



Orange Water and Sewer Authority

OWASA is Carrboro-Chapel Hill's not-for-profit public service agency delivering high quality water, wastewater, and reclaimed water services.

January 6, 2021

Mr. David Andrews
Carrboro Town Manager
301 W. Main St.
Carrboro, NC 27510

Mr. Maurice Jones
Chapel Hill Town Manager
405 Martin Luther King Jr. Blvd.
Chapel Hill, NC 27514

Subject: OWASA's Long-Range Water Supply Plan Update

Dear Mr. Andrews and Mr. Jones:

We are looking forward to presenting information about our Long-Range Water Supply Plan and receiving feedback from your Councilmembers at the Town Council meetings on January 12 and 13, 2021. This letter and attachments are intended to serve as the information for your agenda package. If you have any questions about this information, please contact Ruth Rouse, Planning and Development Manager, at rrouse@owasa.org.

OWASA is committed to supplying reliable and high-quality water to our growing community and economy for years to come. The planning, permitting, and partnerships required in water supply development can take decades to develop and secure. That is why OWASA is planning for the water needs of our community two generations ahead.

In coordination with local planners, OWASA recently updated our 50-year forecast for water demands in the Chapel Hill-Carrboro community, as well as our projected water supply with current resources in a changing climate. These analyses show that OWASA has enough water under most circumstances for the next few decades.

We do have one vulnerability: the watershed that fills Cane Creek Reservoir, which stores most of the community's water, is relatively small and the reservoir is slow to refill. University Lake has a relatively large watershed for its size, but it offers significantly less water storage than Cane Creek Reservoir and by itself does not meet the community's needs. Thus, when we experience an extended drought or back-to-back droughts in the future, we risk low water supplies, particularly in light of increased climate variability.

Over the past six years, OWASA staff have met with local government planners, UNC, and developers, obtained input from OWASA Board members and neighboring utilities, and reviewed existing plans and documents to identify demand management, reuse, and supply alternatives that could potentially meet our long-term needs through 2070.

We considered the relative environmental, financial, and societal impacts in our evaluation of each alternative. Alternatives that are not currently legal, do not substantially close the gap between projected demands and supply, or are simply not cost effective were removed from



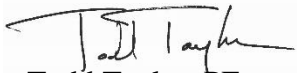
further evaluation. Conservation by residents and customers across the service area in recent years has greatly reduced our average daily water use. This means that our future water supply needs cannot be met through additional day-to-day conservation measures.

Based on our analysis, a suite of alternatives that improve our access to treated drinking water from Jordan Lake show the most promise in meeting our long-term water needs. Some of these alternatives also provide an additional facility for water treatment (beyond our own Jones Ferry Road Water Treatment Plant), which further increases drinking water supply resiliency but would require significant capital investment. Some also have the potential to improve economies of scale of water treatment and transmission expenses by working with our regional partners. These alternatives for accessing water from Jordan Lake will be further reviewed by OWASA before a preferred alternative is selected in fiscal year 2022.

With our initial analysis completed, we are currently inviting feedback and questions from the community before making the decision to move forward with a more in-depth analysis of the most viable options.

More information on our Long-Range Water Supply Planning efforts can be found in the attached information and on our website at <https://www.owasa.org/plans/owasa-long-range-water-supply-plan/>.

Sincerely,



Todd Taylor, PE
Executive Director

c: Ms. Bonnie Hammersley, Orange County Manager
OWASA Board of Directors
Ruth Rouse, Planning and Development Manager

Attachments:

- 1: Information on OWASA's Long-Range Water Supply Plan
- 2: Draft Presentation on OWASA's Long-Range Water Supply Plan

Information on OWASA's Long-Range Water Supply Plan

January 6, 2021

Executive Summary

OWASA is committed to supplying reliable and high-quality water to our growing community and economy for years to come. The planning, permitting, and partnerships required in water supply development can take decades to develop and secure. That is why OWASA is planning for the water needs of our community two generations ahead.

In coordination with local planners, OWASA recently updated our 50-year forecast for water demands in the Chapel Hill-Carrboro community, as well as our projected water supply with current resources in a changing climate. These analyses show that OWASA has enough water under most circumstances for the next few decades.

We do have one vulnerability: the watershed that fills the Cane Creek Reservoir, which stores most of the community's water, is relatively small and the reservoir is slow to refill. University Lake has a relatively large watershed for its size, but it offers significantly less water storage than Cane Creek Reservoir and by itself does not meet the community's needs. Thus, when we experience an extended drought or back-to-back droughts in the future, we risk low water supplies, particularly in light of increasing climate variability.

Over the past six years, OWASA staff met with local government planners, UNC Chapel Hill (UNC), and developers, obtained input from Board members and neighboring utilities, and reviewed existing plans and documents to identify demand management, reuse, and supply alternatives to meet our long-term needs through 2070.

We considered the relative environmental, financial, and societal impacts in our evaluation of each alternative. Alternatives that are not currently legal, do not substantially close the gap between projected demands and supply, or are simply not cost-effective were removed from further evaluation. Conservation by residents and customers across the service area in recent years has greatly reduced our average daily water use. This means that our future water supply needs cannot be met through additional day-to-day conservation measures.

Based on our analysis, a suite of alternatives that improve our access to treated drinking water from Jordan Lake show the most promise in meeting our long-term needs. Some of these alternatives also provide an additional facility for water treatment (beyond our own Jones Ferry Road Water Treatment Plant), which further increases drinking water supply resiliency but would require significant capital investment. Some also have the potential to improve economies of scale of water treatment and transmission expenses by working with our regional partners. These alternatives for accessing water from Jordan Lake will be further reviewed by OWASA before a preferred alternative is selected in fiscal year (FY) 2022.

What is OWASA's Long-Range Water Supply Plan?

OWASA's Long-Range Water Supply Plan (LRWSP) is an evaluation of our 50-year water needs (through 2070) and alternatives to meet those needs to ensure we have enough water for our community two generations from now.

Why do we need to look out 50 years?

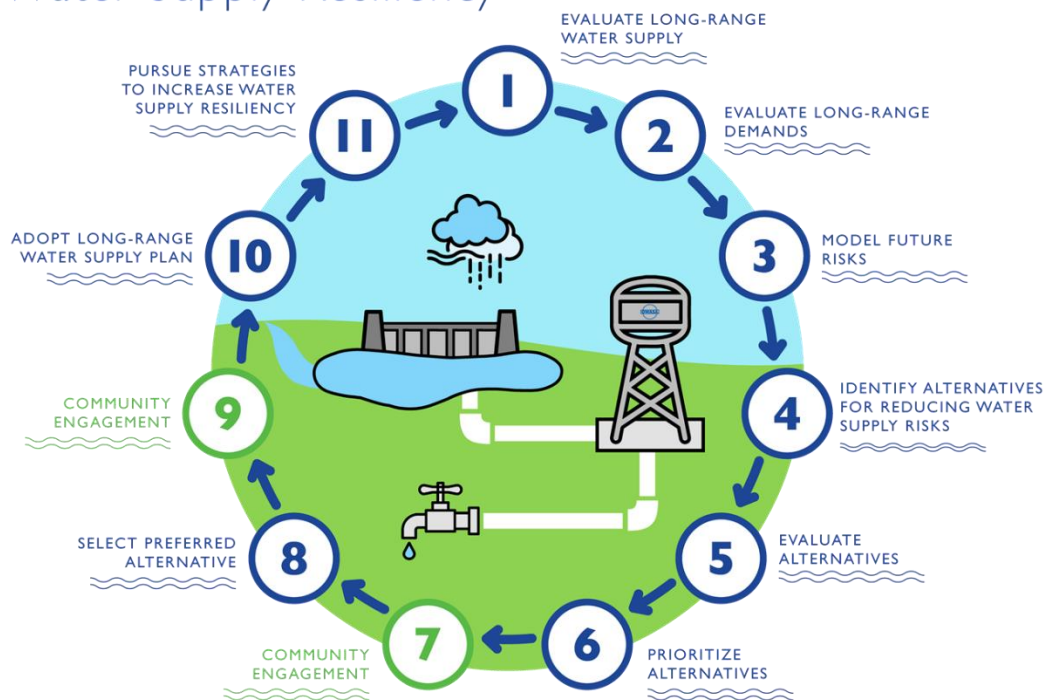
The planning, permitting, and partnerships required to develop new water supplies can take decades to develop and secure. Thus, it is common practice for water utilities to plan for water needs 30-50 years into the future, and even longer.

