durham's raw and finished water transmission mains have been sized to accommodate Orange County's future use of Jordan Lake).

Also as shown in **Figure 1-3**, finished water delivery to Chatham County and Pittsboro would be as described above under Alternative 2. For OWASA and Durham, finished water delivery would be through their respective existing water distribution systems, with Durham serving Orange County as previously described.

Conceptual level costs for Alternative 3 are summarized in **Table 3-3**. As discussed hereinafter, capital and life cycle costs for this alternative are generally higher than those for both Alternative 1 and Alternative 2.

Table 3-3: Conceptual-Level Cost Summary – Alternative 3: Raw Water Only Facilities

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs Per 1,000 gallons (2014 $)	
	Initial Facilities	Ultimate Facilities	Total		Usage	Level I Allocation Purchased
Chatham County	$74.7 M	$21.5 M	$96.2 M	$193.2 M	$1.9	$0.7
Durham and Orange County	$208.6 M	$20.9 M	$229.5 M	$730.6 M	--	--
Durham	$189.9 M	$13.1 M	$203.0 M	$690.6 M	$2.8	$2.8
Orange County	$18.7 M	$7.8 M	$26.5 M	$40.0 M	$2.1	$1.3
OWASA	$27.8 M	$7.1 M	$34.9 M	$47.7 M	$10.0	$0.6
Pittsboro	$29.5 M	$21.5 M	$51.0 M	$78.7 M	$2.1	$0.9
Total	**$340.6 M**	**$71.0 M**	**$411.6 M**	**$1,050.2 M**	**--**	**--**

3.4 Alternatives Cost Comparison

The initial capital costs, total capital costs, and life cycle costs for the three alternatives are summarized graphically in **Figure 3-1**, **Figure 3-2**, and **Figure 3-3**, respectively. These graphs clearly show that Alternative 1 - Regional Water Treatment Facility is the most economical alternative for all of the partners, followed by Alternative 2, and lastly by Alternative 3.

Tables 3-4 and **3-5** present a cost comparison between the three alternatives on a percentage basis. Relative to Alternative 1 - Regional Water Treatment Facility, overall costs for Alternative 2 - South Durham and Jordan Lake WTFs are 9% higher on a capital cost basis and 8% higher on a life cycle cost basis, while costs for Alternative 3 - Raw Water Only Facilities are 30% higher on a capital cost basis and 51% higher on a life cycle cost basis. The cost of WTF construction is a major factor that favors the construction of a single RWTF rather than two WTFs, as in the case of Alternative 2. The higher costs for Alternative 3 are driven largely by the costs associated with repurposing Durham's existing Williams WTP to include advanced water treatment processes, and upgrading treatment processes at OWASA's Jones Ferry Road WTP. Overall pipeline length is another major cost factor. The ranking in this case follows the overall cost ranking, with Alternative 1 having the lowest combined linear footage of raw and finished water mains, Alternative 2 the second lowest, and Alternative 3 the highest.

Table 3-4: Percent Increase (Decrease) in costs for Alternative 2 – South Durham and Jordan Lake Water Treatment Facilities vs. Alternative 1 - Regional Water Treatment Facility

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)
	Initial Facilities	Ultimate Facilities	Total	
Chatham County	13%	0%	10%	6%
Durham	7%	8%	7%	8%
Orange County	14%	6%	11%	11%
OWASA	51%	8%	34%	37%
Pittsboro	0%	(2%)	(1%)	5%
Total	**11%**	**3%**	**9%**	**8%**

Table 3-5: Percent Increase (Decrease) in Costs for Alternative 3 – Raw Water Only Facilities vs. Alternative 1 - Regional Water Treatment Facility

Partner	Capital Costs (2014 Million $)			Total Life-Cycle Costs (2014 Million $)
	Initial Facilities	Ultimate Facilities	Total	
Chatham County	13%	0%	10%	5%
Durham	58%	2%	53%	78%
Orange County	46%	1%	29%	31%
OWASA	85%	(26%)	42%	54%
Pittsboro	0%	(2%)	(1%)	28%
Total	**40%**	**(3%)**	**30%**	**51%**

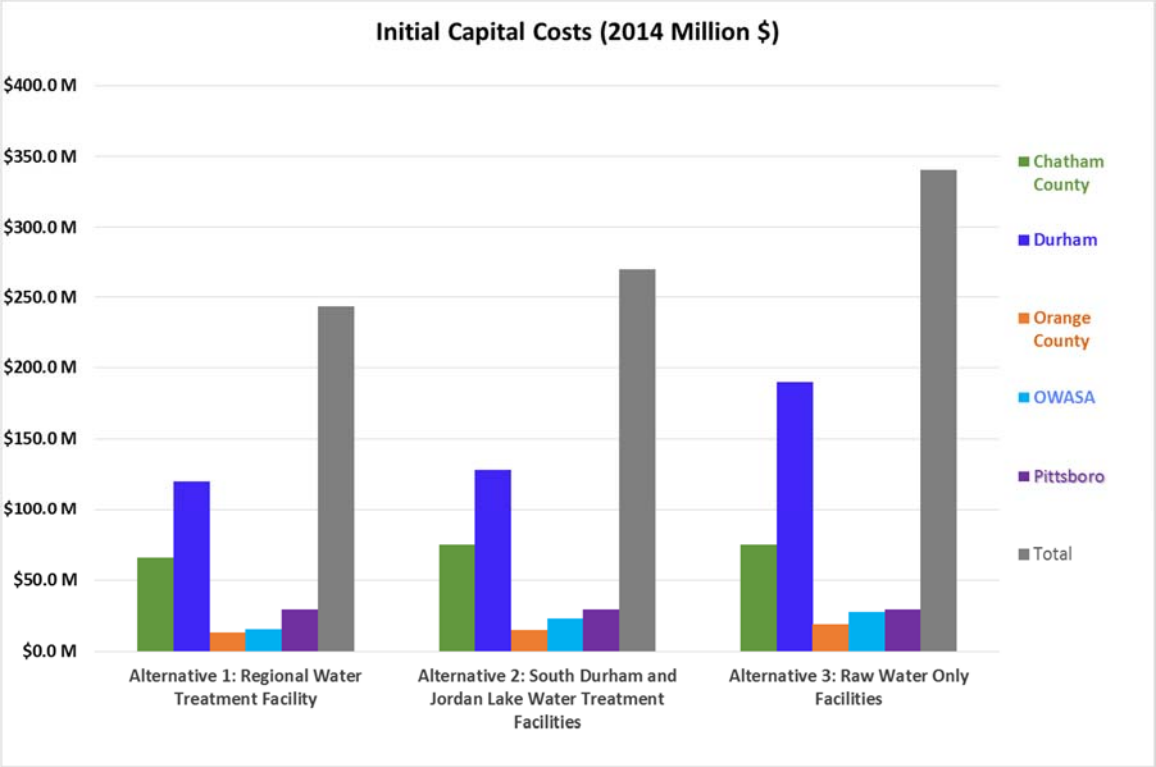


Figure 3-1: Initial Capital Cost Comparison

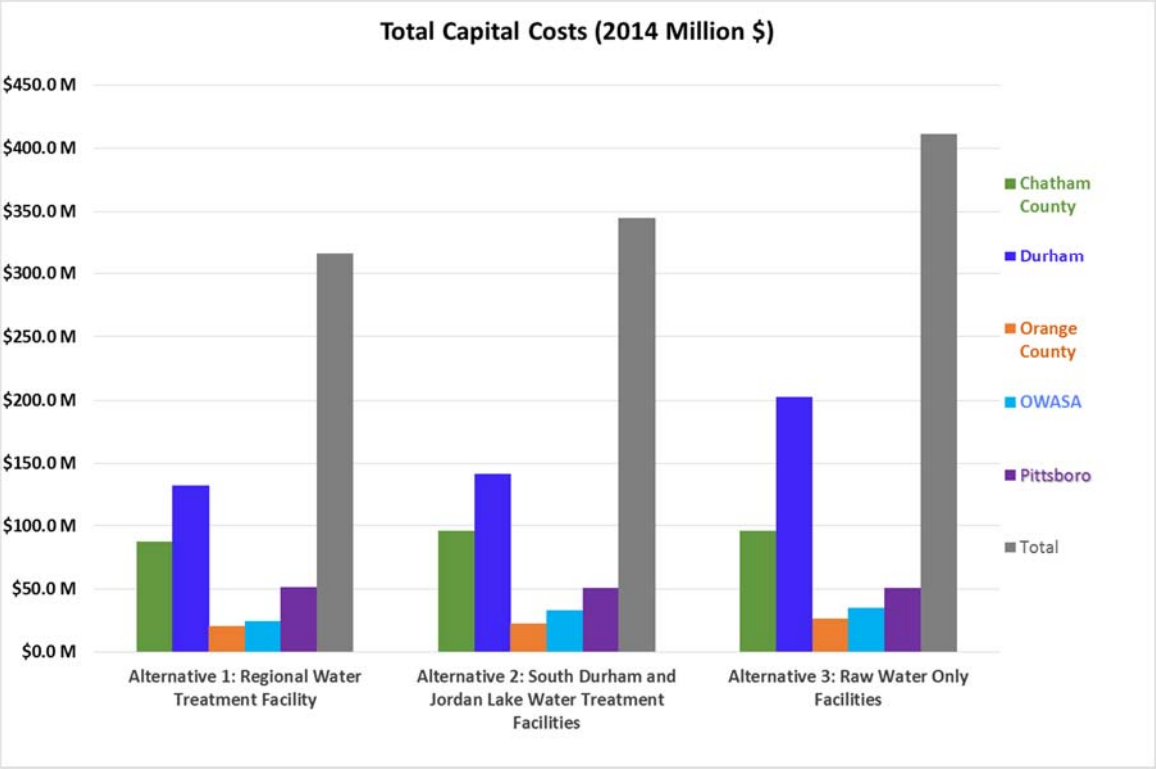


Figure 3-2: Total Capital Cost Comparison

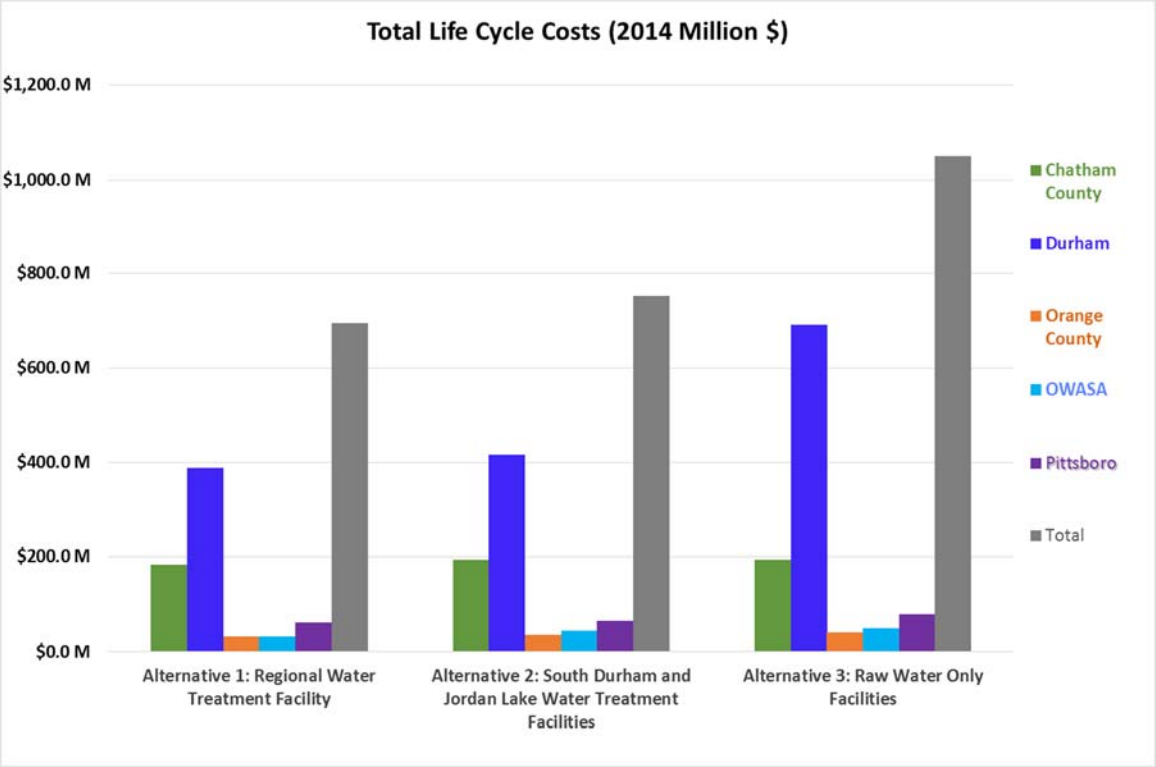


Figure 3-3: Life Cycle Cost Comparison

4.0 Other Project Considerations

While cost is a major component of the feasibility of the regional western intake and its alternatives, other factors influence project feasibility, including the advantages and disadvantages of pumping raw water versus finished water, pipeline routing considerations, water quality issues, and interbasin transfers.

4.1 Advantages / Disadvantages to Receiving Raw Versus Finished Water

The relative advantages and disadvantages to each partner for receiving raw versus finished water are discussed below.

4.1.1 Raw Water

Chatham County

Chatham County owns and operates three separate water systems: North (HGL's 740 ft and 570 ft), Asbury (HGL 620 ft) and South (HGL 770 ft). For the purpose of this analysis, the only Chatham County system to be served is the North system, which is currently being supplied by Chatham County's existing 3 mgd treatment plant located near US 64 and Beaver Creek Road (the Asbury and South system demands are met by water purchases from other systems). Currently, there are no plans to expand Chatham County's existing North treatment plant, which is located on the east side of the lake. Therefore, delivery of raw water to Chatham County is not considered a feasible alternative to meet future water supply demands.

Durham

The City of Durham has the option of receiving either raw or finished water from Jordan Lake. Two of the alternatives in this report involve delivering raw water to Durham: construct a new South Durham WTF under Alternative 2, or pump raw water to the Williams Water Treatment Plant site under Alternative 3. The facility cost analysis indicates the Jordan Lake RWTF alternative is the most economical option for Durham. In the case of Alternative 3, the Williams Water Treatment Plant is nearing the end of its useful life; it does not have advanced processes necessary to treat water from Jordan Lake; and because of the facility age, land, and other constraints, it cannot be easily upgraded to provide the required level of advanced water treatment. Thus, on the basis of conceptual-level evaluations completed during the present study for Alternative 3, the cost to upgrade the Williams plant is considered equivalent to the cost of constructing a new treatment plant in its place. A further disadvantage of Alternative 3 is that it would involve construction of a major raw water line to the Williams Plant through a highly developed urban corridor.

Orange County

As previously noted, Orange County is not a WIP. For the purpose of this study it is assumed Orange County would enter into an interlocal agreement with Durham to purchase drinking water.

OWASA

OWASA could receive raw or finished water from Jordan Lake. Raw water would be treated at the Jones Ferry Road Water Treatment Plant, which has adequate capacity to treat its full Jordan Lake allocation. Hazen and Sawyer recommends that to address potential taste and odor and other treatability issues, OWASA upgrade the Jones Ferry Road WTP with advanced processes to adequately treat Jordan Lake water. In addition, delivery of raw water to OWASA would involve the construction of a major raw water

line to the Jones Ferry Road Plant from the south in the vicinity of downtown Carrboro, which would represent a major challenge due to highway and stream crossings and a highly developed urban corridor.

Pittsboro

The Town of Pittsboro water system is currently served by the Haw River WTP, which has a permitted capacity of 2.0 mgd. The estimated reliable yield from the Haw River is 6 mgd. Future plans may call for the expansion of the Haw River Plant in 2.0 mgd increments, or no expansion of this facility pending outcomes of the present investigation and several ongoing water quality investigations on Haw River source water. Similar to OWASA, upgrades would be needed to treat Jordan Lake water at Pittsboro's Haw River WTP, and the construction of a major raw water line to the WTP from Jordan Lake through Pittsboro represents a major challenge due to major highway and stream crossings and a highly developed urban corridor. In addition, Pittsboro's growth, primarily associated with the recently approved Chatham Park development, will occur on the Jordan Lake (east) side of Pittsboro. Given these constraints, delivery of raw water to Pittsboro's Haw River WTP is not considered a feasible alternative to meet future, long term water supply demands.

4.1.2 Finished Water

The present analysis has assumed that finished water would be delivered to each of the WIPs at their respective specified connection to their existing distribution system for each of the three project alternatives. For this initial feasibility study phase, the alternatives comparison does not account for additional costs that may be needed to upgrade the connections to each WIP's respective distribution system. However, each connection location is evaluated below in broad terms in order to generally assess whether or not the proposed connection was feasible.

Chatham County

The proposed finished water connection to Chatham County's North distribution system would be in the vicinity of Lystra and Jack Bennett Roads (**Figure 4-1**). This is where Chatham County's 740 ft and 570 ft pressure zones meet. There are several 12-inch water mains and an elevated tank and pump station at this location. Due to the volume of water to be transferred at this location, it would be desirable to provide additional distribution system piping in order to avoid excessive velocities in the existing water mains. In addition, a detailed review of the tank and pump operations is recommended.

Durham / OWASA / Orange County

The proposed finished water supply to Durham / OWASA / Orange County would be conveyed through the existing Durham-OWASA distribution system interconnection at I-40 at Old Chapel Hill – Durham Road (**Figure 4-2**). This interconnection includes a pump station. The current interconnection transfer capacity is 5.9 mgd from Durham to OWASA and 3.0 mgd from OWASA to Durham. The transfer capacity into the OWASA system is adequate to meet their assumed 5.0 mgd ultimate maximum day capacity. However, improvements to the Durham distribution system would likely be necessary to convey the 24 mgd projected to be ultimately needed by Durham/Orange County. It is recommended that a detailed review be completed to identify the location, features, and costs of any needed improvements.

Pittsboro

The Town of Pittsboro owns and operates a water distribution system that supplies the Town and the adjacent area north to the Haw River. Chatham Park, a large recently approved mixed use development project east of Pittsboro, represents the majority of Pittsboro's anticipated growth (**Figure 4-3**). Consequently, this study looked at the proposed finished water line connecting to the Town's eastern most distribution system, in the vicinity of Business 64 and Hanks Chapel Road (**Figure 4-4**). The existing water line at this location is only 6-inches in diameter. Further analysis of the Pittsboro system at the proposed connection location is necessary to determine what improvements are needed, and should include an evaluation of the demands from the proposed Chatham Park development (including fire flow requirements).

4.2 Pipeline Routing and Easement Acquisition Considerations

Pipeline routes for each of the three project alternatives were primarily established by following existing corridors. In developing the planned routes, consideration was given to the need to minimize impacts to property owners and to wetlands and streams. Several issues that could affect the location of the future pipelines and acquisition of easements impact all three alternatives evaluated, and are summarized below.

Big Woods Interchange

NCDOT plans include the construction of a significant new interchange at the intersection of Big Woods Road and US 64, which would impact pipeline routing for each of the three project alternatives.

Chatham Park Development

Planned improvements in connection with the proposed Chatham Park development include upgrades to roadways and utilities, including drinking water, reclaimed water, and wastewater collection systems. The planned infrastructure improvements will affect the location and sizing of the proposed Pittsboro finished water line for all project alternatives.

Raw Water Facilities Easement

The US Army Corps of Engineers (USACE) will not issue an easement to the partners directly for the raw water intake, pump station, and pipeline. Rather, the easement would be issued to the State of North Carolina, which owns the water supply storage volume of Jordan Lake. The State would then allow the partners to use the easement. This represents a potentially significant limitation to the pursuit of Alternative 3 - Raw Water Only Facilities, given that extensive portions of the raw water pipeline route are located on USACE property.

As part of the application process to construct an intake at Jordan Lake, the USACE will require the submittal of a "Request for Use of Land/Water Application." The first step in this process is filing a "Minimum Information for Initial Request," which is similar to a draft Environment Assessment (EA). Under the second step (submittal of a "Detailed Proposal"), the USACE would likely require a formal EA, if not a more detailed Environment Impact Statement (EIS). EA/EIS document(s) must provide preliminary design-level details of the proposed project, a thorough evaluation of alternatives to the proposed project, and the identification of adverse impacts and proposed mitigation measures for those impacts. An application for development of a multi-user water intake facility would likely be viewed more favorably than a single-user proposal.

Another easement consideration is North Carolina General Statute 153A-15, which requires that *"before any county, city or town, special district, or other unit of local government which is located wholly or primarily*

outside another county acquires any real property located in the other county by exchange, purchase or lease, it must have the approval of the county board of commissioners of the county where the land is located." Given the collaborative nature of the project, board of commissioner approval is not considered to be a major impediment for project implementation.

Constrained Easements

Following the construction of Jordan Lake, the USACE granted 200-ft wide rights-of-way to NCDOT for the relocation of Seaforth Road and portions of Big Woods Road. Consequently, where the pipeline is routed adjacent to these roads, it can be located within the NCDOT right-of-way. However, further north, the established NCDOT rights-of-way narrow to approximately 60 feet wide and include the portions of the potential major water transmission main routes that would parallel Jack Bennett Road, Lystra Road, Farrington Point Road, Old Farrington Point Road, and Barbee Chapel Road. The narrower corridors will likely require pipeline easements that extend beyond the NCODT right-of-way, much of which is owned by the USACE. Acquisition of property from the USACE for water supply purposes is allowed but will require a "no practical alternatives" analysis and mitigation.

Environmental Impacts

Wetland and stream crossings associated with the proposed raw and finished water transmission mains were identified for the three project alternatives using GIS data. Field surveys of these features and other potential environmental impacts will be required as part of future investigations. An estimate of mitigation costs resulting from unavoidable impacts to wetlands and streams has been included for each of the evaluated alternatives. Alternative 2 – South Durham and Jordan Lake WTFs and Alternative 3 – Raw Water Only Facilities will require greater lengths pipeline, to include parallel pipelines in the same corridors (see **Figures 1-2** and **1-3**) than Alternative 1 - RWTF. Consequently, Alternatives 2 and 3 would result in greater impacts to wetlands and streams than Alternative 1.

Cultural and Historic Resources Impacts

Potential cultural and historic resources are known to exist in the project area. Based on preliminary conversations with the USACE there is a State Designated Historic District in the project area, though this could not be confirmed during a search of the North Carolina Historic Preservation Office database and GIS service. In addition, the pipeline would cross through the Jordan Lake State Recreation Area along Big Woods Road. Field surveys to identify these cultural and historic resources areas will be required as part of future investigations to help minimize project impacts.

4.3 Water Quality Issues

Potential water quality issues were investigated for the three project alternatives and are summarized below.

Source Water Quality

The water quality of Jordan Lake, similar to Falls Lake and other surface water supplies in North Carolina, is considered to be impaired due to nutrient loading from the watershed. While the lake meets water quality criteria for drinking water supplies, current and projected excessive nutrient loading may result in algal blooms and taste and odor and treatability issues. As previously discussed in Section 2.2, it is essential that advanced drinking water treatment processes be used to ensure high quality drinking water from Jordan Lake.

Because of the importance of Jordan Lake as a resource for water supply, water quality control, and recreation, a considerable amount of water quality data has been collected at the lake by various parties. Appendix D is a partial summary of potentially pertinent monitoring locations and available data. If the WIPs decide to proceed with a new intake and treatment facility at Jordan Lake, the existing data should be reviewed to assist in the evaluation and planning of appropriate treatment strategies and processes required to produce a high quality drinking water. Hazen and Sawyer recommends a site-specific source water monitoring study at the Vista Point intake site and any other potential intake site of interest to the WIP be conducted to fill in data gaps and to collect additional data on contaminants and other parameters of concern for drinking water that will help inform treatment process selection.

Raw Water Conveyance

In addition to source water quality issues, potential raw water quality issues that must be addressed include those related to the water being withdrawn from Jordan Lake, and those related to its transportation to the point of treatment.

As required by the NC Rules Governing Water Supplies (NCAC Title 15A.18C.0602) and good engineering practice, the Jordan Lake Regional Intake would be furnished with multiple withdrawal levels for selection of optimal water quality. Future studies should include careful evaluation of intake siting and the selection of intake withdrawal levels. Potential in-reservoir water quality enhancements, such as mixing or hypolimnetic aeration of waters in the vicinity of the intake (as currently being implemented by Cary/Apex), should also be evaluated (along with permitting feasibility). Future studies should also include a review of the feasibility and potential benefits of constructing terminal raw water storage on the RWTF site.

In addition, it is recommended that careful evaluation be made of provisions for adding oxidants such as potassium permanganate as well as powdered activated carbon at the intake to help improve the quality of raw water as it is conveyed to the head of the water treatment facilities. These provisions should address most water quality concerns at the Jordan Lake RWTF, where the raw water main from the intake has a length of approximately 6,000 feet.

The much longer raw water mains to the South Durham WTF site (21 miles) under Alternative 2 or OWASA's Jones Ferry Road WTP (19 miles) and Durham's Williams WTP site (28.5 miles) under Alternative 3 raise other concerns. The addition of potassium permanganate or other oxidants at the intake should help address water quality degradation over long travel distances, but additional measures would be required in the case where the water may not be pumped continuously. This would be an especially important consideration for OWASA, as its anticipated use of water from Jordan Lake would be on an infrequent basis. Raw water tends to become anoxic/stagnant as it sits in a pipeline to the point that delivery to a terminal reservoir for storage and mixing and/or provisions for wasting/flushing of stagnant water may be necessary to avoid the significant water quality issues that would otherwise ensue upon its direct delivery to a WTF.

Provisions for pigging raw water mains should also be considered to address the potential for buildup of biofilm on the pipe interior.

Treated Water Age

Due to the pipeline sizes and travel distances involved, water age and quality may present a challenge for the three project alternatives, especially during the early years when water demands are projected to be the lowest. Generally, a finished water age of less than seven days minimizes water quality-related issues in the distribution system. Calculations performed show that water ages for the average daily flow at start-

up for each WIP are all less than one day. Hence, water quality issues due to finished water age considerations are not expected to present an implementation issue.

Distribution System / Disinfectant Coordination and Flushing

The distribution systems for all partners rely on chloramines as a disinfectant. However, in accordance with the NC Public Water Supply Section's requirements, each system must conduct an annual flush or "chlorine burnout" in which the system is switched to free chlorine for a 30-day period. Coordination of the annual flushing would be required among the partners to prevent chlorinated and chloraminated water from mixing. However, this is not expected to present any major implementation issues.

4.4 Interbasin Transfers

None of the WIPs currently transfer water out of the Haw River Basin (2-1). Chatham County, Pittsboro, and OWASA would return water to the Haw River Basin through their respective wastewater treatment facilities. Durham's service area includes both the Haw and Neuse River Basin, while Orange County's service area is entirely in the Neuse River Basin (10-2).

Water obtained and treated from Durham's Jordan Lake allocation would be used only within the Cape Fear (Haw) portion of Durham's service area and would not require an interbasin transfer (IBT) certification. It is notable that Jordan Lake would support a significant reduction in Durham's current and future transfers out of the Neuse Basin by decreasing its reliance on Lake Michie and the Little River Reservoir for all of its needs. Because Durham would use its full 16.5 mgd Jordan Lake allocation immediately upon completion of the new regional facilities, its projected transfer of 19.4 mgd from the Neuse River Basin in 2020 would be reduced to 8.8 mgd. Similarly, if Durham were required to rely solely on its Neuse Basin sources to meet all of its future needs, the projected transfer of 26.6 mgd in 2045 would be reduced to 16.0 mgd.

Jordan Lake water received by Orange County is assumed to be obtained via a finished water interconnection between the Durham and Hillsborough systems. This transfer involves an IBT of up to 2 mgd from the Haw to the Neuse River Basin (10-2), however, no IBT certification would be required because this transfer would not exceed the 2 mgd statutory threshold (Durham's draft Jordan Lake Round 4 Allocation Request, 2014).

Figure 4-1: Chatham County Finished Water Connection Location: Lystra Road & Jack Bennett Road

Figure 4-2: Durham/OWASA/Orange County Finished Water Connection Location: I-40 at Old Chapel Hill – Durham Road

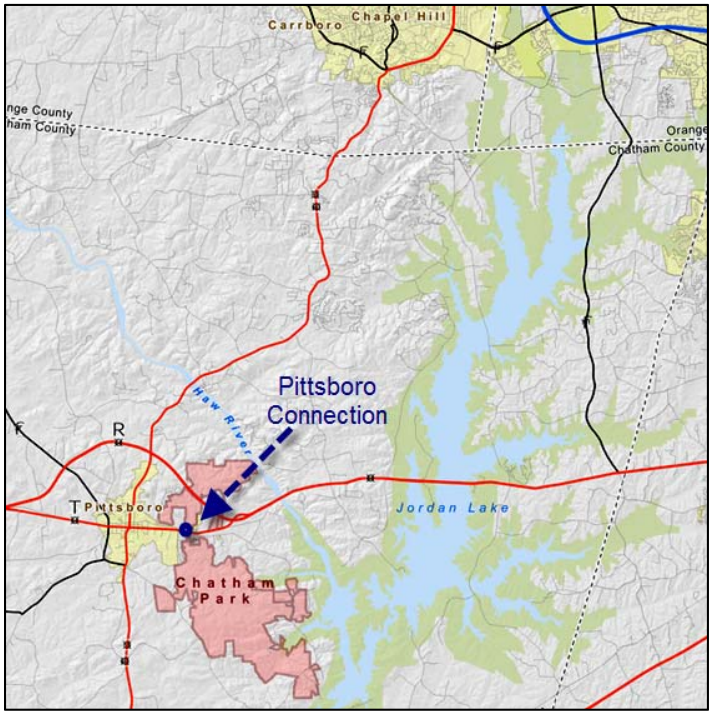


Figure 4-3: Chatham Park Proposed Development with Finished Water Connection (photo Preston Development Company)

Figure 4-4: Town of Pittsboro Finished Water Connection Location: US 64 & Hanks Chapel Road

5.0 Project Implementation Considerations

Hazen and Sawyer has developed a list of anticipated permits, a draft schedule, and a cost-loaded schedule to assist the WIPs with continued interlocal discussions and planning efforts as they work to develop a shared intake and related facilities at Jordan Lake. These items are discussed below.

5.1 Anticipated Permits and Approvals

A summary of the anticipated permits and approvals necessary for the design and construction of the Regional Water Treatment Facility alternative is provided below. Due to the scale and complexity of the project, a significant permitting effort is expected and would trigger State and Federal environmental impact reviews. The following summary addresses only those permits and approvals identified for the current conceptual level of project development. Additional permits may be required.

<u>Environmental Permitting</u>

- USACE Land Use Request
- DWR Site Evaluation Approval
- SEPA/NEPA Environmental Analysis (EA)
- Section 401/404 Permits

<u>Design Phase Permitting</u>

- NCDLQ Sedimentation and Erosion Control
- NPDES Permits (for waste process water and stormwater management)
- Duke-Progress Energy
- NCDOT Encroachment Agreements
- NCDOT Driveway Permit
- Chatham County Site Plan/Construction Plan Approval
- Durham Public Works/Water Main Extension
- Water System Management Plan Certification/DWR Authorization to Construct

<u>Construction Phase Permitting</u>

- Chatham County Building Permit
- Blasting Permit

<u>Post Construction</u>

- DWR Operating Permit

<u>Other Potential Permits</u>

- Railroad Encroachment(s)
- Gas Line Encroachment(s)
- Local Government Permits

5.2 Draft Project Schedule and Implementation

Figure 5-1 is a draft project implementation schedule for the Regional Water Treatment Facility alternative. The schedule illustrates that once the project is initiated it will take approximately 3.5 years to design and permit, and approximately 3 years to construct – assuming no major delays in obtaining authorization to proceed with project engineering, financing, and construction. If this effort began in mid-2014, the schedule indicates that new regional facilities at Jordan Lake and the associated system connections could be on-line around mid-2021.

Water demand data from the Triangle Regional Water Supply Plan Volumes I and II indicate the WIPs will need to begin withdrawing water from Jordan Lake by the year 2020. The draft schedule shown in **Figure 5-1** indicates it is likely that the partners will need to implement interim arrangements to access their respective Jordan Lake allocations before new regional facilities on the west side of Jordan Lake can be designed, built, and placed in service to ensure that they can meet their respective water demands.

In light of the uncertainty of future supply and demand conditions, and the challenging water supply risks and investment decisions that some partners face, it is recommended that the WIPs proceed without delay to implement a plan to obtain water from Jordan Lake.

5.3 Funding the Next Major Step: Cost-Loaded Schedule for Engineering Services

Recognizing that the next major cost item for this effort will be to fund the required engineering services, a cost-loaded schedule was developed to illustrate the expected engineering cost outlays in actual dollars (i.e., adjusted for inflation) for each WIP as the project is implemented. The cost-loaded schedule for engineering services, which are estimated to total about $37.9 million, is depicted graphically in **Figure 5-2** and in Tabular form in **Table 5-1**, and assumes that a portion of the upfront engineering costs are included in Year 1 of the project schedule. It should be noted that **Figure 5-2** and **Table 5-1** *do not include the capital costs for the facilities*. Base year costs are presented as 2014 dollars. For the purpose of estimating life cycle costs the present year (2014) is assumed to be Year 1. The capital outlays correspond to the costs shown on the right-hand side of **Figure 5-1** for the preliminary engineering, permitting, field work, permitting, design, and construction administration. As illustrated in **Figure 5-2**, the engineering services costs gradually increase to a peak in Year 4 when the design effort is fully underway and property for the treatment facility and easements is acquired. For this analysis, the costs have been divided proportionally among the WIPs based on their respective facility capacity allocations as described in Section 2.1 above. *The estimated life cycle costs for each WIP for the planning period, including the capital costs for the facilities, are included in Appendix A.*

Table 5-1: **Summary of Partner Cash Flows (Actual Dollars) for Engineering Services Through Construction Completion**[1]

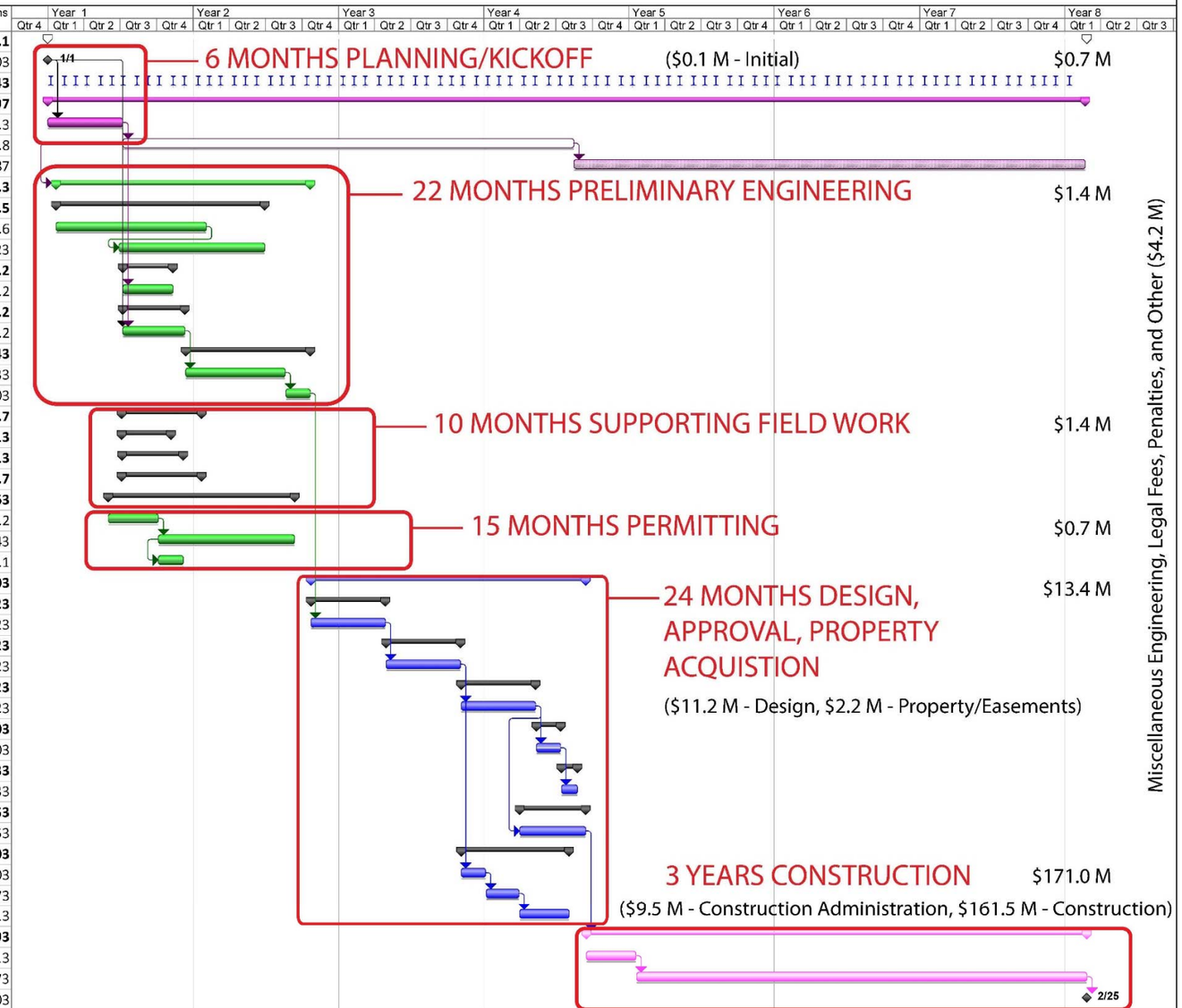
Year	Chatham Co. (1)	Durham Comp. (2+3)	Durham (2)	Orange Co. (3)	OWASA (4)	Pittsboro (5)	Total (1-5)
1	$281,000	$573,000	$519,000	$55,000	$65,000	$125,000	$1,045,000
2	$887,000	$1,812,000	$1,639,000	$172,000	$205,000	$394,000	$3,297,000
3	$1,922,000	$3,924,000	$3,551,000	$373,000	$444,000	$854,000	$7,144,000
4	$2,643,000	$5,118,000	$4,613,000	$505,000	$508,000	$1,212,000	$9,481,000
5	$1,217,000	$2,443,000	$2,208,000	$235,000	$266,000	$546,000	$4,472,000
6	$1,262,000	$2,576,000	$2,331,000	$245,000	$291,000	$561,000	$4,690,000
7	$1,265,000	$2,583,000	$2,337,000	$246,000	$292,000	$562,000	$4,702,000
8	$835,000	$1,705,000	$1,543,000	$162,000	$193,000	$371,000	$3,104,000

[1] Base year costs are in 2014 dollars. For the purpose of estimating life cycle costs the present year (2014) is assumed to be Year 1.

