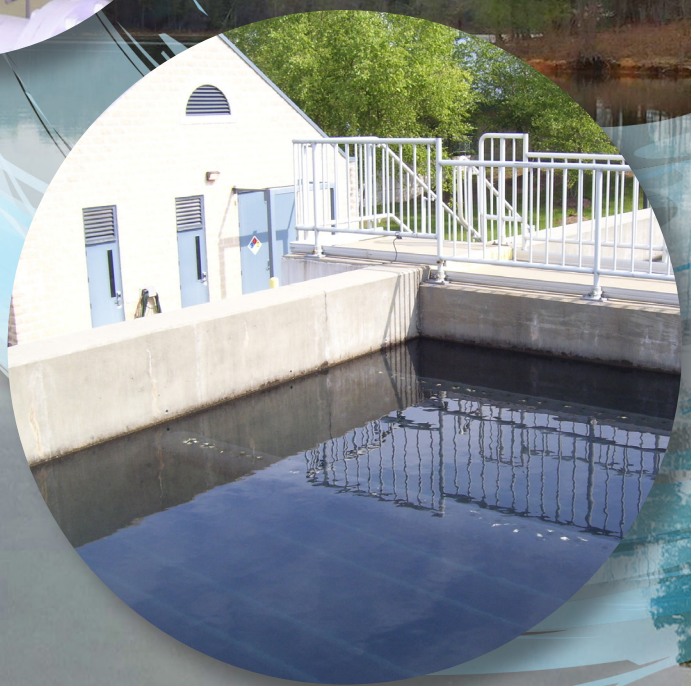
Final Report

Long Range Water Resources Plan Update



Prepared for:

Towns of Cary, Morrisville, and Apex and Wake County

December 2018

JACOBS®

CH2M HILL North Carolina, Inc.
111 Corning Road
Suite 116
Cary, NC 27518

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Executive Summary

This report is the 2018 update to the Long Range Water Resources Plan (LRWRP) for the Towns of Cary, Apex and Morrisville and Wake County. This LRWRP serves as a working strategy for the Towns to actively manage a flexible portfolio of water resources options. Strategies and options in the 2013 LRWRP were re-appraised for their ability to meet updated projections of future water and wastewater demands to identify and recommend the best path forward to meet these growing and changing needs.

The Towns of Cary and Apex continue to partner in the management of water and wastewater infrastructure and water supply to meet the growing and changing demands of their customers. They remain active members of the Triangle Water Supply Partnership. Since 2000, the Towns have taken actions on the recommendations provided in the initial Long Range Water Supply Plan (CH2M, 2000) and the Integrated Water Resources Management Plan (CH2M, 2007) including regular updates to the LRWRP and detailed demand projects. The Towns have also implemented major infrastructure and regulatory recommendations highlighted in the Water Resources Portfolio, ranging from the start of a reclaimed water program to the addition of water supply allocation and treatment capacity as well as wastewater treatment capacity and securing additional flexibility for interbasin transfer (IBT). These updates were prepared in alignment with the Town of Cary's land use planning updates and the *Imagine Cary* Community Plan (Town of Cary, 2017). These actions, implemented at the right times, allow the Towns to meet customers' water needs, support long-term planning goals and continue to make this area a premier place to live, work and play in North Carolina.

This LRWRP Update continues to provide the Towns with a guide for development of a reliable, flexible water supply and management solutions that are financially responsible, maintain quality of service provided to customers, and support the commitment to protecting health and being good stewards of the natural environment.

This LRWRP updates the strategic view presented in the 2013 LRWRP using data from 2013 through 2016 and extends the planning period from 2060 to 2065. Since the 2010 water use analysis used in the 2013 LRWRP, the Town has replaced its water meter system with an advanced metering infrastructure (AMI) system, Aquastar. Aquastar provides the Town with water meter reading data on hourly and daily bases, compared to the previous process, which provided only monthly billing data. The increased frequency of the meter readings provides for a more accurate representation of consumption patterns, compared to monthly billing data. The finer resolution of consumption data provides the ability to complete more robust comparative analyses with other daily data, such as the Cary/Apex Water Treatment Facility (WTF) production data, daily wastewater flow monitoring data, and weather data.

Water Resources Supply and Infrastructure

Since the 2013 LRWRP was issued, the Towns of Cary and Apex have worked to expand water supply allocation and infrastructure capacity to meet customer demands in their service areas and plan for growth. The Towns of Cary and Apex jointly own and share treatment capacity at the Cary/Apex WTF and the Western Wake Regional Water Reclamation Facility (WWRWRF) and share an IBT certificate.