What are the key steps to develop the Long-Range Water Supply Plan?

Figure 1 illustrates the key steps to develop the LRWSP. Water supply planning is an ongoing process. The remainder of this document includes headers which are numbered according to the processes included in Figure 1.

Figure 1: Long-Range Water Supply Planning Process

Ensuring Long-Range Water Supply Resiliency

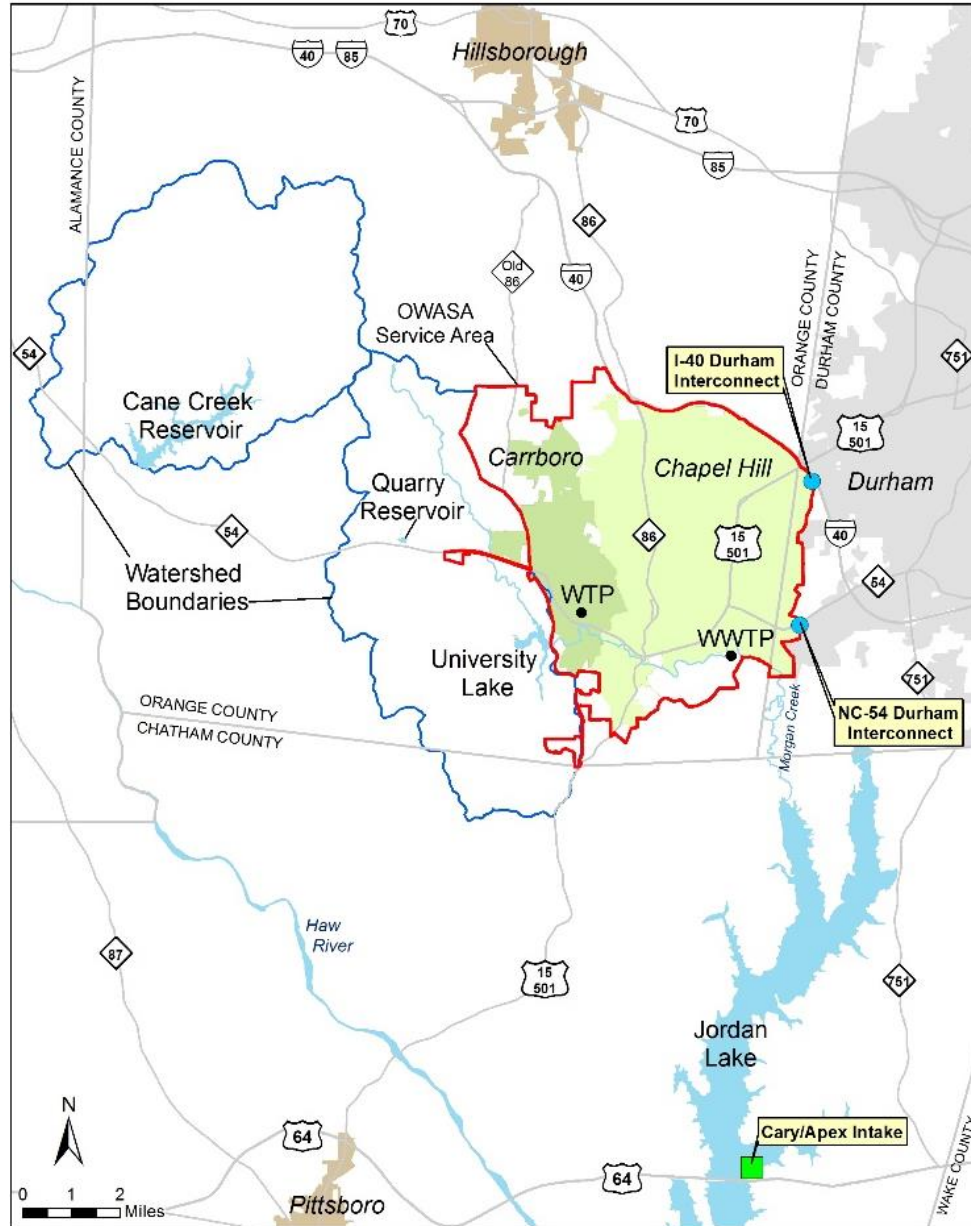


1. Evaluate Long-Range Water Supply

Where does OWASA currently get its water?

OWASA has three locally managed water supply sources including Cane Creek Reservoir, University Lake, and its Quarry Reservoir as illustrated in Figure 2. OWASA also has an allocation of 5 percent of Jordan Lake's water supply pool which we can access through our mutual aid agreements with the Town of Cary and City of Durham.

Figure 2: OWASA's Water Supply Sources



How much water do we currently have?

OWASA's three local reservoirs can provide approximately 10.5 million gallons per day (mgd) of water over the course of a year, assuming the drought-of-record. There are plans to expand our Quarry Reservoir, and when that expansion is completed in approximately 2035, we will have about 12.6 mgd of water. We expect that our allocation from Jordan Lake can reliably provide approximately 5 mgd, but we do not have the infrastructure in place to access that water on a permanent basis and have no guaranteed access to it.

2. Evaluate Long-Range Water Demands

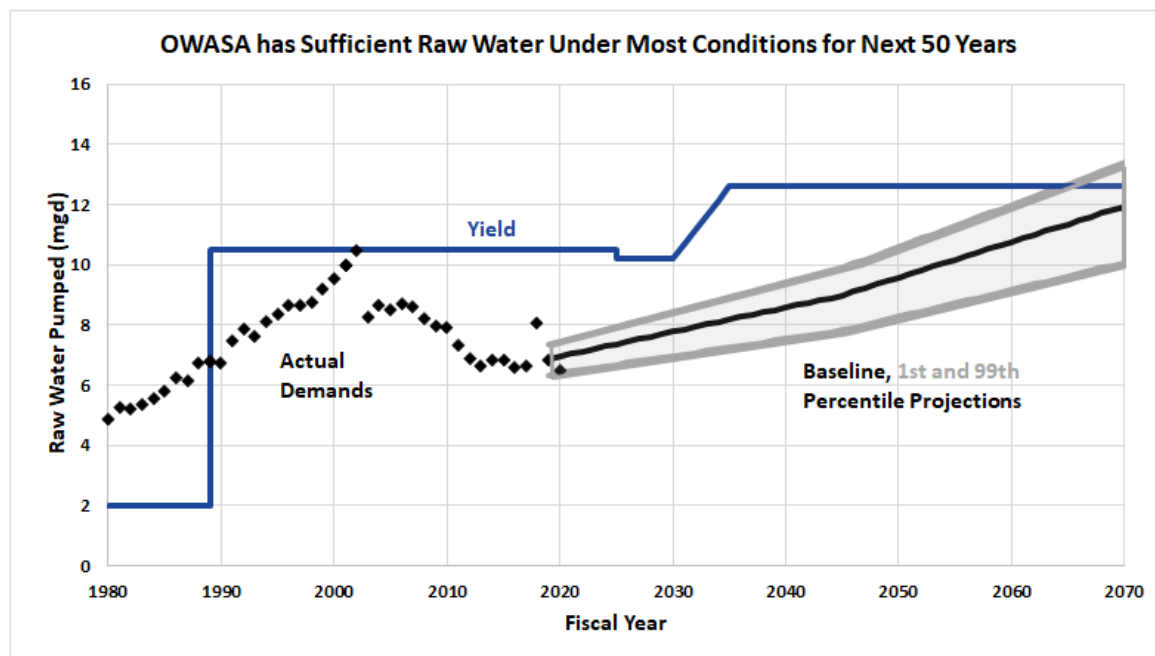
How much water do we currently use?