Figure 5-1: Draft Project Schedule

Draft - Western Intake Partners Regional Raw Water Intake, Pump Station, and Water Treatment Facility 8/ 11/14

ID	Task Name	Duration in Months
1	**Western Intake Partners - Regional Intake, Pump Station and WTF**	**87.1**
2	Notice to Proceed	0.03
3	**Progress Meetings**	**85.43**
89	**Policy/Technical Planning**	**86.97**
90	Initial Planning	6.3
91	Partnership Development - Design Guidance	37.8
92	Construction, Ownership, Management and Operation	42.87
93	**Preliminary Engineering and Permitting**	**21.3**
94	**Source Water Treatability Study/Preliminary Design**	**17.5**
95	Monitoring/Pilot Testing	12.6
96	Process Evaluation/Facility Layout	12.23
97	**Pipeline Routing Study**	**4.2**
98	Preliminary Route Evaluation	4.2
99	**Hydraulic Evaluations**	**5.2**
100	Preliminary Hydraulic Evaluation	5.2
101	**Preliminary Engineering Report (PER)**	**10.43**
102	Prepare Draft PER	8.33
103	Prepare Final PER	2.03
104	**Field Evaluations (Survey, SUE, Environmental Resources)**	**6.7**
105	**Intake / Raw Water Pump Station**	**4.13**
109	**Water Treatment Facilities / Booster Pump Stations**	**5.13**
113	**Pipelines**	**6.7**
118	**Permitting**	**15.63**
119	USACE Land Use Request	4.2
120	NEPA/SEPA Environmental Assessment (EA)	11.43
121	DWR Site Evaluation	2.1
122	**Design and Plan Review**	**23.03**
123	**30% Design**	**6.23**
124	30% Design and Review	6.23
125	**60% Design**	**6.23**
126	60% Design and Review	6.23
127	**90% Design**	**6.23**
128	90% Design and Review	6.23
129	**95% Design**	**2.03**
130	95% Design and Review	2.03
131	**Final (100%) Design**	**1.33**
132	Final Plans and Specifications	1.33
133	**Plan Submittals/Approvals**	**5.53**
134	Permitting and Plan Review	5.53
135	**Property Acquisition**	**9.03**
136	Prepare Plats	2.03
137	Appraisals	2.73
138	Property/Easement Acquistions	4.13
139	**Construction**	**41.93**
140	Bid Advertise Award	4.13
141	Construction	37.73
142	Final Completion	0.03



Project: 2014-08-05 JLP Western Intak
Date: Mon 8/11/14

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

25% Contingency	$48.2 M
Jordan Lake Allocation	$2.3 M
Total	$243.3 M

Page 1

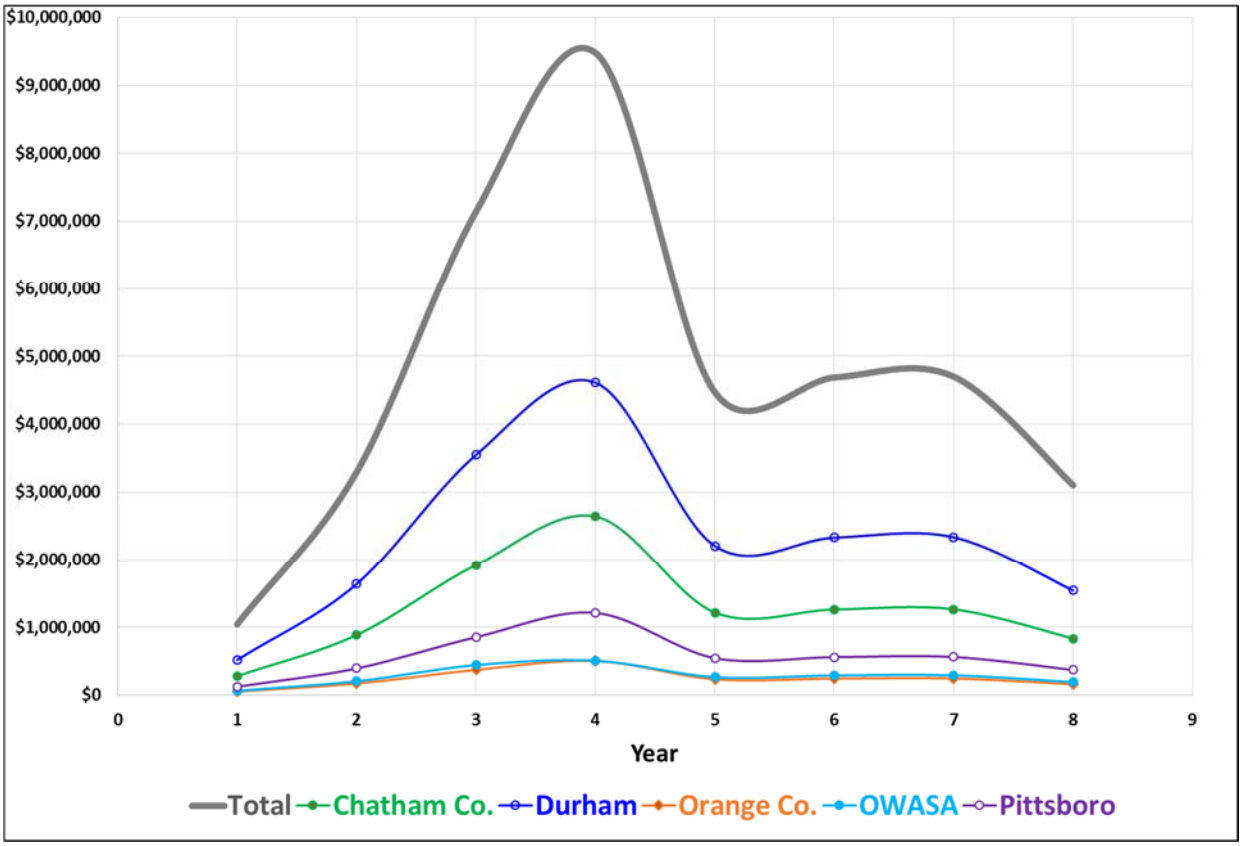


Figure 5-2: **Partner Cash Flows (Actual Dollars) for Engineering Services through Construction Completion**

6.0 Potential Partnership Structures and Interim Planning

If the WIPs agree to move forward with plans to collaborate on regional water facilities at Jordan Lake, the logical next step would be for the WIPs to obtain approval from their respective governing Boards and to establish a formal cost sharing agreement to initiate the next phase of project planning, such as preliminary engineering studies and associated field work. Following that phase, a subsequent agreement would cover project implementation, including but not limited to, securing permits, acquiring easements/land, and financing, designing, owning, constructing, managing, operating and maintaining the shared facilities.

North Carolina General Statutes provide numerous organizational options for intergovernmental cooperation for water service. Three models considered to most applicable for this effort are:

- Interlocal Agreement (N.C.G.S. §160A-461)
- Water Authority (N.C.G.S. §§162A-1 to 162A-19)
- Metropolitan Water District (N.C.G.S. §§162A-31 to 162A-59)

Examples of each type of organizational model currently exist in North Carolina, and some are summarized below.

Traditional organizational theory suggests that local governments create organizations to provide services in a manner that accomplishes community goals and objectives. For municipal governments in North Carolina, community goals and objectives are generally determined through the political process and are translated into service requirements through the policy decisions of governing boards and the administrative actions of municipal managers. Service requirements are typically expressed as level of service, quality of service, and cost of service.

Pursuant to North Carolina General Statute § 160A-312, local governments (including Water and Sewer Authorities) have the legal authority to acquire, construct, establish, enlarge, improve, maintain, own, operate, and contract for the operation of, any public enterprise such as a water and/or sewer utility.

6.1 Interlocal Agreement Model

Under this organizational model, two or more local governments would execute an interlocal agreement for either one or all of them to provide a service that each is already authorized to provide by statute. This organizational model is very flexible and allows for centralized operation, maintenance and management of a local government service, while providing for local control over service levels.

There are two organizational models associated with interlocal agreements. The first model is the sales-and-purchase model, and the second is the joint agency model.

6.1.1 Sales and Purchase Model

The sales-and-purchase model is authorized by North Carolina General Statute §160A-461: *Interlocal Cooperation Authorized.* Under this organizational model, one local government, usually the largest or most centrally located, agrees to provide a service or program to other local governments at a negotiated price and for a negotiated duration. The interlocal agreement must be ratified by resolution by each local government before becoming a binding contract. Ownership of property, hiring of employees, and the setting of rates, fees and charges for the service are the responsibility of the local government providing the service.

Example Application

This is the most common form of intergovernmental cooperation used in North Carolina. The City of Raleigh used this organizational model prior to the merger of their system with the Town of Garner for water supply services. Under the provisions of the interlocal agreement, the City of Raleigh agreed to provide the Town of Garner with finished water from the E.M. Johnson Water Treatment Plant. The interlocal agreement stipulated the level of service to be provided, the methods for determining cost of service, and the methods for amending the interlocal agreement.

6.1.2 Joint Agency Model

The joint agency model is authorized by North Carolina General Statute §160A-462: *Joint Agencies.* Under this organizational model, two or more local governments enter into an agreement to create a joint agency for the delivery of services associated with a public enterprise, such as wastewater pumping, conveyance, treatment and disposal facilities. It is important to note that under this organizational model, the legal title to all real property associated with the program must be held by the participating local governments individually, or jointly as tenants in common, and in such proportions as determined by the participating local governments. On an annual basis, each local government must appropriate funds to the joint agency based on an annual budget recommendation prepared by the joint agency personnel. The annual budget recommendation must be submitted to the governing board of each local government for approval. With regard to staffing for the joint agency, North Carolina General Statute § 160A-463: *Personnel*, allows for three options:

1) The participating local governments jointly appoint the officers, agents, and employees necessary to execute the program;

2) The joint agency appoints all personnel required to execute the program, or

3) One of the local governments appoints all personnel required to execute the program, and the services of these personnel shall be contracted for by the other local governments or by the joint agency.

Example Application

The Town of Apex and the Town of Cary are currently using this organizational model for water supply and treatment services. Under the provisions of the interlocal agreement, Apex and Cary have agreed to create a joint agency for the planning, permitting, design, financing, construction, management, operation and maintenance of the Cary/Apex Water Treatment Facility, including raw water intake, pumping station and transmission pipelines. The interlocal agreement stipulates that the Town of Apex owns 23 percent of the facilities and the Town of Cary owns 77 percent of the facilities. The interlocal agreement further stipulates that the parties agree that the Town of Cary will serve as the lead agency for both local governments and be responsible for staffing, operations and maintenance, budgeting, management and administration.

6.2 Special Purpose District/Authority Model

Under this organizational model two or more local governments would work together to create a special purpose district/authority in accordance with North Carolina General Statutes. Once established, the special purpose district/authority would be recognized as a separate and independent political subdivision within the State of North Carolina – having an independent governing body, set of ordinances, schedule of rates, fees and charges, etc.

The members of the governing board for a special purpose district/authority are appointed by the jurisdictions involved in forming the entity. The presiding officer of the governing board is designated the Chair, and the Chair is elected by a majority of the governing board members. A special purpose district/authority has powers similar to a municipality including the right to sue; issue debt; set rates; assess and collect fees and charges ; exercise the right of eminent domain (in accord with applicable laws of North Carolina); and enter into interlocal agreements for services. Two alternatives have been evaluated for the special purpose district/authority organizational model. The first model is the water authority approach, and the second model is the metropolitan water district.

6.2.1 Water Authority

Pursuant to North Carolina General Statute §162A-3: *Procedure for Creation*, the governing body of a single county or the governing bodies of any two or more municipal local governments may organize a water authority. To create the water authority, each participating local government must prepare a resolution signifying their desire to create an authority, and a public hearing must be conducted to receive comments on the proposed resolution and the proposed articles of incorporation.

At the conclusion of the public hearing, certified copies of the resolutions, along with documentation of the public hearing, are to be submitted to the Secretary of State of North Carolina. If the Secretary of State finds that the documentation is in accordance with the requirements of North Carolina General Statute §162A-3: *Procedure for Creation*, then the Secretary of State shall issue a certificate of incorporation under the seal of the State of North Carolina. The certificate of incorporation shall constitute the authority as a public body of the State of North Carolina.

Joining or Withdrawing From an Existing Water Authority

Local governments may join, or withdraw from, an existing authority by preparing a resolution signifying their desire, and conducting a public hearing to receive comments on the proposed resolution. At the conclusion of the public hearing, certified copies of the resolution to join, or withdraw from, along with documentation of the public hearing, are to be submitted to the Secretary of State of North Carolina. If the Secretary of State finds that the documentation is in accordance with the requirements of North Carolina General Statute § 162A-4: *Withdrawal from, or Joining to, an Authority*, then the Secretary of State shall issue a certificate of withdrawal, or a certificate of joinder.

Governing Board Composition

North Carolina General Statutes do not prescribe the makeup and composition of the governing board for a water authority; rather, they simply indicate that the water authority shall consist of the number of members as may be agreed upon by the participating local governments, such members to be selected by the respective local governments.

Water Authority Powers

An authority is generally authorized and empowered to:

- adopt bylaws for the regulation of its affairs and the conduct of its business;
- sue, and be sued, in its own name, plead and be impleaded;
- issue revenue bonds of the authority to pay the costs for acquisition, construction, reconstruction, improvement, extension, enlargement or equipment;

- fix, revise and collect rates, fees and other charges for the use of services and facilities furnished by the authority;
- acquire lands in the name of the authority by exercising the right of eminent domain;
- make and enter into contracts and agreements as necessary for the performance of its duties and the execution of its powers;
- enter into contracts with the government of the United States, any political subdivision, private corporation, association or individual for the acquisition, construction, reconstruction, improvement, extension, enlargement, operation or maintenance of the system;
- receive and accept from any federal, State or other public agency and any private agency, person or other entity, donations, loans, grants, aid or contributions of any money, property, labor or other things of value for any system component;
- enter into contracts with any political subdivision by which the authority shall assume the payment of the principal of, and interest on, indebtedness of such subdivision;
- make special assessments against benefited property within the area served, or to be served, by the authority;
- require the owners of developed property to connect the property to the water and sewer system and fix charges for the connections;
- purchase real or personal property.

Example Application

The Piedmont Triad Regional Water Authority (PTRWA) is an example of this organizational model. The PTRWA was formed in 1986 to provide a safe and dependable water supply for the Piedmont Triad Region through the construction of the 3,000 ± acre Randleman Regional Reservoir and the associated 12 mgd John Franklin Kime Water Treatment Plant. The PTRWA owns and maintains approximately 12 miles of finished water pipelines that vary in size from 18 to 48 inches and are used to deliver finished water to each of its six members: Greensboro, High Point, Randolph County, Archdale, Jamestown, and Randleman. The facility services a population of over 400,000 and has an annual operating budget of approximately $4 million.

A ten-member board, whose members are appointed by the local governments that comprise the authority, governs the PTRWA. The board is responsible for establishing organizational policies, adopting ordinances and setting rates, fees and charges. The chief executive officer for PTRWA is designated the Executive Director. The Executive Director is responsible for directing the activities of the organization to implement the policies and ordinances adopted by the governing board. The composition of the governing board was not prescribed by North Carolina General Statutes, but was mutually agreed upon by the participating local governments. The composition of the governing board is as follows:

- City of Greensboro – 3 members
- City of High Point – 2 members
- Randolph County – 2 members
- City of Archdale – 1 member

- Town of Jamestown – 1 member
- City of Randleman – 1 member

As an independent unit of local government, PTRWA must maintain a full complement of general support services for the operation and administration of the organization, including human resources, finance, purchasing, business information systems, customer service, and legal counsel. The full costs for these general support services are recovered through the schedule of rates, fees and charges.

6.2.2 Metropolitan Water Districts

Any two or more local governments in a county may petition the local board of commissioners for the creation of a metropolitan water district. The petition, along with a resolution from each local government, is to be submitted to the board of commissioners stating the necessity for the creation of the metropolitan water district and requesting the creation. Upon receipt of the petitions and resolutions requesting the creation of a metropolitan water district, the chair of the board of commissioners must notify the North Carolina Environmental Management Commission (EMC) and request that the EMC hold a public hearing with the board of commissioners concerning the creation of a metropolitan water district.

If, after the public hearing, the EMC and the board of commissioners determine that the creation of a metropolitan water district is warranted, the EMC would adopt a resolution creating the entity. The resolution would be distributed to the board of commissioners, as well as to each local government included in the metropolitan water district. The resolution shall constitute the metropolitan water district a public body of the State of North Carolina.

Joining an Existing Metropolitan Water District

A local government may join an existing metropolitan water district by filing a resolution with the district board. If the district board favors the addition of the local government, then the district board shall notify the board of commissioners, and submit a report to the board of commissioners and the EMC detailing the plans to add the local government and expand the service area boundaries of the district.

Upon receipt of the report detailing the plans to add a local government, the chair of the board of commissioners must request the EMC to hold a joint public hearing with the board of commissioners concerning the addition of a local government and the expansion of the service area boundary. If, after the public hearing, the EMC and the board of commissioners determine that the expansion of the service area boundary is warranted, the EMC would adopt a resolution adding the new local government. The resolution would be distributed to the board of commissioners, as well as to each local government included in the district. The resolution shall constitute the metropolitan water district as a public body of the State of North Carolina.

Governing Board Composition

North Carolina General Statutes prescribe the makeup and composition of the governing board for a metropolitan water district. The board of commissioners of the county must appoint to the district board three members who are qualified voters residing within the district. In addition, the governing board of each local government included in the district shall each appoint one member to the district board. However, if any local government within the district has a population greater than that of all other local governments within the district, then the governing body of that local government appoints three members to the governing board.

Metropolitan Water District Powers

Each district shall be authorized and empowered to:

- adopt bylaws for the regulation of its affairs and the conduct of its business not in conflict with this or other law;
- sue and be sued in its own name, plead and be impleaded;
- issue general obligation bonds and revenue bonds of the district to pay for the costs of the water system;
- fix, revise and collect rents, rates, fees and other charges for the use of the services and facilities furnished by the district;
- cause taxes to be levied and collected upon all taxable property within the district sufficient to meet the obligations of the district;
- acquire property by exercising the right of eminent domain;
- make and enter into contracts and agreements as necessary for the performance of its duties and the execution of its powers;
- receive and accept from any federal, State or other public agency and any private agency, person or other entity, donations, loans, grants, aid or contributions of any money, property, labor or other things of value for the water system;
- adopt ordinances to regulate and control the discharge of sewage into the water system;
- require the owners of developed property to connect the property to the water system and fix charges for the connections;
- do all acts and things necessary or convenient to carry out the powers granted by this Article;
- assume all outstanding indebtedness of any local government in the district incurred for water system facilities, subject to approval by a majority of the qualified voters of the district at an election;
- receive advance funds from any local government in the district in connection with the creation of the district and to provide for the preliminary expenses of the district.

Example Application

The only Metropolitan Water District currently active in North Carolina is the Seagrove-Ulah Metro Water District in Randolph County. This system has less than 1,000 metered connections and serves less than 2,300 people. The Seagrove-Ulah Metro Water district obtains all of its water through interconnections with the City of Asheboro, with whom it negotiates a yearly contract for up to 0.5 mgd of treated water.

North Carolina General Statute 162A-64 authorizes the establishment of Metropolitan Sewerage Districts, which have similar powers and authorities to water districts. A longstanding example is the Metropolitan Sewerage District (MSD) of Buncombe County (District). The MSD of Buncombe County was formed in 1962 to address public health issues related to the discharge of raw sewage into the French Broad River

and its tributaries. The District was initially formed to finance, construct, own and operate approximately 19 miles of wastewater conveyance system and a 25 mgd wastewater treatment facility.

An eleven-member board, whose members are appointed by the local governments that comprise the district, governs the MSD of Buncombe County. The board is responsible for establishing organizational policies, adopting ordinances and setting rates, fees and charges. The chief executive officer for the MSD of Buncombe County is designated the General Manager. The General Manager is responsible for directing the activities of the 158-employee organization to implement the policies and ordinances adopted by the governing board. The composition of the governing board is prescribed by the North Carolina General Statutes, and is as follows:

- County of Buncombe – 3 members
- City of Asheville – 3 members
- Town of Biltmore Forest – 1 member
- Town of Black Mountain – 1 member
- Town of Montreat – 1 member
- Town of Weaverville – 1 member
- Woodfin Sanitary Water and Sewer District – 1 member

In 1990, the District executed a series of utility merger agreements to acquire the collections systems for each unit of local government that discharge to the District. The District currently owns and operates approximately 900 miles of collection and conveyance facilities, and a 40 mgd wastewater treatment facility.

As an independent unit of local government, the MSD of Buncombe County must maintain a full complement of general support services for the operation and administration of the organization, including human resources, finance, purchasing, business information systems, customer service, and legal counsel. The full costs for these general support services are recovered through the schedule of rates, fees and charges.

6.3 Application of Organizational Models

In evaluating the application of alternative organizational models for intergovernmental cooperation, the basic issues to address include:

- Who will be the lead agency responsible for service delivery?
- What will be the scope of service delivery?
- What will be the costs for service delivery, and how will costs be allocated?
- What is the schedule for service delivery?

Recognizing that changes in environmental conditions (social, political, financial, regional, and regulatory) will present both challenges and opportunities, there is a need to select an organizational model with sufficient flexibility that would allow for continued efficient and effective service delivery under varying environmental conditions.

6.3.1 Lead Agency Responsible for Service Delivery

Regardless of which organizational model is selected, it is expected that delivery of the regional facilities and services would be provided by a lead agency of some form. The lead agency can be one of the local government participants, a joint agency created by the local governments, or a special purpose

district/authority created by the local governments. Once the lead agency has been designated, each local government would execute an interlocal agreement with the lead agency for the delivery of the facilities and services.

6.3.1.1 Service Delivery by Special Purpose District/Authority

The objective of this organizational model would be to create an organization that would have an independent governing body, staff, set of ordinances, schedule of rates, fees and charges, etc.

With regard to staffing, the special purpose district/authority could either hire independent staff for administration, management, operations and maintenance, or could contract with one of the participating local governments for some, or all, of these services. Once the special purpose district/authority has been established, the participating local governments would execute separate interlocal agreements with the district/authority for the delivery of the facilities and services.

As envisioned, the special purpose district/authority would provide wholesale water service and bill for such services based on each partner's share of system capacity, and the volume of water used within the billing period.

6.3.1.2 Joint Agency

The objective of this organizational model would be to capture the efficiencies available from an existing service delivery organization as opposed to creating a new or independent organization. To establish the joint agency it would be necessary for the participating local governments to prepare an interlocal agreement that, at a minimum, would specify the following:

1) The purpose of the agreement;

2) The duration of the agreement;

3) The composition, organization, nature, and powers conferred on the joint agency;

4) The manner of appointing the personnel necessary to deliver the regional facilities and services;

5) The method of financing the permitting, design, construction, operation, maintenance, management and administration of the regional facilities;

6) The methods to be used for determining the pro-rata proportions allocated to each local government for the total direct and indirect costs associated with the regional facilities;

7) The formula for allocating the ownership of real property associated with the facilities, and the procedures for the disposition of such property when the contract or agreement expires or is terminated;

8) The methods for allowing local governments to withdraw from the joint agency, as well as methods to allow additional local governments to join the joint agency;

9) The methods for amending the agreement; and

10) The methods for terminating the agreement.

6.3.2 Scope of Service Delivery

It is anticipated that each local government would continue to own, operate, and maintain its existing water infrastructure facilities, to expand and control its water system, and be responsible for all activities related to water and sewer billing, revenue collection, management, administration and customer service. For example, it is not anticipated that the local governments will implement an organizational model for intergovernmental cooperation that would result in transferring responsibility for any existing infrastructure, such as the Jones Ferry Road WTP or Pittsboro WTP.

As envisioned, the scope of the facilities and services that would be subject to intergovernmental cooperation would include:

- The regional raw water intake and raw water pump station;
- The regional water treatment facility; and
- The finished water pump station and shared finished water transmission mains.

The interface between the existing facilities to be retained by each local government and the new facilities to be provided through intergovernmental cooperation would be as defined by each partner, be a point outside the water treatment facility where the finished water piping is no longer shared. Accordingly, each local government would be responsible for permitting, planning, financing, designing and constructing all facilities required to deliver water into their respective water distribution systems.

The scope of service delivery is anticipated to be divided into multiple phases, and be designed to provide "off-ramps" or exit points for each partner that would not result in a derailment of the overall implementation process.

6.3.3 Costs for Service Delivery

It is anticipated that each local government (including water and sewer authorities) will continue to operate an enterprise fund for its respective water and sewer utility. As such, each local government would continue to adopt a balanced water and sewer utility budget on an annual basis; and the budget would be prepared to demonstrate that forecasted operating revenues are equal to, or exceed, forecasted operating expenditures. It is further anticipated that each local government would continue to maintain an independent schedule of rates, fees and charges, and that the schedule would be designed to fully recover the total direct and indirect costs associated with providing water and sewer services for the local government's service area, including its share of the capital and operating costs for the Jordan Lake regional water supply facilities.

Consistent with the scope of service delivery, the costs for service delivery would be segregated into phases. It is anticipated that the local governments would use revenues from their water and sewer enterprise funds to contribute their pro-rata proportions of the costs for capital facilities constructed and the level of service received. It would be the responsibility of the lead agency to provide timely and accurate revenue requirement forecasts to each local government for costs related to the management, administration, operations and maintenance of the regional water withdrawal, treatment, and transmission facilities. The local governments would integrate this information into their respective budget planning processes for their water and sewer enterprise funds. Each local government would be responsible for adjusting their individual schedule of rates, fees and charges as necessary to support the revenue requirements of their water and sewer enterprise funds, including their obligations to the regional partnership.

On an annual basis, the lead agency would present an operating budget to the local governments for the total direct and indirect costs required for the management, administration, operations and maintenance of the regional wastewater management facilities.

6.3.4 Schedule for Service Delivery

Based on current water demand projections, it is anticipated the regional facilities would be needed early in the next decade. The recent Triangle Regional Water Supply Plan Volume II (TJCOG, 2014) indicates the WIPs will need to begin accessing their allocations from Jordan Lake by the year 2020.

There is not a specific proposed date for completion and start-up of the regional facilities; however, the schedule anticipates that at least 87 months would be required for project planning, permitting, preliminary engineering design, final design, and construction. Based on that, if it was determined that if the facilities need to be placed in service by mid-2021 to meet the projected demands of one or more partners, water quality assessment and preliminary engineering design would need to begin in the summer of 2014. If the partners desire to evaluate additional sites for regional water treatment facilities, then the schedule would need to be extended to accommodate that evaluation and subsequent purchase actions.

The schedule likely understates the time that will be required to discuss, negotiate, and execute inter-local agreements relating to the authorization and funding of subsequent phases of this regional effort, such as preliminary and final engineering and design, environmental assessment, bidding, and construction. To ensure that they can meet their respective water demands, the partners will likely need to implement interim arrangements to access their respective Jordan Lake allocations between now and the time that new regional facilities on the west side of Jordan Lake can be designed, built, and placed in service.

The complexity of organizational issues that the partners must deal with include differing levels of water supply capacity, water supply risk levels, financial capacity, need for upgrades/expansions to existing water supply, treatment, and distribution systems, and so on. This complexity will present substantial challenges—and require a significant time commitment—to arrive at a suitable agreement that aligns the partners' individual needs with the project's organizational and implementation requirements. In consideration thereof, the partners should consider interim interlocal agreements and related infrastructure improvements as a bridge between near- and long-term planning. A primary information source for planning interim arrangements will be the Phase 2 Potable Water Interconnection Study–Hydraulic Modeling, which is currently in progress for the Jordan Lake Partnership (JLP) and scheduled to be completed in 2015. The JLP, including members of the WIP, commissioned Hazen and Sawyer to complete this study in order to develop a regional approach for planning potable water interconnections that could increase the reliability and sustainability of drinking water sources and infrastructure by allowing the Partners to use their water resources cooperatively and thus defer construction of new facilities (on Jordan Lake or elsewhere).

Recognizing this complexity, one approach for advancing the regional project would be for one partner to take the lead in financing and arranging for the next phase of project engineering and design services, with the understanding that other partners would participate in the review process and would reimburse the lead partner for a proportionate share of the expenses incurred at such time as they formally decide to become a partner in the regional facilities.

6.4 Partnership Structure Comparison

As illustrated with the examples provided above, each of the organizational models presented herein have been used for water supply projects and are potentially viable for implementation, operation, and management of the Jordan Lake west regional intake, treatment, and major transmission facilities and

services. In an effort to aid decision-making by the Partners, the following **Table 6-1** highlights some of the important characteristics of the two primary frameworks presented, i.e. the Interlocal Agreement (ILA) and District/Authority frameworks.

Table 6-1: Institutional Framework Organizational Model Comparison

	Interlocal Agreement (ILA)	Special Purpose District/Authority
Flexibility	• Can be customized to any organization and financial structure, except as required or prohibited by law • Major decisions can be delegated to one partner in advance, or can be reserved for contemporaneous approval • Can be amended as needed, with the agreement of the partners	• As prescribed by statute
Efficiency and Administrative Costs	• The Partners can make choices to limit the administrative costs for operations, such as allowing one of the partners to operate all facilities within its existing organization • The Partners can create incentives for efficient administration, if desired, or can agree to limit their respective outlay for overhead costs	• Creates an additional local governmental agency, which may require additional personnel, an additional board, additional professional services, etc. • Requires State approval • Requires public hearing
Independence	• Generally as defined by the agreement	• High degree of independence because it would be responsible to its own board, not directly to the Partners • The new agency would be allowed to make final decisions without seeking approvals from the Partners
Authority	• Generally as defined by the agreement • Individual Partners may authorize a lead partner to acquire property rights or perform other functions	• Broad powers as allowed by statute, including the power of eminent domain in the name of the new agency • Ability of OWASA to join a district or authority may require legal counsel review
Experience	• Relatively common in North Carolina in a variety of contexts • All Partners currently have experience with these types of agreements	• Less common: 13 Authorities (including OWASA), and 4 Special Purpose Districts in the State of NC

Based on our experience with other institutional frameworks for regional collaboration involving multiple water systems, Hazen and Sawyer believes the interlocal agreement model may be the most appropriate for the WIP to facilitate implementation, operation, and management of the Jordan Lake west regional intake, treatment, and major transmission facilities and services. Such an approach would likely be simpler to implement and support, while still being capable of ensuring that the needs of all project partners can be met in an equitable and timely manner. ILAs have been used successfully for several similar projects in the Triangle region, including Cary and Apex's ILA for the existing regional intake and treatment facilities on the east side of Jordan Lake.

7.0 Conclusions and Recommendations

7.1 Conclusions

1. Of the three Jordan Lake water supply alternatives that have been developed and evaluated collaboratively with the WIP to meet the individual partner and group water supply needs, Alternative 1 - Regional Water Treatment Facility appears to be the overall optimal alternative to be carried forward for facilities planning and potential implementation.

2. As summarized in **Table 7-1**, Alternative 1 has the lowest capital as well as life cycle costs, followed by Alternative 2 - South Durham and Jordan Lake Water Treatment Facilities. Alternative 3 - Raw Water Only Facilities has the highest overall costs.

3. Alternative 1 is also estimated to provide the overall optimum use of resources and have the lowest environmental impacts. It is thus expected to be the easiest alternative to implement. Although the present study involved only conceptual design and did not include a detailed estimate of environmental impacts, a single RWTF at Jordan Lake tends to minimize environmental impacts. As noted in **Table 7-1**, Alternative 1 is estimated to have the lowest wetland and stream impacts. This is largely because this alternative has the lowest overall linear footage of water pipeline. An added advantage is that it maximizes the footage of finished water main and thus the potential for water sales along the pipeline routes.

4. At this conceptual level of study, cost estimates were prepared based on planning-level conceptual designs, desktop site evaluations, and simplifying assumptions. The processes assumed for the WTF assume advanced treatment processes that address multiple water quality concerns, and should be further evaluated following a site specific water quality monitoring study. No physical site evaluations or surveys were performed. Final costs of the project will depend on the concepts that are carried forward and developed during final design, and a wide range of factors to be determined during the design process.

5. The DWR and the USACE expect regional participation in any Jordan Lake water supply project and are likely to approve only one more municipal water supply intake on Jordan Lake. With the existing Cary-Apex located on the east side of the lake, the new intake would logically be located at a site on the western shores of the lake to serve communities on the west side.

6. This study assumes the development of a regional water intake at a location north of the Vista Point and use of OWASA's property at Jordan Lake for construction of either a RWTF or a smaller facility to serve Chatham County and Pittsboro. In future studies the WIP may wish to consider alternative locations for the intake and/or RWTF.

7. Report Section 4 reviews a number of Other Project Considerations. Of these, evaluation of source water quality, with a focus on evaluations related to the configuration of the selected regional intake location, is judged to merit consideration for further study in the near term.

8. Report Section 5 includes a number of project implementation items that merit considerations for action by the WIP.

9. As discussed in Section 6, there are a number of institutional models under which the WIP could organize to collaboratively develop the Jordan Lake Regional Water Supply Project.

10. Based on our experience with other institutional frameworks for regional collaboration involving multiple water systems, Hazen and Sawyer believes the interlocal agreement model may be the most appropriate for the WIP to facilitate implementation, operation, and management of the Jordan Lake west regional intake, treatment, and major transmission facilities and services. Such an approach would likely be simpler to implement and support, while still being capable of ensuring that the needs of all project partners can be met in an equitable and timely manner.

11. The local governments should begin the process of obtaining governing board approval to proceed with additional work on the western intake and/or RWTF.

12. In advance of construction for the first phase of facilities, it will be necessary for the lead WIP agency to complete a number of activities, including preliminary engineering and design, land acquisition, environmental permitting, and final design.

Table 7-1: Alternatives Comparison

Alternative	Capital Costs (2014 Million $)			Total Life Cycle Costs (2014 Million $)	Total Pipeline Length (ft)	Relative Wetland and Stream Impacts
	Initial Facilities	Ultimate Facilities	Total			
Alternative 1 – Regional Water Treatment Facility	$243.3	$73.5	$316.8	$694.3	~151,000	Lowest
Alternative 2 – South Durham and Jordan Lake Water Treatment Facilities	$296.6	$75.4	$345.0	$752.4	~200,000	Greater than Alt 1
Alternative 3 – Raw Water Only Facilities	$340.6	$71.0	$411.6	$1050.2	~271,000	Greatest

7.2 Recommendations

1. Based on the foregoing, Hazen and Sawyer recommends that the WIP select Alternative 1 - RWTF as the preferred alternative for planning for the potential collaborative development of a regional Jordan Lake Supply. This recommendation was presented to and concurred with by technical staff of the WIPs at meetings held on May 9, 2014, and June 27, 2014.

2. Hazen and Sawyer has developed a list of anticipated permits, a draft schedule, and a cost-loaded schedule for the RWTF to assist the WIPs with continued discussions and planning efforts as they work to develop a shared intake and related facilities at Jordan Lake. Several actions are recommended to be completed by the WIPs in the following weeks and months to align with the draft project schedule presented. These include the following:

   - Present the study and findings to each local government's Board;

- Initiate a water quality monitoring study for the intake site on Jordan Lake to establish a baseline and continue to advance the project schedule;
- Obtain approval of the governing Boards to proceed with additional work, including the interlocal agreement(s) necessary to initiate policy planning, preliminary engineering and design, and related consulting services;
- Establish a Technical Advisory Committee (TAC) to guide the technical aspects of the Regional Facilities Preliminary Engineering and Design Process; and,
- Form a Policy Advisory Committee (PAC) to review and provide guidance to the TAC.

3. In light of current and potential water quality conditions at Jordan Lake, it is recommended that future drinking water treatment facilities using water from Jordan Lake include advanced treatment processes to address taste and odor challenges, disinfection by-product formation, algal toxins, and other issues. Therefore, the cost estimates in this report assume that drinking water treatment facilities receiving water from Jordan Lake would include the following minimum processes: conventional treatment processes plus ozone and ultraviolet light disinfection and granular activated carbon treatment. Alternative 3 (which includes delivery of raw water to Durham's and OWASA's existing water treatment plants) includes estimated costs for construction and operation of major process improvements at those two existing facilities.