We currently use about 7 mgd of water on an annual average basis.

How much water will we need in the future?

Figure 3 illustrates the amount of water we can obtain from our existing water supplies and planned Quarry Reservoir expansion along with our 50-year estimated water demands.

Figure 3: The Yield of OWASA's Water Supplies and Long-Term Water Demands



3. Model Future Risks

How did OWASA develop its water demand projections?

OWASA based its water demand projections on regional growth projections that were finalized in 2018 for the regional Metropolitan Transportation Plan, in which the Towns of Carrboro and Chapel Hill and Orange County participated. The transportation planning effort also included information obtained from UNC about its expected growth. This regional transportation planning

effort used a model to estimate the number of new single family and multi-family dwelling units and non-residential square footage for 2045 and build-out conditions based on land use plans provided by the local governments. OWASA then applied water use factors estimated from billing data for each residential dwelling unit and each square foot of non-residential space. We assumed that build-out will occur in 2070. We tested this assumption, and it appeared reasonable assuming a linear rate of growth. More details on the methods used to develop the water demands can be found in this [report](#).

OWASA recognizes that estimating water demands in 50 years has much uncertainty. Growth could occur faster or slower than anticipated, different types of growth could occur than anticipated (new large water user could move to area), our service area boundary could change, and water demands could change depending on behaviors and technology. Climate change could also impact the rate of growth (will people relocate from coastal areas to the Triangle) and water use (will we use more water as temperatures rise). Thus we included an uncertainty analysis in our demand projections as illustrated by the grey shading in Figure 3 (more information is [here](#)).

Is there also uncertainty in our yield estimates?

Yes. The following factors contribute to uncertainty in the yield estimates:

- Streamflow records – the stream flow records available to estimate the yield of our reservoirs have measurement errors and limited spatial and temporal extent. They may not be representative of long-term historical flows.
- Estimates in storage volume – potential errors in storage volume include (1) the accuracy of the original survey data, and (2) the rate of sedimentation into the reservoir
- Climate change – climate change will impact flows into our reservoirs and evaporation rates. The majority of climate change models indicate that the southeast will receive approximately the same or more rainfall on an average basis, but we will have more frequent high flow events. Some of those models also indicate there will be more intense droughts. More intense droughts and different types of droughts will impact our estimated yield.

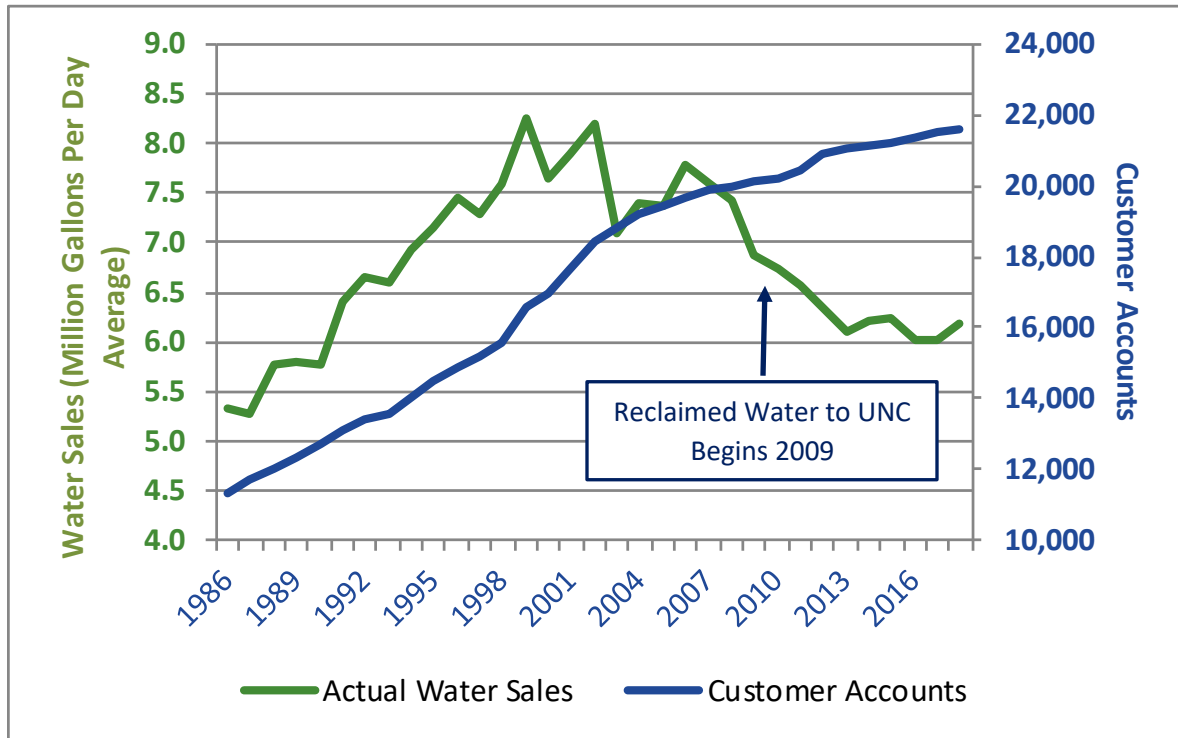
Because of the difficulty in estimating uncertainty around climate change and the cost to develop an analysis similar to the one completed for the demand projections, OWASA opted not to perform a similar analysis for yield. However, our consultant did perform a sensitivity analysis around the inputs and noted that changing inflows to the reservoir have the highest impact on our estimated yield. Based on the sensitivity runs performed, OWASA's estimate yield after the expanded Quarry Reservoir is online could vary between 11.5 and 15 mgd (baseline estimated yield is 12.6 mgd).

What role does water conservation and water recycling and reuse play in our water needs?

Water conservation and recycling water have played a very important role in OWASA's service area resulting in reduced drinking water demands and energy use. As illustrated in Figure 4, we are using the same amount of water that we were using in the early 1990s despite an increase of about 70 percent in customer accounts. Following the droughts of 2001-02 and 2007-08, our

customers conserved water and have continued to save water. In addition, UNC partnered with us to develop a reclaimed water system that allows them to use highly treated wastewater to meet non-drinking water needs such as for cooling buildings and irrigation. Our reclaimed water system now meets over 10 percent of the community's water needs. OWASA also developed a system to recycle water within its Jones Ferry Road Water Treatment Plant (WTP), which saves approximately 7 percent of our drinking water.

Figure 4: OWASA Water Sales and Customer Accounts



Our water demand projections assume that our customers will continue to look for ways to save water. We assume that conservation practices will continue to result in demands decreasing by 5 to 10 percent per account (factors varied depending on whether new/existing development and whether residential or commercial development) over the next 25 years.

Why do we need additional supplies or demand management strategies?

As seen in Figure 3, we will have plenty of water under most circumstances. However, it is imperative to the resiliency of our community that we plan for an unclear future given the uncertainty in our demand projections, the uncertainty in the model used to estimate the reliable yield of our reservoirs, and the uncertainty of a changing climate. We also need to be prepared to reliably meet demands should we have a major operational emergency at one of our water supplies.

While we have plenty of water under most circumstance, Cane Creek Reservoir is vulnerable to extended drought or back-to-back droughts. It was designed to maximize storage, which is generally good and provides us a higher yield. However, it has a relatively small drainage area

for its storage volume and can take a long time to refill. University Lake refills quickly, but it does not hold enough water to meet our daily needs. Thus, the small watershed area of Cane Creek Reservoir leaves our water supply susceptible for a period of time after a drought.

Having options to meet future needs helps ensure the reliability and resiliency of our water. Running out of water is not an option.

4. Identify Alternatives for Reducing Water Supply Risks

What are supply and demand management strategies?

Supply-side options are strategies which increase the total reliable yield of our water supply system. In other words, they would raise the blue line shown in Figure 3. Demand-side management options are strategies which reduce raw water demands from existing and/or new development or lower the black line shown in Figure 3.

How did OWASA identify which supplies and demand management strategies to evaluate?

We met with local government planners and UNC, obtained input from Board members and neighboring utilities, and reviewed existing plans and documents to identify potential alternatives to meet our long-term needs through 2070. Through this process we selected demand management (increased water efficiency and conservation) and reuse strategies, as well as supply strategies to evaluate in further detail.

5. Evaluate Alternatives

What supplies and demand management strategies did OWASA consider?

OWASA evaluated nine supply alternatives which can be grouped into three major categories:

1. Jordan Lake alternatives (4 alternatives)
2. Quarry Reservoir (2 alternatives)
3. Indirect and direct potable reuse (3 alternatives)

Each of these alternatives are summarized below along with OWASA staff recommendation for next steps in its consideration.

The four Jordan Lake alternatives are summarized below:

- **Alternative 1 – Full Partner in New Intake and Water Treatment Plant (WTP) on Western Side of Jordan Lake** – OWASA would partner with the Western Intake Partners (currently City of Durham, Town of Pittsboro, and Chatham County) on a new water supply intake, water treatment plant, and major transmission infrastructure on the western side of Jordan Lake.
 - **Recommendation:** Continue to evaluate alternative
- **Alternative 2 – Continue with Mutual Aid Agreements** – This is our existing baseline condition. Under this alternative, OWASA would access its Jordan Lake allocation using

its mutual aid agreements with the Town of Cary and City of Durham. This alternative does not guarantee access to our allocation.

- **Recommendation:** Baseline condition; maintain for the time being
- **Alternative 3 – Develop New Agreement with Towns of Cary and Apex to Guarantee Access to Jordan Lake Water** – The Towns of Cary and Apex jointly own the only water supply intake on Jordan Lake and share a water treatment plant. Under this alternative, OWASA would develop a new agreement with the Towns to guarantee withdrawal and treatment of a certain amount of water on an annual basis.
 - **Recommendation:** Alternative not feasible at this time
- **Alternative 4 – Develop Agreement with Western Intake Partners to Guarantee Access to Jordan Lake Water** – OWASA would develop an agreement with the Western Intake Partners to guarantee capacity in the proposed intake and water treatment plant on the western side of Jordan Lake. This agreement would guarantee a certain amount of water on an annual basis in return for payment from OWASA.
 - **Recommendation:** Continue to evaluate

Two Quarry Reservoir supply alternatives were evaluated:

- **Alternative 5 – Shallow Quarry** – access with existing pumping infrastructure. This is the alternative selected in the 2010 LRWSP and considered the future baseline alternative. The yield from the expanded Quarry Reservoir is included on Figure 3.
 - **Recommendation:** Baseline condition; included in our capital improvements program
- **Alternative 6 – Deep Quarry** – deeper quarry depths would be accessed with new pumping infrastructure when the expanded Quarry Reservoir is online.
 - **Recommendation:** Eliminate from further consideration due to high capital cost and does not address vulnerability of small Cane Creek Reservoir watershed

OWASA evaluated the use of reclaimed water (highly treated wastewater) for drinking (potable) water uses. As used in our LRWSP, indirect potable reuse involves mixing reclaimed water in an environmental buffer prior to being treated at the Jones Ferry Road WTP; direct potable reuse involves further treating the reclaimed water at the Mason Farm Wastewater Treatment Plant (WWTP) and then pumping it directly into our water distribution system. Potable reuse alternatives evaluated are summarized below:

- **Alternative 7a: Indirect Potable Reuse with Pretreatment Mixing Basin near Quarry Reservoir** – This alternative was developed to meet the requirements of a general statute which allows for indirect potable reuse mixed at specified ratios with another source water in an engineered pretreatment mixing basin. Reclaimed water from the Mason Farm WWTP would be pumped to a new pretreatment mixing basin near the Quarry Reservoir. This water would be mixed with water from Cane Creek Reservoir in accordance with the statute.

- **Recommendation:** Eliminate from further evaluation since very high capital and life cycle costs
- **Alternative 7b: Indirect Potable Reuse with Return to Quarry Reservoir** – This alternative is similar to Alternative 7a, but water from the Mason Farm WWTP would be pumped to the Quarry Reservoir rather than a new pretreatment mixing basin.
 - **Recommendation:** Eliminate from further evaluation since very high capital and life cycle costs
- **Alternative 8: Indirect Potable Reuse with Return to University Lake** – Reclaimed water from the Mason Farm WWTP is returned to University Lake.
 - **Recommendation:** Eliminate from further evaluation since it is not legal
- **Alternative 9: Direct Potable Reuse** – Under this alternative, additional treatment would be constructed at the Mason Farm WWTP and treated water would then be pumped directly to our distribution system. Two methods of treating the reclaimed water were identified: (1) use of carbon (generally preferred since typically lower capital and operating/maintenance costs) and (2) reverse osmosis – may be required to removed total dissolved solids.
 - **Recommendation:** Eliminate from further evaluation since it is not legal

OWASA considered four main demand management alternatives based on research and stakeholder engagement with the Towns and UNC Chapel Hill. Three of these alternatives involve the use of reclaimed water and one is a series of programmatic demand management strategies that collectively had the potential to reduce water demand to a degree that could delay the need for additional supply.

- **Alternative 10: Reclaimed Water to UNC Cogeneration Facility** – This alternative involves the installation, operation and maintenance of new infrastructure that would enable UNC to use RCW instead of drinking water at its Cogeneration Facility.
 - **Recommendation:** Eliminate from further evaluation due to very high capital cost per gallon of water saved and UNC concerns about quality requirements
- **Alternative 11: Expanded Reclaimed Water Use at UNC Main Campus** – This alternative involves expanding the use of reclaimed water on UNC's campus to meet certain non-drinking water demands in new buildings envisioned in the University's recently updated Master Plan.
 - **Recommendation:** Eliminate from further evaluation due to high life cycle cost per gallon of water saved
- **Alternative 12: Onsite Wastewater Treatment and Reuse** – This alternative evaluated the use of reclaimed water systems to meet non-drinking water needs at the building or major development scale.
 - **Recommendation:** Eliminated from evaluation due to high capital and life cycle costs per gallon of water saved
- **Alternative 13: Programmatic Demand Management Strategies** – Four alternatives were evaluated:

- **Alternative 13a: Unit Submetering and WaterSense Installation** – Multi-family development is projected to be a significant area of water use growth in our service area. Sub-metering will help to ensure that the users of water within those developments are aware of the amount of water they use. This strategy was coupled with a requirement for developers to use high efficiency WaterSense fixtures. The impact was assumed to be relatively minor because most new developments are installing submeters without a requirement.
 - **Recommendation:** Eliminate from including as long-range water supply option because of minor impact on water use; consider as part of Water Conservation Plan
- **Alternative 13b: Water Efficiency Design Assistance and Conservation-Oriented System Development Fee** – Under this alternative, OWASA would provide individualized design review assistance for new development. This service would be complemented with a system development fee that further incentivizes efficiency beyond our current fee structure. Rather than a regulatory requirement, this alternative would act more as a customer service enhancement to encourage more efficient development.
 - **Recommendation:** Eliminate from including as long-range water supply option because of minor impact on water use; consider as part of Water Conservation Plan
- **Alternative 13c: On-bill Financing for Water Efficient Fixtures** – Older homes may have inefficient water fixtures, which became a requirement in 1994. Under this alternative, OWASA would loan a customer money to replace older fixtures, and the loan is paid back through an on-bill financing program.
 - **Recommendation:** Eliminate from further evaluation due to minor impact on water use and high cost per gallon of water saved
- **Alternative 13d: Minimize Need for System Flushing for Water Quality Purposes** – OWASA flushes its water lines to maintain high levels of water quality. There are some locations in the system where low water flow results in “stale” water (dead end lines) that require more frequent flushing. Under this alternative, OWASA would loop lines to remove dead end areas.
 - **Recommendation:** Eliminate from further evaluation due to high capital cost

6. Prioritize Alternatives

What option(s) are recommended for further evaluation?