8.0 References

CH2MHill, “Water Intake Site Investigation B Everett Jordan Lake”, prepared for the Orange Water and Sewer Authority, Carrboro, North Carolina, 1991

City of Durham, “Draft Jordan Lake Water Supply Storage Allocation - Round 4 Level I Allocation Request”, prepared for NCDWR, 2014

Hazen and Sawyer, “Technical Memorandum Appendix VII, Option 3: Develop Jordan Lake in Partnership with Others”, prepared for the Orange Water and Sewer Authority, Carrboro North Carolina, 2010, http://www.owasa.org/Data/Sites/1/media/whatwedo/appendix%20vii.pdf

Triangle J Council of Governments, “Triangle Regional Water Supply Plan Volume I – Regional Needs Assessment”, prepared for the Jordan Lake Partnership, 2012

Triangle J Council of Governments, “Triangle Regional Water Supply Plan Volume II – Regional Water Supply Alternatives Analysis”, prepared for the Jordan Lake Partnership, 2014

Appendix A: Regional Water Treatment Facilities - Detailed Cost Summary

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Regional Water Treatment Facilities
Summary Data

Final

Partner	Pressure Zone (ft)	Existing Jordan Lake Allocations	Initial Basis for Initial WTP Production					Interim Basis for Initial WTP Capacity					Ultimate Basis for Ultimate WTP Capacity					Summary of Conceptual-Level Cost Estimates						
																		Capital Costs (2014 Million $)				Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs per 1,000 gallons (2014 $)	
																		Year Financed		Total	Total Per MGD Ultimate Capacity			
			Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% of Total Capacity	Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% of Total Capacity	Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% of Total Capacity	Initial	Interim				Usage	Level 1 Allocation Purchased
Chatham Co.	740	6	18	3.0	1.5	5	21.7%	18	6.5	1.5	10.0	30.3%	18	10.5	1.5	16.0	29.6%	$65.9 M	$21.4 M	$87.3 M	$5.5 M	$183.4 M	$1.7	$0.6
Durham Comp.*	568 / 840	11	18.5	17.5	--	18	78.3%	18.5	17.5	--	18.0	54.5%	18.5	18.5	--	24.0	44.4%	$132.9 M	$20.5 M	$153.4 M	$6.4 M	$418.7 M	$1.5	$1.4
Durham	568	10	16.5	16.5	1	17	73.9%	16.5	16.5	1	17.0	51.5%	16.5	16.5	1.25	21.0	38.9%	$120.1 M	$12.8 M	$132.9 M	$6.3 M	$388.2 M	$1.5	$1.5
Orange Co.	840	1	2	1.0	1	1	4.3%	2	1.0	1	1.0	3.0%	2	2.0	1.5	3.0	5.6%	$12.8 M	$7.7 M	$20.5 M	$6.8 M	$30.5 M	$1.5	$1.0
OWASA	642	5	5	0.0	1	0	0.0%	5	2.0	1	2.0	6.1%	5	5.0	1	5.0	9.3%	$15.0 M	$9.6 M	$24.6 M	$4.9 M	$31.0 M	$4.1	$0.4
Pittsboro	565	0	6	0.0	0	0	0.0%	6	2.0	1.5	3.0	9.1%	6	6.0	1.5	9.0	16.7%	$29.5 M	$22.0 M	$51.5 M	$5.7 M	$61.3 M	$1.5	$0.7
Total	--		**47.5**	20.5	--	**23**	**100%**	**47.5**	28.0	--	**33.0**	**100%**	**47.5**	40.0	--	**54.0**	**100%**	**$243.3 M**	**$73.5 M**	**$316.8 M**	**$5.9 M**	**$694.3 M**		

*Durham Comp. represents composite costs for Durham and Orange County since Durham will be supplying Orange County with finished water under all project alternatives.

Water Facilities Cost Share Distribution

Partner	Shared Facilities							Separate Facilities						
	Intake & Pipelines	RWPS		WTP/PS		Shared FW Main		Chatham	Durham	OWASA	Orange	Pittsboro		H'boro
		Initial	Expansion	Initial	Expansion	Seg. 1	Seg. 2	BPS	BPS	BPS	BPS	FW Main	BPS	--
Capacity (mgd):	**54**	**33**	**(+21) 54**	**33**	**(+21) 54**	**69**	**29**	**1/1**	**--**	**--**	**1/3**	**9**	**3/9**	**--**
Chatham County N	29.6%	30.3%	28.6%	30.3%	28.6%	35.6%	0.0%	100%	--	--	--	--	--	--
Durham	38.9%	51.5%	19.0%	51.5%	19.0%	46.7%	72.4%	--	N/A	--	--	--	--	--
OWASA	9.3%	6.1%	14.3%	6.1%	14.3%	11.1%	17.2%	--	--	--	--	--	--	--
Orange County	5.6%	3.0%	9.5%	3.0%	9.5%	6.7%	10.3%	--	--	--	100.0%	--	--	--
Pittsboro	16.7%	9.1%	28.6%	9.1%	28.6%	0.0%	0.0%	--	--	--	--	100.0%	100.0%	--
Hillsborough	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	--	--	--	--	--	--
TOTAL:	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	--	--	--	--	--	--	--

(1) Includes capital costs for a new Jordan Lake Western intake, raw water transmission facilities, a new water treatment plant (WTP), and related shared and separate finished water pumping and transmission lines. Also, where applicable, costs are included for purchase of land/easements, environmental mitigation, and water storage allocations. All costs are in constant year 2014 dollars and include costs for construction, contractor profit and overhead, engineering, legal and permitting expenses, and an overall 25% contingency. Consistent with the preliminary project schedule, capital funding for the initial facilities (see note 2 below) is assumed to occur in year 2018 and construction is assumed to be completed in year 2021.

(2) The Western Jordan Lake intake and all pipelines are sized to meet ultimate (year 2060) maximum day demands. Capital cost for each partner is calculated as a direct ratio of the partner's ultimate capacity to total ultimate facility capacity. The WTP and shared pumping facilities are assumed to be constructed in phases, with initial sizing to meet interim (year 2040) demands. For these facilities, capital cost for each partner is calculated as a direct ratio of the partner's interim capacity to total interim facility capacity.

(3) Facility expansion is based on the ultimate capacity in year 2060. Financing is assumed to occur in 2035 and construction completion in 2040. Capital cost for each partner is calculated as a direct ratio of the partner's incremental increase in capacity from year 2040 to year 2060 to the total increase in facility capacity.

(4) All capital and life-cycle costs are in 2014 dollars.

(5) The present analysis assumes that each partner will maintain/obtain a Level I Allocation. No costs are included for Level II Allocations.

Jordan Lake Joint Development – Regional Water Treatment Facilities
SUMMARY of VARIABLES

Description	Value	Units	Notes
General			
Current ENR CCI:	9795.92		May 2014
Project Cost Start Date:	2010		
Project Cost Begin Capital Finance:	2015		
Project Cost Complete Initial Construction:	2020		
Project Cost Complete Expansion:	2040		
Project Cost End Date:	2060		
Project Cost Lifespan:	50	years	

Calculation of Capital Costs

Updated EPA cost curves (2010, ENR CCI 8802) for Water Treatment Facilities
Includes ozone, UV, GAC, & residuals.
Does not Include Land, Contractor Profit & Overhead, engineering, legal costs, or contingencies
Add 10% for provisions for plant expansion
Add 20% for expansion phasing

	Capacity	Construction
Cost = a*(Q+1)^b	(mgd)	Cost (2010 $)
R^2 = 0.99958	42	$82,645,000
a = 3097698.29	62	$114,109,000
b = 0.8446521286	+20	$31,464,000

Contractor Mobilization, Overhead, and Profit:	15%		
Contingency:	25%		
Raw and Finished Water Main - Rural:	$9.00	per inch-diameter/ft	2011 Western Wake BCFM - 26,000 lf 42-inch, 26,000 lf 36-inch. Project Cost $14 Million
Raw and Finished Water Main - Urban:	$15.00	per inch-diameter/ft	BCFMs were constructed in a similar corridor to the WIP pipelines.

Calculate cost per inch diameter =

	Diameter	Length	Cost (M$)	$/per inch c	2014 Cost	Escalate 20% to remove efficiency as pipes shared same corridor
Pipe 1	42	26000				
Pipe 2	36	26000				
TOTAL	39	52000	$14	$6.90	$7.65	$9.18

Calculation of Life Cycle Costs

General Conditions

Discount Rate:	1.295%			
Initial Construction Year:	2018	2019	2020	2021
Capital financing incurred as % of Total	30%	60%	90%	100%

Capital /Rehabilitation and Replacement Costs

Issuing Expense:	0.0%	
Capital Recovery Interest Rate:	3.225%	
Financing Term (Years):	25	years
Equipment Lifespan:	25	years
Pipelines/Structures Lifespan:	50	years
Equipment Replacement as % of Total Construction Cost:	15%	
Number of Years Replacement Equipment Defrayed Over:	5	years
Cost multiplier for shared pumping facilities w/ high-low head pumps:	1.2	not used
Cost multiplier for WTPs with shared high-low head pumping facilities:	1.02	not used

Urban Cos Assume takes twice as long to construct are rural. Crew cost for BCFM was $3 Million

$1.97	Crew cost ~$2 per inch diameter per LF
$11.15	Revised Total
$14.65	Add $3.5 per inch diameter per LF for additional borings
$15.00	Round up

NOTE: Pipeline unit costs include 15% contractor overhead and profit. This 15% is removed for each partner.

Operation and Maintenance Costs

Annual O&M Costs as Percent of Construction Costs:	10%	
Fixed O&M Costs as % of Total O&M Costs:	70%	
Variable O&M Costs as % of Total O&M Costs:	30%	
Variable O&M Cost Constant (mgd, 70% eff, Kw-hr/yr):	2,195	
Energy Cost:	$0.092	per kW-hr electrical energy

Level I Allocation Costs

Total Purchase Cost:	$91,040.76	per mgd
Annual Cost for Subsequent Years:	$2,218.85	per mgd/yr
Additional Fixed Administration Cost (annual):	$250	

Level II Allocation Costs

Total Annual Cost :	$2,218.85	per mgd/yr
Additional Fixed Administration Cost (annual):	$250	

USACE Easement Acquisition

Easement for Intake and RW Main	2.1	Acres
Estimated lump sum cost	$200,000	

WTP Site Land Acquisition

OWASA WTP Site Acreage	125	acres
Cost per Acre	$10,000	per acre
WTP Site EL:	332	ft
Jordan Lake NP EL:	216	ft

Pipeline Sizing

Partner (s) Served	% Share of Pipeline, Capacity & Characteristics					Fin P.	WTP Share (mgd)	Diam (inch) V = 6
	Raw	Fin. G1	Fin G2	G1 & G2	Fin_Ch.			
Chatham Co.	30%	36%	0%	x	100%	--	16.0	30
Durham Comp.								
Durham	39%	47%	72%	x	--	--	21.0	36
Orange Co.	6%	7%	10%	x	--	--	3.0	12
OWASA	9%	11%	17%	x	--	--	5.0	16
Pittsboro	17%	0%	0%	--	--	100%	9.0	24
Hillsboro	0%	0%	0%					
Total:	100%	100%	100%	--	100%	100%		
Design Peak Pumping Capacity (mgd)	54	45	29	45, 29	16	9		
Design Pipeline Velocity (ft/s):	6	5	5	5, 5	6	6		
Calculated Pipeline Diam. (inches):	54	54	42	54, 42	30	24		
Length (ft):	3,000	48,800	62,905	111,705	--	31,552		
Calculated Velocity (ft/s):	5.3	4.4	4.7	4.4, 4.7	5.0	4.4		
Pipeline head Loss (C=120) for use in calculating variable operating costs								
HL in Year 2020 @ Avg Pumped Flow (ft):	0.8	40.9	42.6	83.5	--	0.0		
HL in Year 2040 @ Avg Pumped Flow (ft):	1.4	52.5	52.1	104.5	--	5.9		
HL in Year 2060 @ Avg Pumped Flow (ft):	2.8	74.3	73.5	147.8	--	44.9		

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Regional Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for

Chatham County

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	6	18	18	18	--
Chatham County Capacity (equal to maximum day demand, mgd):	--	5.0	10.0	16.0	--
Average Water Use:	--	3.0	6.5	10.5	--
WTP Design Capacity (mgd):	--	33	54	54	49
WTP Expansion Increment (mgd):	--	--	21	--	--
Chatham County Share of WTP Capacity (mgd):	--	10.0	6.0 inc.	16.0	16.0
% Total Capacity & Fixed Operating Cost Share:	--	30.3%	28.6%	29.6%	32.7%
% Avg. Plant Production & Variable Operating Cost Share:	--	14.6%	23.2%	26.3%	--
% Share of Common Finished Water Main, Section 1:	--	--	--	35.6%	--
% Share of Common Finished Water Main, Section 2:	--	--	--	0.0%	--
Friction Head Applied to Variable Operating Costs (ft):	--	84	106	151	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	508	530	575	--
Chatham County Pressure Zone (ft):		**740**			

	CAPITAL COSTS (2014 Dollars)								Allocated to Chatham County		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	29.6%	$2,815,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	29.6%	$1,700,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	29.6%	$830,000	
3	**Raw Water Pump Station (Shared)**										
	Interim Capacity	33	mgd		1	LS	$8,260,000	$8,260,000	30.3%	$2,503,000	
	Ultimate Capacity	54	mgd		1	LS	$4,020,000	$4,020,000	28.6%		$1,149,000
4	**Jordan Lake Regional WTP (Shared, includes High Service PS, TDH = 100 ft)**										
	Interim Capacity	33	mgd		1	LS	$64,828,000	$64,828,000	30.3%	$19,645,000	
	Ultimate Capacity	54	mgd		1	LS	$35,445,000	$35,445,000	28.6%		$10,127,000
5	**Shared Finished Water Transmission Pipeline**										
	Northern Segment No. 1 - Rural			54 in	48,800	LF	$423	$20,623,304	35.6%	$7,333,000	
6	**Finished Water Booster Station (Chatham County)**										
	Interim Capacity	10	mgd		1	LS	$2,960,000	$2,960,000	100.0%	$2,960,000	
	Ultimate Capacity	16	mgd		1	LS	$1,352,727	$1,352,727	100.0%		$1,353,000
7							**CONSTRUCTION COST SUBTOTAL**			**$37,790,000**	**$12,630,000**
	CAPITAL COST ALLOWANCES										
8							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 7)**		15%	$5,669,000	$1,895,000
9							**TOTAL CONSTRUCTION COST**			**$43,459,000**	**$14,525,000**
10	**ENGINEERING COST ALLOWANCES**						**Engineering - Policy Planning (@ 0.5% x Line 7)**		0.50%	$189,000	$63,000
11							**Engineering - Preliminary Engineering(@ 1.0% x Line 7)**		1.00%	$378,000	$126,000
12							**Engineering - Field Work (@ 1.0% x Line 7)**		1.00%	$378,000	$126,000
13							**Engineering - Permitting (@ 0.5% x Line 7)**		0.50%	$189,000	$63,000
14							**Engineering - Design (@ 8.0% x Line 7)**		8.00%	$3,023,000	$1,010,000
15							**Engineering - Construction Administration (@ 6.8% x Line 7)**		6.75%	$2,551,000	$853,000
16							**Misc. Administration, Legal Fees, Permits, Approvals, & Other (@ 3.0% x Line 7)**		3.00%	$1,134,000	$379,000
17							**ENGINEERING SUBTOTAL**			**$7,842,000**	**$2,620,000**
18	**LAND ACQUISITIONS AND EASEMENTS**	OWASA WTP Site			125	Acre	$10,000	$1,250,000	32.7%	$408,000	
19		USACE Jordan Lake Easement			1	LS	$200,000	$200,000	29.6%	$59,000	
20		Allowance for Additional Land/Easement			1	LS	$50,000	$50,000	100.0%	$50,000	
21		Mitigation Costs for Stream Impacts			101	LF	$374	$37,599	100.0%	$38,000	
22		Mitigation Costs for Wetlands Impacts			0.32	Acre	$68,502	$22,164	100.0%	$22,000	
22							**LAND ACQUISTIONS AND EASEMENTS SUBTOTAL**	**$1,559,764**		**$577,000**	**$0**
23	**CONTINGENCY**						**Contingency (@ 25% (Line 9+Line 17+Line 23))**		25%	$12,970,000	$4,286,000
24							**ESTIMATED PROJECT CAPITAL COST:**			**$64,848,000**	**$21,431,000**
25										**$86,279,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
26	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	12	mgd	$91,041	$1,092,489	100.0%	$1,093,000	
27	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
28	Additional Fixed Administration Cost (annual)				1	LS	$250				
29							**Subtotal Allocation Capital Costs:**			**$1,093,000**	**$0**
30							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$65,900,000**	**$21,400,000**
31										**$87,300,000**	
32							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$183,400,000**	
33							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.72**	
34							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.65**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Chatham County

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 74%

Year and Water Usage					Actual (Inflated) Dollars								2014 Dollars	
						Other Capital / Fixed Costs			O&M Costs		Total Annual Costs			
			Water Quantity (mgd)										Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Engineering, Legal & OWASA Land	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0					$281,000					$281,000	$281,000		
2	1					$887,000					$887,000	$876,000		
3	2					$1,922,000					$1,922,000	$1,873,000		
4	3					$2,643,000					$2,643,000	$2,543,000		
5	4				$1,001,000	$1,217,000					$2,218,000	$2,107,000		
6	5				$2,002,000	$1,262,000					$3,264,000	$3,061,000		
7	6		18	3.00	$3,004,000	$1,265,000		$1,195,000	$1,098,000	$559,000	$7,121,000	$6,592,000	$2.64	$15.83
8	7		18	3.18	$3,337,000	$835,000		$44,000	$1,112,000	$585,000	$5,913,000	$5,404,000	$1.73	$10.09
9	8	33	18	3.35	$3,337,000			$45,000	$1,127,000	$613,000	$5,122,000	$4,621,000	$1.39	$7.87
10	9	33	18	3.53	$3,337,000			$45,000	$1,141,000	$641,000	$5,164,000	$4,599,000	$1.22	$6.71
11	10	33	18	3.70	$3,337,000			$46,000	$1,156,000	$670,000	$5,209,000	$4,580,000	$1.11	$5.98
12	11	33	18	3.88	$3,337,000			$46,000	$1,171,000	$699,000	$5,253,000	$4,560,000	$1.04	$5.46
13	12	33	18	4.05	$3,337,000			$47,000	$1,186,000	$729,000	$5,299,000	$4,541,000	$0.99	$5.07
14	13	33	18	4.23	$3,337,000			$47,000	$1,202,000	$759,000	$5,345,000	$4,522,000	$0.95	$4.76
15	14	33	18	4.40	$3,337,000			$48,000	$1,217,000	$791,000	$5,393,000	$4,504,000	$0.92	$4.50
16	15	33	18	4.58	$3,337,000			$49,000	$1,233,000	$823,000	$5,442,000	$4,487,000	$0.90	$4.28
17	16	33	18	4.75	$3,337,000			$49,000	$1,249,000	$855,000	$5,490,000	$4,469,000	$0.88	$4.09
18	17	33	18	4.93	$3,337,000			$50,000	$1,265,000	$889,000	$5,541,000	$4,452,000	$0.86	$3.92
19	18	33	18	5.10	$3,337,000			$51,000	$1,281,000	$923,000	$5,592,000	$4,436,000	$0.85	$3.77
20	19	33	18	5.28	$3,337,000			$51,000	$1,298,000	$957,000	$5,643,000	$4,419,000	$0.84	$3.64
21	20	33	18	5.45	$3,337,000			$52,000	$1,315,000	$993,000	$5,697,000	$4,404,000	$0.83	$3.52
22	21	33	18	5.63	$3,337,000			$53,000	$1,332,000	$1,029,000	$5,751,000	$4,389,000	$0.82	$3.40
23	22	33	18	5.80	$3,337,000			$53,000	$1,349,000	$1,066,000	$5,805,000	$4,374,000	$0.81	$3.30
24	23	33	18	5.98	$3,337,000			$54,000	$1,367,000	$1,104,000	$5,862,000	$4,360,000	$0.80	$3.20
25	24	33	18	6.15	$5,033,000			$55,000	$1,384,000	$1,143,000	$7,615,000	$5,592,000	$0.80	$3.15
26	25	33	18	6.33	$5,033,000			$55,000	$1,402,000	$1,182,000	$7,672,000	$5,562,000	$0.80	$3.10
27	26	33	18	6.50	$5,033,000			$56,000	$1,420,000	$1,223,000	$7,732,000	$5,534,000	$0.81	$3.05
28	27	33	18	6.7	$5,033,000			$57,000	$1,439,000	$1,267,000	$7,796,000	$5,508,000	$0.81	$3.00
29	28	54	18	6.9	$5,033,000			$58,000	$1,457,000	$1,313,000	$7,861,000	$5,483,000	$0.81	$2.95
30	29	54	18	7.1	$1,696,000			$58,000	$1,476,000	$1,360,000	$4,590,000	$3,161,000	$0.79	$2.85
31	30	54	18	7.3	$1,696,000			$59,000	$1,495,000	$1,408,000	$4,658,000	$3,166,000	$0.78	$2.75
32	31	54	18	7.5	$1,696,000		$2,899,000	$60,000	$1,515,000	$1,456,000	$7,626,000	$5,118,000	$0.78	$2.71
33	32	54	18	7.7	$1,696,000		$2,937,000	$61,000	$1,534,000	$1,506,000	$7,734,000	$5,124,000	$0.78	$2.66
34	33	54	18	7.9	$1,696,000		$2,975,000	$61,000	$1,554,000	$1,557,000	$7,843,000	$5,130,000	$0.78	$2.61
35	34	54	18	8.1	$1,696,000		$3,013,000	$62,000	$1,574,000	$1,609,000	$7,954,000	$5,136,000	$0.78	$2.57
36	35	54	18	8.3	$1,696,000		$3,052,000	$63,000	$1,595,000	$1,662,000	$8,068,000	$5,143,000	$0.78	$2.52
37	36	54	18	8.5	$1,696,000			$64,000	$1,615,000	$1,716,000	$5,091,000	$3,204,000	$0.77	$2.45
38	37	54	18	8.7	$1,696,000			$65,000	$1,636,000	$1,771,000	$5,168,000	$3,210,000	$0.76	$2.38
39	38	54	18	8.9	$1,696,000			$65,000	$1,658,000	$1,827,000	$5,246,000	$3,217,000	$0.76	$2.32
40	39	54	18	9.1	$1,696,000			$66,000	$1,679,000	$1,884,000	$5,325,000	$3,224,000	$0.75	$2.26
41	40	54	18	9.3	$1,696,000			$67,000	$1,701,000	$1,943,000	$5,407,000	$3,232,000	$0.74	$2.20
42	41	54	18	9.5	$1,696,000			$68,000	$1,723,000	$2,003,000	$5,490,000	$3,239,000	$0.73	$2.15
43	42	54	18	9.7	$1,696,000			$69,000	$1,745,000	$2,064,000	$5,574,000	$3,247,000	$0.73	$2.10
44	43	54	18	9.9	$1,696,000			$70,000	$1,768,000	$2,126,000	$5,660,000	$3,255,000	$0.72	$2.05
45	44	54	18	10.1	$1,696,000			$71,000	$1,791,000	$2,190,000	$5,748,000	$3,263,000	$0.71	$2.00
46	45	54	18	10.3	$1,696,000			$72,000	$1,814,000	$2,255,000	$5,837,000	$3,271,000	$0.71	$1.96
47	46	54	18	10.5	$1,696,000			$72,000	$1,837,000	$2,321,000	$5,926,000	$3,279,000	$0.70	$1.91
48	47	54	18	10.5	$1,696,000			$73,000	$1,861,000	$2,351,000	$5,981,000	$3,267,000	$0.70	$1.87
49	48	54	18	10.5	$1,696,000		-$23,843,947	$74,000	$1,885,000	$2,381,000	-$17,808,000	-$9,603,000	$0.65	$1.72
Totals:	--	--	--	**292.8**	**$121,821,000**	**$10,312,000**	**-$8,967,947**	**$3,626,000**	**$62,657,000**	**$58,203,000**	**$247,651,000**	**$183,416,000**	**$0.65**	**$1.72**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Regional Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Durham

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	10	16.5	16.5	16.5	--
Durham Capacity (equal to maximum day demand, mgd):	--	17.0	17.0	21.0	--
Average Water Use:	--	16.5	16.5	16.5	--
WTP Design Capacity (mgd):	--	33	54	54	52
WTP Expansion Increment (mgd):	--	--	21	--	--
Durham Share of WTP Capacity (mgd):	--	17.0	4.0 inc.	21.0	21.0
% Total Capacity & Fixed Operating Cost Share:	--	51.5%	19.0%	38.9%	40.4%
% Avg. Plant Production & Variable Operating Cost Share:	--	80.5%	58.9%	41.3%	--
% Share of Common Finished Water Main, Section 1:	--	--	--	46.7%	--
% Share of Common Finished Water Main, Section 2:	--	--	--	72.4%	--
Friction Head Applied to Variable Operating Costs (ft):	--	84.3	106.0	150.6	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	336	358	403	--
Durham Pressure Zone (ft):		**568**			

	CAPITAL COSTS (2014 Dollars)								Allocated to Durham		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	38.9%	$3,694,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	38.9%	$2,232,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	38.9%	$1,089,000	
3	**Raw Water Pump Station (Shared)**										
	Interim Capacity	33	mgd		1	LS	$8,260,000	$8,260,000	51.5%	$4,255,000	
	Ultimate Capacity	54	mgd		1	LS	$4,020,000	$4,020,000	19.0%		$766,000
4	**Jordan Lake Regional WTP (Shared, includes High Service PS, TDH = 100 ft)**										
	Interim Capacity	33	mgd		1	LS	$64,828,000	$64,828,000	51.5%	$33,396,000	
	Ultimate Capacity	54	mgd		1	LS	$35,445,000	$35,445,000	19.0%		$6,751,000
5	**Shared Finished Water Transmission Pipeline**										
	Northern Segment No. 1 - Rural			54 in	48,800	LF	$423	$20,623,304	47%	$9,624,000	
	Northern Segment No. 2 - Rural			42 in	59,405	LF	$329	$19,526,165	72%	$14,140,000	
	Northern Segment No. 2 - Urban			42 in	3,500	LF	$548	$1,917,391	72%	$1,388,000	
6							**CONSTRUCTION COST SUBTOTAL**			**$69,820,000**	**$7,520,000**
	CAPITAL COST ALLOWANCES										
7							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 6)**		15%	$10,473,000	$1,128,000
8							**TOTAL CONSTRUCTION COST**			**$80,293,000**	**$8,648,000**
9	**ENGINEERING COST ALLOWANCES**						**Engineering - Policy Planning (@ 0.5% x Line 6)**		0.50%	$349,000	$38,000
10							**Engineering - Preliminary Engineering(@ 1.0% x Line 6)**		1.00%	$698,000	$75,000
11							**Engineering - Field Work (@ 1.0% x Line 6)**		1.00%	$698,000	$75,000
12							**Engineering - Permitting (@ 0.5% x Line 6)**		0.50%	$349,000	$38,000
13							**Engineering - Design (@ 8.0% x Line 6)**		8.00%	$5,586,000	$602,000
14							**Engineering - Construction Administration (@ 6.8% x Line 6)**		6.75%	$4,713,000	$508,000
15							**Misc. Administration, Legal Fees, Permits, Approvals, & Other (@ 3.0% x Line 6)**		3.00%	$2,095,000	$226,000
16							**ENGINEERING SUBTOTAL**			**$14,488,000**	**$1,562,000**
17	**LAND ACQUISITIONS AND EASEMENTS**	OWASA WTP Site			125	Acre	$10,000	$1,250,000	40.4%	$505,000	
18		USACE Jordan Lake Easement			1	LS	$200,000	$200,000	38.9%	$78,000	
19		Allowance for Additional Land/Easement			1	LS	$100,000	$100,000	100.0%	$100,000	
20		Mitigation Costs for Stream Impacts			337	LF	$374	$125,912	100.0%	$126,000	
21		Mitigation Costs for Wetlands Impacts			0.80	Acre	$68,502	$54,885	100.0%	$55,000	
22							**LAND ACQUISTIONS AND EASEMENTS SUBTOTAL**	**$1,730,797**		**$864,000**	**$0**
23							**Contingency (@ 25% (Line 8+Line 16+Line 22))**		25%	$23,911,000	$2,553,000
24							**ESTIMATED PROJECT CAPITAL COST:**			**$119,556,000**	**$12,763,000**
25										**$132,319,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
26	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	7	mgd	$91,041	$591,765	100.0%	$592,000	
27	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
28	Additional Fixed Administration Cost (annual)				1	LS	$250				
29							**Subtotal Allocation Capital Costs:**			**$592,000**	**$0**
30							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$120,100,000**	**$12,800,000**
31										**$132,900,000**	
32							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$388,173,000**	
33							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.50**	
34							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$1.50**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Durham

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 59%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars			
						Other Capital / Fixed Costs			O&M Costs		Total Annual Costs			
			Water Quantity (mgd)										Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Engineering, Legal & OWASA Land	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0					$519,000					$519,000	$519,000		
2	1					$1,639,000					$1,639,000	$1,618,000		
3	2					$3,551,000					$3,551,000	$3,461,000		
4	3					$4,613,000					$4,613,000	$4,438,000		
5	4				$1,851,000	$2,208,000					$4,059,000	$3,855,000		
6	5				$3,702,000	$2,331,000					$6,033,000	$5,657,000		
7	6		17	16.50	$5,552,000	$2,337,000		$663,000	$2,758,000	$3,053,000	$14,363,000	$13,296,000	$5.45	$5.45
8	7		17	16.50	$6,169,000	$1,543,000		$40,000	$2,794,000	$3,092,000	$13,638,000	$12,463,000	$3.76	$3.76
9	8	33	17	16.50	$6,169,000			$41,000	$2,830,000	$3,132,000	$12,172,000	$10,981,000	$3.12	$3.12
10	9	33	17	16.50	$6,169,000			$41,000	$2,867,000	$3,173,000	$12,250,000	$10,910,000	$2.79	$2.79
11	10	33	17	16.50	$6,169,000			$42,000	$2,904,000	$3,214,000	$12,329,000	$10,840,000	$2.59	$2.59
12	11	33	17	16.50	$6,169,000			$42,000	$2,941,000	$3,255,000	$12,407,000	$10,770,000	$2.46	$2.46
13	12	33	17	16.50	$6,169,000			$43,000	$2,979,000	$3,298,000	$12,489,000	$10,702,000	$2.36	$2.36
14	13	33	17	16.50	$6,169,000			$44,000	$3,018,000	$3,340,000	$12,571,000	$10,635,000	$2.29	$2.29
15	14	33	17	16.50	$6,169,000			$44,000	$3,057,000	$3,384,000	$12,654,000	$10,568,000	$2.23	$2.23
16	15	33	17	16.50	$6,169,000			$45,000	$3,097,000	$3,427,000	$12,738,000	$10,502,000	$2.18	$2.18
17	16	33	17	16.50	$6,169,000			$45,000	$3,137,000	$3,472,000	$12,823,000	$10,437,000	$2.14	$2.14
18	17	33	17	16.50	$6,169,000			$46,000	$3,177,000	$3,517,000	$12,909,000	$10,373,000	$2.10	$2.10
19	18	33	17	16.50	$6,169,000			$46,000	$3,218,000	$3,562,000	$12,995,000	$10,308,000	$2.07	$2.07
20	19	33	17	16.50	$6,169,000			$47,000	$3,260,000	$3,608,000	$13,084,000	$10,246,000	$2.05	$2.05
21	20	33	17	16.50	$6,169,000			$48,000	$3,302,000	$3,655,000	$13,174,000	$10,185,000	$2.02	$2.02
22	21	33	17	16.50	$6,169,000			$48,000	$3,345,000	$3,702,000	$13,264,000	$10,123,000	$2.00	$2.00
23	22	33	17	16.50	$6,169,000			$49,000	$3,388,000	$3,750,000	$13,356,000	$10,063,000	$1.98	$1.98
24	23	33	17	16.50	$6,169,000			$49,000	$3,432,000	$3,799,000	$13,449,000	$10,004,000	$1.96	$1.96
25	24	33	17	16.50	$7,179,000			$50,000	$3,477,000	$3,848,000	$14,554,000	$10,687,000	$1.95	$1.95
26	25	33	17	16.50	$7,179,000			$51,000	$3,522,000	$3,898,000	$14,650,000	$10,620,000	$1.94	$1.94
27	26	33	17	16.50	$7,179,000			$51,000	$3,567,000	$3,948,000	$14,745,000	$10,553,000	$1.94	$1.94
28	27	33	17	16.5	$7,179,000			$52,000	$3,614,000	$4,000,000	$14,845,000	$10,488,000	$1.93	$1.93
29	28	54	17	16.5	$7,179,000			$53,000	$3,660,000	$4,051,000	$14,943,000	$10,423,000	$1.92	$1.92
30	29	54	16.5	16.5	$1,010,000			$53,000	$3,708,000	$4,104,000	$8,875,000	$6,111,000	$1.88	$1.88
31	30	54	16.5	16.5	$1,010,000			$54,000	$3,756,000	$4,157,000	$8,977,000	$6,102,000	$1.85	$1.85
32	31	54	16.5	16.5	$1,010,000		$5,345,000	$55,000	$3,804,000	$4,211,000	$14,425,000	$9,680,000	$1.84	$1.84
33	32	54	16.5	16.5	$1,010,000		$5,414,000	$56,000	$3,854,000	$4,265,000	$14,599,000	$9,672,000	$1.83	$1.83
34	33	54	16.5	16.5	$1,010,000		$5,484,000	$56,000	$3,904,000	$4,321,000	$14,775,000	$9,663,000	$1.82	$1.82
35	34	54	16.5	16.5	$1,010,000		$5,555,000	$57,000	$3,954,000	$4,377,000	$14,953,000	$9,655,000	$1.81	$1.81
36	35	54	16.5	16.5	$1,010,000		$5,627,000	$58,000	$4,005,000	$4,433,000	$15,133,000	$9,646,000	$1.81	$1.81
37	36	54	16.5	16.5	$1,010,000			$58,000	$4,057,000	$4,491,000	$9,616,000	$6,051,000	$1.78	$1.78
38	37	54	16.5	16.5	$1,010,000			$59,000	$4,110,000	$4,549,000	$9,728,000	$6,043,000	$1.76	$1.76
39	38	54	16.5	16.5	$1,010,000			$60,000	$4,163,000	$4,608,000	$9,841,000	$6,035,000	$1.73	$1.73
40	39	54	16.5	16.5	$1,010,000			$61,000	$4,217,000	$4,667,000	$9,955,000	$6,027,000	$1.71	$1.71
41	40	54	16.5	16.5	$1,010,000			$62,000	$4,272,000	$4,728,000	$10,072,000	$6,020,000	$1.69	$1.69
42	41	54	16.5	16.5	$1,010,000			$62,000	$4,327,000	$4,789,000	$10,188,000	$6,011,000	$1.67	$1.67
43	42	54	16.5	16.5	$1,010,000			$63,000	$4,383,000	$4,851,000	$10,307,000	$6,004,000	$1.65	$1.65
44	43	54	16.5	16.5	$1,010,000			$64,000	$4,440,000	$4,914,000	$10,428,000	$5,997,000	$1.64	$1.64
45	44	54	16.5	16.5	$1,010,000			$65,000	$4,497,000	$4,978,000	$10,550,000	$5,989,000	$1.62	$1.62
46	45	54	16.5	16.5	$1,010,000			$66,000	$4,555,000	$5,042,000	$10,673,000	$5,982,000	$1.60	$1.60
47	46	54	16.5	16.5	$1,010,000			$66,000	$4,614,000	$5,107,000	$10,797,000	$5,974,000	$1.59	$1.59
48	47	54	16.5	16.5	$1,010,000			$67,000	$4,674,000	$5,173,000	$10,924,000	$5,967,000	$1.57	$1.57
49	48	54	17	16.5	$1,010,000		-$29,933,320	$68,000	$4,735,000	$5,240,000	-$18,880,000	-$10,181,000	$1.50	$1.50
Totals:	--	--	--	**709.5**	**$172,073,000**	**$18,741,000**	**-$2,508,320**	**$2,890,000**	**$157,373,000**	**$174,183,000**	**$522,752,000**	**$388,173,000**	**$1.50**	**$1.50**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Regional Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for

Orange County

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	1	2	2	2	--
Orange County Capacity (equal to maximum day demand, mgd):	--	1.0	1.0	3.0	--
Average Water Use:	--	1.0	1.0	2.0	--
WTP Design Capacity (mgd):	--	33	54	54	52
WTP Expansion Increment (mgd):	--	--	21	--	--
Orange County Share of WTP Capacity (mgd):	--	1.0	2.0 inc.	3.0	3.0
% Total Capacity & Fixed Operating Cost Share:	--	3.0%	9.5%	5.6%	0.1
% Avg. Plant Production & Variable Operating Cost Share:	--	4.9%	3.6%	5.0%	--
% Share of Common Finished Water Main, Section 1:	--	--	--	6.7%	--
% Share of Common Finished Water Main, Section 2:	--	--	--	10.3%	--
Friction Head Applied to Variable Operating Costs (ft):	--	84.3	106.0	150.6	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	608	630	675	--
Orange County Pressure Zone (ft):		**840**			

	CAPITAL COSTS (2014 Dollars)								Allocated to Orange County		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	5.6%	$528,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	5.6%	$319,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	5.6%	$156,000	
3	**Raw Water Pump Station (Shared)**										
	Interim Capacity	33	mgd		1	LS	$8,260,000	$8,260,000	3.0%	$250,000	
	Ultimate Capacity	54	mgd		1	LS	$4,020,000	$4,020,000	9.5%		$383,000
4	**Jordan Lake Regional WTP (Shared, includes High Service PS, TDH = 100 ft)**										
	Interim Capacity	33	mgd		1	LS	$64,828,000	$64,828,000	3.0%	$1,964,000	
	Ultimate Capacity	54	mgd		1	LS	$35,445,000	$35,445,000	9.5%		$3,376,000
5	**Shared Finished Water Transmission Pipeline**										
	Northern Segment No. 1 - Rural			54 in	48,800	LF	$423	$20,623,304	6.7%	$1,375,000	
	Northern Segment No. 2 - Rural			42 in	59,405	LF	$329	$19,526,165	10.3%	$2,020,000	
	Northern Segment No. 2 - Urban			42 in	3,500	LF	$548	$1,917,391	10.3%	$198,000	
6	**Finished Water Booster Station**										
	Interim Capacity	1.0	mgd		1	LS	$530,000	$530,000	100.0%	$530,000	
	Ultimate Capacity	3.0	mgd		1	LS	$741,818	$741,818	100.0%		$742,000
7							**CONSTRUCTION COST SUBTOTAL**			**$7,340,000**	**$4,510,000**
	CAPITAL COST ALLOWANCES										
8							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 7)**		15.0%	$1,101,000	$677,000
9							**TOTAL CONSTRUCTION COST**			**$8,441,000**	**$5,187,000**
10	**ENGINEERING COST ALLOWANCES**						**Engineering - Policy Planning (@ 0.5% x Line 7)**		0.50%	$37,000	$23,000
11							**Engineering - Preliminary Engineering(@ 1.0% x Line 7)**		1.00%	$73,000	$45,000
12							**Engineering - Field Work (@ 1.0% x Line 7)**		1.00%	$73,000	$45,000
13							**Engineering - Permitting (@ 0.5% x Line 7)**		0.50%	$37,000	$23,000
14							**Engineering - Design (@ 8.0% x Line 7)**		8.00%	$587,000	$361,000
15							**Engineering - Construction Administration (@ 6.8% x Line 7)**		6.75%	$495,000	$304,000
16							**Misc. Administration, Legal Fees, Permits, Approvals, & Other (@ 3.0% x Line 7)**		3.00%	$220,000	$135,000
17							**ENGINEERING SUBTOTAL**			**$1,522,000**	**$936,000**
18	**LAND ACQUISITIONS AND EASEMENTS**	OWASA WTP Site			125	Acre	$10,000	$1,250,000	5.8%	$72,000	
19		USACE Jordan Lake Easement			1	LS	$200,000	$200,000	5.6%	$11,000	
20		Allowance for Additional Land/Easement			1	LS	$100,000	$100,000	100.0%	$100,000	
21		Mitigation Costs for Stream Impacts			48	LF	$374	$17,987	100.0%	$18,000	
22		Mitigation Costs for Wetlands Impacts			0.11	Acre	$68,502	$7,841	100.0%	$8,000	
23							**LAND ACQUISTIONS AND EASEMENTS SUBTOTAL**	**$1,575,828**		**$209,000**	**$0**
24							**Contingency (@ 25% (Line 9+Line 17+Line 23))**		25.0%	$2,543,000	$1,531,000
25							**ESTIMATED PROJECT CAPITAL COST:**			**$12,715,000**	**$7,654,000**
26										**$20,369,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
27	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	1	mgd	$91,041	$91,041	100.0%	$91,000	
28	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
29	Additional Fixed Administration Cost (annual)				1	LS	$250				
30							**Subtotal Allocation Capital Costs:**			**$91,000**	**$0**
31							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$12,800,000**	**$7,700,000**
32										**$20,500,000**	
33							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$30,512,000**	
34							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.51**	
35							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.97**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Orange County

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 45%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars			
						Other Capital / Fixed Costs			O&M Costs		Total Annual Costs			
			Water Quantity (mgd)										Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Engineering, Legal & OWASA Land	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0					$55,000					$55,000	$55,000		
2	1					$172,000					$172,000	$170,000		
3	2					$373,000					$373,000	$364,000		
4	3					$505,000					$505,000	$486,000		
5	4				$197,000	$235,000					$432,000	$410,000		
6	5				$394,000	$245,000					$639,000	$599,000		
7	6		2	1.00	$590,000	$246,000		$101,000	$13,000	$141,000	$1,091,000	$1,010,000	$4.24	$8.48
8	7		2	1.00	$656,000	$162,000		$5,000	$13,000	$143,000	$979,000	$895,000	$2.73	$5.46
9	8	33	2	1.00	$656,000			$5,000	$13,000	$145,000	$819,000	$739,000	$2.16	$4.32
10	9	33	2	1.00	$656,000			$5,000	$13,000	$147,000	$821,000	$731,000	$1.87	$3.74
11	10	33	2	1.00	$656,000			$5,000	$14,000	$149,000	$824,000	$725,000	$1.69	$3.39
12	11	33	2	1.00	$656,000			$5,000	$14,000	$151,000	$826,000	$717,000	$1.58	$3.15
13	12	33	2	1.00	$656,000			$5,000	$14,000	$152,000	$827,000	$709,000	$1.49	$2.98
14	13	33	2	1.00	$656,000			$5,000	$14,000	$154,000	$829,000	$701,000	$1.42	$2.85
15	14	33	2	1.00	$656,000			$6,000	$14,000	$156,000	$832,000	$695,000	$1.37	$2.74
16	15	33	2	1.00	$656,000			$6,000	$15,000	$158,000	$835,000	$688,000	$1.33	$2.66
17	16	33	2	1.00	$656,000			$6,000	$15,000	$161,000	$838,000	$682,000	$1.29	$2.58
18	17	33	2	1.00	$656,000			$6,000	$15,000	$163,000	$840,000	$675,000	$1.26	$2.52
19	18	33	2	1.00	$656,000			$6,000	$15,000	$165,000	$842,000	$668,000	$1.23	$2.47
20	19	33	2	1.00	$656,000			$6,000	$15,000	$167,000	$844,000	$661,000	$1.21	$2.42
21	20	33	2	1.00	$656,000			$6,000	$16,000	$169,000	$847,000	$655,000	$1.19	$2.38
22	21	33	2	1.00	$656,000			$6,000	$16,000	$171,000	$849,000	$648,000	$1.17	$2.34
23	22	33	2	1.00	$656,000			$6,000	$16,000	$173,000	$851,000	$641,000	$1.15	$2.31
24	23	33	2	1.00	$656,000			$6,000	$16,000	$176,000	$854,000	$635,000	$1.14	$2.28
25	24	33	2	1.00	$1,262,000			$6,000	$16,000	$178,000	$1,462,000	$1,074,000	$1.16	$2.31
26	25	33	2	1.00	$1,262,000			$6,000	$17,000	$180,000	$1,465,000	$1,062,000	$1.17	$2.34
27	26	33	2	1.00	$1,262,000			$6,000	$17,000	$183,000	$1,468,000	$1,051,000	$1.18	$2.37
28	27	33	2	1.1	$1,262,000			$7,000	$17,000	$194,000	$1,480,000	$1,046,000	$1.20	$2.38
29	28	54	2	1.1	$1,262,000			$7,000	$17,000	$205,000	$1,491,000	$1,040,000	$1.21	$2.39
30	29	54	2	1.2	$606,000			$7,000	$17,000	$216,000	$846,000	$583,000	$1.19	$2.35
31	30	54	2	1.2	$606,000			$7,000	$18,000	$228,000	$859,000	$584,000	$1.17	$2.30
32	31	54	2	1.3	$606,000		$568,000	$7,000	$18,000	$240,000	$1,439,000	$966,000	$1.18	$2.29
33	32	54	2	1.3	$606,000		$576,000	$7,000	$18,000	$253,000	$1,460,000	$967,000	$1.18	$2.28
34	33	54	2	1.4	$606,000		$583,000	$7,000	$18,000	$265,000	$1,479,000	$967,000	$1.19	$2.26
35	34	54	2	1.4	$606,000		$591,000	$7,000	$19,000	$278,000	$1,501,000	$969,000	$1.19	$2.25
36	35	54	2	1.5	$606,000		$598,000	$7,000	$19,000	$291,000	$1,521,000	$970,000	$1.20	$2.23
37	36	54	2	1.5	$606,000			$7,000	$19,000	$305,000	$937,000	$590,000	$1.19	$2.18
38	37	54	2	1.6	$606,000			$7,000	$19,000	$319,000	$951,000	$591,000	$1.17	$2.13
39	38	54	2	1.6	$606,000			$7,000	$20,000	$333,000	$966,000	$592,000	$1.16	$2.08
40	39	54	2	1.7	$606,000			$8,000	$20,000	$347,000	$981,000	$594,000	$1.15	$2.03
41	40	54	2	1.7	$606,000			$8,000	$20,000	$362,000	$996,000	$595,000	$1.14	$1.99
42	41	54	2	1.8	$606,000			$8,000	$20,000	$377,000	$1,011,000	$597,000	$1.13	$1.94
43	42	54	2	1.8	$606,000			$8,000	$21,000	$392,000	$1,027,000	$598,000	$1.13	$1.90
44	43	54	2	1.9	$606,000			$8,000	$21,000	$408,000	$1,043,000	$600,000	$1.12	$1.86
45	44	54	2	1.9	$606,000			$8,000	$21,000	$424,000	$1,059,000	$601,000	$1.11	$1.82
46	45	54	2	2.0	$606,000			$8,000	$21,000	$441,000	$1,076,000	$603,000	$1.10	$1.78
47	46	54	2	2.0	$606,000			$8,000	$22,000	$457,000	$1,093,000	$605,000	$1.10	$1.75
48	47	54	2	2.0	$606,000			$8,000	$22,000	$463,000	$1,099,000	$600,000	$1.09	$1.71
49	48	54	2	2.0	$606,000		-$6,467,693	$8,000	$22,000	$469,000	-$5,363,000	-$2,892,000	$0.97	$1.51
Totals:	--	--	--	**55.5**	**$30,763,000**	**$1,993,000**	**-$3,551,693**	**$378,000**	**$740,000**	**$10,649,000**	**$40,971,000**	**$30,512,000**	**$0.97**	**$1.51**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Regional Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
OWASA

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	5	5	5	5	--
OWASA Capacity (equal to maximum day demand, mgd):	--	0.0	2.0	5.0	--
Average Water Use:	--	0.0	2.0	5.0	--
WTP Design Capacity (mgd):	--	33	54	54	--
WTP Expansion Increment (mgd):	--	--	21	--	--
OWASA Share of WTP Capacity (mgd):	--	2.0	3.0 inc.	5.0	0.0
% Total Capacity & Fixed Operating Cost Share:	--	6.1%	14.3%	9.3%	0.0%
% Avg. Plant Production & Variable Operating Cost Share:	--	0.0%	7.1%	12.5%	--
% Share of Common Finished Water Main, Section 1:	--	--	--	11.1%	--
% Share of Common Finished Water Main, Section 2:	--	--	--	17.2%	--
Friction Head Applied to Variable Operating Costs (ft):	--	84.3	106.0	150.6	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	410	432	477	--
OWASA Pressure Zone (ft):		**642**			

	CAPITAL COSTS (2014 Dollars)								Allocated to OWASA		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	9.3%	$880,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	9.3%	$531,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	9.3%	$259,000	
3	**Raw Water Pump Station (Shared)**										
	Interim Capacity	33	mgd		1	LS	$8,260,000	$8,260,000	6.1%	$501,000	
	Ultimate Capacity	54	mgd		1	LS	$4,020,000	$4,020,000	14.3%		$574,000
4	**Jordan Lake Regional WTP (Shared, includes High Service PS, TDH = 100 ft)**										
	Interim Capacity	33	mgd		1	LS	$64,828,000	$64,828,000	6.1%	$3,929,000	
	Ultimate Capacity	54	mgd		1	LS	$35,445,000	$35,445,000	14.3%		$5,064,000
5	**Shared Finished Water Transmission Pipeline**										
	Northern Segment No. 1 - Rural			54 in	48,800	LF	$423	$20,623,304	11.1%	$2,291,000	
	Northern Segment No. 2 - Rural			42 in	59,405	LF	$329	$19,526,165	17.2%		
	Northern Segment No. 2 - Urban			42 in	3,500	LF	$548	$1,917,391	17.2%	$331,000	
6							**CONSTRUCTION COST SUBTOTAL**			**$8,730,000**	**$5,640,000**
	CAPITAL COST ALLOWANCES										
7							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 6)**		15%	$1,310,000	$846,000
8							**TOTAL CONSTRUCTION COST**			**$10,040,000**	**$6,486,000**
9	**ENGINEERING COST ALLOWANCES**						**Engineering - Policy Planning (@ 0.5% x Line 6)**		0.50%	$44,000	$28,000
10							**Engineering - Preliminary Engineering(@ 1.0% x Line 6)**		1.00%	$87,000	$56,000
11							**Engineering - Field Work (@ 1.0% x Line 6)**		1.00%	$87,000	$56,000
12							**Engineering - Permitting (@ 0.5% x Line 6)**		0.50%	$44,000	$28,000
13							**Engineering - Design (@ 8.0% x Line 6)**		8.00%	$698,000	$451,000
14							**Engineering - Construction Administration (@ 6.8% x Line 6)**		6.75%	$589,000	$381,000
15							**Misc. Administration, Legal Fees, Permits, Approvals, & Other (@ 3.0% x Line 6)**		3.00%	$262,000	$169,000
16							**ENGINEERING SUBTOTAL**			**$1,811,000**	**$1,169,000**
17	**LAND ACQUISITIONS AND EASEMENTS**	OWASA WTP Site			0	Acre	$10,000	$0	0.0%	$0	
18		USACE Jordan Lake Easement			1	LS	$200,000	$200,000	9.3%	$19,000	
19		Allowance for Additional Land/Easement			1	LS	$100,000	$100,000	100.0%	$100,000	
20		Mitigation Costs for Stream Impacts			80	LF	$374	$29,979	100.0%	$30,000	
21		Mitigation Costs for Wetlands Impacts			0.19	Acre	$68,502	$13,068	100.0%	$13,000	
22							**LAND ACQUISITIONS AND EASEMENTS SUBTOTAL**	**$343,047**		**$162,000**	**$0**
23							**Contingency (@ 25% (Line 8+Line 16+Line 22))**		25%	$3,003,000	$1,914,000
24							**ESTIMATED PROJECT CAPITAL COST:**			**$15,016,000**	**$9,569,000**
25										**$24,585,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
26	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	0	mgd	$91,041	$0	100.0%	$0	
27	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
28	Additional Fixed Administration Cost (annual)				1	LS	$250				
29							**Subtotal Allocation Capital Costs:**			**$0.00**	**$0.00**
30							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$15,000,000**	**$9,600,000**
31										**$24,600,000**	
32							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$30,996,000**	
33							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$4.14**	
34							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.39**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for OWASA

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 61%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars			
			Water Quantity (mgd)			Other Capital / Fixed Costs			O&M Costs		Total Annual Costs			
													Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Engineering, Legal & OWASA Land	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0					$65,000					$65,000	$65,000		
2	1					$205,000					$205,000	$202,000		
3	2					$444,000					$444,000	$433,000		
4	3					$508,000					$508,000	$489,000		
5	4				$234,000	$266,000					$500,000	$475,000		
6	5				$468,000	$291,000					$759,000	$712,000		
7	6		5	0.0	$702,000	$292,000		$12,000	$42,000	$0	$1,048,000	$970,000	$1.83	$0.00
8	7		5		$780,000	$193,000		$12,000	$42,000	$0	$1,027,000	$939,000	$1.17	$0.00
9	8	33	5		$780,000			$13,000	$43,000	$0	$836,000	$754,000	$0.92	$0.00
10	9	33	5		$780,000			$13,000	$44,000	$0	$837,000	$745,000	$0.79	$0.00
11	10	33	5		$780,000			$13,000	$44,000	$0	$837,000	$736,000	$0.71	$0.00
12	11	33	5	0.5	$780,000			$13,000	$45,000	$48,000	$886,000	$769,000	$0.67	$39.94
13	12	33	5		$780,000			$13,000	$45,000	$0	$838,000	$718,000	$0.63	$43.87
14	13	33	5		$780,000			$13,000	$46,000	$0	$839,000	$710,000	$0.60	$47.76
15	14	33	5		$780,000			$14,000	$46,000	$0	$840,000	$702,000	$0.57	$51.61
16	15	33	5		$780,000			$14,000	$47,000	$0	$841,000	$693,000	$0.55	$55.41
17	16	33	5	1.0	$780,000			$14,000	$48,000	$101,000	$943,000	$768,000	$0.54	$19.87
18	17	33	5		$780,000			$14,000	$48,000	$0	$842,000	$677,000	$0.53	$21.11
19	18	33	5		$780,000			$14,000	$49,000	$0	$843,000	$669,000	$0.52	$22.33
20	19	33	5		$780,000			$14,000	$50,000	$0	$844,000	$661,000	$0.50	$23.54
21	20	33	5		$780,000			$15,000	$50,000	$0	$845,000	$653,000	$0.49	$24.73
22	21	33	5	1.5	$780,000			$15,000	$51,000	$162,000	$1,008,000	$769,000	$0.49	$13.07
23	22	33	5		$780,000			$15,000	$52,000	$0	$847,000	$638,000	$0.48	$13.65
24	23	33	5		$780,000			$15,000	$52,000	$0	$847,000	$630,000	$0.47	$14.23
25	24	33	5		$1,537,000			$15,000	$53,000	$0	$1,605,000	$1,179,000	$0.48	$15.30
26	25	33	5		$1,537,000			$16,000	$54,000	$0	$1,607,000	$1,165,000	$0.49	$16.37
27	26	33	5	2.0	$1,537,000			$16,000	$54,000	$231,000	$1,838,000	$1,315,000	$0.50	$10.54
28	27	33	5		$1,537,000			$16,000	$55,000	$0	$1,608,000	$1,136,000	$0.51	$11.16
29	28	54	5		$1,537,000			$16,000	$56,000	$0	$1,609,000	$1,122,000	$0.51	$11.78
30	29	54	5		$757,000			$16,000	$56,000	$0	$829,000	$571,000	$0.50	$12.09
31	30	54	5		$757,000			$17,000	$57,000	$0	$831,000	$565,000	$0.50	$12.40
32	31	54	5	2.8	$757,000		$671,000	$17,000	$58,000	$338,000	$1,841,000	$1,235,000	$0.50	$8.44
33	32	54	5		$757,000		$680,000	$17,000	$59,000	$0	$1,513,000	$1,002,000	$0.50	$8.79
34	33	54	5		$757,000		$689,000	$17,000	$59,000	$0	$1,522,000	$995,000	$0.51	$9.14
35	34	54	5		$757,000		$698,000	$17,000	$60,000	$0	$1,532,000	$989,000	$0.51	$9.49
36	35	54	5		$757,000		$707,000	$18,000	$61,000	$0	$1,543,000	$984,000	$0.51	$9.84
37	36	54	5	3.5	$757,000			$18,000	$62,000	$459,000	$1,296,000	$816,000	$0.51	$6.98
38	37	54	5		$757,000			$18,000	$62,000	$0	$837,000	$520,000	$0.50	$7.10
39	38	54	5		$757,000			$18,000	$63,000	$0	$838,000	$514,000	$0.49	$7.23
40	39	54	5		$757,000			$19,000	$64,000	$0	$840,000	$509,000	$0.49	$7.35
41	40	54	5		$757,000			$19,000	$65,000	$0	$841,000	$503,000	$0.48	$7.48
42	41	54	5	4.3	$757,000			$19,000	$66,000	$594,000	$1,436,000	$847,000	$0.48	$5.58
43	42	54	5		$757,000			$19,000	$67,000	$0	$843,000	$491,000	$0.47	$5.66
44	43	54	5		$757,000			$20,000	$67,000	$0	$844,000	$485,000	$0.47	$5.75
45	44	54	5		$757,000			$20,000	$68,000	$0	$845,000	$480,000	$0.46	$5.83
46	45	54	5		$757,000			$20,000	$69,000	$0	$846,000	$474,000	$0.46	$5.92
47	46	54	5	5.0	$757,000			$20,000	$70,000	$746,000	$1,593,000	$881,000	$0.46	$4.59
48	47	54	5		$757,000			$21,000	$71,000	$0	$849,000	$464,000	$0.45	$4.65
49	48	54	5		$757,000		-$7,938,861	$21,000	$72,000	$0	-$7,089,000	-$3,823,000	$0.39	$4.14
Totals:	--	--	--	**20.5**	**$37,489,000**	**$2,264,000**	**-$4,493,861**	**$696,000**	**$2,392,000**	**$2,679,000**	**$41,026,000**	**$30,996,000**	**$0.39**	**$4.14**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Regional Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Pittsboro

Final

Summary of Water Facilities Capacity & Cost Sharing						
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing	
Water Supply Storage Allocation (mgd):	0	6	6	6	--	
Pittsboro Capacity (equal to maximum day demand, mgd):	--	0.0	3.0	9.0	--	
Average Water Use:	--	0.0	2.0	6.0	--	
WTP Design Capacity (mgd):	--	33	54	54	52	
WTP Expansion Increment (mgd):	--	--	21	--	--	
Pittsboro Share of WTP Capacity (mgd):	--	3.0	6.0 inc.	9.0	9.0	
% Total Capacity & Fixed Operating Cost Share:	--	9.1%	28.6%	16.7%	17.3%	
% Avg. Plant Production & Variable Operating Cost Share:	--	0.0%	7.1%	15.0%	--	
% Share of Common Finished Water Main, Section 1:	--	--	--	0.0%	--	$28,954,000
% Share of Common Finished Water Main, Section 2:	--	--	--	0.0%	--	$51,500,000
Friction Head Applied to Variable Operating Costs (ft):	--	0.8	7.3	47.7	--	
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	250	256	297	--	
Pittsboro Pressure Zone (ft):		**565**				

CAPITAL COSTS (2014 Dollars)									Allocated to Pittsboro		
										Costs Subtotals	
No.	**Description**			**Pipe Diam.**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**	**% of Total**	**Initial Const. (2015-2020)**	**Expansion (2035-2040)**
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	16.7%	$1,583,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	16.7%	$957,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	16.7%	$467,000	
3	**Raw Water Pump Station (Shared)**										
	Interim Capacity	33	mgd		1	LS	$8,260,000	$8,260,000	9.1%	$751,000	
	Ultimate Capacity	54	mgd		1	LS	$4,020,000	$4,020,000	28.6%		$1,149,000
4	**Jordan Lake Regional WTP (Shared, includes High Service PS, TDH = 100 ft)**										
	Interim Capacity	33	mgd		1	LS	$64,828,000	$64,828,000	9.1%	$5,893,000	
	Ultimate Capacity	54	mgd		1	LS	$35,445,000	$35,445,000	28.6%		$10,127,000
5	**Finished Water Transmission Pipeline**										
	Western Segment - Rural			24 in	31,552	LF	$188	$5,926,289	100.0%	$5,926,000	
6	**Finished Water Booster Station (Pittsboro)**										
	Interim Capacity	3	mgd		1	LS	$1,210,000	$1,210,000	100.0%	$1,210,000	
	Ultimate Capacity	9	mgd		1	LS	$1,658,182	$1,658,182	100.0%		$1,658,000
7							**CONSTRUCTION COST SUBTOTAL**			**$16,790,000**	**$12,940,000**
	CAPITAL COST ALLOWANCES										
8							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 7)**		15%	$2,519,000	$1,941,000
9							**TOTAL CONSTRUCTION COST**			**$19,309,000**	**$14,881,000**
10	**ENGINEERING COST ALLOWANCES**						**Engineering - Policy Planning (@ 0.5% x Line 7)**		0.50%	$84,000	$65,000
11							**Engineering - Preliminary Engineering(@ 1.0% x Line 7)**		1.00%	$168,000	$129,000
12							**Engineering - Field Work (@ 1.0% x Line 7)**		1.00%	$168,000	$129,000
13							**Engineering - Permitting (@ 0.5% x Line 7)**		0.50%	$84,000	$65,000
14							**Engineering - Design (@ 8.0% x Line 7)**		8.00%	$1,343,000	$1,035,000
15							**Engineering - Construction Administration (@ 6.8% x Line 7)**		6.75%	$1,133,000	$873,000
16							**Misc. Administration, Legal Fees, Permits, Approvals, & Other (@ 3.0% x Line 7)**		3.00%	$504,000	$388,000
17							**ENGINEERING SUBTOTAL**			**$3,484,000**	**$2,684,000**
18	**LAND ACQUISITIONS AND EASEMENTS**		OWASA WTP Site		125	Acre	$10,000	$1,250,000	17.3%	$216,000	
19			USACE Jordan Lake Easement		1	LS	$200,000	$200,000	16.7%	$33,000	
20			Allowance for Additional Land/Easement		1	LS	$50,000	$50,000	100.0%	$50,000	
21			Mitigation Costs for Stream Impacts		144	LF	$374	$53,725	100.0%	$54,000	
22			Mitigation Costs for Wetlands Impacts		0.25	Acre	$68,502	$17,126	100.0%	$17,000	
23							**LAND ACQUISTIONS AND EASEMENTS SUBTOTAL**	**$1,570,851**		**$370,000**	**$0**
24							**Contingency (@ 25% (Line 9+Line 17+Line 23))**		25%	$5,791,000	$4,391,000
25							**ESTIMATED PROJECT CAPITAL COST:**			**$28,954,000**	**$21,956,000**
26										**$50,910,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
27	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	6	mgd	$91,041	$546,245	100.0%	$546,000	
28	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
29	Additional Fixed Administration Cost (annual)				1	LS	$250				
30							**Subtotal Allocation Capital Costs:**			**$546,000.00**	**$0.00**
31							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$29,500,000**	**$22,000,000**
32										**$51,500,000**	
33							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$61,265,000**	
34							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.46**	
35							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.65**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Pittsboro

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 56%

Final

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars			
			Water Quantity (mgd)			Other Capital / Fixed Costs			O&M Costs		Total Annual Costs			
													Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Engineering, Legal & OWASA Land	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0					$125,000					$125,000	$125,000		
2	1					$394,000					$394,000	$389,000		
3	2					$854,000					$854,000	$832,000		
4	3					$1,212,000					$1,212,000	$1,166,000		
5	4				$447,000	$546,000					$993,000	$943,000		
6	5				$893,000	$561,000					$1,454,000	$1,363,000		
7	6		6	0.00	$1,340,000	$562,000		$590,000	$112,000	$0	$2,604,000	$2,411,000	$3.30	$0.00
8	7		6	0.10	$1,489,000	$371,000		$15,000	$113,000	$5,000	$1,993,000	$1,821,000	$2.07	$247.95
9	8	33	6	0.20	$1,489,000			$15,000	$115,000	$11,000	$1,630,000	$1,471,000	$1.60	$96.08
10	9	33	6	0.30	$1,489,000			$15,000	$116,000	$17,000	$1,637,000	$1,458,000	$1.37	$54.70
11	10	33	6	0.40	$1,489,000			$15,000	$118,000	$23,000	$1,645,000	$1,446,000	$1.23	$36.78
12	11	33	6	0.50	$1,489,000			$16,000	$119,000	$29,000	$1,653,000	$1,435,000	$1.13	$27.14
13	12	33	6	0.60	$1,489,000			$16,000	$121,000	$35,000	$1,661,000	$1,423,000	$1.06	$21.24
14	13	33	6	0.70	$1,489,000			$16,000	$122,000	$42,000	$1,669,000	$1,412,000	$1.01	$17.31
15	14	33	6	0.80	$1,489,000			$16,000	$124,000	$48,000	$1,677,000	$1,401,000	$0.97	$14.53
16	15	33	6	0.90	$1,489,000			$16,000	$126,000	$55,000	$1,686,000	$1,390,000	$0.94	$12.47
17	16	33	6	1.00	$1,489,000			$17,000	$127,000	$62,000	$1,695,000	$1,380,000	$0.91	$10.89
18	17	33	6	1.10	$1,489,000			$17,000	$129,000	$69,000	$1,704,000	$1,369,000	$0.88	$9.65
19	18	33	6	1.20	$1,489,000			$17,000	$131,000	$76,000	$1,713,000	$1,359,000	$0.86	$8.64
20	19	33	6	1.30	$1,489,000			$17,000	$132,000	$83,000	$1,721,000	$1,348,000	$0.85	$7.81
21	20	33	6	1.40	$1,489,000			$17,000	$134,000	$91,000	$1,731,000	$1,338,000	$0.83	$7.12
22	21	33	6	1.50	$1,489,000			$18,000	$136,000	$99,000	$1,742,000	$1,330,000	$0.82	$6.53
23	22	33	6	1.60	$1,489,000			$18,000	$137,000	$107,000	$1,751,000	$1,319,000	$0.80	$6.03
24	23	33	6	1.70	$1,489,000			$18,000	$139,000	$115,000	$1,761,000	$1,310,000	$0.79	$5.59
25	24	33	6	1.80	$3,227,000			$18,000	$141,000	$123,000	$3,509,000	$2,577,000	$0.81	$5.42
26	25	33	6	1.90	$3,227,000			$19,000	$143,000	$132,000	$3,521,000	$2,553,000	$0.83	$5.24
27	26	33	6	2.00	$3,227,000			$19,000	$145,000	$140,000	$3,531,000	$2,527,000	$0.85	$5.07
28	27	33	6	2.2	$3,227,000			$19,000	$147,000	$156,000	$3,549,000	$2,507,000	$0.86	$4.89
29	28	54	6	2.4	$3,227,000			$19,000	$149,000	$173,000	$3,568,000	$2,489,000	$0.87	$4.70
30	29	54	6	2.6	$1,738,000			$20,000	$150,000	$190,000	$2,098,000	$1,445,000	$0.86	$4.40
31	30	54	6	2.8	$1,738,000			$20,000	$152,000	$207,000	$2,117,000	$1,439,000	$0.85	$4.13
32	31	54	6	3.0	$1,738,000		$1,294,000	$20,000	$154,000	$225,000	$3,431,000	$2,302,000	$0.86	$3.95
33	32	54	6	3.2	$1,738,000		$1,311,000	$20,000	$156,000	$243,000	$3,468,000	$2,298,000	$0.87	$3.78
34	33	54	6	3.4	$1,738,000		$1,328,000	$21,000	$158,000	$261,000	$3,506,000	$2,293,000	$0.88	$3.62
35	34	54	6	3.6	$1,738,000		$1,345,000	$21,000	$160,000	$280,000	$3,544,000	$2,288,000	$0.88	$3.47
36	35	54	6	3.8	$1,738,000		$1,363,000	$21,000	$163,000	$300,000	$3,585,000	$2,285,000	$0.89	$3.32
37	36	54	6	4.0	$1,738,000			$21,000	$165,000	$319,000	$2,243,000	$1,411,000	$0.88	$3.14
38	37	54	6	4.2	$1,738,000			$22,000	$167,000	$340,000	$2,267,000	$1,408,000	$0.87	$2.98
39	38	54	6	4.4	$1,738,000			$22,000	$169,000	$361,000	$2,290,000	$1,404,000	$0.86	$2.82
40	39	54	6	4.6	$1,738,000			$22,000	$171,000	$382,000	$2,313,000	$1,400,000	$0.86	$2.68
41	40	54	6	4.8	$1,738,000			$23,000	$173,000	$404,000	$2,338,000	$1,397,000	$0.85	$2.55
42	41	54	6	5.0	$1,738,000			$23,000	$176,000	$426,000	$2,363,000	$1,394,000	$0.85	$2.43
43	42	54	6	5.2	$1,738,000			$23,000	$178,000	$449,000	$2,388,000	$1,391,000	$0.84	$2.32
44	43	54	6	5.4	$1,738,000			$23,000	$180,000	$472,000	$2,413,000	$1,388,000	$0.83	$2.22
45	44	54	6	5.6	$1,738,000			$24,000	$182,000	$496,000	$2,440,000	$1,385,000	$0.83	$2.13
46	45	54	6	5.8	$1,738,000			$24,000	$185,000	$520,000	$2,467,000	$1,383,000	$0.82	$2.04
47	46	54	6	6.0	$1,738,000			$24,000	$187,000	$545,000	$2,494,000	$1,380,000	$0.82	$1.96
48	47	54	6	6.0	$1,738,000			$25,000	$190,000	$552,000	$2,505,000	$1,368,000	$0.81	$1.88
49	48	54	6	6.0	$1,738,000		-$27,895,251	$25,000	$192,000	$559,000	-$25,381,000	-$13,686,000	$0.65	$1.46
Totals:	--	--	--	**115.0**	**$78,888,000**	**$4,625,000**	**-$21,254,251**	**$1,407,000**	**$6,384,000**	**$9,222,000**	**$79,272,000**	**$61,265,000**	**$0.65**	**$1.46**

Appendix B: South Durham and Jordan Lake Regional Water Treatment Facilities - Detailed Cost Summary

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – South Durham and Jordan Lake Water Treatment Facilities
Summary Data

Final

Partner	Pressure Zone (ft)	Existing Jordan Lake Allocations	Initial Basis for Initial Facilities Production					Interim Basis for Initial Facilities Capacity					Ultimate Basis for Ultimate Facilities Capacity						Summary of Conceptual-Level Cost Estimates: Capital Costs (2014 Million $)				Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs per 1,000 gallons (2014 $)	
																			Year Financed		Total	Total Per MGD Ultimate Capacity			
			Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% of Total Capacity	Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% of Total Capacity	Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% Inc.	% of Total Capacity	Initial	Interim				Usage	Level 1 Allocation Purchased
Chatham Co.	740	6	18	3.0	1.5	5	21.7%	18	6.5	1.5	10.0	30.3%	18	10.5	1.5	16.0	28.6%	29.6%	$74.7 M	$21.5 M	$96.2 M	$6.0 M	$194.2 M	$2.0	$0.7
Durham	568	10	16.5	16.5	1	17	73.9%	16.5	16.5	1	17.0	51.5%	16.5	16.5	1.25	21.0	19.0%	38.9%	$128.2 M	$13.8 M	$142.0 M	$6.8 M	$417.4 M	$1.7	$1.7
OWASA	642	5	5	0.0	1	0	0.0%	5	2.0	1	2.0	6.1%	5	5.0	1	5.0	14.3%	9.3%	$22.6 M	$10.4 M	$33.0 M	$6.6 M	$42.4 M	$8.9	$0.6
Orange County	840	1	2	1.0	1	1	4.3%	2	1.0	1	1.0	3.0%	2	2.0	1.5	3.0	9.5%	5.6%	$14.6 M	$8.2 M	$22.8 M	$7.6 M	$33.8 M	$1.8	$1.1
Pittsboro	565	0	6	0.0	0	0	0.0%	6	2.0	1.5	3.0	9.1%	6	6.0	1.5	9.0	28.6%	16.7%	$29.5 M	$21.5 M	$51.0 M	$5.7 M	$64.6 M	$1.7	$0.7
Total	--		**47.5**	**20.5**	--	**23**	**100%**	**47.5**	**28.0**	--	**33**	**100%**	**47.5**	**40.0**	--	**54**	**21.0**	**100%**	**$269.6 M**	**$75.4 M**	**$345.0 M**	**$6.4 M**	**$752.4 M**	**$1.8**	**$1.1**

Water Facilities Cost Share Distribution

Partner	Shared Facilities									Separate Facilities					
	Intake & Pipelines	RWPS		Jordan Lake WTP		South Durham WTP		Shared RW Main	Shared FW Main	Chatham County	Durham	OWASA	Orange County	Pittsboro	Hillsboro
		Initial	Expansion	Initial	Expansion	Initial	Expansion			FW Main	BPS	BPS	BPS	FW Main	--
Capacity (mgd):	**54**	**33**	**54**	**13**	**25**	**20**	**29**	**29**	**29**	**16**	--	--	**1/3**	**9**	--
Chatham County	29.6%	30.3%	28.6%	76.9%	50.0%	--	--	--	--	100%	--	--	--	--	--
Durham	38.9%	51.5%	19.0%	--	--	85.0%	44.4%	72.4%	72.4%	--	N/A	--	--	--	--
OWASA	9.3%	6.1%	14.3%	--	--	10.0%	33.3%	17.2%	17.2%	--	--	--	--	--	--
Orange County	5.6%	3.0%	9.5%	--	--	5.0%	22.2%	10.3%	10.3%	--	--	--	100.0%	--	--
Pittsboro	16.7%	9.1%	28.6%	23.1%	50.0%	--	--	--	--	--	--	--	--	100.0%	--
Hillsborough	0.0%	0.0%	0.0%	--	--	0.0%	0.0%	0.0%	0.0%	--	--	--	--	--	--
TOTAL:	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	--	--	--	--	--	--

(1) Includes capital costs for a new Jordan Lake Western intake, raw water transmission facilities, new water treatment plants (WTPs) located at the Durham South District Wastewater Treatment Plant (WWTP) (to serve Durham, OWASA, Hillsboro, and Orange County) and at the OWASA Jordan Lake property (for Chatham County and Pittsboro), and related shared and separate finished water pumping and transmission lines. Also, where applicable, costs are included for purchase of land/easements, environmental mitigation, and water storage allocations. All costs are in constant year 2014 dollars and include costs for construction, contractor profit and overhead, engineering, legal and permitting expenses, and an overall 25% contingency. Capital funding for the initial facilities (see note 2 below) is assumed to occur in year 2015 and construction is assumed to be completed in year 2020.

(2) The Western Jordan Lake intake and all pipelines are sized to meet ultimate (year 2060) maximum day demands. Capital cost for each partner is calculated as a direct ratio of the partner's ultimate capacity to total ultimate facility capacity. The WTPs and pumping stations are assumed to be constructed in phases, with initial sizing to meet interim (year 2040) demands. For these facilities, capital cost for each partner is calculated as a direct ratio of the partner's interim capacity to total interim facility capacity.

(3) Facility expansion is based on the ultimate capacity in year 2060. Financing is assumed to occur in 2037 and construction completion in 2040. Capital cost for each partner is calculated as a direct ratio of the partner's incremental increase in capacity from year 2040 to year 2060 to the total increase in facility capacity.

(4) All capital and life-cycle costs are in 2014 dollars.

(5) The present analysis assumes that each partner will maintain/obtain a Level I Allocation. No costs are included for Level II Allocations.