We evaluated each of the alternatives against the three pillars of sustainability: social performance, environmental performance, and financial performance and more detailed information on the alternatives analysis is found [here](#). The section immediately above also briefly identifies whether OWASA plans to continue evaluating an alternative, and if not, why it is recommended to eliminate from further consideration.

OWASA has not yet selected a preferred alternative and will consider feedback from the community before it makes its final selection in FY22. The Jordan Lake alternatives are the most cost-effective alternatives that will meet our long-term needs. OWASA plans to develop guiding principles to evaluate the Jordan Lake alternatives against one another and perform additional analyses. Community feedback will be incorporated into the guiding principles and into the selection of a preferred alternative.

OWASA plans to evaluate the cost-effective demand management strategies in a Water Conservation Plan that will be included as an appendix or companion document to the LRWSP.

What are OWASA's next steps? (Steps 7 through 11)

OWASA's next steps are as follows:

- Engage the community to obtain feedback on work completed to date and proposed path forward (in process).
- Develop guiding principles to evaluate the Jordan Lake alternatives against based on feedback from the community. The public is invited to participate in this process through OWASA Board meetings.
- Develop a Water Conservation Plan to be included as an appendix to the LRWSP.
- Perform evaluation of Jordan Lake alternatives.
- Draft LRWSP and select the preferred alternative.
- Engage the community to obtain feedback on the preferred alternative and draft LRWSP
- Adopt the LRWSP including the Water Conservation Plan.
- Pursue selected alternative(s) and conservation strategies to increase our water supply resiliency.



DRAFT

Long-Range Water Supply Plan:

Information to Elected Boards

Ruth Rouse, Planning and Development Manager

January 2021



Carrboro-Chapel Hill's not-for-profit public service agency delivering high quality water, wastewater, and reclaimed water services.

Purpose of Evening

- Provide information on work completed to-date on OWASA's Long-Range Water Supply Plan
- Receive questions and feedback on that work
- Receive feedback on proposed path forward



University Lake

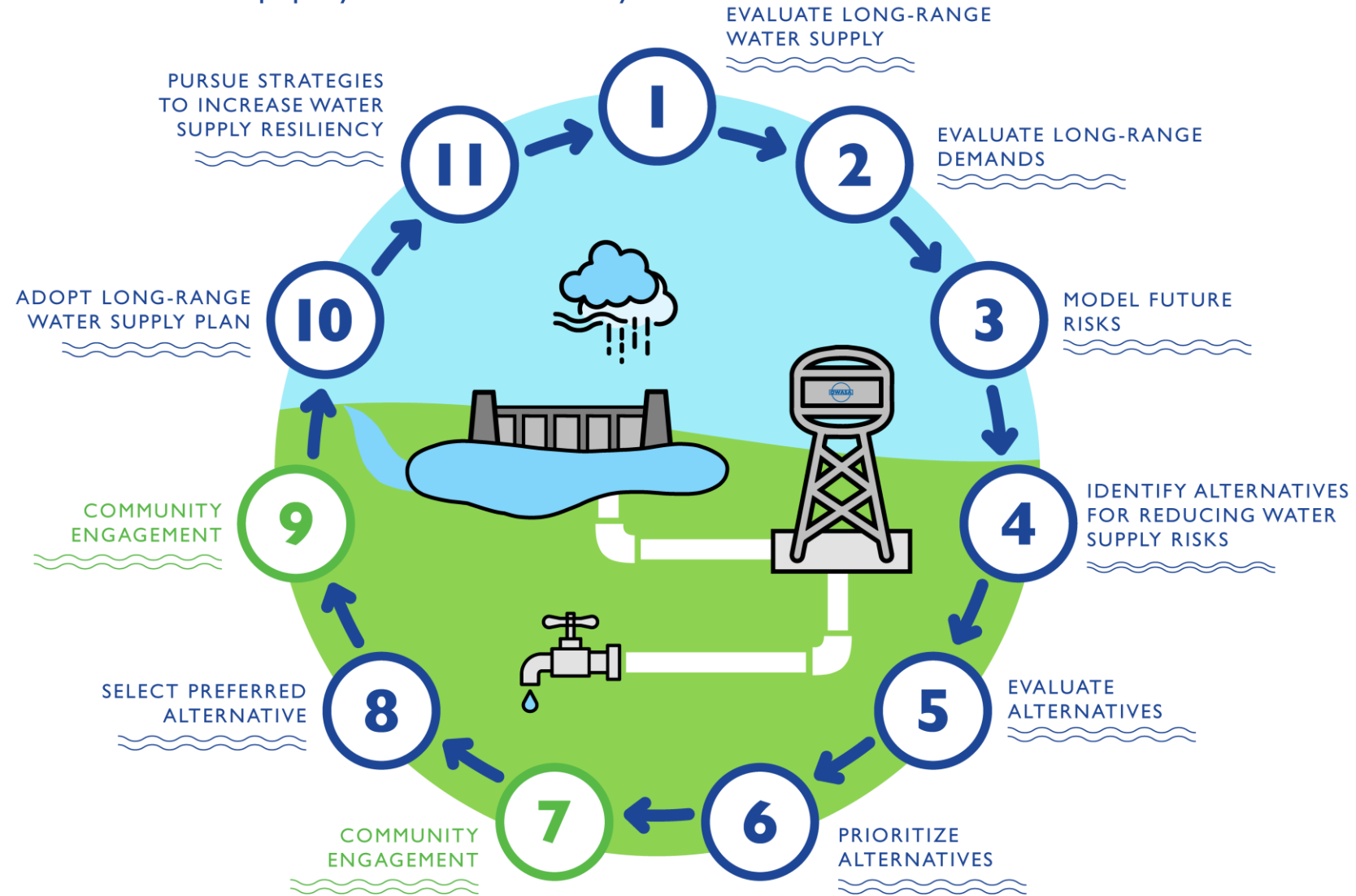
Key Messages

- We have a low risk of running out of water.
- Our largest vulnerability is in extended drought.
- Jordan Lake alternatives appear to be most cost-effective option for increasing resiliency.