Jordan Lake Joint Development – South Durham and Jordan Lake Water Treatment Facilities

SUMMARY of VARIABLES

Description	Value	Units	Notes
General			
Current ENR CCI:	9795.92		May 2014
Project Cost Start Date:	2010		
Project Cost Begin Capital Finance:	2015		
Project Cost Complete Initial Construction:	2020		
Project Cost Complete Expansion:	2040		
Project Cost End Date:	2060		
Project Cost Lifespan:	50	years	

Calculation of Capital Costs

Updated EPA cost curves (2010, ENR CCI 8802) for Water Treatment Facilities
Includes ozone, UV, GAC, & residuals.
Does not Include Land, Contractor Profit & Overhead, engineering, legal costs, or contingencies
Add 10% for provisions for plant expansion
Add 20% for expansion phasing

Cost = a*(Q+1)^b	Capacity (mgd)	Construction Cost (2010 $)
R^2 = 0.99958	42	$82,645,000
a = 3097698.29	62	$114,109,000
b = 0.8446521286	+20	$31,464,000

Contractor Mobilization, Overhead, and Profit:	15%	
Engineering Studies, Design, and Construction Services:	15%	
Land Acquisition and Easements:	Project Specific	
Legal Fees, Permits, and Approvals:	5%	
Contingency:	25%	
Raw and Finished Water Main - Rural:	$9.00	per inch-diameter/ft
Raw and Finished Water Main - Urban:	$15.00	per inch-diameter/ft

Calculation of Life Cycle Costs

General Conditions

Discount Rate:	1.295%	

Capital /Rehabilitation and Replacement Costs

Issuing Expense:	0.0%	
Capital Recovery Interest Rate:	3.225%	
Financing Term (Years):	25	years
Equipment Lifespan:	25	years
Pipelines/Structures Lifespan:	50	years
Equipment Replacement as % of Total Construction Cost:	15%	
Number of Years Replacement Equipment Defrayed Over:	5	years
Cost multiplier for shared pumping facilities w/ high-low pumps:	1.02	

Operation and Maintenance Costs

Annual O&M Costs as Percent of Construction Costs:	10%	
Fixed O&M Costs as % of Total O&M Costs:	70%	
Variable O&M Costs as % of Total O&M Costs:	30%	
Variable O&M Cost Constant (mgd, 70% eff, Kw-hr/yr):	2,195	
Energy Cost:	$0.092	per kW-hr electrical energy

Level I Allocation Costs

Total Purchase Cost:	$91,040.76	per mgd
Annual Cost for Subsequent Years:	$2,218.85	per mgd/yr
Additional Fixed Administration Cost (annual):	$250	

Level II Allocation Costs

Total Annual Cost :	$2,218.85	per mgd/yr
Additional Fixed Administration Cost (annual):	$250	

USACE Easement Acquisition

Easement for Intake and RW Main	2.1	Acres
Estimated lump sum cost	$200,000	

WTP Site Land Acquisition

OWASA WTP Site Acreage	125	acres
Cost per Acre	$10,000	per acre
WTP Site EL:	332	ft
Jordan Lake NP EL:	216	ft

Pipeline Sizing

Partner (s) Served	% Share of Pipeline, Capacity & Characteristics			Fin Ch.	Fin P.	WTP Share (mgd)	Diam (inch) V = 6
	Raw	Raw G1	Fin. G2				
Chatham Co.	30%	--	--	100%	--	16.0	30
Durham	39%	72%	72%	--	--	21.0	36
OWASA	9%	17%	17%	--	--	5.0	16
Orange Co.	6%	10%	10%	--	--	3.0	12
Pittsboro	17%	--	--	--	100%	9.0	24
Hillsboro	0%	0%	0%	--	--		
Total:	100%	100%	100%	100%	100%		
Design Peak Pumping Capacity (mgd)	54	29	29	16	9		
Design Pipeline Velocity (ft/s):	6	5	5	6	6		
Calculated Pipeline Diam. (inches):	54	42	42	30	24		
Length (ft):	3,000	91,800	18,800	48,800	31,552		
Calculated Velocity (ft/s):	5.3	4.7	4.7	5.0	4.4		
Pipeline head Loss (C=120) for use in calculating variable operating costs							
HL in Year 2020 @ Avg Pumped Flow (ft):	0.8	63.0	12.9	23.8	0.0		
HL in Year 2040 @ Avg Pumped Flow (ft):	1.4	77.0	15.8	3.1	6.0		
HL in Year 2060 @ Avg Pumped Flow (ft):	2.8	108.8	22.3	23.8	45.5		

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – South Durham and Jordan Lake Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Chatham County

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	6	18	18	18	--
Chatham County Capacity (equal to maximum day demand, mgd):	--	5.0	10.0	16.0	--
Average Water Use:	--	3.0	6.5	10.5	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Chatham County Share of System Capacity (mgd):	--	10.0	6.0 inc.	16.0	--
% Total Capacity & Fixed Operating Cost Share:	--	30.3%	28.6%	29.6%	--
% Average Capacity & Variable Operating Cost Share:	--	14.6%	23.2%	26.3%	
Jordan Lake WTP Design Capacity - Chatham County / Pittsboro (mgd):	--	13.0	25.0	25.0	25.0
Jordan Lake WTP Expansion Increment (mgd):	--	--	12	--	--
Chatham County Share of Jordan Lake WTP Capacity (mgd):	--	10.0	6.0 inc.	16.0	16
% Total Capacity & Fixed Operating Cost Share:	--	76.9%	50.0%	64.0%	64.0%
Friction Head Applied to Variable Operating Costs (ft):	--	25	5	27	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	449	429	451	--
Chatham County Pressure Zone (ft):		**740**			

CAPITAL COSTS (2014 Dollars)									Allocated to Chatham County		
										Costs Subtotals	
No.	Description		Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total		Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)			1	LS	$9,500,000	$9,500,000	29.6%		$2,815,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)		48 in	2,000	LF	$2,870	$5,739,130	29.6%		$1,700,000	
	Pipeline to New Raw Water Pump Station		54 in	6,625	LF	$423	$2,799,783	29.6%		$830,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**										
	Interim Capacity	33 mgd		1	LS	$8,420,000	$8,420,000	30.3%		$2,552,000	
	Ultimate Capacity	54 mgd		1	LS	$4,110,000	$4,110,000	28.6%			$1,174,000
4	**Jordan Lake WTP (Shared with Pittsboro, includes High Service PS to deliver to Chatham/Pittsboro)**										
	Interim Capacity	13 mgd		1	LS	$30,639,000	$30,639,000	76.9%		$23,568,000	
	Ultimate Capacity	25 mgd		1	LS	$22,958,000	$22,958,000	50.0%			$11,479,000
5	**Finished Water Transmission Pipeline**										
	Chatham County Finished Water Transmission - Rural		30 in	48,800	LF	$235	$11,457,391	100.0%		$11,457,000	
6						**CONSTRUCTION COST SUBTOTAL**				**$42,930,000**	**$12,660,000**
	CAPITAL COST ALLOWANCES										
7						**Contractor Mobilization, Overhead & Profit (@ 15% x Line 6)**			15%	$6,440,000	$1,899,000
8						**TOTAL CONSTRUCTION COST**				**$49,370,000**	**$14,559,000**
9						**Engineering Studies, Design, and Construction Services (@ 15% x Line 6)**			15%	$6,440,000	$1,899,000
10						**Subtotal**				**$55,810,000**	**$16,458,000**
11	**Land Acquisition and Easements**	Jordan Lake WTP Site		63	Acre	$10,000	$625,000	64.0%		$400,000	
12		USACE Jordan Lake Easement		1	LS	$200,000	$200,000	29.6%		$59,000	
13		Allowance for Additional Land/Easement		1	LS	$50,000	$50,000	100.0%		$50,000	
14		Mitigation Costs for Stream Impacts		268	LF	$374	$100,145	100.0%		$100,000	
15		Mitigation Costs for Wetlands Impacts		0.43	Acre	$68,502	$29,228	100.0%		$29,000	
15						**Subtotal**				**$56,448,000**	**$16,458,000**
16						**Legal Fees, Permits and Approvals (@ 5% x Line 8)**			5%	$2,469,000	$728,000
17						**Subtotal**				**$58,917,000**	**$17,186,000**
18						**Contingency (@ 25% x Line 17)**			25%	$14,729,000	$4,297,000
19										**$73,646,000**	**$21,483,000**
20						**ESTIMATED PROJECT CAPITAL COST:**				**$95,129,000**	
				Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total			
21	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)		2022	12	mgd	$91,041	$1,092,489	100.0%		$1,093,000	
22	Annual Allocation O&M cost (included in life-cycle analysis)			Varies	mgd	$2,219					
23	Additional Fixed Administration Cost (annual)			1	LS	$250					
24						**Subtotal Allocation Capital Costs:**				**$1,093,000.00**	**$0.00**
25						**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**				**$74,700,000**	**$21,500,000**
26										**$96,200,000**	
27						**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**				**$194,200,000**	
28						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**				**$1.96**	
29						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**				**$0.72**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Chatham County

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 67%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
Year	# Yrs from 2014	WTP Capacity	Water Quantity (mgd)		Construction Capital Financing	Other Capital / Fixed Costs		O&M Costs		Total Annual Costs			
			Jordan Lake Allocation	Avg. Usage		Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Running Present Per 1,000 gal's Allocation	Running Present Per 1,000 gal's Pumped
1	0												
2	1				$4,392,000					$4,392,000	$4,336,000		
3	2				$4,392,000					$4,392,000	$4,280,000		
4	3				$4,392,000					$4,392,000	$4,226,000		
5	4				$4,392,000					$4,392,000	$4,172,000		
6	5				$4,392,000					$4,392,000	$4,118,000		
7	6	33	18	3.0	$4,392,000		$1,195,000	$1,138,000	$528,000	$7,253,000	$6,714,000	$4.24	$25.43
8	7	33	18	3.2	$4,392,000		$44,000	$1,152,000	$552,000	$6,140,000	$5,611,000	$2.55	$14.84
9	8	33	18	3.4	$4,392,000		$45,000	$1,167,000	$577,000	$6,181,000	$5,576,000	$1.98	$11.23
10	9	33	18	3.5	$4,392,000		$45,000	$1,183,000	$602,000	$6,222,000	$5,542,000	$1.70	$9.36
11	10	33	18	3.7	$4,392,000		$46,000	$1,198,000	$628,000	$6,264,000	$5,508,000	$1.52	$8.19
12	11	33	18	3.9	$4,392,000		$46,000	$1,213,000	$654,000	$6,305,000	$5,473,000	$1.41	$7.38
13	12	33	18	4.1	$4,392,000		$47,000	$1,229,000	$681,000	$6,349,000	$5,441,000	$1.33	$6.77
14	13	33	18	4.2	$4,392,000		$47,000	$1,245,000	$708,000	$6,392,000	$5,407,000	$1.26	$6.30
15	14	33	18	4.4	$4,392,000		$48,000	$1,261,000	$736,000	$6,437,000	$5,376,000	$1.21	$5.91
16	15	33	18	4.6	$4,392,000		$49,000	$1,277,000	$765,000	$6,483,000	$5,345,000	$1.17	$5.58
17	16	33	18	4.8	$4,392,000		$49,000	$1,294,000	$794,000	$6,529,000	$5,314,000	$1.14	$5.30
18	17	33	18	4.9	$4,392,000		$50,000	$1,311,000	$824,000	$6,577,000	$5,285,000	$1.11	$5.05
19	18	33	18	5.1	$4,392,000		$51,000	$1,328,000	$855,000	$6,626,000	$5,256,000	$1.09	$4.84
20	19	33	18	5.3	$4,392,000		$51,000	$1,345,000	$886,000	$6,674,000	$5,227,000	$1.07	$4.64
21	20	33	18	5.5	$4,392,000		$52,000	$1,362,000	$918,000	$6,724,000	$5,198,000	$1.05	$4.47
22	21	33	18	5.6	$6,049,000		$53,000	$1,380,000	$951,000	$8,433,000	$6,436,000	$1.04	$4.36
23	22	33	18	5.8	$6,049,000		$53,000	$1,398,000	$984,000	$8,484,000	$6,392,000	$1.04	$4.26
24	23	33	18	6.0	$6,049,000		$54,000	$1,416,000	$1,018,000	$8,537,000	$6,350,000	$1.04	$4.16
25	24	33	18	6.2	$6,049,000		$55,000	$1,434,000	$1,053,000	$8,591,000	$6,309,000	$1.03	$4.06
26	25	33	18	6.3	$6,049,000		$55,000	$1,453,000	$1,088,000	$8,645,000	$6,267,000	$1.03	$3.97
27	26	54	18	6.5	$1,657,000		$56,000	$1,472,000	$1,124,000	$4,309,000	$3,084,000	$1.00	$3.80
28	27	54	18	6.7	$1,657,000		$57,000	$1,491,000	$1,164,000	$4,369,000	$3,087,000	$0.98	$3.64
29	28	54	18	6.9	$1,657,000		$58,000	$1,510,000	$1,205,000	$4,430,000	$3,090,000	$0.96	$3.49
30	29	54	18	7.1	$1,657,000		$58,000	$1,530,000	$1,247,000	$4,492,000	$3,093,000	$0.94	$3.36
31	30	54	18	7.3	$1,657,000	$3,250,000	$59,000	$1,549,000	$1,290,000	$7,805,000	$5,306,000	$0.93	$3.28
32	31	54	18	7.5	$1,657,000	$3,292,000	$60,000	$1,569,000	$1,333,000	$7,911,000	$5,309,000	$0.93	$3.20
33	32	54	18	7.7	$1,657,000	$3,335,000	$61,000	$1,590,000	$1,378,000	$8,021,000	$5,314,000	$0.92	$3.13
34	33	54	18	7.9	$1,657,000	$3,378,000	$61,000	$1,610,000	$1,423,000	$8,129,000	$5,317,000	$0.92	$3.06
35	34	54	18	8.1	$1,657,000	$3,422,000	$62,000	$1,631,000	$1,470,000	$8,242,000	$5,322,000	$0.91	$3.00
36	35	54	18	8.3	$1,657,000		$63,000	$1,652,000	$1,517,000	$4,889,000	$3,116,000	$0.90	$2.90
37	36	54	18	8.5	$1,657,000		$64,000	$1,674,000	$1,565,000	$4,960,000	$3,121,000	$0.89	$2.81
38	37	54	18	8.7	$1,657,000		$65,000	$1,695,000	$1,615,000	$5,032,000	$3,126,000	$0.87	$2.72
39	38	54	18	8.9	$1,657,000		$65,000	$1,717,000	$1,665,000	$5,104,000	$3,130,000	$0.86	$2.64
40	39	54	18	9.1	$1,657,000		$66,000	$1,740,000	$1,716,000	$5,179,000	$3,136,000	$0.85	$2.57
41	40	54	18	9.3	$1,657,000		$67,000	$1,762,000	$1,769,000	$5,255,000	$3,141,000	$0.84	$2.50
42	41	54	18	9.5	$1,657,000		$68,000	$1,785,000	$1,822,000	$5,332,000	$3,146,000	$0.83	$2.43
43	42	54	18	9.7	$1,657,000		$69,000	$1,808,000	$1,877,000	$5,411,000	$3,152,000	$0.82	$2.36
44	43	54	18	9.9	$1,657,000		$70,000	$1,831,000	$1,933,000	$5,491,000	$3,158,000	$0.81	$2.30
45	44	54	18	10.1	$1,657,000		$71,000	$1,855,000	$1,989,000	$5,572,000	$3,163,000	$0.80	$2.24
46	45	54	18	10.3	$1,657,000		$72,000	$1,879,000	$2,047,000	$5,655,000	$3,169,000	$0.79	$2.19
47	46	54	18	10.5		-$30,201,788	$72,000	$1,904,000	$2,107,000	-$26,119,000	-$14,451,000	$0.72	$1.96
Totals:	--	--	--	**271.8**	**$151,225,000**	**-$13,524,788**	**$3,479,000**	**$61,038,000**	**$49,058,000**	**$251,275,000**	**$194,188,000**	**$0.72**	**$1.96**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – South Durham and Jordan Lake Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Durham

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	10.0	16.5	16.5	16.5	--
Durham Capacity (equal to maximum day demand, mgd):	--	17.0	17.0	21.0	--
Average Water Use:	--	16.5	16.5	16.5	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Durham Share of System Capacity (mgd):	--	17.0	4.0 inc.	21.0	--
% Total Capacity & Fixed Operating Cost Share:	--	51.5%	19.0%	38.9%	--
% Avg. Capacity & Variable Operating Cost Share:	--	80.5%	58.9%	41.3%	--
South Durham WTP Design Capacity (mgd):	--	20.0	29.0	29.0	8.0
South Durham WTP Expansion Increment (mgd):	--	--	9	--	--
Durham Share of South District WTP Capacity (mgd):	--	17.0	4.0 inc.	21.0	0.0
% Total Capacity & Fixed Operating Cost Share:	--	85.0%	44.4%	72.4%	0.0%
Friction Head Applied to Variable Operating Costs (ft):	--	76.8	94.2	133.9	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	329	346	386	--
Durham Pressure Zone (ft):		**568**			

	CAPITAL COSTS (2014 Dollars)								Allocated to Durham		
										Costs Subtotals	
No.	Description		Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**									
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)			1	LS	$9,500,000	$9,500,000	38.9%	$3,694,000	
2	**Intake Piping (Shared)**									
	Dual Microtunneled Intake Lines (sized for 54 mgd total)		48 in	2,000	LF	$2,870	$5,739,130	38.9%	$2,232,000	
	Pipeline to New Raw Water Pump Station		54 in	6,625	LF	$423	$2,799,783	38.9%	$1,089,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**									
	Interim Capacity	33 mgd		1	LS	$8,420,000	$8,420,000	51.5%	$4,338,000	
	Ultimate Capacity	54 mgd		1	LS	$4,110,000	$4,110,000	19.0%		$783,000
4	**South Durham WTP (Shared, includes High Service PS, includes High Service PS to deliver to Durham/Orange/OWASA)**									
	Interim Capacity	20 mgd		1	LS	$43,153,000	$43,153,000	85.0%	$36,680,000	
	Ultimate Capacity	29 mgd		1	LS	$16,551,000	$16,551,000	44.4%		$7,356,000
5	**Shared Raw Water Transmission Pipeline**									
	Jordan Lake RWPS to South Durham WTP - Rural		42 in	91,800	LF	$329	$30,174,261	72.4%	$21,850,000	
6	**Shared Finished Water Transmission Pipeline**									
	South Durham WTP to Durham / OWASA Interconnect - Rural		42 in	15,300	LF	$329	$5,029,043	72.4%	$3,642,000	
	South Durham WTP to Durham / OWASA Interconnect - Urban		42 in	3,500	LF	$548	$1,917,391	72.4%	$1,388,000	
7						**CONSTRUCTION COST SUBTOTAL**			**$74,920,000**	**$8,140,000**
	CAPITAL COST ALLOWANCES									
8						**Contractor Mobilization, Overhead & Profit (@ 15% x Line 7)**		15%	$11,238,000	$1,221,000
9						**TOTAL CONSTRUCTION COST**			**$86,158,000**	**$9,361,000**
10						**Engineering Studies, Design, and Construction Services (@ 15% x Line 7)**		15%	$11,238,000	$1,221,000
11						**Subtotal**			**$97,396,000**	**$10,582,000**
12	**Land Acquisition and Easements**	South Durham WTP Site		63	Acre	$10,000	$625,000	0.0%	$0	
13		USACE Jordan Lake Easement		1	LS	$200,000	$200,000	38.9%	$78,000	
14		Allowance for Additional Land/Easement		1	LS	$100,000	$100,000	100.0%	$100,000	
15		Mitigation Costs for Stream Impacts		403	LF	$374	$150,901	100.0%	$151,000	
16		Mitigation Costs for Wetlands Impacts		0.84	Acre	$68,502	$57,707	100.0%	$58,000	
17						**Subtotal**			**$97,783,000**	**$10,582,000**
18						**Legal Fees, Permits and Approvals (@ 5% x Line 9)**		5%	$4,308,000	$468,000
19						**Subtotal**			**$102,091,000**	**$11,050,000**
20						**Contingency (@ 25% x Line 19)**		25%	$25,523,000	$2,763,000
21									**$127,614,000**	**$13,813,000**
22						**ESTIMATED PROJECT CAPITAL COST:**			**$141,427,000**	
				Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
23	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)		2022	7	mgd	$91,041	$591,765	100.0%	$592,000	
24	Annual Allocation O&M cost (included in life-cycle analysis)			Varies	mgd	$2,219				
25	Additional Fixed Administration Cost (annual)			1	LS	$250				
26						**Subtotal Allocation Capital Costs:**			**$592,000.00**	**$0.00**
27						**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$128,200,000**	**$13,800,000**
28									**$142,000,000**	
29						**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$417,372,000**	
30						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.69**	
31						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$1.69**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Durham

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 62%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs		Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$7,611,000					$7,611,000	$7,514,000		
3	2				$7,611,000					$7,611,000	$7,418,000		
4	3				$7,611,000					$7,611,000	$7,323,000		
5	4				$7,611,000					$7,611,000	$7,229,000		
6	5				$7,611,000					$7,611,000	$7,137,000		
7	6	33	16.5	16.5	$7,611,000		$663,000	$3,059,000	$3,227,000	$14,560,000	$13,478,000	$8.32	$8.32
8	7	33	16.5	16.5	$7,611,000		$40,000	$3,099,000	$3,269,000	$14,019,000	$12,812,000	$5.22	$5.22
9	8	33	16.5	16.5	$7,611,000		$41,000	$3,139,000	$3,312,000	$14,103,000	$12,724,000	$4.19	$4.19
10	9	33	16.5	16.5	$7,611,000		$41,000	$3,180,000	$3,354,000	$14,186,000	$12,635,000	$3.66	$3.66
11	10	33	16.5	16.5	$7,611,000		$42,000	$3,221,000	$3,398,000	$14,272,000	$12,549,000	$3.35	$3.35
12	11	33	16.5	16.5	$7,611,000		$42,000	$3,263,000	$3,442,000	$14,358,000	$12,463,000	$3.13	$3.13
13	12	33	16.5	16.5	$7,611,000		$43,000	$3,305,000	$3,486,000	$14,445,000	$12,378,000	$2.98	$2.98
14	13	33	16.5	16.5	$7,611,000		$44,000	$3,348,000	$3,532,000	$14,535,000	$12,296,000	$2.86	$2.86
15	14	33	16.5	16.5	$7,611,000		$44,000	$3,391,000	$3,577,000	$14,623,000	$12,212,000	$2.77	$2.77
16	15	33	16.5	16.5	$7,611,000		$45,000	$3,435,000	$3,624,000	$14,715,000	$12,132,000	$2.69	$2.69
17	16	33	16.5	16.5	$7,611,000		$45,000	$3,479,000	$3,671,000	$14,806,000	$12,051,000	$2.63	$2.63
18	17	33	16.5	16.5	$7,611,000		$46,000	$3,524,000	$3,718,000	$14,899,000	$11,972,000	$2.58	$2.58
19	18	33	16.5	16.5	$7,611,000		$46,000	$3,570,000	$3,766,000	$14,993,000	$11,893,000	$2.53	$2.53
20	19	33	16.5	16.5	$7,611,000		$47,000	$3,616,000	$3,815,000	$15,089,000	$11,816,000	$2.49	$2.49
21	20	33	16.5	16.5	$7,611,000		$48,000	$3,663,000	$3,864,000	$15,186,000	$11,740,000	$2.45	$2.45
22	21	33	16.5	16.5	$8,677,000		$48,000	$3,711,000	$3,915,000	$16,351,000	$12,479,000	$2.43	$2.43
23	22	33	16.5	16.5	$8,677,000		$49,000	$3,759,000	$3,965,000	$16,450,000	$12,395,000	$2.41	$2.41
24	23	33	16.5	16.5	$8,677,000		$49,000	$3,807,000	$4,017,000	$16,550,000	$12,310,000	$2.39	$2.39
25	24	33	16.5	16.5	$8,677,000		$50,000	$3,857,000	$4,069,000	$16,653,000	$12,229,000	$2.37	$2.37
26	25	33	16.5	16.5	$8,677,000		$51,000	$3,907,000	$4,121,000	$16,756,000	$12,147,000	$2.35	$2.35
27	26	54	16.5	16.5	$1,066,000		$51,000	$3,957,000	$4,175,000	$9,249,000	$6,619,000	$2.29	$2.29
28	27	54	16.5	16.5	$1,066,000		$52,000	$4,008,000	$4,229,000	$9,355,000	$6,609,000	$2.24	$2.24
29	28	54	16.5	16.5	$1,066,000		$53,000	$4,060,000	$4,283,000	$9,462,000	$6,600,000	$2.19	$2.19
30	29	54	16.5	16.5	$1,066,000		$53,000	$4,113,000	$4,339,000	$9,571,000	$6,590,000	$2.14	$2.14
31	30	54	16.5	16.5	$1,066,000	$5,632,000	$54,000	$4,166,000	$4,395,000	$15,313,000	$10,409,000	$2.13	$2.13
32	31	54	16.5	16.5	$1,066,000	$5,705,000	$55,000	$4,220,000	$4,452,000	$15,498,000	$10,400,000	$2.11	$2.11
33	32	54	16.5	16.5	$1,066,000	$5,779,000	$56,000	$4,275,000	$4,510,000	$15,686,000	$10,392,000	$2.10	$2.10
34	33	54	16.5	16.5	$1,066,000	$5,854,000	$56,000	$4,330,000	$4,568,000	$15,874,000	$10,382,000	$2.08	$2.08
35	34	54	16.5	16.5	$1,066,000	$5,929,000	$57,000	$4,386,000	$4,627,000	$16,065,000	$10,373,000	$2.07	$2.07
36	35	54	16.5	16.5	$1,066,000		$58,000	$4,443,000	$4,687,000	$10,254,000	$6,536,000	$2.04	$2.04
37	36	54	16.5	16.5	$1,066,000		$58,000	$4,501,000	$4,748,000	$10,373,000	$6,527,000	$2.01	$2.01
38	37	54	16.5	16.5	$1,066,000		$59,000	$4,559,000	$4,809,000	$10,493,000	$6,518,000	$1.98	$1.98
39	38	54	16.5	16.5	$1,066,000		$60,000	$4,618,000	$4,872,000	$10,616,000	$6,511,000	$1.95	$1.95
40	39	54	16.5	16.5	$1,066,000		$61,000	$4,678,000	$4,935,000	$10,740,000	$6,502,000	$1.93	$1.93
41	40	54	16.5	16.5	$1,066,000		$62,000	$4,738,000	$4,999,000	$10,865,000	$6,494,000	$1.90	$1.90
42	41	54	16.5	16.5	$1,066,000		$62,000	$4,800,000	$5,063,000	$10,991,000	$6,485,000	$1.88	$1.88
43	42	54	16.5	16.5	$1,066,000		$63,000	$4,862,000	$5,129,000	$11,120,000	$6,478,000	$1.86	$1.86
44	43	54	16.5	16.5	$1,066,000		$64,000	$4,925,000	$5,195,000	$11,250,000	$6,469,000	$1.84	$1.84
45	44	54	16.5	16.5	$1,066,000		$65,000	$4,989,000	$5,263,000	$11,383,000	$6,462,000	$1.82	$1.82
46	45	54	16.5	16.5	$1,066,000		$66,000	$5,053,000	$5,331,000	$11,516,000	$6,454,000	$1.80	$1.80
47	46	54	16.5	16.5		-$39,088,473	$66,000	$5,119,000	$5,400,000	-$28,503,000	-$15,770,000	$1.69	$1.69
Totals:	--	--	--	**676.5**	**$216,925,000**	**-$10,189,473**	**$2,755,000**	**$164,133,000**	**$173,151,000**	**$546,775,000**	**$417,372,000**	**$1.69**	**$1.69**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – South Durham and Jordan Lake Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
OWASA

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	5.0	5.0	5.0	5.0	--
OWASA Capacity (equal to maximum day demand, mgd):	--	0.0	2.0	5.0	--
Average Water Use:	--	0.0	2.0	5.0	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
OWASA Share of System Capacity (mgd):	--	2.0	3.0 inc.	5.0	--
% Total Capacity & Fixed Operating Cost Share:	--	6.1%	14.3%	9.3%	--
% Avg. Capacity & Variable Operating Cost Share:	--	0.0%	7.1%	12.5%	--
South Durham WTP Design Capacity (mgd):	--	20.0	29.0	29.0	8.0
South Durham WTP Expansion Increment (mgd):	--	--	9	--	--
OWASA Share of South District WTP Capacity (mgd):	--	2.0	3.0 inc.	5.0	5.0
% Total Capacity & Fixed Operating Cost Share:	--	10.0%	33.3%	17.2%	62.5%
Friction Head Applied to Variable Operating Costs (ft):	--	76.8	94.2	133.9	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	403	420	460	--
OWASA Pressure Zone (ft):		**642**			

CAPITAL COSTS (2014 Dollars)									Allocated to OWASA		
										Costs Subtotals	
No.	Description		Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**									
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)			1	LS	$9,500,000	$9,500,000	9.3%	$880,000	
2	**Intake Piping (Shared)**									
	Dual Microtunneled Intake Lines (sized for 54 mgd total)		48 in	2,000	LF	$2,870	$5,739,130	9.3%	$531,000	
	Pipeline to New Raw Water Pump Station		54 in	6,625	LF	$423	$2,799,783	9.3%	$259,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**									
	Interim Capacity	33 mgd		1	LS	$8,420,000	$8,420,000	6.1%	$510,000	
	Ultimate Capacity	54 mgd		1	LS	$4,110,000	$4,110,000	14.3%		$587,000
4	**South Durham WTP (Shared, includes High Service PS, includes High Service PS to deliver to Durham/Orange/OWASA)**									
	Interim Capacity	20 mgd		1	LS	$43,153,000	$43,153,000	10.0%	$4,315,000	
	Ultimate Capacity	29 mgd		1	LS	$16,551,000	$16,551,000	33.3%		$5,517,000
5	**Shared Raw Water Transmission Pipeline**									
	Jordan Lake RWPS to South Durham WTP - Rural		42 in	91,800	LF	$329	$30,174,261	17.2%	$5,202,000	
6	**Shared Finished Water Transmission Pipeline**									
	South Durham WTP to Durham / OWASA Interconnect - Rural		42 in	15,300	LF	$329	$5,029,043	17.2%	$867,000	
	South Durham WTP to Durham / OWASA Interconnect - Urban		42 in	3,500	LF	$548	$1,917,391	17.2%	$331,000	
7						**CONSTRUCTION COST SUBTOTAL**			**$12,900,000**	**$6,110,000**
	CAPITAL COST ALLOWANCES									
8						**Contractor Mobilization, Overhead & Profit (@ 15% x Line 7)**		15%	$1,935,000	$917,000
9						**TOTAL CONSTRUCTION COST**			**$14,835,000**	**$7,027,000**
10						**Engineering Studies, Design, and Construction Services (@ 15% x Line 7)**		15%	$1,935,000	$917,000
11						**Subtotal**			**$16,770,000**	**$7,944,000**
12	**Land Acquisition and Easements**	South Durham WTP Site		63	Acre	$10,000	$625,000	62.5%	$391,000	
13		USACE Jordan Lake Easement		1	LS	$200,000	$200,000	9.3%	$19,000	
14		Allowance for Additional Land/Easement		1	LS	$100,000	$100,000	100.0%	$100,000	
15		Mitigation Costs for Stream Impacts		96	LF	$374	$35,929	100.0%	$36,000	
16		Mitigation Costs for Wetlands Impacts		0.20	Acre	$68,502	$13,740	100.0%	$14,000	
17						**Subtotal**			**$17,330,000**	**$7,944,000**
18						**Legal Fees, Permits and Approvals (@ 5% x Line 9)**		5%	$742,000	$351,000
19						**Subtotal**			**$18,072,000**	**$8,295,000**
20						**Contingency (@ 25% x Line 19)**		25%	$4,518,000	$2,074,000
21									**$22,590,000**	**$10,369,000**
22						**ESTIMATED PROJECT CAPITAL COST:**			**$32,959,000**	
				Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
23	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)		2022	0	mgd	$91,041	$0	100.0%	$0	
24	Annual Allocation O&M cost (included in life-cycle analysis)			Varies	mgd	$2,219				
25	Additional Fixed Administration Cost (annual)			1	LS	$250				
26						**Subtotal Allocation Capital Costs:**			**$0.00**	**$0.00**
27						**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$22,600,000**	**$10,400,000**
28									**$33,000,000**	
29						**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$42,407,000**	
30						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$8.94**	
31						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.57**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for OWASA

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 47%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs		Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$1,347,000					$1,347,000	$1,330,000		
3	2				$1,347,000					$1,347,000	$1,313,000		
4	3				$1,347,000					$1,347,000	$1,296,000		
5	4				$1,347,000					$1,347,000	$1,279,000		
6	5				$1,347,000					$1,347,000	$1,263,000		
7	6	33	5	0.0	$1,347,000		$12,000	$48,000	$0	$1,407,000	$1,302,000	$4.26	
8	7	33	5		$1,347,000		$12,000	$49,000	$0	$1,408,000	$1,287,000	$2.48	
9	8	33	5		$1,347,000		$13,000	$50,000	$0	$1,410,000	$1,272,000	$1.89	
10	9	33	5		$1,347,000		$13,000	$50,000	$0	$1,410,000	$1,256,000	$1.59	
11	10	33	5		$1,347,000		$13,000	$51,000	$0	$1,411,000	$1,241,000	$1.41	
12	11	33	5	0.5	$1,347,000		$13,000	$52,000	$47,000	$1,459,000	$1,266,000	$1.29	$77.29
13	12	33	5		$1,347,000		$13,000	$52,000	$0	$1,412,000	$1,210,000	$1.20	$83.92
14	13	33	5		$1,347,000		$13,000	$53,000	$0	$1,413,000	$1,195,000	$1.13	$90.47
15	14	33	5		$1,347,000		$14,000	$54,000	$0	$1,415,000	$1,182,000	$1.08	$96.94
16	15	33	5		$1,347,000		$14,000	$54,000	$0	$1,415,000	$1,167,000	$1.03	$103.34
17	16	33	5	1.0	$1,347,000		$14,000	$55,000	$100,000	$1,516,000	$1,234,000	$1.00	$36.70
18	17	33	5		$1,347,000		$14,000	$56,000	$0	$1,417,000	$1,139,000	$0.97	$38.78
19	18	33	5		$1,347,000		$14,000	$57,000	$0	$1,418,000	$1,125,000	$0.94	$40.83
20	19	33	5		$1,347,000		$14,000	$57,000	$0	$1,418,000	$1,110,000	$0.92	$42.86
21	20	33	5		$1,347,000		$15,000	$58,000	$0	$1,420,000	$1,098,000	$0.90	$44.87
22	21	33	5	1.5	$2,147,000		$15,000	$59,000	$159,000	$2,380,000	$1,816,000	$0.90	$24.09
23	22	33	5		$2,147,000		$15,000	$60,000	$0	$2,222,000	$1,674,000	$0.90	$25.62
24	23	33	5		$2,147,000		$15,000	$60,000	$0	$2,222,000	$1,653,000	$0.90	$27.13
25	24	33	5		$2,147,000		$15,000	$61,000	$0	$2,223,000	$1,632,000	$0.90	$28.62
26	25	33	5		$2,147,000		$16,000	$62,000	$0	$2,225,000	$1,613,000	$0.90	$30.09
27	26	54	5	2.0	$800,000		$16,000	$63,000	$268,000	$1,147,000	$821,000	$0.88	$18.51
28	27	54	5		$800,000		$16,000	$64,000	$0	$880,000	$622,000	$0.86	$18.85
29	28	54	5		$800,000		$16,000	$64,000	$0	$880,000	$614,000	$0.83	$19.18
30	29	54	5		$800,000		$16,000	$65,000	$0	$881,000	$607,000	$0.81	$19.52
31	30	54	5		$800,000	$997,000	$17,000	$66,000	$0	$1,880,000	$1,278,000	$0.81	$20.22
32	31	54	5	2.0	$800,000	$1,010,000	$17,000	$67,000	$286,000	$2,180,000	$1,463,000	$0.81	$15.01
33	32	54	5		$800,000	$1,023,000	$17,000	$68,000	$0	$1,908,000	$1,264,000	$0.80	$15.51
34	33	54	5		$800,000	$1,036,000	$17,000	$69,000	$0	$1,922,000	$1,257,000	$0.80	$16.00
35	34	54	5		$800,000	$1,050,000	$17,000	$70,000	$0	$1,937,000	$1,251,000	$0.80	$16.49
36	35	54	5		$800,000		$18,000	$70,000	$0	$888,000	$566,000	$0.78	$16.71
37	36	54	5	2.0	$800,000		$18,000	$71,000	$305,000	$1,194,000	$751,000	$0.77	$13.23
38	37	54	5		$800,000		$18,000	$72,000	$0	$890,000	$553,000	$0.75	$13.39
39	38	54	5		$800,000		$18,000	$73,000	$0	$891,000	$546,000	$0.74	$13.56
40	39	54	5		$800,000		$19,000	$74,000	$0	$893,000	$541,000	$0.73	$13.73
41	40	54	5		$800,000		$19,000	$75,000	$0	$894,000	$534,000	$0.71	$13.89
42	41	54	5	2.0	$800,000		$19,000	$76,000	$325,000	$1,220,000	$720,000	$0.71	$11.54
43	42	54	5		$800,000		$19,000	$77,000	$0	$896,000	$522,000	$0.69	$11.67
44	43	54	5		$800,000		$20,000	$78,000	$0	$898,000	$516,000	$0.68	$11.80
45	44	54	5		$800,000		$20,000	$79,000	$0	$899,000	$510,000	$0.67	$11.93
46	45	54	5		$800,000		$20,000	$80,000	$0	$900,000	$504,000	$0.66	$12.05
47	46	54	5	2.0		-$11,325,738	$20,000	$81,000	$406,000	-$10,819,000	-$5,986,000	$0.57	$8.94
Totals:	--	--	--	**13.0**	**$53,675,000**	**-$6,209,738**	**$654,000**	**$2,600,000**	**$1,896,000**	**$52,615,000**	**$42,407,000**	**$0.57**	**$8.94**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – South Durham and Jordan Lake Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for

Orange County

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	1.0	2.0	2.0	2.0	--
Orange County Capacity (equal to maximum day demand, mgd):	--	1.0	1.0	3.0	--
Average Water Use:	--	1.0	1.0	2.0	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Orange County Share of System Capacity (mgd):	--	1.0	2.0 inc.	3.0	--
% Total Capacity & Fixed Operating Cost Share:	--	3.0%	9.5%	5.6%	--
% Avg. Capacity & Variable Operating Cost Share:	--	4.9%	3.6%	5.0%	--
South Durham WTP Design Capacity (mgd):	--	20.0	29.0	29.0	8.0
South Durham WTP Expansion Increment (mgd):	--	--	9	--	--
Orange County Share of South District WTP Capacity (mgd):	--	1.0	2.0 inc.	3.0	3.0
% Total Capacity & Fixed Operating Cost Share:	--	5.0%	22.2%	10.3%	37.5%
Friction Head Applied to Variable Operating Costs (ft):	--	76.8	94.2	133.9	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	601	618	658	--
Orange County Pressure Zone (ft):		**840**			

	CAPITAL COSTS (2014 Dollars)								Allocated to Orange County		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	5.6%	$528,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	5.6%	$319,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	5.6%	$156,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**										
	Interim Capacity	33	mgd		1	LS	$8,420,000	$8,420,000	3.0%	$255,000	
	Ultimate Capacity	54	mgd		1	LS	$4,110,000	$4,110,000	9.5%		$391,000
4	**South Durham WTP (Shared, includes High Service PS, includes High Service PS to deliver to Durham/Orange/OWASA)**										
	Interim Capacity	20	mgd		1	LS	$43,153,000	$43,153,000	5.0%	$2,158,000	
	Ultimate Capacity	29	mgd		1	LS	$16,551,000	$16,551,000	22.2%		$3,678,000
5	**Shared Raw Water Transmission Pipeline**										
	Jordan Lake RWPS to South Durham WTP - Rural			42 in	91,800	LF	$378	$34,700,400	10.3%	$3,590,000	
6	**Shared Finished Water Transmission Pipeline**										
	South Durham WTP to Durham / OWASA Interconnect - Rural			42 in	15,300	LF	$329	$5,029,043	10.3%	$520,000	
	South Durham WTP to Durham / OWASA Interconnect - Urban			42 in	3,500	LF	$548	$1,917,391	10.3%	$198,000	
7	**Finished Water Booster Station**										
	Interim Capacity	1	mgd		1	LS	$530,000	$530,000	100.0%	$530,000	
	Ultimate Capacity	3	mgd		1	LS	$741,818	$741,818	100.0%		$742,000
8							**CONSTRUCTION COST SUBTOTAL**			**$8,260,000**	**$4,820,000**
	CAPITAL COST ALLOWANCES										
9							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 8)**		15.0%	$1,239,000	$723,000
10							**TOTAL CONSTRUCTION COST**			**$9,499,000**	**$5,543,000**
11							**Engineering Studies, Design, and Construction Services (@ 15% x Line 8)**		15.0%	$1,239,000	$723,000
12							**Subtotal**			**$10,738,000**	**$6,266,000**
13	**Land Acquisition and Easements**		South Durham WTP Site		63	Acre	$10,000	$625,000	37.5%	$234,000	
14			USACE Jordan Lake Easement		1	LS	$200,000	$200,000	5.6%	$11,000	
15			Allowance for Additional Land/Easement		1	LS	$100,000	$100,000	100.0%	$100,000	
16			Mitigation Costs for Stream Impacts		58	LF	$374	$21,557	100.0%	$22,000	
17			Mitigation Costs for Wetlands Impacts		0.12	Acre	$68,502	$8,244	100.0%	$8,000	
18							**Subtotal**			**$11,113,000**	**$6,266,000**
19							**Legal Fees, Permits and Approvals (@ 5% x Line 10)**		5.0%	$475,000	$277,000
20							**Subtotal**			**$11,588,000**	**$6,543,000**
21							**Contingency (@ 25% x Line 20)**		25.0%	$2,897,000	$1,636,000
22							**ESTIMATED PROJECT CAPITAL COST:**			**$14,485,000**	**$8,179,000**
23										**$22,664,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
24	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	1	mgd	$91,041	$91,041	100.0%	$91,000	
25	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
26	Additional Fixed Administration Cost (annual)				1	LS	$250				
27							**Subtotal Allocation Capital Costs:**			**$91,000.00**	**$0.00**
28							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$14,600,000**	**$8,200,000**
29										**$22,800,000**	
30							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$33,824,000**	
31							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.80**	
32							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$1.13**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Orange County

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 44%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
Year	# Yrs from 2014	WTP Capacity	Water Quantity (mgd)		Construction Capital Financing	Other Capital / Fixed Costs		O&M Costs		Total Annual Costs		Running Present	
			Jordan Lake Allocation	Avg. Usage		Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$864,000					$864,000	$853,000		
3	2				$864,000					$864,000	$842,000		
4	3				$864,000					$864,000	$831,000		
5	4				$864,000					$864,000	$821,000		
6	5				$864,000					$864,000	$810,000		
7	6	33	2	1.0	$864,000		$93,000	$15,000	$141,000	$1,113,000	$1,030,000	$7.11	$14.21
8	7	33	2	1.0	$864,000		$5,000	$15,000	$143,000	$1,027,000	$939,000	$4.20	$8.39
9	8	33	2	1.0	$864,000		$5,000	$15,000	$144,000	$1,028,000	$927,000	$3.22	$6.44
10	9	33	2	1.0	$864,000		$5,000	$15,000	$146,000	$1,030,000	$917,000	$2.73	$5.46
11	10	33	2	1.0	$864,000		$5,000	$16,000	$148,000	$1,033,000	$908,000	$2.43	$4.86
12	11	33	2	1.0	$864,000		$5,000	$16,000	$150,000	$1,035,000	$898,000	$2.23	$4.46
13	12	33	2	1.0	$864,000		$5,000	$16,000	$152,000	$1,037,000	$889,000	$2.09	$4.17
14	13	33	2	1.0	$864,000		$5,000	$16,000	$154,000	$1,039,000	$879,000	$1.98	$3.95
15	14	33	2	1.0	$864,000		$6,000	$16,000	$156,000	$1,042,000	$870,000	$1.89	$3.78
16	15	33	2	1.0	$864,000		$6,000	$17,000	$158,000	$1,045,000	$862,000	$1.82	$3.64
17	16	33	2	1.0	$864,000		$6,000	$17,000	$160,000	$1,047,000	$852,000	$1.76	$3.52
18	17	33	2	1.0	$864,000		$6,000	$17,000	$162,000	$1,049,000	$843,000	$1.71	$3.42
19	18	33	2	1.0	$864,000		$6,000	$17,000	$164,000	$1,051,000	$834,000	$1.67	$3.33
20	19	33	2	1.0	$864,000		$6,000	$17,000	$166,000	$1,053,000	$825,000	$1.63	$3.25
21	20	33	2	1.0	$864,000		$6,000	$18,000	$169,000	$1,057,000	$817,000	$1.59	$3.19
22	21	33	2	1.0	$1,495,000		$6,000	$18,000	$171,000	$1,690,000	$1,290,000	$1.60	$3.21
23	22	33	2	1.0	$1,495,000		$6,000	$18,000	$173,000	$1,692,000	$1,275,000	$1.61	$3.23
24	23	33	2	1.0	$1,495,000		$6,000	$18,000	$175,000	$1,694,000	$1,260,000	$1.62	$3.24
25	24	33	2	1.0	$1,495,000		$6,000	$19,000	$177,000	$1,697,000	$1,246,000	$1.62	$3.25
26	25	33	2	1.0	$1,495,000		$6,000	$19,000	$180,000	$1,700,000	$1,232,000	$1.63	$3.25
27	26	54	2	1.0	$631,000		$6,000	$19,000	$182,000	$838,000	$600,000	$1.59	$3.18
28	27	54	2	1.1	$631,000		$7,000	$19,000	$193,000	$850,000	$601,000	$1.55	$3.10
29	28	54	2	1.1	$631,000		$7,000	$20,000	$204,000	$862,000	$601,000	$1.52	$3.02
30	29	54	2	1.2	$631,000		$7,000	$20,000	$216,000	$874,000	$602,000	$1.49	$2.95
31	30	54	2	1.2	$631,000	$639,000	$7,000	$20,000	$227,000	$1,524,000	$1,036,000	$1.49	$2.92
32	31	54	2	1.3	$631,000	$648,000	$7,000	$20,000	$239,000	$1,545,000	$1,037,000	$1.49	$2.89
33	32	54	2	1.3	$631,000	$656,000	$7,000	$21,000	$251,000	$1,566,000	$1,037,000	$1.48	$2.86
34	33	54	2	1.4	$631,000	$664,000	$7,000	$21,000	$264,000	$1,587,000	$1,038,000	$1.48	$2.82
35	34	54	2	1.4	$631,000	$673,000	$7,000	$21,000	$277,000	$1,609,000	$1,039,000	$1.48	$2.79
36	35	54	2	1.5	$631,000		$7,000	$21,000	$290,000	$949,000	$605,000	$1.46	$2.71
37	36	54	2	1.5	$631,000		$7,000	$22,000	$303,000	$963,000	$606,000	$1.44	$2.64
38	37	54	2	1.6	$631,000		$7,000	$22,000	$317,000	$977,000	$607,000	$1.42	$2.57
39	38	54	2	1.6	$631,000		$7,000	$22,000	$331,000	$991,000	$608,000	$1.40	$2.51
40	39	54	2	1.7	$631,000		$8,000	$23,000	$345,000	$1,007,000	$610,000	$1.39	$2.44
41	40	54	2	1.7	$631,000		$8,000	$23,000	$360,000	$1,022,000	$611,000	$1.37	$2.38
42	41	54	2	1.8	$631,000		$8,000	$23,000	$374,000	$1,036,000	$611,000	$1.35	$2.32
43	42	54	2	1.8	$631,000		$8,000	$23,000	$390,000	$1,052,000	$613,000	$1.34	$2.27
44	43	54	2	1.9	$631,000		$8,000	$24,000	$405,000	$1,068,000	$614,000	$1.33	$2.21
45	44	54	2	1.9	$631,000		$8,000	$24,000	$421,000	$1,084,000	$615,000	$1.32	$2.16
46	45	54	2	2.0	$631,000		$8,000	$24,000	$437,000	$1,100,000	$616,000	$1.30	$2.11
47	46	54	2	2.0		-$8,137,889	$8,000	$25,000	$454,000	-$7,651,000	-$4,233,000	$1.13	$1.80
Totals:	--	--	--	**51.5**	**$37,375,000**	**-$4,857,889**	**$354,000**	**$792,000**	**$9,669,000**	**$43,332,000**	**$33,824,000**	**$1.13**	**$1.80**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – South Durham and Jordan Lake Water Treatment Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Pittsboro

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	0.0	6.0	6.0	6.0	--
Pittsboro Capacity (equal to maximum day demand, mgd):	--	0.0	3.0	9.0	--
Average Water Use:	--	0.0	2.0	6.0	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Pittsboro Share of System Capacity (mgd):	--	3.0	6.0 inc.	9.0	--
% Total Capacity & Fixed Operating Cost Share:	--	9.1%	28.6%	16.7%	--
% Avg. Capacity & Variable Operating Cost Share:	--	0.0%	7.1%	15.0%	--
Jordan Lake WTP Design Capacity - Chatham County / Pittsboro (mgd):	--	13.0	25.0	25.0	25.0
Jordan Lake WTP Expansion Increment (mgd):	--	--	12	--	--
Pittsboro Share of Jordan Lake WTP Capacity (mgd):	--	3.0	6.0 inc.	9.0	9.0
% Total Capacity & Fixed Operating Cost Share:	--	23.1%	50.0%	36.0%	36.0%
Friction Head Applied to Variable Operating Costs (ft):	--	0.8	7.4	48.3	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	250	256	297	--
Pittsboro Pressure Zone (ft):		**565**			

	CAPITAL COSTS (2014 Dollars)							Allocated to Pittsboro		
									Costs Subtotals	
No.	Description		Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**									
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)			1	LS	$9,500,000	$9,500,000	16.7%	$1,583,000	
2	**Intake Piping (Shared)**									
	Dual Microtunneled Intake Lines (sized for 54 mgd total)		48 in	2,000	LF	$2,870	$5,739,130	16.7%	$957,000	
	Pipeline to New Raw Water Pump Station		54 in	6,625	LF	$423	$2,799,783	16.7%	$467,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**									
	Interim Capacity	33 mgd		1	LS	$8,420,000	$8,420,000	9.1%	$765,000	
	Ultimate Capacity	54 mgd		1	LS	$4,110,000	$4,110,000	28.6%		$1,174,000
4	**Jordan Lake WTP (Shared with Pittsboro, includes High Service PS to deliver to Chatham/Pittsboro)**									
	Interim Capacity	13 mgd		1	LS	$30,639,000	$30,639,000	23.1%	$7,071,000	
	Ultimate Capacity	25 mgd		1	LS	$22,958,000	$22,958,000	50.0%		$11,479,000
5	**Finished Water Transmission Pipeline**									
	Western Segment - Rural		24 in	31,552	LF	$188	$5,926,289	100.0%	$5,926,000	
6						**CONSTRUCTION COST SUBTOTAL**			**$16,770,000**	**$12,660,000**
	CAPITAL COST ALLOWANCES									
7						**Contractor Mobilization, Overhead & Profit (@ 15% x Line 6)**		15%	$2,516,000	$1,899,000
8						**TOTAL CONSTRUCTION COST**			**$19,286,000**	**$14,559,000**
9						**Engineering Studies, Design, and Construction Services (@ 15% x Line 6)**		15%	$2,516,000	$1,899,000
10						**Subtotal**			**$21,802,000**	**$16,458,000**
11	**Land Acquisition and Easements**	OWASA WTP Site		63	Acre	$10,000	$625,000	36.0%	$225,000	
12		USACE Jordan Lake Easement		1	LS	$200,000	$200,000	16.7%	$33,000	
13		Allowance for Additional Land/Easement		1	LS	$50,000	$50,000	100.0%	$50,000	
14		Mitigation Costs for Stream Impacts		144	LF	$374	$53,725	100.0%	$54,000	
15		Mitigation Costs for Wetlands Impacts		0.25	Acre	$68,502	$17,126	100.0%	$17,000	
16						**Subtotal**			**$22,181,000**	**$16,458,000**
17						**Legal Fees, Permits and Approvals (@ 5% x Line 8)**		5%	$964,000	$728,000
18						**Subtotal**			**$23,145,000**	**$17,186,000**
19						**Contingency (@ 25% x Line 18)**		25%	$5,786,000	$4,297,000
20						**ESTIMATED PROJECT CAPITAL COST:**			**$28,931,000**	**$21,483,000**
21									**$50,414,000**	
				Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
22	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)		2022	6	mgd	$91,041	$546,245	100.0%	$546,000	
23	Annual Allocation O&M cost (included in life-cycle analysis)			Varies	mgd	$2,219				
24	Additional Fixed Administration Cost (annual)			1	LS	$250				
25						**Subtotal Allocation Capital Costs:**			**$546,000.00**	**$0.00**
26						**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$29,500,000**	**$21,500,000**
27									**$51,000,000**	
28						**CAPITAL COST PER MGD ULTIMATE ALLOCATION:**			**$8,500,000**	
28						**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$64,617,000**	
29						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.72**	
30						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.72**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Pittsboro

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 56%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs			
												Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$1,725,000								
3	2				$1,725,000								
4	3				$1,725,000					$1,725,000	$1,660,000		
5	4				$1,725,000					$1,725,000	$1,638,000		
6	5				$1,725,000					$1,725,000	$1,618,000		
7	6	33	6	0.0	$1,725,000		$590,000	$112,000	$0	$2,427,000	$2,247,000	$3.27	
8	7	33	6	0.1	$1,725,000		$15,000	$113,000	$6,000	$1,859,000	$1,699,000	$2.02	$242.32
9	8	33	6	0.2	$1,725,000		$15,000	$115,000	$11,000	$1,866,000	$1,683,000	$1.61	$96.21
10	9	33	6	0.3	$1,725,000		$15,000	$116,000	$17,000	$1,873,000	$1,668,000	$1.39	$55.73
11	10	33	6	0.4	$1,725,000		$15,000	$118,000	$23,000	$1,881,000	$1,654,000	$1.27	$37.97
12	11	33	6	0.5	$1,725,000		$16,000	$119,000	$29,000	$1,889,000	$1,640,000	$1.18	$28.31
13	12	33	6	0.6	$1,725,000		$16,000	$121,000	$35,000	$1,897,000	$1,626,000	$1.12	$22.35
14	13	33	6	0.7	$1,725,000		$16,000	$122,000	$42,000	$1,905,000	$1,612,000	$1.07	$18.34
15	14	33	6	0.8	$1,725,000		$16,000	$124,000	$48,000	$1,913,000	$1,598,000	$1.03	$15.48
16	15	33	6	0.9	$1,725,000		$16,000	$125,000	$55,000	$1,921,000	$1,584,000	$1.00	$13.35
17	16	33	6	1.0	$1,725,000		$17,000	$127,000	$62,000	$1,931,000	$1,572,000	$0.98	$11.70
18	17	33	6	1.1	$1,725,000		$17,000	$129,000	$69,000	$1,940,000	$1,559,000	$0.95	$10.40
19	18	33	6	1.2	$1,725,000		$17,000	$130,000	$76,000	$1,948,000	$1,545,000	$0.93	$9.34
20	19	33	6	1.3	$1,725,000		$17,000	$132,000	$83,000	$1,957,000	$1,533,000	$0.92	$8.47
21	20	33	6	1.4	$1,725,000		$17,000	$134,000	$91,000	$1,967,000	$1,521,000	$0.90	$7.74
22	21	33	6	1.5	$3,382,000		$18,000	$135,000	$99,000	$3,634,000	$2,774,000	$0.93	$7.40
23	22	33	6	1.6	$3,382,000		$18,000	$137,000	$107,000	$3,644,000	$2,746,000	$0.94	$7.09
24	23	33	6	1.7	$3,382,000		$18,000	$139,000	$115,000	$3,654,000	$2,718,000	$0.96	$6.79
25	24	33	6	1.8	$3,382,000		$18,000	$141,000	$123,000	$3,664,000	$2,691,000	$0.98	$6.50
26	25	33	6	1.9	$3,382,000		$19,000	$143,000	$132,000	$3,676,000	$2,665,000	$0.99	$6.24
27	26	54	6	2.0	$1,657,000		$19,000	$145,000	$140,000	$1,961,000	$1,403,000	$0.97	$5.83
28	27	54	6	2.2	$1,657,000		$19,000	$146,000	$156,000	$1,978,000	$1,397,000	$0.96	$5.44
29	28	54	6	2.4	$1,657,000		$19,000	$148,000	$173,000	$1,997,000	$1,393,000	$0.94	$5.08
30	29	54	6	2.6	$1,657,000		$20,000	$150,000	$190,000	$2,017,000	$1,389,000	$0.93	$4.74
31	30	54	6	2.8	$1,657,000	$1,277,000	$20,000	$152,000	$207,000	$3,313,000	$2,252,000	$0.93	$4.51
32	31	54	6	3.0	$1,657,000	$1,293,000	$20,000	$154,000	$225,000	$3,349,000	$2,247,000	$0.94	$4.30
33	32	54	6	3.2	$1,657,000	$1,310,000	$20,000	$156,000	$243,000	$3,386,000	$2,243,000	$0.94	$4.09
34	33	54	6	3.4	$1,657,000	$1,327,000	$21,000	$158,000	$261,000	$3,424,000	$2,239,000	$0.94	$3.90
35	34	54	6	3.6	$1,657,000	$1,344,000	$21,000	$160,000	$280,000	$3,462,000	$2,235,000	$0.95	$3.72
36	35	54	6	3.8	$1,657,000		$21,000	$162,000	$300,000	$2,140,000	$1,364,000	$0.93	$3.51
37	36	54	6	4.0	$1,657,000		$21,000	$164,000	$319,000	$2,161,000	$1,360,000	$0.92	$3.31
38	37	54	6	4.2	$1,657,000		$22,000	$166,000	$340,000	$2,185,000	$1,357,000	$0.92	$3.13
39	38	54	6	4.4	$1,657,000		$22,000	$169,000	$361,000	$2,209,000	$1,355,000	$0.91	$2.96
40	39	54	6	4.6	$1,657,000		$22,000	$171,000	$382,000	$2,232,000	$1,351,000	$0.90	$2.81
41	40	54	6	4.8	$1,657,000		$23,000	$173,000	$404,000	$2,257,000	$1,349,000	$0.89	$2.67
42	41	54	6	5.0	$1,657,000		$23,000	$175,000	$426,000	$2,281,000	$1,346,000	$0.88	$2.54
43	42	54	6	5.2	$1,657,000		$23,000	$178,000	$449,000	$2,307,000	$1,344,000	$0.87	$2.42
44	43	54	6	5.4	$1,657,000		$23,000	$180,000	$472,000	$2,332,000	$1,341,000	$0.87	$2.31
45	44	54	6	5.6	$1,657,000		$24,000	$182,000	$496,000	$2,359,000	$1,339,000	$0.86	$2.21
46	45	54	6	5.8	$1,657,000		$24,000	$185,000	$520,000	$2,386,000	$1,337,000	$0.85	$2.12
47	46	54	6	6.0		-$19,327,170	$24,000	$187,000	$545,000	-$18,571,000	-$10,275,000	$0.72	$1.72
Totals:	--	--	--	**103.0**	**$84,550,000**	**-$12,776,170**	**$1,357,000**	**$5,993,000**	**$8,112,000**	**$83,786,000**	**$64,617,000**	**$0.72**	**$1.72**

Appendix C: Raw Water Only Facilities Alternative – Detailed Cost Summary

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Raw Water Only Facilities
Summary Data

Final

Partner	Pressure Zone (ft)	WTP Gradient (ft)	Existing Jordan Lake Allocations	Initial Basis for Initial Facilities Production					Interim Basis for Initial Facilities Capacity					Ultimate Basis for Ultimate Facilities Capacity						Summary of Conceptual-Level Cost Estimates: Capital Costs (2014 Million $)				Total Life-Cycle Costs (2014 Million $)	Unit Life-Cycle Costs per 1,000 gallons (2014 $)	
																				Year Financed		Total	Total			
				Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% of Total Capacity	Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% of Total Capacity	Alloc'n	Avg. Usage	Peak factor	Max. Day Capacity	% Inc.	% of Total Capacity	Initial	Interim		Per MGD Ultimate Allocation		Usage	Level 1 Allocation Purchased
Chatham Co.	740		6	18	3.0	1.5	5	21.7%	18	6.5	1.5	10.0	30.3%	18	10.5	1.5	16.0	28.6%	29.6%	$74.7 M	$21.5 M	$96.2 M	$5.3 M	$193.2 M	$1.9	$0.7
Durham	568	397 (W)	10	16.5	16.5	1	17	73.9%	16.5	16.5	1	17.0	51.5%	16.5	16.5	1.25	21.0	19.0%	38.9%	$189.9 M	$13.1 M	$203.0 M	$12.3 M	$690.6 M	$2.8	$2.8
OWASA	642	481	5	5	0.0	1	0	0.0%	5	2.0	1	2.0	6.1%	5	5.0	1	5.0	14.3%	9.3%	$27.8 M	$7.1 M	$34.9 M	$7.0 M	$47.7 M	$10.0	$0.6
Orange County	840		1	2	1.0	1	1	4.3%	2	1.0	1	1.0	3.0%	2	2.0	1.5	3.0	9.5%	5.6%	$18.7 M	$7.8 M	$26.5 M	$13.3 M	$40.0 M	$2.1	$1.3
Pittsboro	565		0	6	0.0	0	0	0.0%	6	2.0	1.5	3.0	9.1%	6	6.0	1.5	9.0	28.6%	16.7%	$29.5 M	$21.5 M	$51.0 M	$8.5 M	$78.7 M	$2.1	$0.9
Total	--	--		**47.5**	**20.5**	--	**23**	**100%**	**47.5**	**28.0**	--	**33**	**100%**	**47.5**	**40.0**	--	**54**	**21.0**	**100%**	**$340.6 M**	**$71.0 M**	**$411.6 M**	**$8.7 M**	**$1,050.2 M**	**$2.6**	**$1.5**

Water Facilities Cost Share Distribution

Partner	Shared Facilities: Intake & Pipelines	RWPS Initial	RWPS Expansion	Jordan Lake WTP Initial	Jordan Lake WTP Expansion	Williams WTP Expansion Initial	Williams WTP Expansion Expansion	Shared RW Main	Shared RW Main (Durham /Orange)	Separate Facilities: Chatham County FW Main	Durham BPS	OWASA RW Main	Pittsboro FW Main	Hillsboro --
Capacity (mgd):	**54**	**33**	**54**	**13**	**25**	**18**	**24**	**29.0**	**24.0**	**16**	**--**	**5**	**9**	**--**
Chatham County	29.6%	30.3%	28.6%	76.9%	50.0%	--	--	--	--	100%	--	--	--	--
Durham	38.9%	51.5%	19.0%	--	--			72.4%	87.5%	--	N/A		--	--
OWASA	9.3%	6.1%	14.3%	--	--	--	--	17.2%	--	--	--	100%	--	--
Orange County	5.6%	3.0%	9.5%	--	--			10.3%	12.5%	--	--		--	--
Pittsboro	16.7%	9.1%	28.6%	23.1%	50.0%	--	--	--	--	--	--		100.0%	--
Hillsborough	0.0%	0.0%	0.0%	--	--			0.0%	--	--	--		--	--
TOTAL:	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**			**100.0%**	**100.0%**		--		--	--

(1) Includes capital costs for a new Jordan Lake Western intake, raw water pumping and transmission facilities, a new water treatment plant (WTP) located at the OWASA Jordan Lake property to serve Chatham County and Pittsboro, advanced treatment upgrades to Durham's Williams WTP and OWASA's Jones Ferry Road WTP, and related shared and separate raw / finished water pumping and transmission lines. Also, where applicable, costs are included for purchase of land/easements, environmental mitigation, and water storage allocations. All costs are in constant year 2014 dollars and include costs for construction, contractor profit and overhead, engineering, legal and permitting expenses, and an overall 25% contingency. Capital funding for the initial facilities (see note 2 below) is assumed to occur in year 2015 and construction is assumed to be completed in year 2020.

(2) The Western Jordan Lake intake and all pipelines are sized to meet ultimate (year 2060) maximum day demands. Capital cost for each partner is calculated as a direct ratio of the partner's ultimate capacity to total ultimate facility capacity. The WTPs and pumping stations are assumed to be constructed in phases, with initial sizing to meet interim (year 2040) demands. For these facilities, capital cost for each partner is calculated as a direct ratio of the partner's interim capacity to total interim facility capacity.

(3) Facility expansion is based on the ultimate capacity in year 2060. Financing is assumed to occur in 2035 and construction completion in 2040. Capital cost for each partner is calculated as a direct ratio of the partner's incremental increase in capacity from year 2040 to year 2060 to the total increase in facility capacity.

(4) All capital and life-cycle costs are in 2014 dollars.

(5) The present analysis assumes that each partner will maintain/obtain a Level I Allocation. No costs are included for Level II Allocations.

Jordan Lake Joint Development – Raw Water Only Facilities
SUMMARY of VARIABLES

Description	Value	Units	Notes
General			
Current ENR CCI:	9795.92		May 2014
Project Cost Start Date:	2010		
Project Cost Begin Capital Finance:	2015		
Project Cost Complete Initial Construction:	2020		
Project Cost Complete Expansion:	2040		
Project Cost End Date:	2060		
Project Cost Lifespan:	50	years	

Calculation of Capital Costs

Updated EPA cost curves (2010, ENR CCI 8802) for Water Treatment Facilities
Includes ozone, UV, GAC, & residuals.
Does not Include Land, Contractor Profit & Overhead, engineering, legal costs, or contingencies
Add 10% for provisions for plant expansion
Add 20% for expansion phasing

Cost = a*(Q+1)^b	Capacity (mgd)	Construction Cost (2010 $)
R^2 = 0.99958	42	$82,645,000
a = 3097698.29	62	$114,109,000
b = 0.8446521286	+20	$31,464,000

Contractor Mobilization, Overhead, and Profit:	15%	
Engineering Studies, Design, and Construction Services:	15%	
Land Acquisition and Easements:	Project Specific	
Legal Fees, Permits, and Approvals:	5%	
Contingency:	25%	
Raw and Finished Water Main - Rural:	$9.00	per inch-diameter/ft
Raw and Finished Water Main - Urban:	$15.00	per inch-diameter/ft

Calculation of Life Cycle Costs

General Conditions

Discount Rate:	1.295%	

Capital /Rehabilitation and Replacement Costs

Issuing Expense:	0.0%	
Capital Recovery Interest Rate:	3.225%	
Financing Term (Years):	25	years
Equipment Lifespan:	25	years
Pipelines/Structures Lifespan:	50	years
Equipment Replacement as % of Total Construction Cost:	15%	
Number of Years Replacement Equipment Defrayed Over:	5	years
Cost multiplier for shared pumping facilities w/ high-low head pumps:	1.02	

Operation and Maintenance Costs

Annual O&M Costs as Percent of Construction Costs:	10%	
Fixed O&M Costs as % of Total O&M Costs:	70%	
Variable O&M Costs as % of Total O&M Costs:	30%	
Variable O&M Cost Constant (mgd, 70% eff, Kw-hr/yr):	2,195	
Energy Cost:	$0.092	per kW-hr electrical energy

Level I Allocation Costs

Total Purchase Cost:	$91,040.76	per mgd
Annual Cost for Subsequent Years:	$2,218.85	per mgd/yr
Additional Fixed Administration Cost (annual):	$250	

Level II Allocation Costs

Total Annual Cost :	$2,218.85	per mgd/yr
Additional Fixed Administration Cost (annual):	$250	

USACE Easement Acquisition

Easement for Intake and RW Main	2.1	Acres
Estimated lump sum cost	$200,000	

WTP Site Land Acquisition

OWASA WTP Site Acreage	125	acres
Cost per Acre	$10,000	per acre
WTP Site EL:	332	ft
Jordan Lake NP EL:	216	ft

Pipeline Sizing

Partner (s) Served	**% Share of Pipeline, Capacity & Characteristics**			**Finished Chatham**	**Raw OWASA**	**Finished Pitts.**	**WTP Share (mgd)**	**Diam (inch)**
	Raw	**S. Durham -OWASA**	**S. Durham**					**V = 6**
Chatham Co.	**30%**	**--**	**--**	**100%**	**--**	**--**	**16.0**	**30**
Durham	**39%**	**72%**	**88%**	**--**	**--**	**--**	**21.0**	**36**
OWASA	**9%**	**17%**	**--**	**--**	**100%**	**--**	**5.0**	**16**
Orange Co.	**6%**	**10%**	**13%**	**--**	**--**	**--**	**3.0**	**12**
Pittsboro	**17%**	**--**	**--**	**--**	**--**	**100%**	**9.0**	**24**
Hillsboro	**0%**	**0%**	**0%**	**--**	**--**	**--**		
Total:	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**		
Design Peak Pumping Capacity (mgd)	**54**	**29**	**24**	**16**	**5**	**9**		
Design Pipeline Velocity (ft/s):	**6**	**5**	**5**	**6**	**5**	**6**		
Calculated Pipeline Diam. (inches):	**54**	**42**	**42**	**30**	**18**	**24**		
Length (ft):	3,000	68,300	82,000	48,800	32,500	31,552		
Calculated Velocity (ft/s):	5.3	4.7	3.9	5.0	4.4	4.4		
Pipeline head Loss (C=120) for use in calculating variable operating costs								
HL in Year 2020 @ Avg Pumped Flow (ft):	0.8	46.9	56.3	6.6	0.0	0.0		
HL in Year 2040 @ Avg Pumped Flow (ft):	1.4	57.3	55.6	27.2	24.6	6.0		
HL in Year 2060 @ Avg Pumped Flow (ft):	2.8	80.9	61.6	66.1	133.9	45.5		
RW Water Static Head			181.0		265.0			
Total RW Pump Head			326.3		401.7			

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Raw Water Only Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for

Chatham County

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	6	18	18	18	--
Chatham County Capacity (equal to maximum day demand, mgd):	--	5.0	10.0	16.0	--
Average Water Use:	--	3.0	6.5	10.5	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Chatham County Share of System Capacity (mgd):	--	10.0	6.0 inc.	16.0	--
% Total Capacity & Fixed Operating Cost Share:	--	30.3%	28.6%	29.6%	--
% Average Capacity & Variable Operating Cost Share:	--	14.6%	23.2%	26.3%	
Jordan Lake WTP Design Capacity - Chatham County / Pittsboro (mgd):	--	13.0	25.0	25.0	25.0
Jordan Lake WTP Expansion Increment (mgd):	--	--	12	--	--
Chatham County Share of Jordan Lake WTP Capacity (mgd):	--	10.0	6.0 inc.	16.0	16
% Total Capacity & Fixed Operating Cost Share:	--	76.9%	50.0%	64.0%	64.0%
Friction Head Applied to Variable Operating Costs (ft):	--	7	29	69	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	431	453	493	--
Chatham County Pressure Zone (ft):		**740**			

	CAPITAL COSTS (2014 Dollars)								Allocated to Chatham County		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	29.6%	$2,815,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	29.6%	$1,700,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	29.6%	$830,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**										
	Interim Capacity	33	mgd		1	LS	$8,420,000	$8,420,000	30.3%	$2,552,000	
	Ultimate Capacity	54	mgd		1	LS	$4,110,000	$4,110,000	28.6%		$1,174,000
4	**Jordan Lake WTP (Shared with Pittsboro, includes High Service PS to deliver to Chatham/Pittsboro)**										
	Interim Capacity	13	mgd		1	LS	$30,639,000	$30,639,000	76.9%	$23,568,000	
	Ultimate Capacity	25	mgd		1	LS	$22,958,000	$22,958,000	50.0%		$11,479,000
5	**Finished Water Transmission Pipeline**										
	Chatham County Finished Water Transmission - Rural			30 in	48,800	LF	$235	$11,457,391	100.0%	$11,457,000	
6							**CONSTRUCTION COST SUBTOTAL**			**$42,930,000**	**$12,660,000**
	CAPITAL COST ALLOWANCES										
7							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 6)**		15%	$6,440,000	$1,899,000
8							**TOTAL CONSTRUCTION COST**			**$49,370,000**	**$14,559,000**
9							**Engineering Studies, Design, and Construction Services (@ 15% x Line 6)**		15%	$6,440,000	$1,899,000
10							**Subtotal**			**$55,810,000**	**$16,458,000**
11	**Land Acquisition and Easements**	OWASA WTP Site			63	Acre	$10,000	$625,000	64.0%	$400,000	
12		USACE Jordan Lake Easement			1	LS	$200,000	$200,000	29.6%	$59,000	
13		Allowance for Additional Land/Easement			1	LS	$50,000	$50,000	100.0%	$50,000	
14		Mitigation Costs for Stream Impacts			268	LF	$374	$100,145	100.0%	$100,000	
15		Mitigation Costs for Wetlands Impacts			0.43	Acre	$68,502	$29,228	100.0%	$29,000	
15							**Subtotal**			**$56,448,000**	**$16,458,000**
16							**Legal Fees, Permits and Approvals (@ 5% x Line 8)**		5%	$2,469,000	$728,000
17							**Subtotal**			**$58,917,000**	**$17,186,000**
18							**Contingency (@ 25% x Line 17)**		25%	$14,729,000	$4,297,000
19							**ESTIMATED PROJECT CAPITAL COST:**			**$73,646,000**	**$21,483,000**
20										**$95,129,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
21	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	12	mgd	$91,041	$1,092,489	100.0%	$1,093,000	
22	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
23	Additional Fixed Administration Cost (annual)				1	LS	$250				
24							**Subtotal Allocation Capital Costs:**			**$1,093,000.00**	**$0.00**
25							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$74,700,000**	**$21,500,000**
26										**$96,200,000**	
27							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$193,200,000**	
28							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$1.95**	
29							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.72**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Chatham County