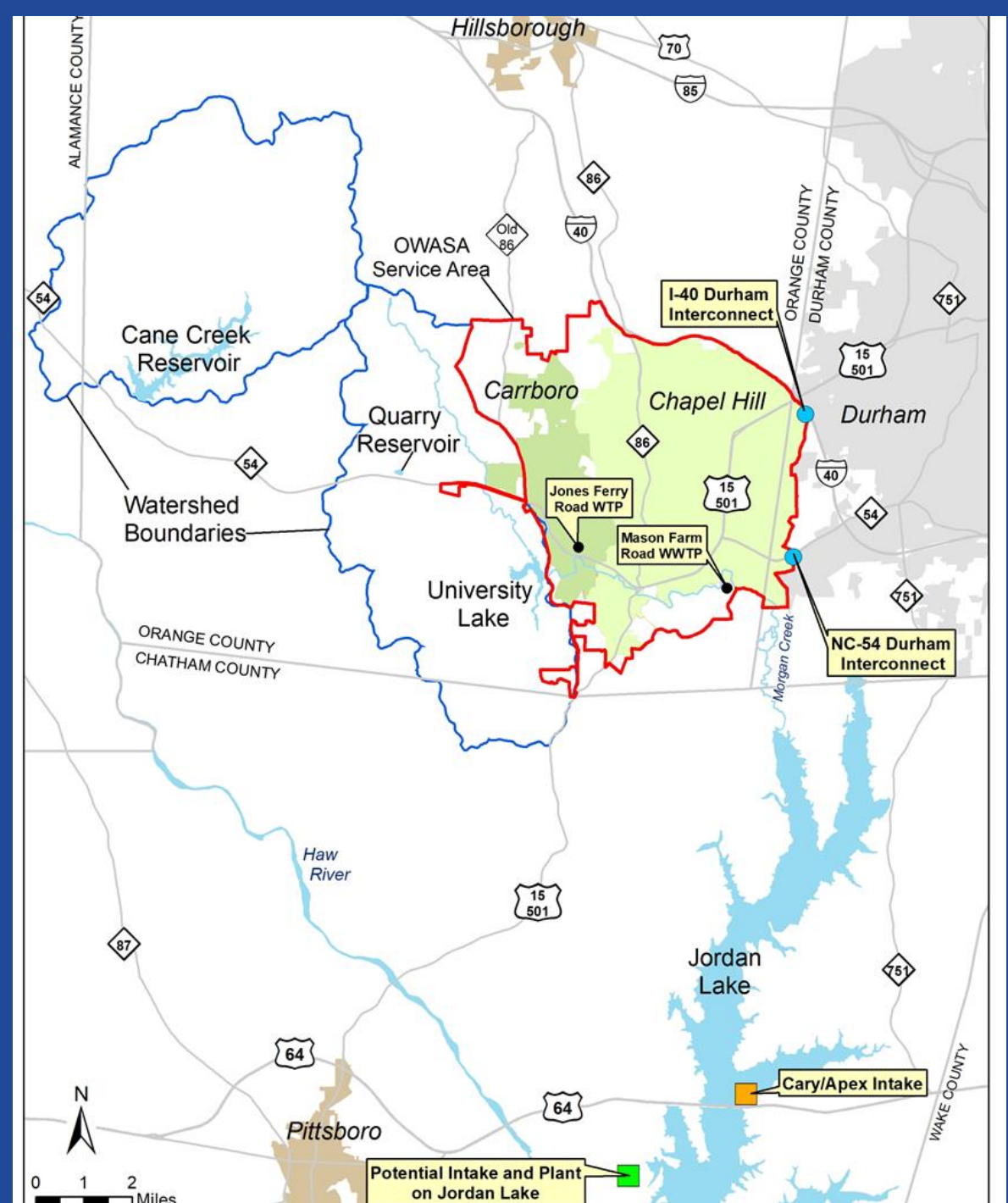
Intake on Cane Creek Reservoir

Ensuring Long-Range Water Supply Resiliency



OWASA's Water Supplies

- Local Water Supplies
 - Cane Creek Reservoir
 - University Lake
 - Quarry Reservoir
- Jordan Lake

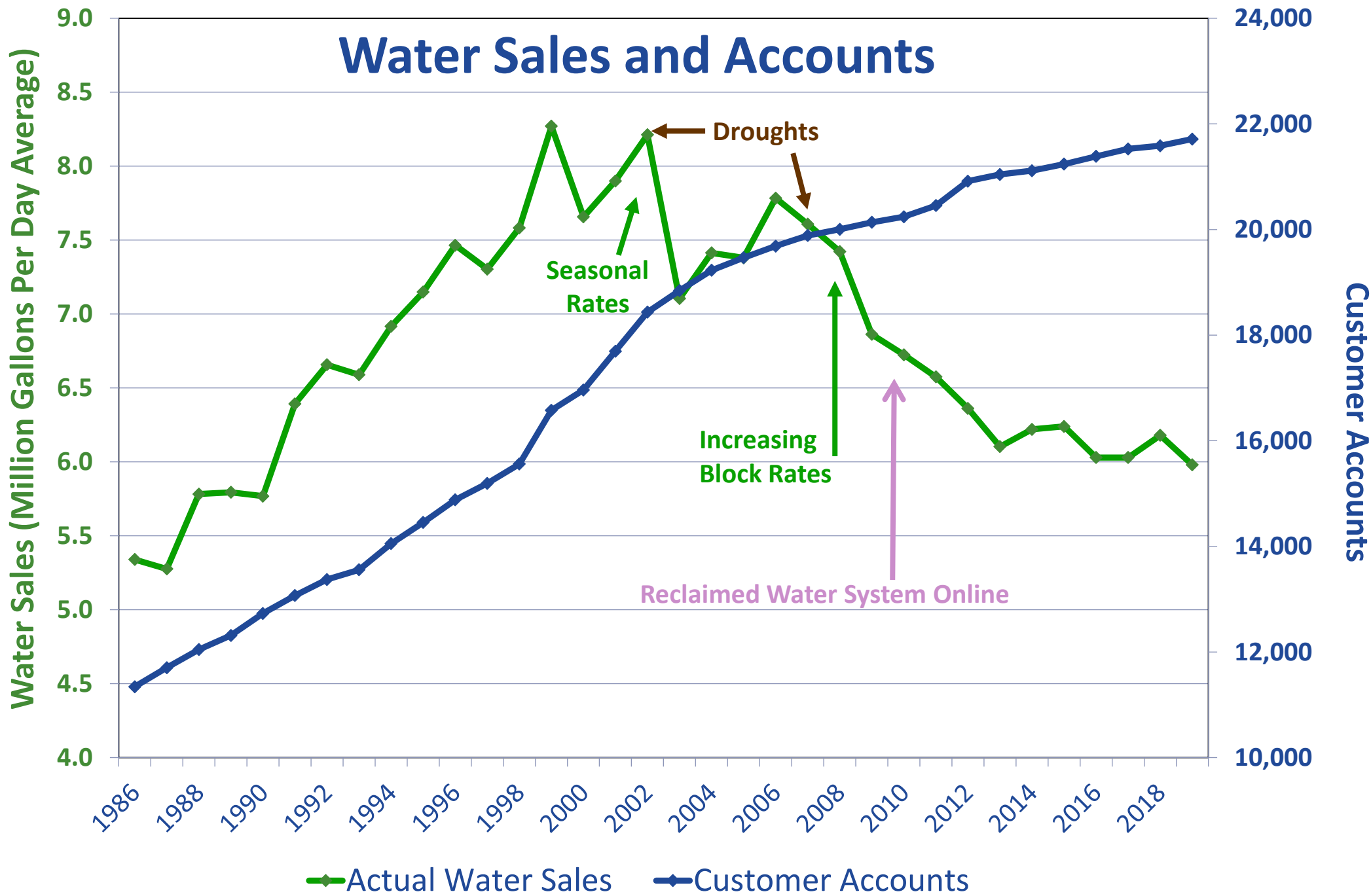


Jordan Lake

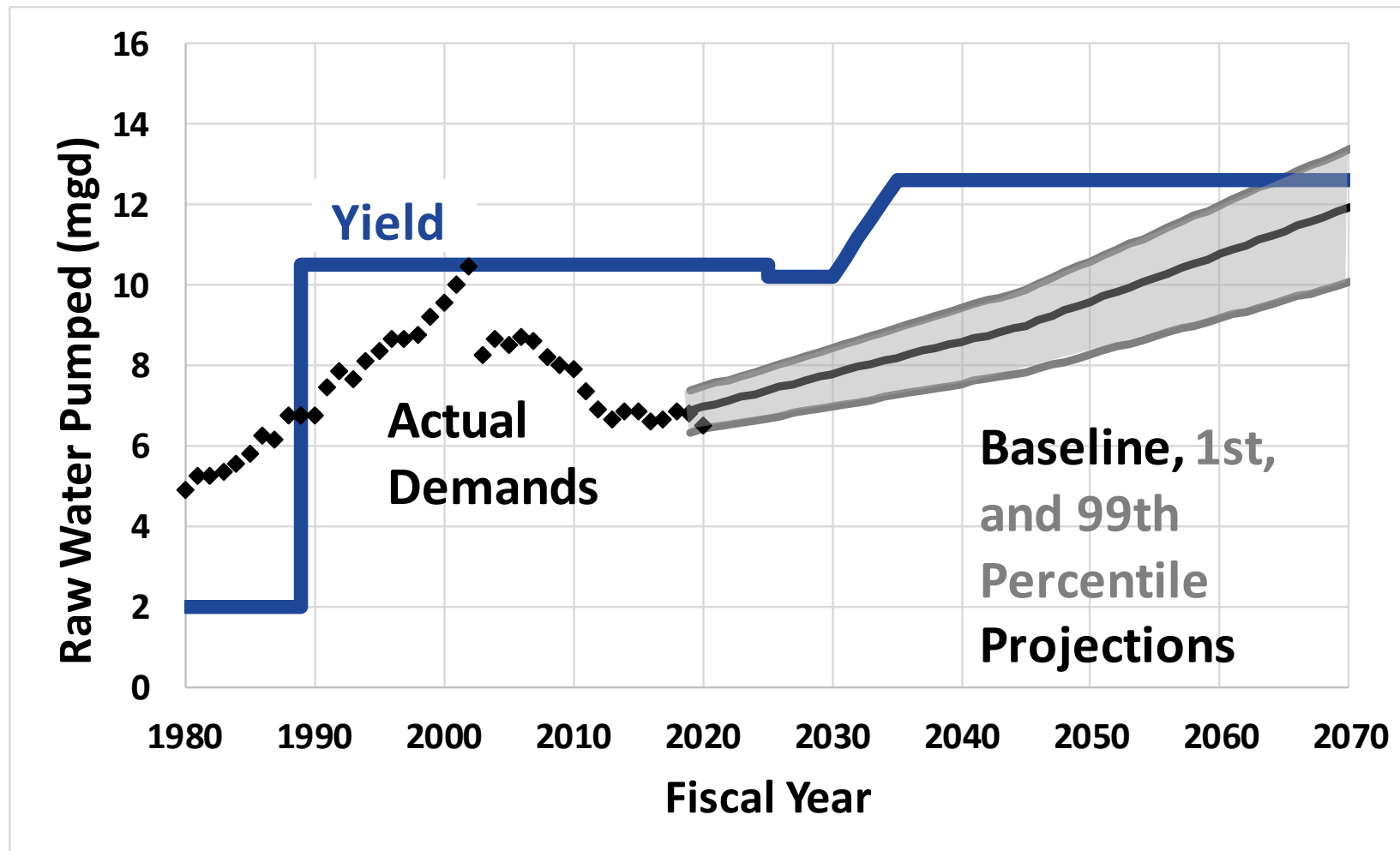
- Federal, multi-purpose reservoir
 - Flood control
 - Water supply
 - Downstream water quality
 - Recreation
- OWASA has had an allocation since 1988.
- Practice has been to only use Jordan Lake during water shortage
- We have no guaranteed access to Jordan Lake.