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 67%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs		Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$4,392,000					$4,392,000	$4,336,000		
3	2				$4,392,000					$4,392,000	$4,280,000		
4	3				$4,392,000					$4,392,000	$4,226,000		
5	4				$4,392,000					$4,392,000	$4,172,000		
6	5				$4,392,000					$4,392,000	$4,118,000		
7	6	33	18.0	3.0	$4,392,000		$1,195,000	$1,138,000	$517,000	$7,242,000	$6,704,000	$4.24	$25.42
8	7	33	18.0	3.2	$4,392,000		$44,000	$1,152,000	$540,000	$6,128,000	$5,600,000	$2.54	$14.83
9	8	33	18.0	3.4	$4,392,000		$45,000	$1,167,000	$564,000	$6,168,000	$5,565,000	$1.98	$11.22
10	9	33	18.0	3.5	$4,392,000		$45,000	$1,183,000	$588,000	$6,208,000	$5,529,000	$1.69	$9.35
11	10	33	18.0	3.7	$4,392,000		$46,000	$1,198,000	$613,000	$6,249,000	$5,495,000	$1.52	$8.18
12	11	33	18.0	3.9	$4,392,000		$46,000	$1,213,000	$639,000	$6,290,000	$5,460,000	$1.41	$7.37
13	12	33	18.0	4.1	$4,392,000		$47,000	$1,229,000	$665,000	$6,333,000	$5,427,000	$1.32	$6.76
14	13	33	18.0	4.2	$4,392,000		$47,000	$1,245,000	$691,000	$6,375,000	$5,393,000	$1.26	$6.29
15	14	33	18.0	4.4	$4,392,000		$48,000	$1,261,000	$718,000	$6,419,000	$5,361,000	$1.21	$5.90
16	15	33	18.0	4.6	$4,392,000		$49,000	$1,277,000	$746,000	$6,464,000	$5,329,000	$1.17	$5.57
17	16	33	18.0	4.8	$4,392,000		$49,000	$1,294,000	$774,000	$6,509,000	$5,298,000	$1.14	$5.29
18	17	33	18.0	4.9	$4,392,000		$50,000	$1,311,000	$803,000	$6,556,000	$5,268,000	$1.11	$5.05
19	18	33	18.0	5.1	$4,392,000		$51,000	$1,328,000	$833,000	$6,604,000	$5,239,000	$1.09	$4.83
20	19	33	18.0	5.3	$4,392,000		$51,000	$1,345,000	$863,000	$6,651,000	$5,209,000	$1.07	$4.64
21	20	33	18.0	5.5	$4,392,000		$52,000	$1,362,000	$894,000	$6,700,000	$5,180,000	$1.05	$4.46
22	21	33	18.0	5.6	$6,049,000		$53,000	$1,380,000	$925,000	$8,407,000	$6,416,000	$1.04	$4.35
23	22	33	18.0	5.8	$6,049,000		$53,000	$1,398,000	$957,000	$8,457,000	$6,372,000	$1.04	$4.25
24	23	33	18.0	6.0	$6,049,000		$54,000	$1,416,000	$990,000	$8,509,000	$6,329,000	$1.03	$4.15
25	24	33	18.0	6.2	$6,049,000		$55,000	$1,434,000	$1,024,000	$8,562,000	$6,287,000	$1.03	$4.05
26	25	33	18.0	6.3	$6,049,000		$55,000	$1,453,000	$1,058,000	$8,615,000	$6,245,000	$1.03	$3.96
27	26	54	18.0	6.5	$1,657,000		$56,000	$1,472,000	$1,093,000	$4,278,000	$3,062,000	$1.00	$3.79
28	27	54	18.0	6.7	$1,657,000		$57,000	$1,491,000	$1,132,000	$4,337,000	$3,064,000	$0.98	$3.63
29	28	54	18.0	6.9	$1,657,000		$58,000	$1,510,000	$1,171,000	$4,396,000	$3,066,000	$0.95	$3.48
30	29	54	18.0	7.1	$1,657,000		$58,000	$1,530,000	$1,211,000	$4,456,000	$3,068,000	$0.93	$3.35
31	30	54	18.0	7.3	$1,657,000	$3,250,000	$59,000	$1,549,000	$1,253,000	$7,768,000	$5,280,000	$0.93	$3.27
32	31	54	18.0	7.5	$1,657,000	$3,292,000	$60,000	$1,569,000	$1,295,000	$7,873,000	$5,283,000	$0.92	$3.19
33	32	54	18.0	7.7	$1,657,000	$3,335,000	$61,000	$1,590,000	$1,338,000	$7,981,000	$5,287,000	$0.92	$3.12
34	33	54	18.0	7.9	$1,657,000	$3,378,000	$61,000	$1,610,000	$1,382,000	$8,088,000	$5,290,000	$0.91	$3.06
35	34	54	18.0	8.1	$1,657,000	$3,422,000	$62,000	$1,631,000	$1,426,000	$8,198,000	$5,293,000	$0.91	$2.99
36	35	54	18.0	8.3	$1,657,000		$63,000	$1,652,000	$1,472,000	$4,844,000	$3,088,000	$0.90	$2.89
37	36	54	18.0	8.5	$1,657,000		$64,000	$1,674,000	$1,519,000	$4,914,000	$3,092,000	$0.88	$2.80
38	37	54	18.0	8.7	$1,657,000		$65,000	$1,695,000	$1,566,000	$4,983,000	$3,096,000	$0.87	$2.72
39	38	54	18.0	8.9	$1,657,000		$65,000	$1,717,000	$1,615,000	$5,054,000	$3,099,000	$0.86	$2.63
40	39	54	18.0	9.1	$1,657,000		$66,000	$1,740,000	$1,664,000	$5,127,000	$3,104,000	$0.85	$2.56
41	40	54	18.0	9.3	$1,657,000		$67,000	$1,762,000	$1,715,000	$5,201,000	$3,109,000	$0.84	$2.49
42	41	54	18.0	9.5	$1,657,000		$68,000	$1,785,000	$1,767,000	$5,277,000	$3,114,000	$0.83	$2.42
43	42	54	18.0	9.7	$1,657,000		$69,000	$1,808,000	$1,819,000	$5,353,000	$3,118,000	$0.82	$2.35
44	43	54	18.0	9.9	$1,657,000		$70,000	$1,831,000	$1,873,000	$5,431,000	$3,123,000	$0.81	$2.29
45	44	54	18.0	10.1	$1,657,000		$71,000	$1,855,000	$1,928,000	$5,511,000	$3,129,000	$0.80	$2.23
46	45	54	18.0	10.3	$1,657,000		$72,000	$1,879,000	$1,984,000	$5,592,000	$3,134,000	$0.79	$2.18
47	46	54	18.0	10.5		-$30,201,788	$72,000	$1,904,000	$2,041,000	-$26,185,000	-$14,488,000	$0.72	$1.95
Totals:	--	--	--	**271.8**	**$151,225,000**	**-$13,524,788**	**$3,479,000**	**$61,038,000**	**$47,666,000**	**$249,883,000**	**$193,249,000**	**$0.72**	**$1.95**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Raw Water Only Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Durham

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	10	16.5	17	17	--
Durham Capacity (equal to maximum day demand, mgd):	--	17.0	17.0	21.0	--
Average Water Use:	--	16.5	16.5	16.5	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Durham Share of System Capacity (mgd):	--	17.0	4.0 inc.	21.0	--
% Total Capacity & Fixed Operating Cost Share:	--	51.5%	19.0%	38.9%	--
% Avg. Capacity & Variable Operating Cost Share:	--	80.5%	58.9%	41.3%	--
% Share of Durham-OWASA-Orange Co. Raw Water Main	--	--	--	72.4%	--
% Share of Durham-Orange Co. Raw Water Main	--	--	--	87.5%	--
Williams WTP Improvements Design Capacity (mgd):	--	18.0	24.0	24.0	--
Williams WTP Improvements Expansion Increment (mgd):	--	--	6	--	--
Durham Share of Williams WTP Capacity (mgd):	--	17.0	4.0 inc.	21.0	--
% Total Capacity & Fixed Operating Cost Share:	--	94.4%	66.7%	87.5%	--
Friction Head Applied to Variable Operating Costs (ft):	--	104	114	145	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	356	366	397	--
Durham Pressure Zone (ft):		**568**			

	CAPITAL COSTS (2014 Dollars)									Allocated to Durham		
											Costs Subtotals	
No.	Description				Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**											
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)					1	LS	$9,500,000	$9,500,000	38.9%	$3,694,000	
2	**Intake Piping (Shared)**											
	Dual Microtunneled Intake Lines (sized for 54 mgd total)				48 in	2,000	LF	$2,870	$5,739,130	38.9%	$2,232,000	
	Pipeline to New Raw Water Pump Station				54 in	6,625	LF	$423	$2,799,783	38.9%	$1,089,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**											
	Interim Capacity	33	mgd			1	LS	$8,420,000	$8,420,000	51.5%	$4,338,000	
	Ultimate Capacity	54	mgd			1	LS	$4,110,000	$4,110,000	19.0%		$783,000
4	**Shared Raw Water Transmission Pipeline**											
	Jordan Lake RWPS to Durham / OWASA Split - Rural				42 in	68,300	LF	$329	$22,449,913	72.4%	$16,257,000	
5	**Raw Water Transmission Pipeline**											
	Durham / OWASA Split to Williams WTP - Rural				42 in	42,000	LF	$329	$13,805,217	87.5%	$12,080,000	
	Durham / OWASA Split to Williams WTP - Urban				42 in	40,000	LF	$548	$21,913,043	87.5%	$19,174,000	
6	**Repurpose Williams WTP (Advanced Treatment)**			**Cost Factor**								
	Repurpose Existing WTP			20%		1	LS	$8,089,600	$8,089,600	100.0%	$8,090,000	
	Interim Capacity	18	mgd			1	LS	$40,448,000	$40,448,000	94.4%	$38,201,000	
	Contingency			15%		1	LS	$6,067,200	$6,067,200	100.0%	$6,067,000	
	Ultimate Capacity	24	mgd			1	LS	$10,420,000	$10,420,000	66.7%		$6,947,000
7								**CONSTRUCTION COST SUBTOTAL**			**$111,230,000**	**$7,730,000**
	CAPITAL COST ALLOWANCES											
8								**Contractor Mobilization, Overhead & Profit (@ 15% x Line 7)**		15%	$16,685,000	$1,160,000
9								**TOTAL CONSTRUCTION COST**			**$127,915,000**	**$8,890,000**
10								**Engineering Studies, Design, and Construction Services (@ 15% x Line 7)**		15%	$16,685,000	$1,160,000
11								**Subtotal**			**$144,600,000**	**$10,050,000**
12	**Land Acquisition and Easements**			Williams WTP Site		0	Acre	$10,000	$0	0.0%	$0	
13				USACE Jordan Lake Easement		1	LS	$200,000	$200,000	38.9%	$78,000	
14				Allowance for Additional Land/Easement		1	LS	$100,000	$100,000	100.0%	$100,000	
15				Mitigation Costs for Stream Impacts		510	LF	$374	$190,677	100.0%	$191,000	
16				Mitigation Costs for Wetlands Impacts		0.92	Acre	$68,502	$63,277	100.0%	$63,000	
17								**Subtotal**			**$145,032,000**	**$10,050,000**
18								**Legal Fees, Permits and Approvals (@ 5% x Line 9)**		5%	$6,396,000	$445,000
19								**Subtotal**			**$151,428,000**	**$10,495,000**
20								**Contingency (@ 25% x Line 19)**		25%	$37,857,000	$2,624,000
21								**ESTIMATED PROJECT CAPITAL COST:**			**$189,285,000**	**$13,119,000**
22											**$202,404,000**	
						Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
23	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)				2022	7	mgd	$91,041	$591,765	100.0%	$592,000	
24	Annual Allocation O&M cost (included in life-cycle analysis)					Varies	mgd	$2,219				
25	Additional Fixed Administration Cost (annual)					1	LS	$250				
26								**Subtotal Allocation Capital Costs:**			**$592,000.00**	**$0.00**
27								**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$189,900,000**	**$13,100,000**
28											**$203,000,000**	
29								**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$690,582,000**	
30								**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$2.80**	
31								**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$2.80**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Durham

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 82%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs			
												Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$11,289,000					$11,289,000	$11,145,000		
3	2				$11,289,000					$11,289,000	$11,002,000		
4	3				$11,289,000					$11,289,000	$10,862,000		
5	4				$11,289,000					$11,289,000	$10,723,000		
6	5				$11,289,000					$11,289,000	$10,586,000		
7	6	33	16.5	16.5	$11,289,000		$663,000	$6,076,000	$5,345,000	$23,373,000	$21,636,000	$12.61	$12.61
8	7	33	16.5	16.5	$11,289,000		$40,000	$6,154,000	$5,414,000	$22,897,000	$20,925,000	$8.04	$8.04
9	8	33	16.5	16.5	$11,289,000		$41,000	$6,234,000	$5,484,000	$23,048,000	$20,794,000	$6.51	$6.51
10	9	33	16.5	16.5	$11,289,000		$41,000	$6,315,000	$5,555,000	$23,200,000	$20,663,000	$5.74	$5.74
11	10	33	16.5	16.5	$11,289,000		$42,000	$6,397,000	$5,627,000	$23,355,000	$20,535,000	$5.28	$5.28
12	11	33	16.5	16.5	$11,289,000		$42,000	$6,479,000	$5,700,000	$23,510,000	$20,407,000	$4.96	$4.96
13	12	33	16.5	16.5	$11,289,000		$43,000	$6,563,000	$5,774,000	$23,669,000	$20,283,000	$4.73	$4.73
14	13	33	16.5	16.5	$11,289,000		$44,000	$6,648,000	$5,849,000	$23,830,000	$20,160,000	$4.56	$4.56
15	14	33	16.5	16.5	$11,289,000		$44,000	$6,734,000	$5,924,000	$23,991,000	$20,036,000	$4.42	$4.42
16	15	33	16.5	16.5	$11,289,000		$45,000	$6,822,000	$6,001,000	$24,157,000	$19,917,000	$4.31	$4.31
17	16	33	16.5	16.5	$11,289,000		$45,000	$6,910,000	$6,079,000	$24,323,000	$19,797,000	$4.22	$4.22
18	17	33	16.5	16.5	$11,289,000		$46,000	$6,999,000	$6,158,000	$24,492,000	$19,680,000	$4.14	$4.14
19	18	33	16.5	16.5	$11,289,000		$46,000	$7,090,000	$6,237,000	$24,662,000	$19,563,000	$4.07	$4.07
20	19	33	16.5	16.5	$11,289,000		$47,000	$7,182,000	$6,318,000	$24,836,000	$19,450,000	$4.01	$4.01
21	20	33	16.5	16.5	$11,289,000		$48,000	$7,275,000	$6,400,000	$25,012,000	$19,337,000	$3.96	$3.96
22	21	33	16.5	16.5	$12,301,000		$48,000	$7,369,000	$6,483,000	$26,201,000	$19,997,000	$3.92	$3.92
23	22	33	16.5	16.5	$12,301,000		$49,000	$7,465,000	$6,567,000	$26,382,000	$19,878,000	$3.88	$3.88
24	23	33	16.5	16.5	$12,301,000		$49,000	$7,561,000	$6,652,000	$26,563,000	$19,758,000	$3.85	$3.85
25	24	33	16.5	16.5	$12,301,000		$50,000	$7,659,000	$6,738,000	$26,748,000	$19,642,000	$3.82	$3.82
26	25	33	16.5	16.5	$12,301,000		$51,000	$7,758,000	$6,825,000	$26,935,000	$19,526,000	$3.79	$3.79
27	26	54	16.5	16.5	$1,012,000		$51,000	$7,859,000	$6,914,000	$15,836,000	$11,333,000	$3.70	$3.70
28	27	54	16.5	16.5	$1,012,000		$52,000	$7,961,000	$7,003,000	$16,028,000	$11,324,000	$3.61	$3.61
29	28	54	16.5	16.5	$1,012,000		$53,000	$8,064,000	$7,094,000	$16,223,000	$11,315,000	$3.54	$3.54
30	29	54	16.5	16.5	$1,012,000		$53,000	$8,168,000	$7,186,000	$16,419,000	$11,306,000	$3.47	$3.47
31	30	54	16.5	16.5	$1,012,000	$8,354,000	$54,000	$8,274,000	$7,279,000	$24,973,000	$16,976,000	$3.44	$3.44
32	31	54	16.5	16.5	$1,012,000	$8,462,000	$55,000	$8,381,000	$7,373,000	$25,283,000	$16,967,000	$3.42	$3.42
33	32	54	16.5	16.5	$1,012,000	$8,571,000	$56,000	$8,490,000	$7,469,000	$25,598,000	$16,959,000	$3.40	$3.40
34	33	54	16.5	16.5	$1,012,000	$8,682,000	$56,000	$8,600,000	$7,565,000	$25,915,000	$16,949,000	$3.38	$3.38
35	34	54	16.5	16.5	$1,012,000	$8,795,000	$57,000	$8,711,000	$7,663,000	$26,238,000	$16,941,000	$3.36	$3.36
36	35	54	16.5	16.5	$1,012,000		$58,000	$8,824,000	$7,762,000	$17,656,000	$11,254,000	$3.31	$3.31
37	36	54	16.5	16.5	$1,012,000		$58,000	$8,938,000	$7,863,000	$17,871,000	$11,246,000	$3.26	$3.26
38	37	54	16.5	16.5	$1,012,000		$59,000	$9,054,000	$7,965,000	$18,090,000	$11,238,000	$3.22	$3.22
39	38	54	16.5	16.5	$1,012,000		$60,000	$9,171,000	$8,068,000	$18,311,000	$11,230,000	$3.18	$3.18
40	39	54	16.5	16.5	$1,012,000		$61,000	$9,290,000	$8,172,000	$18,535,000	$11,222,000	$3.14	$3.14
41	40	54	16.5	16.5	$1,012,000		$62,000	$9,410,000	$8,278,000	$18,762,000	$11,214,000	$3.10	$3.10
42	41	54	16.5	16.5	$1,012,000		$62,000	$9,532,000	$8,385,000	$18,991,000	$11,206,000	$3.07	$3.07
43	42	54	16.5	16.5	$1,012,000		$63,000	$9,655,000	$8,494,000	$19,224,000	$11,198,000	$3.03	$3.03
44	43	54	16.5	16.5	$1,012,000		$64,000	$9,780,000	$8,604,000	$19,460,000	$11,191,000	$3.00	$3.00
45	44	54	16.5	16.5	$1,012,000		$65,000	$9,907,000	$8,715,000	$19,699,000	$11,183,000	$2.97	$2.97
46	45	54	16.5	16.5	$1,012,000		$66,000	$10,035,000	$8,828,000	$19,941,000	$11,176,000	$2.95	$2.95
47	46	54	16.5	16.5		-$53,782,255	$66,000	$10,165,000	$8,943,000	-$34,608,000	-$19,148,000	$2.80	$2.80
Totals:	--	--	--	**676.5**	**$307,525,000**	**-$10,918,255**	**$2,755,000**	**$325,959,000**	**$286,753,000**	**$912,074,000**	**$690,582,000**	**$2.80**	**$2.80**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Raw Water Only Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
OWASA

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	5	5	5	5	--
OWASA Capacity (equal to maximum day demand, mgd):	--	0.0	2.0	5.0	--
Average Water Use:	--	0.0	2.0	5.0	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
OWASA Share of System Capacity (mgd):	--	2.0	3.0 inc.	5.0	--
% Total Capacity & Fixed Operating Cost Share:	--	6.1%	14.3%	9.3%	--
% Avg. Capacity & Variable Operating Cost Share:	--	0.0%	7.1%	12.5%	--
% Share of Durham-OWASA-Orange Co. Raw Water Main	--	--	--	17.2%	--
Jones Ferry Road WTP Improvements Design Capacity (mgd):	--	2.0	5.0	5.0	--
Jones Ferry Road WTP Improvements Expansion Increment (mgd):	--	--	3	--	--
OWASA Share of Jones Ferry Road WTP Capacity (mgd):	--	2.0	3.0 inc.	5.0	--
% Total Capacity & Fixed Operating Cost Share:	--	100.0%	100.0%	100.0%	--
Friction Head Applied to Variable Operating Costs (ft):	--	47.7	83.3	217.6	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	374	409	544	--
OWASA Pressure Zone (ft):		**642**			

	CAPITAL COSTS (2014 Dollars)								Allocated to OWASA		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	9.3%	$880,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	9.3%	$531,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	9.3%	$259,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**										
	Interim Capacity	33	mgd		1	LS	$8,420,000	$8,420,000	6.1%	$510,000	
	Ultimate Capacity	54	mgd		1	LS	$4,110,000	$4,110,000	14.3%		$587,000
4	**Shared Raw Water Transmission Pipeline**										
	Jordan Lake RWPS to Durham / OWASA Split - Rural			42 in	68,300	LF	$329	$22,449,913	17.2%	$3,871,000	
5	**Raw Water Transmission Pipeline**										
	Durham / OWASA Split to Jones Ferry Road WTP - Rural			18 in	18,000	LF	$141	$2,535,652	100.0%	$2,536,000	
	Durham / OWASA Split to Jones Ferry Road WTP - Urban			18 in	14,500	LF	$235	$3,404,348	100.0%	$3,404,000	
6	**Raw Water Booster Station**										
	Interim Capacity	2	mgd		1	LS	$890,000	$890,000	100.0%	$890,000	
	Ultimate Capacity	5	mgd		1	LS	$949,091	$949,091	100.0%		$949,000
7	**Upgrades to Jones Ferry Road WTP (Advanced Treatment)**										
	Interim Capacity	2	mgd		1	LS	$3,369,000	$3,369,000	100.0%	$3,369,000	
	Ultimate Capacity	5	mgd		1	LS	$2,643,000	$2,643,000	100.0%		$2,643,000
8							**CONSTRUCTION COST SUBTOTAL**			**$16,250,000**	**$4,180,000**
	CAPITAL COST ALLOWANCES										
9							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 8)**		15%	$2,438,000	$627,000
10							**TOTAL CONSTRUCTION COST**			**$18,688,000**	**$4,807,000**
11							**Engineering Studies, Design, and Construction Services (@ 15% x Line 8)**		15%	$2,438,000	$627,000
12							**Subtotal**			**$21,126,000**	**$5,434,000**
13	**Land Acquisition and Easements**		Jones Ferry Road WTP Site		0	Acre	$10,000	$0	0.0%	$0	
14			USACE Jordan Lake Easement		1	LS	$200,000	$200,000	9.3%	$19,000	
15			Allowance for Additional Land/Easement		1	LS	$100,000	$100,000	100.0%	$100,000	
16			Mitigation Costs for Stream Impacts		162	LF	$374	$60,408	100.0%	$60,000	
17			Mitigation Costs for Wetlands Impacts		0.11	Acre	$68,502	$7,716	100.0%	$8,000	
18							**Subtotal**			**$21,313,000**	**$5,434,000**
19							**Legal Fees, Permits and Approvals (@ 5% x Line 10)**		5%	$934,000	$240,000
20							**Subtotal**			**$22,247,000**	**$5,674,000**
21							**Contingency (@ 25% x Line 20)**		25%	$5,562,000	$1,419,000
22							**ESTIMATED PROJECT CAPITAL COST:**			**$27,809,000**	**$7,093,000**
23										**$34,902,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
24	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	0	mgd	$91,041	$0	100.0%	$0	
25	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
26	Additional Fixed Administration Cost (annual)				1	LS	$250				
27							**Subtotal Allocation Capital Costs:**			**$0.00**	**$0.00**
28							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$27,800,000**	**$7,100,000**
29										**$34,900,000**	
30							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$47,658,000**	
31							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$10.04**	
32							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.64**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for OWASA

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 71%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs		Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$1,659,000					$1,659,000	$1,638,000		
3	2				$1,659,000					$1,659,000	$1,617,000		
4	3				$1,659,000					$1,659,000	$1,596,000		
5	4				$1,659,000					$1,659,000	$1,576,000		
6	5				$1,659,000					$1,659,000	$1,556,000		
7	6	33	5.0	0.0	$1,659,000		$12,000	$91,000	$0	$1,762,000	$1,631,000	$5.27	$0.00
8	7	33	5.0		$1,659,000		$12,000	$92,000	$0	$1,763,000	$1,611,000	$3.08	$0.00
9	8	33	5.0		$1,659,000		$13,000	$93,000	$0	$1,765,000	$1,592,000	$2.34	$0.00
10	9	33	5.0		$1,659,000		$13,000	$94,000	$0	$1,766,000	$1,573,000	$1.97	$0.00
11	10	33	5.0		$1,659,000		$13,000	$96,000	$0	$1,768,000	$1,555,000	$1.75	$0.00
12	11	33	5.0	0.5	$1,659,000		$13,000	$97,000	$43,000	$1,812,000	$1,573,000	$1.60	$95.99
13	12	33	5.0		$1,659,000		$13,000	$98,000	$0	$1,770,000	$1,517,000	$1.49	$104.30
14	13	33	5.0		$1,659,000		$13,000	$99,000	$0	$1,771,000	$1,498,000	$1.41	$112.51
15	14	33	5.0		$1,659,000		$14,000	$101,000	$0	$1,774,000	$1,482,000	$1.34	$120.63
16	15	33	5.0		$1,659,000		$14,000	$102,000	$0	$1,775,000	$1,463,000	$1.29	$128.65
17	16	33	5.0	1.0	$1,659,000		$14,000	$103,000	$92,000	$1,868,000	$1,520,000	$1.25	$45.66
18	17	33	5.0		$1,659,000		$14,000	$105,000	$0	$1,778,000	$1,429,000	$1.21	$48.27
19	18	33	5.0		$1,659,000		$14,000	$106,000	$0	$1,779,000	$1,411,000	$1.17	$50.85
20	19	33	5.0		$1,659,000		$14,000	$107,000	$0	$1,780,000	$1,394,000	$1.14	$53.39
21	20	33	5.0		$1,659,000		$15,000	$109,000	$0	$1,783,000	$1,378,000	$1.12	$55.91
22	21	33	5.0	1.5	$2,206,000		$15,000	$110,000	$148,000	$2,479,000	$1,892,000	$1.11	$29.68
23	22	33	5.0		$2,206,000		$15,000	$112,000	$0	$2,333,000	$1,758,000	$1.10	$31.29
24	23	33	5.0		$2,206,000		$15,000	$113,000	$0	$2,334,000	$1,736,000	$1.10	$32.87
25	24	33	5.0		$2,206,000		$15,000	$115,000	$0	$2,336,000	$1,715,000	$1.09	$34.44
26	25	33	5.0		$2,206,000		$16,000	$116,000	$0	$2,338,000	$1,695,000	$1.08	$35.99
27	26	54	5.0	2.0	$547,000		$16,000	$118,000	$290,000	$971,000	$695,000	$1.05	$21.97
28	27	54	5.0		$547,000		$16,000	$119,000	$0	$682,000	$482,000	$1.01	$22.24
29	28	54	5.0		$547,000		$16,000	$121,000	$0	$684,000	$477,000	$0.98	$22.50
30	29	54	5.0		$547,000		$16,000	$122,000	$0	$685,000	$472,000	$0.95	$22.76
31	30	54	5.0		$547,000	$1,227,000	$17,000	$124,000	$0	$1,915,000	$1,302,000	$0.94	$23.47
32	31	54	5.0	2.0	$547,000	$1,243,000	$17,000	$125,000	$309,000	$2,241,000	$1,504,000	$0.93	$17.35
33	32	54	5.0		$547,000	$1,259,000	$17,000	$127,000	$0	$1,950,000	$1,292,000	$0.93	$17.86
34	33	54	5.0		$547,000	$1,276,000	$17,000	$129,000	$0	$1,969,000	$1,288,000	$0.92	$18.36
35	34	54	5.0		$547,000	$1,292,000	$17,000	$130,000	$0	$1,986,000	$1,282,000	$0.91	$18.86
36	35	54	5.0		$547,000		$18,000	$132,000	$0	$697,000	$444,000	$0.89	$19.04
37	36	54	5.0	2.0	$547,000		$18,000	$134,000	$329,000	$1,028,000	$647,000	$0.87	$15.00
38	37	54	5.0		$547,000		$18,000	$135,000	$0	$700,000	$435,000	$0.85	$15.14
39	38	54	5.0		$547,000		$18,000	$137,000	$0	$702,000	$431,000	$0.83	$15.27
40	39	54	5.0		$547,000		$19,000	$139,000	$0	$705,000	$427,000	$0.82	$15.40
41	40	54	5.0		$547,000		$19,000	$141,000	$0	$707,000	$423,000	$0.80	$15.53
42	41	54	5.0	2.0	$547,000		$19,000	$143,000	$351,000	$1,060,000	$625,000	$0.79	$12.86
43	42	54	5.0		$547,000		$19,000	$144,000	$0	$710,000	$414,000	$0.77	$12.96
44	43	54	5.0		$547,000		$20,000	$146,000	$0	$713,000	$410,000	$0.76	$13.07
45	44	54	5.0		$547,000		$20,000	$148,000	$0	$715,000	$406,000	$0.74	$13.17
46	45	54	5.0		$547,000		$20,000	$150,000	$0	$717,000	$402,000	$0.73	$13.27
47	46	54	5.0	2.0		-$10,834,674	$20,000	$152,000	$530,000	-$10,133,000	-$5,606,000	$0.64	$10.04
Totals:	--	--	--	**13.0**	**$55,150,000**	**-$4,537,674**	**$654,000**	**$4,875,000**	**$2,092,000**	**$58,233,000**	**$47,658,000**	**$0.64**	**$10.04**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Raw Water Only Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Orange County

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	1	2	2	2	--
Orange County Capacity (equal to maximum day demand, mgd):	--	1.0	1.0	3.0	--
Average Water Use:	--	1.0	1.0	2.0	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Orange County Share of System Capacity (mgd):	--	1.0	2.0 inc.	3.0	--
% Total Capacity & Fixed Operating Cost Share:	--	3.0%	9.5%	5.6%	--
% Avg. Capacity & Variable Operating Cost Share:	--	4.9%	3.6%	5.0%	--
% Share of Durham-OWASA-Orange Co. Raw Water Main	--	--	--	10.3%	--
% Share of Durham-Orange Co. Raw Water Main	--	--	--	12.5%	--
Williams WTP Improvements Design Capacity (mgd):	--	18.0	24.0	24.0	--
Williams WTP Improvements Expansion Increment (mgd):	--	--	6	--	--
Orange County Share of Williams WTP Capacity (mgd):	--	1.0	2.0 inc.	3.0	--
% Total Capacity & Fixed Operating Cost Share:	--	5.6%	33.3%	12.5%	--
Friction Head Applied to Variable Operating Costs (ft):	--	104	114	145	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	628	638	669	--
Orange County Pressure Zone (ft):		**840**			

	CAPITAL COSTS (2014 Dollars)								Allocated to Orange County		
										Costs Subtotals	
No.	Description			Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**										
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)				1	LS	$9,500,000	$9,500,000	5.6%	$528,000	
2	**Intake Piping (Shared)**										
	Dual Microtunneled Intake Lines (sized for 54 mgd total)			48 in	2,000	LF	$2,870	$5,739,130	5.6%	$319,000	
	Pipeline to New Raw Water Pump Station			54 in	6,625	LF	$423	$2,799,783	5.6%	$156,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**										
	Interim Capacity	33	mgd		1	LS	$8,420,000	$8,420,000	3.0%	$255,000	
	Ultimate Capacity	54	mgd		1	LS	$4,110,000	$4,110,000	9.5%		$391,000
4	**Shared Raw Water Transmission Pipeline**										
	Jordan Lake RWPS to Durham / OWASA Split - Rural			42 in	68,300	LF	$329	$22,449,913	10.3%	$2,322,000	
5	**Raw Water Transmission Pipeline**										
	Durham / OWASA Split to Williams WTP			42 in	42,000	LF	$329	$13,805,217	12.5%	$1,726,000	
	Durham / OWASA Split to Williams WTP			42 in	40,000	LF	$548	$21,913,043	12.5%	$2,739,000	
6	**Repurpose Williams WTP (Advanced Treatment)**										
	Interim Capacity	18	mgd		1	LS	$40,448,000	$40,448,000	5.6%	$2,247,000	
	Ultimate Capacity	24	mgd		1	LS	$10,420,000	$10,420,000	33.3%		$3,473,000
7	**Finished Water Booster Station**										
	Interim Capacity	1	mgd		1	LS	$530,000	$530,000	100.0%	$530,000	
	Ultimate Capacity	3	mgd		1	LS	$741,818	$741,818	100.0%		$742,000
8							**CONSTRUCTION COST SUBTOTAL**			**$10,830,000**	**$4,610,000**
	CAPITAL COST ALLOWANCES										
9							**Contractor Mobilization, Overhead & Profit (@ 15% x Line 8)**		15.0%	$1,625,000	$692,000
10							**TOTAL CONSTRUCTION COST**			**$12,455,000**	**$5,302,000**
11							**Engineering Studies, Design, and Construction Services (@ 15% x Line 8)**		15.0%	$1,625,000	$692,000
12							**Subtotal**			**$14,080,000**	**$5,994,000**
13	**Land Acquisition and Easements**		Williams WTP Site		0	Acre	$10,000	$0	0.0%	$0	
14			USACE Jordan Lake Easement		1	LS	$200,000	$200,000	5.6%	$11,000	
15			Allowance for Additional Land/Easement		1	LS	$100,000	$100,000	100.0%	$100,000	
16			Mitigation Costs for Stream Impacts		73	LF	$374	$27,240	100.0%	$27,000	
17			Mitigation Costs for Wetlands Impacts		0.13	Acre	$68,502	$9,040	100.0%	$9,000	
18							**Subtotal**			**$14,227,000**	**$5,994,000**
19							**Legal Fees, Permits and Approvals (@ 5% x Line 10)**		5.0%	$623,000	$265,000
20							**Subtotal**			**$14,850,000**	**$6,259,000**
21							**Contingency (@ 25% x Line 20)**		25.0%	$3,713,000	$1,565,000
22							**ESTIMATED PROJECT CAPITAL COST:**			**$18,563,000**	**$7,824,000**
23										**$26,387,000**	
					Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
24	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)			2022	1	mgd	$91,041	$91,041	100.0%	$91,000	
25	Annual Allocation O&M cost (included in life-cycle analysis)				Varies	mgd	$2,219				
26	Additional Fixed Administration Cost (annual)				1	LS	$250				
27							**Subtotal Allocation Capital Costs:**			**$91,000.00**	**$0.00**
28							**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$18,700,000**	**$7,800,000**
29										**$26,500,000**	
30							**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$40,032,000**	
31							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$2.13**	
32							**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$1.34**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Orange County

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 74%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs			
												Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$1,107,000					$1,107,000	$1,093,000		
3	2				$1,107,000					$1,107,000	$1,079,000		
4	3				$1,107,000					$1,107,000	$1,065,000		
5	4				$1,107,000					$1,107,000	$1,051,000		
6	5				$1,107,000					$1,107,000	$1,038,000		
7	6	33	2.0	1.0	$1,107,000		$93,000	$32,000	$158,000	$1,390,000	$1,287,000	$9.06	$18.12
8	7	33	2.0	1.0	$1,107,000		$5,000	$32,000	$160,000	$1,304,000	$1,192,000	$5.35	$10.69
9	8	33	2.0	1.0	$1,107,000		$5,000	$32,000	$162,000	$1,306,000	$1,178,000	$4.10	$8.20
10	9	33	2.0	1.0	$1,107,000		$5,000	$33,000	$164,000	$1,309,000	$1,166,000	$3.48	$6.95
11	10	33	2.0	1.0	$1,107,000		$5,000	$33,000	$167,000	$1,312,000	$1,154,000	$3.10	$6.19
12	11	33	2.0	1.0	$1,107,000		$5,000	$34,000	$169,000	$1,315,000	$1,141,000	$2.84	$5.68
13	12	33	2.0	1.0	$1,107,000		$5,000	$34,000	$171,000	$1,317,000	$1,129,000	$2.66	$5.31
14	13	33	2.0	1.0	$1,107,000		$5,000	$35,000	$173,000	$1,320,000	$1,117,000	$2.52	$5.03
15	14	33	2.0	1.0	$1,107,000		$6,000	$35,000	$175,000	$1,323,000	$1,105,000	$2.40	$4.81
16	15	33	2.0	1.0	$1,107,000		$6,000	$35,000	$178,000	$1,326,000	$1,093,000	$2.31	$4.63
17	16	33	2.0	1.0	$1,107,000		$6,000	$36,000	$180,000	$1,329,000	$1,082,000	$2.24	$4.48
18	17	33	2.0	1.0	$1,107,000		$6,000	$36,000	$182,000	$1,331,000	$1,070,000	$2.17	$4.35
19	18	33	2.0	1.0	$1,107,000		$6,000	$37,000	$185,000	$1,335,000	$1,059,000	$2.12	$4.24
20	19	33	2.0	1.0	$1,107,000		$6,000	$37,000	$187,000	$1,337,000	$1,047,000	$2.07	$4.14
21	20	33	2.0	1.0	$1,107,000		$6,000	$38,000	$189,000	$1,340,000	$1,036,000	$2.03	$4.05
22	21	33	2.0	1.0	$1,711,000		$6,000	$38,000	$192,000	$1,947,000	$1,486,000	$2.03	$4.05
23	22	33	2.0	1.0	$1,711,000		$6,000	$39,000	$194,000	$1,950,000	$1,469,000	$2.03	$4.05
24	23	33	2.0	1.0	$1,711,000		$6,000	$39,000	$197,000	$1,953,000	$1,453,000	$2.02	$4.05
25	24	33	2.0	1.0	$1,711,000		$6,000	$40,000	$199,000	$1,956,000	$1,436,000	$2.02	$4.04
26	25	33	2.0	1.0	$1,711,000		$6,000	$40,000	$202,000	$1,959,000	$1,420,000	$2.02	$4.03
27	26	54	2.0	1.0	$604,000		$6,000	$41,000	$205,000	$856,000	$613,000	$1.96	$3.92
28	27	54	2.0	1.1	$604,000		$7,000	$41,000	$216,000	$868,000	$613,000	$1.91	$3.81
29	28	54	2.0	1.1	$604,000		$7,000	$42,000	$228,000	$881,000	$614,000	$1.86	$3.70
30	29	54	2.0	1.2	$604,000		$7,000	$42,000	$240,000	$893,000	$615,000	$1.82	$3.60
31	30	54	2.0	1.2	$604,000	$819,000	$7,000	$43,000	$253,000	$1,726,000	$1,173,000	$1.81	$3.55
32	31	54	2.0	1.3	$604,000	$830,000	$7,000	$44,000	$265,000	$1,750,000	$1,174,000	$1.80	$3.51
33	32	54	2.0	1.3	$604,000	$841,000	$7,000	$44,000	$278,000	$1,774,000	$1,175,000	$1.80	$3.46
34	33	54	2.0	1.4	$604,000	$851,000	$7,000	$45,000	$292,000	$1,799,000	$1,177,000	$1.79	$3.41
35	34	54	2.0	1.4	$604,000	$863,000	$7,000	$45,000	$305,000	$1,824,000	$1,178,000	$1.78	$3.36
36	35	54	2.0	1.5	$604,000		$7,000	$46,000	$319,000	$976,000	$622,000	$1.75	$3.26
37	36	54	2.0	1.5	$604,000		$7,000	$46,000	$333,000	$990,000	$623,000	$1.72	$3.17
38	37	54	2.0	1.6	$604,000		$7,000	$47,000	$348,000	$1,006,000	$625,000	$1.70	$3.08
39	38	54	2.0	1.6	$604,000		$7,000	$48,000	$362,000	$1,021,000	$626,000	$1.67	$2.99
40	39	54	2.0	1.7	$604,000		$8,000	$48,000	$378,000	$1,038,000	$628,000	$1.65	$2.91
41	40	54	2.0	1.7	$604,000		$8,000	$49,000	$393,000	$1,054,000	$630,000	$1.63	$2.83
42	41	54	2.0	1.8	$604,000		$8,000	$49,000	$409,000	$1,070,000	$631,000	$1.60	$2.75
43	42	54	2.0	1.8	$604,000		$8,000	$50,000	$425,000	$1,087,000	$633,000	$1.58	$2.68
44	43	54	2.0	1.9	$604,000		$8,000	$51,000	$441,000	$1,104,000	$635,000	$1.57	$2.61
45	44	54	2.0	1.9	$604,000		$8,000	$51,000	$458,000	$1,121,000	$636,000	$1.55	$2.54
46	45	54	2.0	2.0	$604,000		$8,000	$52,000	$476,000	$1,140,000	$639,000	$1.53	$2.47
47	46	54	2.0	2.0		-$9,001,272	$8,000	$53,000	$493,000	-$8,447,000	-$4,674,000	$1.34	$2.13
Totals:	--	--	--	**51.5**	**$42,775,000**	**-$4,797,272**	**$354,000**	**$1,692,000**	**$10,701,000**	**$50,725,000**	**$40,032,000**	**$1.34**	**$2.13**