Jordan Lake

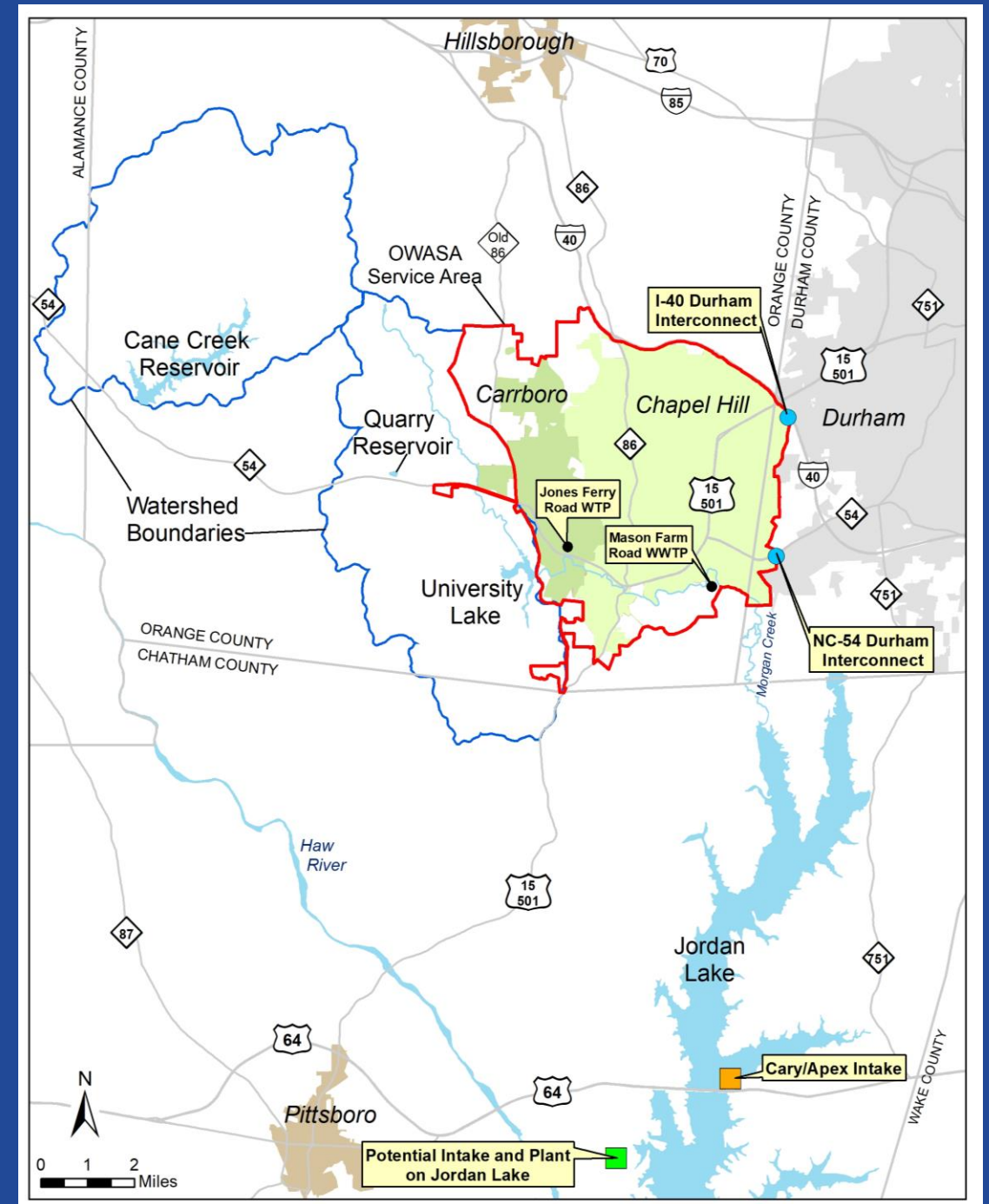


Our Water Supply Meets Demands Under Most Conditions

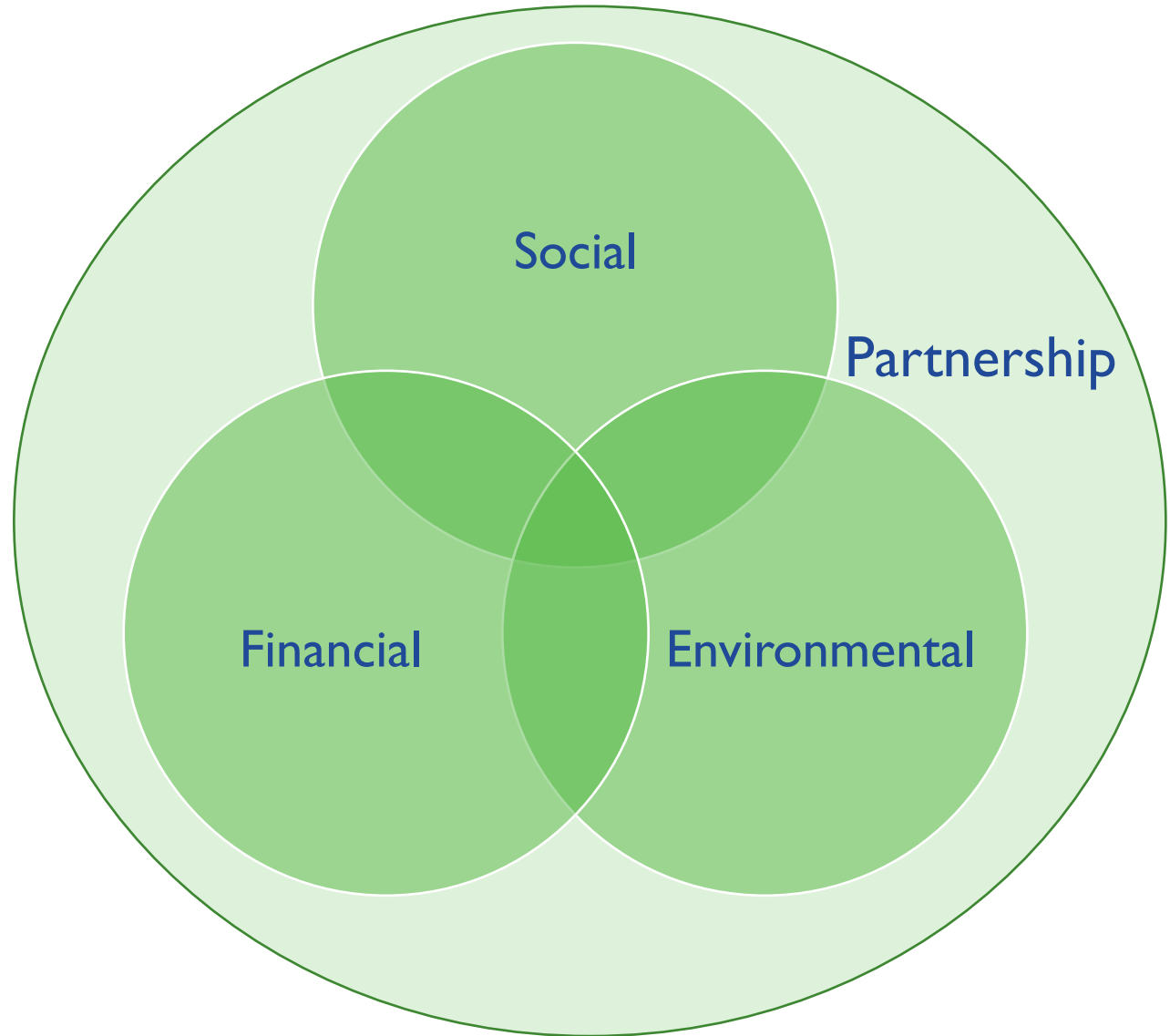


Our Water Supply Risk is Low

- Our predecessors set us up well
 - Supply
 - Conservation
- Cane Creek Reservoir has small watershed relative to its storage
- Long refill times following drought
- Our main vulnerability is extended drought



Sustainability Principles



Identifying Alternatives to Evaluate



- Meetings
- Plans
- OWASA Board and others

- Potential water supply or savings
- Incremental costs
- Implementation

Apples to apples comparison across 3 pillars of sustainability

Preliminary Alternatives Analysis



Demand
Management
Alternatives

Quarry
Reservoir
Alternatives

Supply
Alternative


Potable Reuse
Alternatives

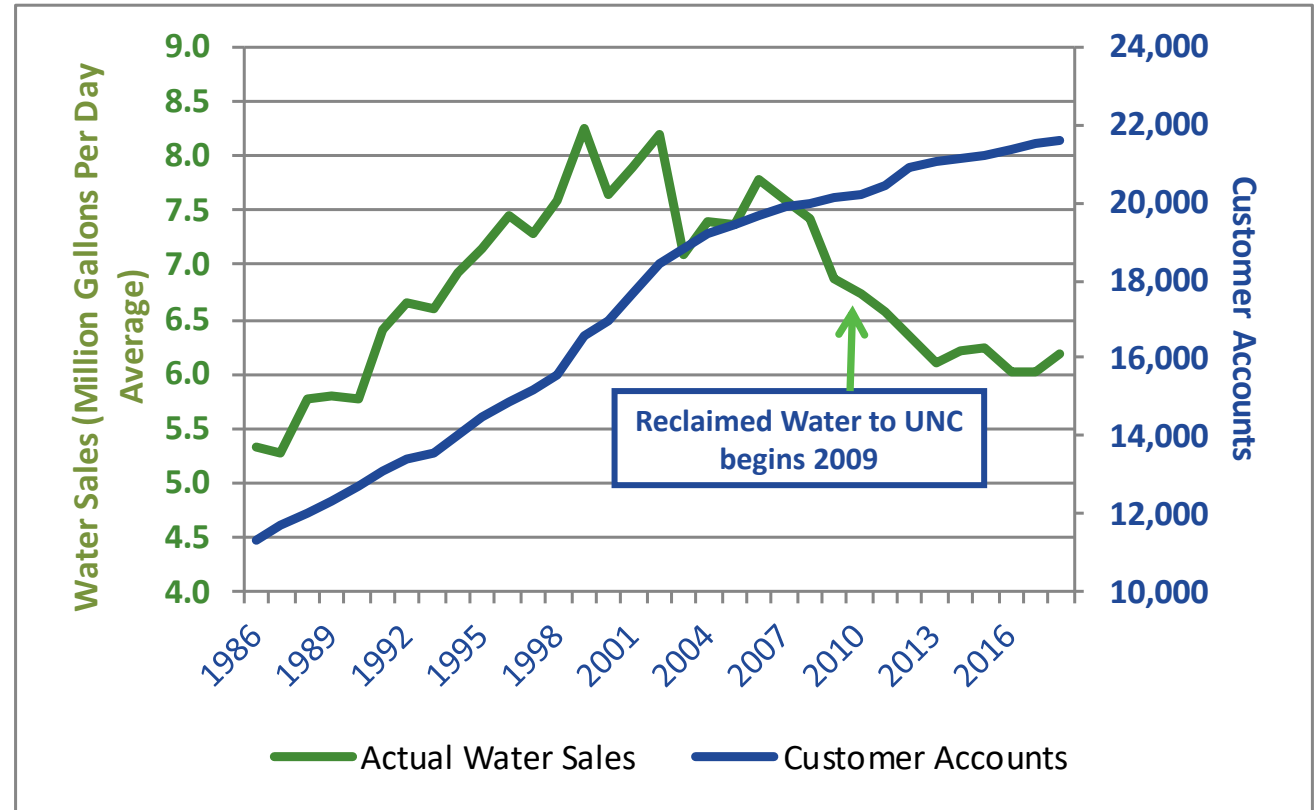
Supply
Alternative

Jordan Lake
Alternatives

Supply
Alternative

Demand Management Alternatives

- Do not meet long-term demands 
- Cost-effective strategies will be considered in Water Conservation Plan as Appendix to LRWSP



Supply Options

- Deep Quarry 
 - Does not diversity water supply
 - High capital cost
- Potable Reuse 
 - Options not legal or have questionable permitting process
 - High capital cost
- Jordan Lake
 - Meets long-term needs and diversifies our water supply
 - Lower capital costs
 - Several potential ways to use Jordan Lake

Where are we headed?

- Report to Board of Directors on community engagement - March
- Develop guiding principles to evaluate Jordan Lake alternatives – May/June
- Continue to evaluate Jordan Lake - FY22
 - Mutual aid agreements
 - Full partner in new intake and plant on western side of Jordan Lake
 - New agreement with Western Intake Partners to guarantee access to our Jordan Lake allocation
- Select draft preferred alternative - FY22
- Engage the community
- Develop final Long-Range Water Supply Plan with preferred alternative

Questions and Discussion

- Does the Council or community have any questions on our long-range water supply planning process?
- What feedback would you like shared with the OWASA Board of Directors regarding future evaluation of Jordan Lake water supply alternatives?
- Other?

Ruth Rouse/ rrouse@owasa.org