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Raw Water Only Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
Pittsboro

Final

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	0	6	6	6	--
Pittsboro Capacity (equal to maximum day demand, mgd):	--	0.0	3.0	9.0	--
Average Water Use:	--	0.0	2.0	6.0	--
System Design Capacity (mgd):	--	33	54	54	--
System Expansion Increment (mgd):	--	--	21	--	--
Pittsboro Share of System Capacity (mgd):	--	3.0	6.0 inc.	9.0	--
% Total Capacity & Fixed Operating Cost Share:	--	9.1%	28.6%	16.7%	--
% Avg. Capacity & Variable Operating Cost Share:	--	0.0%	7.1%	15.0%	--
Jordan Lake WTP Design Capacity - Chatham County / Pittsboro (mgd):	--	13.0	25.0	25.0	25.0
Jordan Lake WTP Expansion Increment (mgd):	--	--	12	--	--
Pittsboro Share of Jordan Lake WTP Capacity (mgd):	--	3.0	6.0 inc.	9.0	9.0
% Total Capacity & Fixed Operating Cost Share:	--	23.1%	50.0%	36.0%	36.0%
Friction Head Applied to Variable Operating Costs (ft):	--	1	7	48	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	250	256	297	--
Pittsboro Pressure Zone (ft):		**565**			

CAPITAL COSTS (2014 Dollars)									Allocated to Pittsboro		
										Costs Subtotals	
No.	Description		Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**									
	Steel Frame Tower w/ Multiple Level Screens (designed for 54 mgd total)			1	LS	$9,500,000	$9,500,000	16.7%	$1,583,000	
2	**Intake Piping (Shared)**									
	Dual Microtunneled Intake Lines (sized for 54 mgd total)		48 in	2,000	LF	$2,870	$5,739,130	16.7%	$957,000	
	Pipeline to New Raw Water Pump Station		54 in	6,625	LF	$423	$2,799,783	16.7%	$467,000	
3	**Raw Water Pump Station (Shared, Dual Lift)**									
	Interim Capacity	33 mgd		1	LS	$8,420,000	$8,420,000	9.1%	$765,000	
	Ultimate Capacity	54 mgd		1	LS	$4,110,000	$4,110,000	28.6%		$1,174,000
4	**Jordan Lake WTP (Shared with Pittsboro, includes High Service PS to deliver to Chatham/Pittsboro)**									
	Interim Capacity	13 mgd		1	LS	$30,639,000	$30,639,000	23.1%	$7,071,000	
	Ultimate Capacity	25 mgd		1	LS	$22,958,000	$22,958,000	50.0%		$11,479,000
5	**Pittsboro Finished Water Transmission Pipeline**									
	Western Segment - Rural		24 in	31,552	LF	$188	$5,926,289	100.0%	$5,926,000	
6						**CONSTRUCTION COST SUBTOTAL**			**$16,770,000**	**$12,660,000**
	CAPITAL COST ALLOWANCES									
7						**Contractor Mobilization, Overhead & Profit (@ 15% x Line 6)**		15%	$2,516,000	$1,899,000
8						**TOTAL CONSTRUCTION COST**			**$19,286,000**	**$14,559,000**
9						**Engineering Studies, Design, and Construction Services (@ 15% x Line 6)**		15%	$2,516,000	$1,899,000
10						**Subtotal**			**$21,802,000**	**$16,458,000**
11	**Land Acquisition and Easements**	OWASA WTP Site		63	Acre	$10,000	$625,000	36.0%	$225,000	
12		USACE Jordan Lake Easement		1	LS	$200,000	$200,000	16.7%	$33,000	
13		Allowance for Additional Land/Easement		1	LS	$50,000	$50,000	100.0%	$50,000	
14		Mitigation Costs for Stream Impacts		144	LF	$374	$53,725	100.0%	$54,000	
15		Mitigation Costs for Wetlands Impacts		0.25	Acre	$68,502	$17,126	100.0%	$17,000	
16						**Subtotal**			**$22,181,000**	**$16,458,000**
17						**Legal Fees, Permits and Approvals (@ 5% x Line 8)**		5%	$964,000	$728,000
18						**Subtotal**			**$23,145,000**	**$17,186,000**
19						**Contingency (@ 25% x Line 18)**		25%	$5,786,000	$4,297,000
20						**ESTIMATED PROJECT CAPITAL COST:**			**$28,931,000**	**$21,483,000**
21									**$50,414,000**	
				Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
22	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)		2022	6	mgd	$91,041	$546,245	100.0%	$546,000	
23	Annual Allocation O&M cost (included in life-cycle analysis)			Varies	mgd	$2,219				
24	Additional Fixed Administration Cost (annual)			1	LS	$250				
25						**Subtotal Allocation Capital Costs:**			**$546,000.00**	**$0.00**
26						**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**			**$29,500,000**	**$21,500,000**
27									**$51,000,000**	
28						**CAPITAL COST PER MGD ULTIMATE ALLOCATION:**			**$8,500,000**	
29						**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**			**$78,694,000**	
30						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**			**$2.09**	
31						**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**			**$0.88**	

Final

CALCULATION OF O&M & LIFE-CYCLE COSTS for Pittsboro

Discount Rate: 1.295%
Capital Recovery Interest Rate: 3.225%
% Construction Cost Applied to O&M: 56%

Year and Water Usage					Actual (Inflated) Dollars						2014 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs		Total Annual Costs		Running Present	
Year	# Yrs from 2014	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
1	0												
2	1				$1,725,000					$1,725,000	$1,703,000		
3	2				$1,725,000					$1,725,000	$1,681,000		
4	3				$1,725,000					$1,725,000	$1,660,000		
5	4				$1,725,000					$1,725,000	$1,638,000		
6	5				$1,725,000					$1,725,000	$1,618,000		
7	6	33	6	0.0	$1,725,000		$590,000	$112,000	$0	$2,427,000	$2,247,000	$4.82	
8	7	33	6	0.1	$1,725,000		$15,000	$113,000	$6,000	$1,859,000	$1,699,000	$2.80	$334.85
9	8	33	6	0.2	$1,725,000		$15,000	$115,000	$11,000	$1,866,000	$1,683,000	$2.12	$127.08
10	9	33	6	0.3	$1,725,000		$15,000	$116,000	$17,000	$1,873,000	$1,668,000	$1.78	$71.18
11	10	33	6	0.4	$1,725,000		$15,000	$118,000	$23,000	$1,881,000	$1,654,000	$1.58	$47.24
12	11	33	6	0.5	$1,725,000		$16,000	$119,000	$29,000	$1,889,000	$1,640,000	$1.44	$34.49
13	12	33	6	0.6	$1,725,000		$16,000	$121,000	$35,000	$1,897,000	$1,626,000	$1.34	$26.76
14	13	33	6	0.7	$1,725,000		$16,000	$122,000	$42,000	$1,905,000	$1,612,000	$1.26	$21.65
15	14	33	6	0.8	$1,725,000		$16,000	$124,000	$48,000	$1,913,000	$1,598,000	$1.20	$18.05
16	15	33	6	0.9	$1,725,000		$16,000	$125,000	$55,000	$1,921,000	$1,584,000	$1.16	$15.41
17	16	33	6	1.0	$1,725,000		$17,000	$127,000	$62,000	$1,931,000	$1,572,000	$1.12	$13.39
18	17	33	6	1.1	$1,725,000		$17,000	$129,000	$69,000	$1,940,000	$1,559,000	$1.08	$11.81
19	18	33	6	1.2	$1,725,000		$17,000	$130,000	$76,000	$1,948,000	$1,545,000	$1.05	$10.53
20	19	33	6	1.3	$1,725,000		$17,000	$132,000	$83,000	$1,957,000	$1,533,000	$1.03	$9.49
21	20	33	6	1.4	$1,725,000		$17,000	$134,000	$91,000	$1,967,000	$1,521,000	$1.01	$8.62
22	21	33	6	1.5	$3,382,000		$18,000	$135,000	$99,000	$3,634,000	$2,774,000	$1.02	$8.18
23	22	33	6	1.6	$3,382,000		$18,000	$137,000	$107,000	$3,644,000	$2,746,000	$1.04	$7.77
24	23	33	6	1.7	$3,382,000		$18,000	$139,000	$115,000	$3,654,000	$2,718,000	$1.05	$7.39
25	24	33	6	1.8	$3,382,000		$18,000	$141,000	$123,000	$3,664,000	$2,691,000	$1.06	$7.04
26	25	33	6	1.9	$3,382,000		$19,000	$143,000	$132,000	$3,676,000	$2,665,000	$1.06	$6.72
27	26	54	6	2.0	$1,657,000		$19,000	$145,000	$140,000	$1,961,000	$1,403,000	$1.04	$6.27
28	27	54	6	2.2	$1,657,000		$19,000	$146,000	$156,000	$1,978,000	$1,397,000	$1.03	$5.84
29	28	54	6	2.4	$1,657,000		$19,000	$148,000	$173,000	$1,997,000	$1,393,000	$1.01	$5.44
30	29	54	6	2.6	$1,657,000		$20,000	$150,000	$190,000	$2,017,000	$1,389,000	$0.99	$5.07
31	30	54	6	2.8	$1,657,000	$1,277,000	$20,000	$152,000	$207,000	$3,313,000	$2,252,000	$0.99	$4.81
32	31	54	6	3.0	$1,657,000	$1,293,000	$20,000	$154,000	$225,000	$3,349,000	$2,247,000	$1.00	$4.57
33	32	54	6	3.2	$1,657,000	$1,310,000	$20,000	$156,000	$243,000	$3,386,000	$2,243,000	$1.00	$4.34
34	33	54	6	3.4	$1,657,000	$1,327,000	$21,000	$158,000	$261,000	$3,424,000	$2,239,000	$1.00	$4.13
35	34	54	6	3.6	$1,657,000	$1,344,000	$21,000	$160,000	$280,000	$3,462,000	$2,235,000	$1.00	$3.93
36	35	54	6	3.8	$1,657,000		$21,000	$162,000	$300,000	$2,140,000	$1,364,000	$0.99	$3.70
37	36	54	6	4.0	$1,657,000		$21,000	$164,000	$319,000	$2,161,000	$1,360,000	$0.97	$3.49
38	37	54	6	4.2	$1,657,000		$22,000	$166,000	$340,000	$2,185,000	$1,357,000	$0.96	$3.29
39	38	54	6	4.4	$1,657,000		$22,000	$169,000	$361,000	$2,209,000	$1,355,000	$0.95	$3.11
40	39	54	6	4.6	$1,657,000		$22,000	$171,000	$382,000	$2,232,000	$1,351,000	$0.94	$2.95
41	40	54	6	4.8	$1,657,000		$23,000	$173,000	$404,000	$2,257,000	$1,349,000	$0.93	$2.80
42	41	54	6	5.0	$1,657,000		$23,000	$175,000	$426,000	$2,281,000	$1,346,000	$0.92	$2.66
43	42	54	6	5.2	$1,657,000		$23,000	$178,000	$449,000	$2,307,000	$1,344,000	$0.92	$2.54
44	43	54	6	5.4	$1,657,000		$23,000	$180,000	$472,000	$2,332,000	$1,341,000	$0.91	$2.42
45	44	54	6	5.6	$1,657,000		$24,000	$182,000	$496,000	$2,359,000	$1,339,000	$0.90	$2.31
46	45	54	6	5.8	$1,657,000		$24,000	$185,000	$520,000	$2,386,000	$1,337,000	$0.89	$2.21
47	46	54	6	6.0			$24,000	$187,000	$545,000	$756,000	$418,000	$0.88	$2.09
Totals:	--	--	--	**103.0**	**$84,550,000**	**$6,551,000**	**$1,357,000**	**$5,993,000**	**$8,112,000**	**$106,563,000**	**$78,694,000**	**$0.88**	**$2.09**

Appendix D: Jordan Lake Water Quality Data Summary

Water Quality Data Available for Jordan Lake

With increasing population in the greater Research Triangle area, a reliance on surface water supply and the potential impact of growth on the water quality of those surface water sources, various water quality monitoring efforts were launched starting in 1988. Local governments collaborating with the Triangle J Council of Governments (TJCOG) formed the Triangle Area Water Supply Monitoring Project, a systematic evaluation of water supply sources in the region, including Jordan Lake. Water quality and water quantity monitoring efforts have been carried out with collaboration of several agencies including the North Carolina Department of Natural Resources (NCDENR), and the United States Geological Survey (USGS). An ample array of data can be retrieved from data bases available for each of these agencies monitoring stations.

NCDENR Data:

NCDENR has been collecting data at nine existing monitoring stations on Jordan Lake as shown on Figure 1. Records at some of these monitoring stations date back to the year 2000. Sampling at these stations occurs twice monthly during the algae growing season (May through September) and monthly during the non-growing season. The purpose of these monitoring stations is to facilitate evaluation of nutrient reduction and nutrient related pollution in Jordan Lake. Monitoring in these stations occurs in the photic zone and throughout the water column. Parameters evaluated include secchi depth, chlorophyll *a*, nutrients (TP, TKN, NH3, NO_2+NO_3), turbidity, temperature, pH, dissolved oxygen, and conductivity. Some stations records include metals concentrations but sampling for this parameter has not occurred with the same frequency.

In addition to the existing monitoring stations, NCDENR has recently added eleven new monitoring stations to be evaluated once a month annually for the purpose of evaluating the performance of the newly installed mechanical water circulators (SolarBees). The locations of these Mechanical Water Circulator monitoring stations is also shown on Figure 1. The water quality data collected at these additional stations is intended to gauge the performance of the mechanical water circulators independent of meteorological or hydrological variability.

Table 1 provides a summary of the parameters evaluated at the twenty (20) NCDENR stations and the number of measurements taken at each location to date.

USGS Data:

The USGS has monitored water quality at Jordan Lake for over twenty years. The location of the USGS monitoring stations are shown on Figure 2. Parameters monitored include nutrients, major ions, and total organic carbon.

During the period of 1988 to 1994 the USGS, in addition sampling the regular ambient parameters, conducted sampling at the listed monitoring stations for pesticides, PCBs, and other synthetic organic compounds that were of concern to local water suppliers (Childress et al., 1995).

During 2002 through 2005 the USGS conducted a study to address concerns due to presence of selected organic wastewater compounds, pharmaceuticals, and antibiotics (Giorgino et al., 2007). Jordan Lake was sampled twice during this period. Of twenty four compounds detected at least once in the samples

from Jordan Lake, 3 were pharmaceutical compounds, 2 were antibiotics, 2 were fire retardants, and 1 was a pesticide.

Due to the highly eutrophic nature of the reservoir and in an effort to analyze the effects of algal blooms on water treatment costs and recreation, several "blue-green algae" toxins such as microcystins, cylindrospermopsin, anatoxin-a, and saxitoxin (toxins that target the nervous system and liver of mammals) are being targeted by the USGS monitoring program for 2014. Also taste and odor compounds such as Geosmin and 2-methylsoborneol are monitored to assess levels of concern.

Currently the USGS is conducting a Triangle Water Supply water quality investigation at Jordan Lake which spans from July 2012 to June 2017 and involves sampling at each monitoring station from four to six times a year for the above parameters and up until June 2014 the USGS has sampled twice a year for trace elements. However, beginning in June 2014 the USGS will discontinue sampling for all trace elements and will monitor only iron and manganese to address water supply treatment issues.

Table 2 provides data observed on various constituents at the Jordan Lake USGS monitoring stations labelled in Figure 2 during the 2007-2008 drought, to include the Jordan Lake at Bells Landing near Griffin Crossroads station which is the closest station to the proposed Western Jordan Lake intake site. It is interesting to note that the monitoring program found that there are instances where some parameters exceeded concentrations recommended by NC water quality standards during the drought.

WQ Historical Overview – 2010 Cary/Apex Source Water Quality Evaluation – Hazen and Sawyer, P.C.

A study was conducted for the Cary/Apex Water Treatment Facility by Hazen and Sawyer in 2009/2010 to assess poor water quality conditions in Jordan Lake as a result of prolonged drought conditions. The evaluation consisted of five major components including:

- Review of existing infrastructure and operating data during water quality excursions
- Review of treatment facility experiences with difficult to treat source water
- Preliminary determination of plant upgrades, and costs to manage events
- Development of Operating Procedures for use during water quality excursions

Water treatment for raw water parameters of interest included turbidity, pH, manganese, UV-254, TOC and color. A pilot treatment facility of the Cary/Apex Treatment Facility was constructed at the plant. Pilot testing of the process train (raw water oxidation, coagulation, settling, intermediate ozone, filtration, etc.) was performed to evaluate process performance for meeting finished water quality goals, as well as any limitations of current processes to handle drought source water quality excursions.

References:

NC DENR, Study Plan for the Assessment of In-Lake Mechanical Reductions of Adverse Impacts Related to Excess Nutrients in the Morgan Creek and Haw River Arms of Jordan Lake, Draft, 2013.

NC DENR, Study Plan for the Ongoing Assessment of Water Quality in Jordan Lake, 2009

Giorgino, M.J., Rasmussen, R.B., and Pfeifle, C.M., 2007, Occurrence of Organic Wastewater Compounds in Selected Surface Water Supplies, Triangle Area of North Carolina, 2002-2005: U.S. Geological Survey Scientific Investigations Report 2007–5054, 28 p., available online at http://pubs.water.usgs.gov/sir2007-5054.

Giorgino, M.J., Rasmussen, R.A., and Pfeifle, C.A., 2012, Quality of surface-water supplies in the Triangle area of North Carolina, water year 2008: U.S. Geological Survey Open-File Report 2012–1013, 12 p.

Childress C.J.O. and Bathala Neeti, Water quality Trends for Streams and Reservoirs in the Research Triangle Area of North Carolina 1983-95, U.S. Geological Survey, 1995

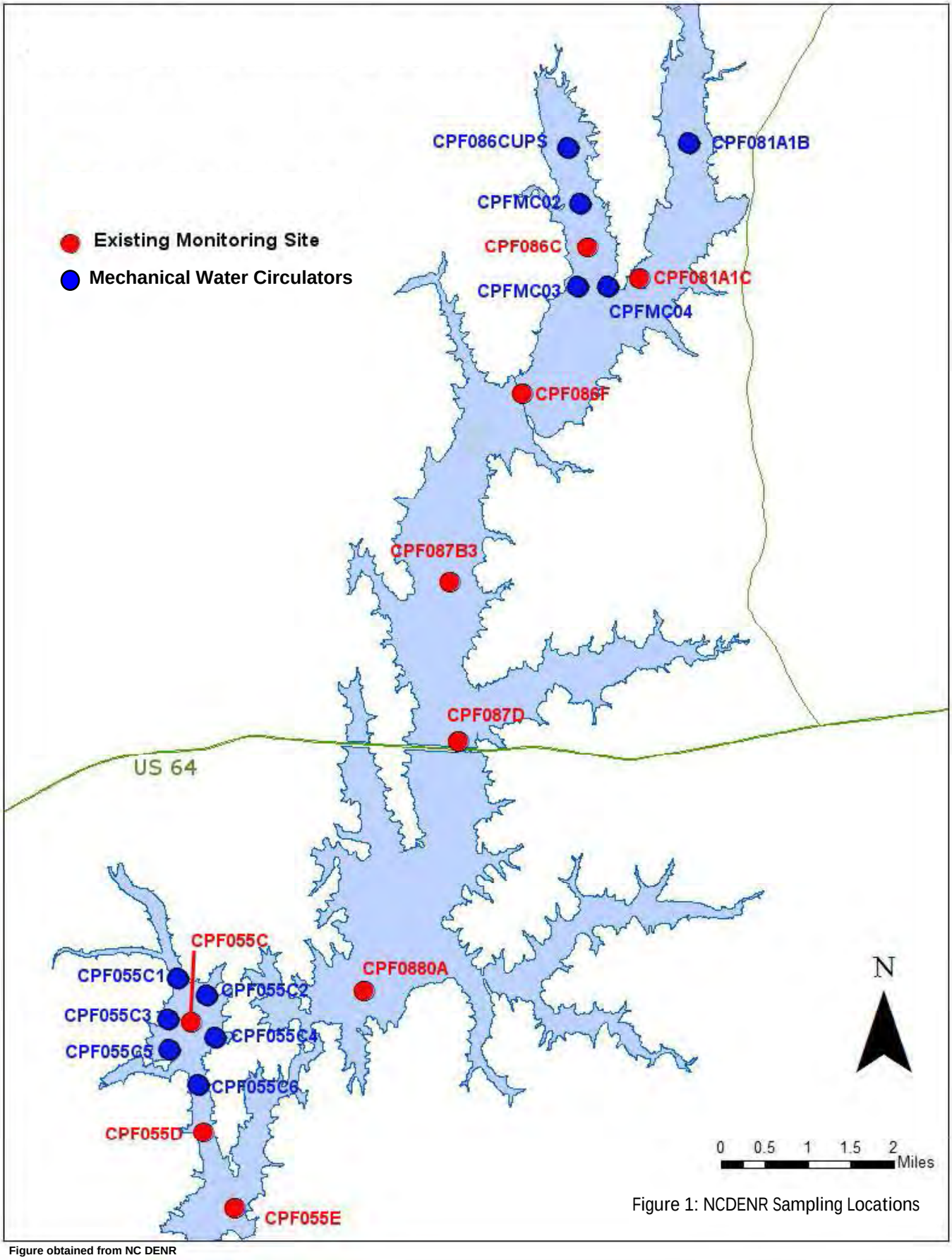


Figure 1: NCDENR Sampling Locations

Figure obtained from NC DENR

Table 1: NCDENR Sampling Parameters and Stations

Parameter	CPF055C	CPF055D	CPF055E	CPF081A1C	PF081A1CUF	CPF086C	CPF086CUPS	CPF086F
Ammonia-nitrogen as N	214	63	213	217	91	217	91	217
Arsenic	1							1
Cadmium	10		7	7		7		10
Calcium	10		7	7		7		10
Chloride	12		9	9		9		12
Chlorophyll a	118	63	115	120	11	122	12	123
Chromium	10		7	7		7		10
Copper	10		7	7		7		10
Dissolved oxygen (DO)	911	678	1575	509	60	522	75	781
Fecal Coliform	1		1	1		1		1
Fluoride	1		1	1		1		1
Inorganic nitrogen (nitrate and nitrite) as N	215	63	214	217	91	217	91	218
Iron	10		7	7		7		10
Kjeldahl nitrogen as N	212	62	213	213	91	213	91	216
Lead	10		7	7		7		10
Magnesium	10		7	7		7		10
Manganese	10		7	7		7		10
Nickel	10		7	7		7		10
Orthophosphate as P	127		129	129	93	129	99	129
pH	905	678	1563	505	58	518	72	775
Phosphorus as P	213	62	213	216	91	216	90	216
Specific conductance	911	678	1575	509	60	522	75	781
Sulfate	1		1	1		1		1
Temperature, water	911	678	1575	509	60	522	75	781
Total solids	74		74	72	24	72	26	73
Total suspended solids	74		74	72	25	73	26	74
Turbidity	111	63	110	113		113		114
Zinc	10		7	7		7		10

Table 1: NCDENR Sampling Parameters and Stations

Parameter	CPF087B	CPF087B3	CPF087D	CPF08801A	CPF0880A	CPF0880Aa	CPF0880Ab	CPF0880Ac
Ammonia-nitrogen as N	102	219	210	146	116	102	100	101
Arsenic		1			1			
Cadmium		10	7	7	10			
Calcium		10	7	7	10			
Chloride		12	9	9	12			
Chlorophyll a	12	122	116	52	109	10	11	11
Chromium		10	7	7	10			
Copper		10	7	7	10			
Dissolved oxygen (DO)	164	1017	1166	741	1145	276	270	255
Fecal Coliform	1	1	1	1	1			
Fluoride		1	1	1	1			
Inorganic nitrogen (nitrate and nitrite) as N	102	217	210	144	116	102	101	102
Iron		10	7	7	10			
Kjeldahl nitrogen as N	102	217	206	144	114	102	100	101
Lead		10	7	7	10			
Magnesium		10	7	7	10			
Manganese		10	7	7	10			
Nickel		10	7	7	10			
Orthophosphate as P	106	129	128	128	23	106	105	106
pH	157	1008	1154	731	1145	266	260	245
Phosphorus as P	102	218	209	146	115	102	101	102
Specific conductance	164	1017	1166	741	1145	276	270	255
Sulfate		1	1	1	1			
Temperature, water	164	1017	1166	741	1145	276	270	255
Total solids	25	73	70	71	48	26	26	26
Total suspended solids	25	74	71	72	49	25	25	26
Turbidity		113	108	45	112			
Zinc		10	7	7	10			

Table 1: NCDENR Sampling Parameters and Stations

Parameter	CPF0884A	CPFJLSB1	CPFJLSB2	CPFJLSB3	CPFJLSB4
Ammonia-nitrogen as N	99				
Arsenic					
Cadmium					
Calcium					
Chloride					
Chlorophyll a	11				
Chromium					
Copper					
Dissolved oxygen (DO)	309			7	
Fecal Coliform	1	2	2	2	2
Fluoride					
Inorganic nitrogen (nitrate and nitrite) as N	99				
Iron					
Kjeldahl nitrogen as N	97				
Lead					
Magnesium					
Manganese					
Nickel					
Orthophosphate as P	105				
pH	297			7	
Phosphorus as P	99				
Specific conductance	309			7	
Sulfate					
Temperature, water	309			7	
Total solids	26				
Total suspended solids	24				
Turbidity					
Zinc					

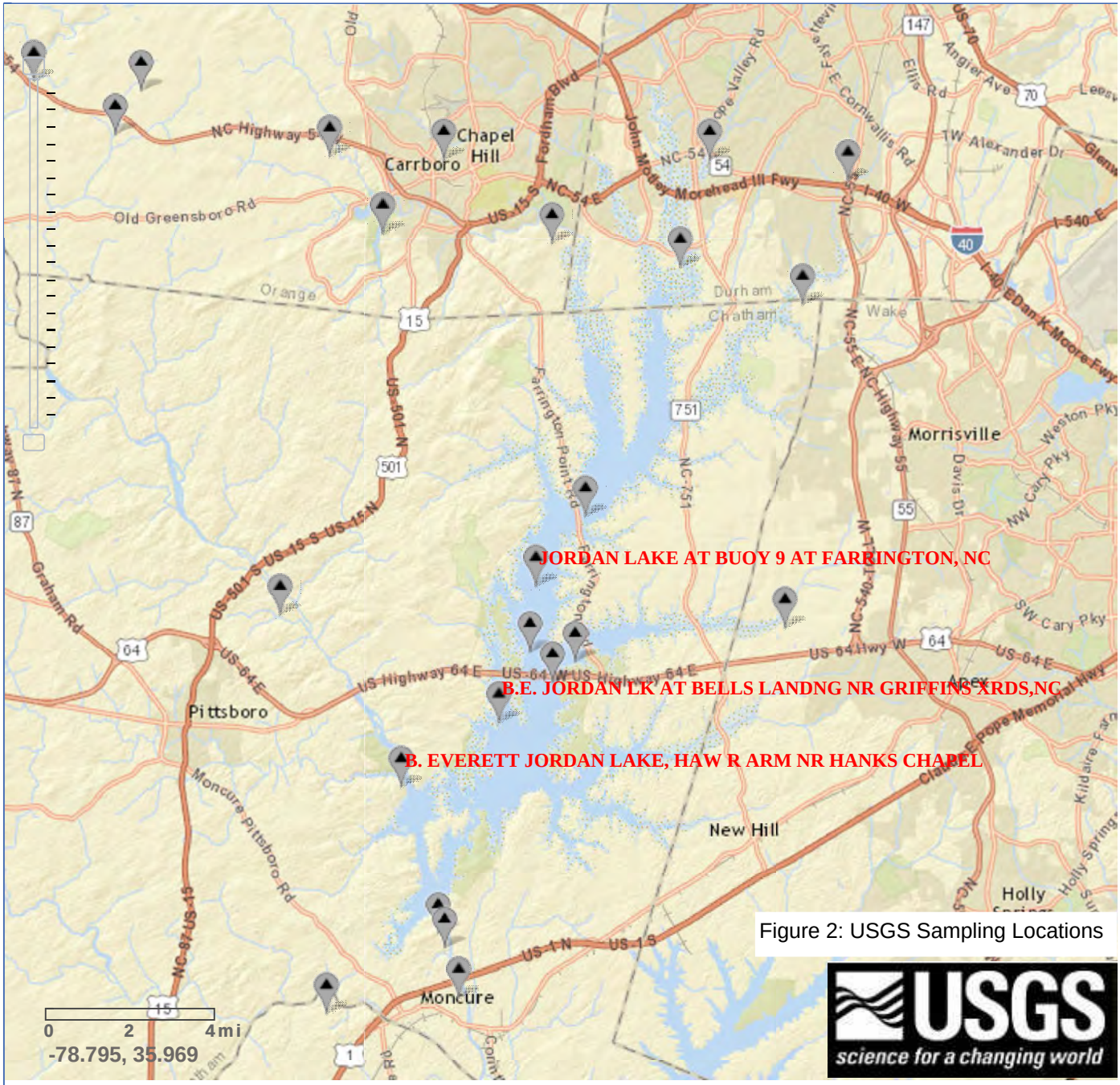


Figure 2: USGS Sampling Locations

Table 2. Summary of water-quality results for sampling sites in the Triangle Area Water Supply Monitoring Project, October 2007 through September 2008.

Constituent	NCDWQ standard[1]	MCL or *SDWR*[2]	Jordan Lake, Haw River arm		Jordan Lake at buoy 12	Jordan Lake at US Highway 64		Jordan Lake at Bells Landing	
			n	range	range	n	range	n	range
Color (platinum cobalt units)	--	*15*	6	25-70	25-60	6	20-50	6	18-30
Transparency, Secchi (m)	--	--	6	0.7-1.4	0.3-0.7	6	0.7-1.4	6	0.7-1.3
Dissolved oxygen (mg/L)	**<5.0**	--	6	6.5-10.9	**4.2-11.4**	6	5.3-10.9	6	8.2-12.9
Dissolved oxygen (percent saturation)	**110**	--	6	**83-123**	56-102	6	**60-118**	6	**75-130**
pH (standard units)	**6.0-9.0**	*6.5-8.5*	6	7.4-8.7	7.2-8.1	6	7.2-8.9	6	**7.2-9.1**
Specific cond at 25 degrees C (µS/cm)	--	--	6	191-371	158-244	6	176-194	6	168-204
Temperature, water (degrees C)	32	--	6	7.9-29.8	8.4-30.4	6	8.9-30.9	6	9.7-30.3
Hardness, water (mg/L as $CaCO_3$)	**100**	--	6	36-43	31-40	6	30-37	6	31-37
Calcium, filtered (mg/L)	--	--	6	8.45-10.8	7.79-10.4	6	7.49-9.43	6	7.50-9.25
Magnesium, filtered (mg/L)	--	--	6	3.54-4.00	2.79-3.49	6	2.78-3.32	6	2.91-3.34
Potassium, filtered (mg/L)	--	--	6	3.33-6.86	3.36-5.59	6	3.79-4.17	6	3.73-4.18
Sodium, filtered (mg/L)	--	--	6	22.4-61.8	16.9-33.1	6	20.0-24.8	6	19.0-27.0
Acid neutralizng capacity (mg/L as $CaCO_3$)	--	--	6	35-64	29-45	6	32-41	6	32-39
Bicarbonate, unfiltered (mg/L as $CaCO_3$)	--	--	6	42-78	35-55	6	39-50	6	39-48
Chloride, filtered (mg/L)	**230** (AL)	*250*	6	18.7-45.9	15.4-25.2	6	16.6-19.9	6	15.4-21.6
Fluoride, filtered (mg/L)	**1.8**	4	6	0.17-0.47	0.16-0.34	6	0.17-0.26	6	0.19-0.27
Silica, filtered (mg/L)	--	-	6	2.08-6.59	0.28-4.82	6	0.47-4.90	6	0.77-5.35
Sulfate, filtered (mg/L)	**250**	*250*	6	19.3-34.3	17.0-30.4	6	12.5-21.8	6	10.4-21.3
Residue, ROE@180C, filtered (mg/L)	--	--	6	127-223	112-151	6	111-128	6	94-128
NH3+orgN, unfiltered (mg/L as N)	--	--	6	0.53-1.1	0.91-1.3	6	0.65-1.1	6	0.61-0.92
Ammonia, filtered (mg/L as N)	--	--	6	<0.020-0.076	<0.020-0.092	6	<0.020-0.106	6	<0.020-0.033
NO3+NO2, filtered (mg/L as N)	**10** (WS)	10	6	0.024-0.976	<0.016-0.435	6	<0.016-0.363	6	<0.016-0.456
Nitrite, filtered (mg/L as N)	--	1	6	0.003-0.020	<0.002-0.012	6	<0.002-0.082	6	<0.002-0.014
Orthophosphate, filtered (mg/L as P)	--	--	6	0.004-0.018	<0.006-0.005	6	<0.006-0.004	6	<0.006-0.004
Phosphorus, unfiltered (mg/L as P)	--	--	6	0.065-0.104	0.067-0.112	6	0.033-0.072	6	0.025-0.047
Organic carbon, filtered (mg/L)	--	--	5	5.0-6.5	6.7-9.5	6	5.9-7.9	6	5.8-7.3
Organic carbon, unfiltered (mg/L)	--	--	6	6.2-9.0	10.6-12.8	6	7.6-10.2	6	7.4-10.9
Chlorophyll *a* (µg/L)	**40**	--	6	**4.2-44.8**	**24.4-57.5**	6	**15.3-52.3**	6	**10.4-50.3**
Pheophytin *a* (µg/L)	--	--	6	5.8-17.0	15.2-32.4	6	4.8-19.3	6	3.1-14.6
Aluminum, unfiltered (µg/L)	--	*50-200*	2	101-253	201-327	2	60-154	2	22-94
Arsenic, unfiltered (µg/L)	**10** (WS, HH)	10	2	0.49-0.66	0.63-0.85	2	0.49-0.75	2	0.50-0.77
Cadmium, unfiltered (µg/L)	**2**	5	2	0.06-0.09	<0.01-0.02	2	<0.01-0.02	2	0.01
Chromium, unfiltered (µg/L)	**50**	100	2	0.38-1.0	0.37-0.54	2	<0.40-0.35	2	<0.40-0.37
Cobalt, unfiltered (µg/L)	--	--	2	0.66-0.94	0.36-0.38	2	0.13-0.18	2	0.10-0.17
Copper, unfiltered (µg/L)	**7** (AL)	1,300[3]	2	1.1-2.5	<1.2-2.4	2	<1.2-1.3	2	<1.2-1.2
Iron, unfiltered (µg/L)	**1,000** (AL)	*300*	6	180-907	256-665	6	61-570	6	41-236
Lead, unfiltered (µg/L)	**25**	15[3]	2	0.24-0.79	0.56-0.74	2	0.19-0.34	2	0.07-0.21

Table 2. Summary of water-quality results for sampling sites in the Triangle Area Water Supply Monitoring Project, October 2007 through September 2008.

Constituent	NCDWQ standard[1]	MCL or *SDWR*[2]	Jordan Lake, Haw River arm		Jordan Lake at buoy 12	Jordan Lake at US Highway 64		Jordan Lake at Bells Landing	
			n	range	range	n	range	n	range
Manganese, unfiltered (µg/L)	**200** (WS)	*50*	6	61.3-145	**101-249**	6	**55.6-302**	6	48.1-166
Mercury, filtered (µg/L)	**0.012**	2	6	**<0.010-0.037**	<0.010	6	**<0.010-0.020**	6	**<0.010-0.025**
Mercury, unfiltered (µg/L)	**0.012**	2	6	**<0.010-0.049**	<0.010-0.012	6	**<0.010-0.023**	6	**<0.010-0.113**
Molybdenum, unfiltered (µg/L)	--	--	2	0.9-4.7	2.2-9.6	2	2.1-4.5	2	1.8-3.3
Nickel, unfiltered (µg/L)	**25** (WS)	--	2	2.3-3.1	1.1-1.3	2	0.56-1.1	2	0.48-1.1
Selenium, unfiltered (µg/L)	**5**	50	2	0.17-0.19	0.17-0.21	2	0.17-0.17	2	0.17-0.17
Silver, unfiltered (µg/L)	**0.06** (AL)	*100*	2	<0.02-0.01	<0.02	2	<0.02	2	<0.02
Zinc, unfiltered (µg/L)	**50** (AL)	*5,000*	2	3.9-10.0	2.8-3.4	2	2.1-2.2	2	<2.0-2.3
Suspended sediment (mg/L)	--	--	--	--	--	--	--	--	--

[1] North Carolina Division of Water Quality criteria listed are the most stringent of either freshwater aquatic life, water supply (WS), or human health (HH) standards; (AL)=Action Level for freshwater aquatic life (accessed November 28, 2008 at: http://h2o.enr.state.nc.us/csu/documents/ncactable290807.pdf).

[2] U.S. Environmental Protection Agency Maximum Contaminant Levels for drinking water are listed if available; Secondary Drinking Water Regulations are listed in italics if MCLs are not available (accessed January 16, 2009 at: http://www.epa.gov/safewater/contaminants/index.html)

[3] U.S. Environmental Protection Agency Treatment Technique action level (accessed January 16, 2009 at: http://www.epa.gov/safewater/contaminants/index.html)

[NCDWQ, North Carolina Division of Water Quality; MCL, maximum contaminant level; SDWR, secondary drinking water regulation; n, number of observations; range, minimum and maximum values; --, not available or constituent not sampled; m, meter; mg/L, milligram per liter; <, less than; µS/cm, microsiemens per centimeter; C, Celsius; CaCO3, calcium carbonate; N, nitrogen; P, phosphorus; µg/L, microgram per liter; bold text indicates an exceedance of the NCDWQ water-quality criterion]

HAZEN AND SAWYER

Environmental Engineers & Scientists

www.hazenandsawyer.com