The Town of Cary's service area also includes the Town of Morrisville, the Wake County portion of Research Triangle Park (RTP South), Raleigh-Durham International Airport (RDU), and the portion of Cary that lies within Chatham County (Figure ES-1).

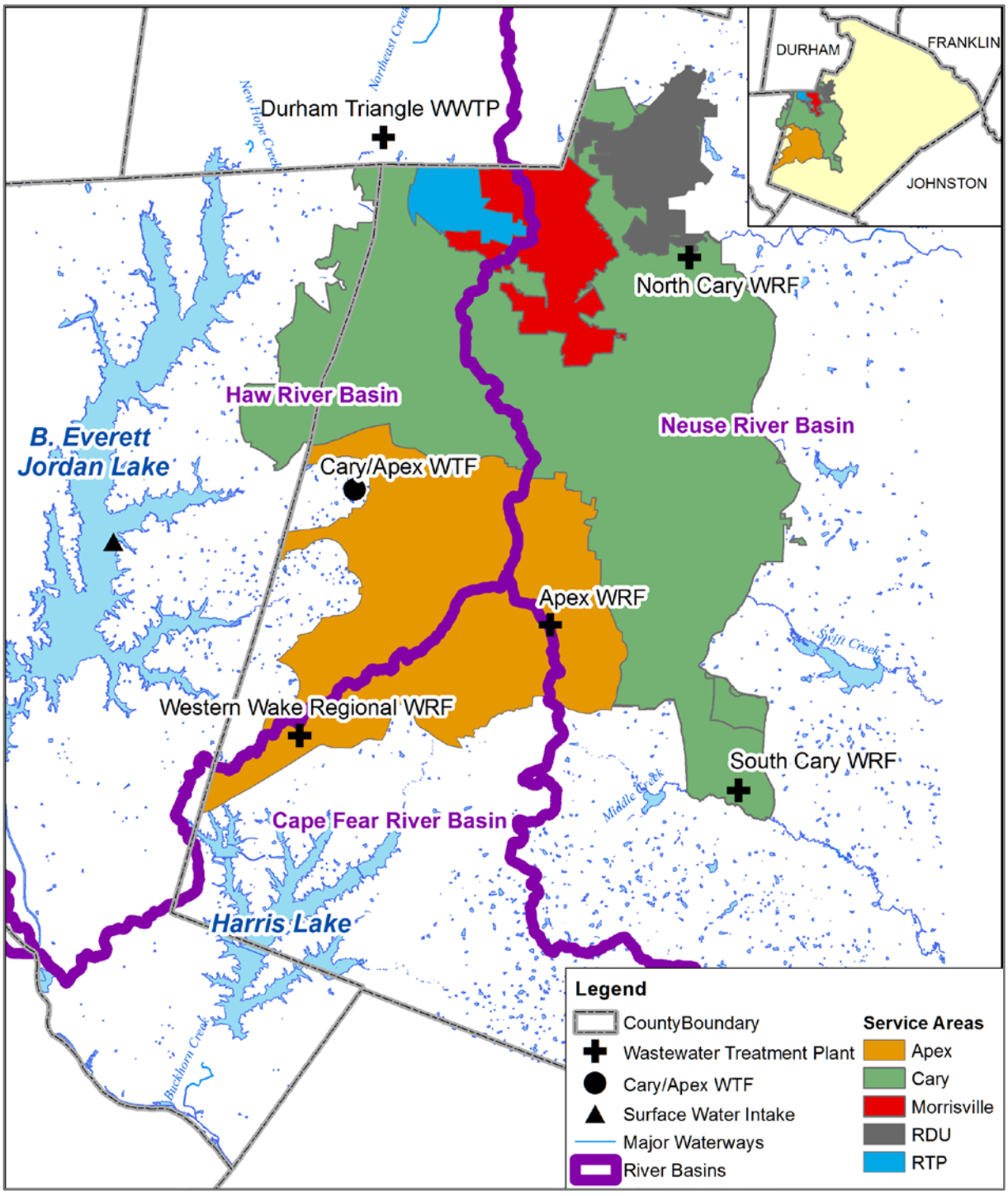

Figure ES-1. Service Areas for the Towns of Cary and Apex
Long Range Water Resources Plan Update

Since 2013, the Towns have completed the following actions:

- Received additional water supply from Jordan Lake Round 4 allocation
- Completed expansion of Cary/Apex WTF expansion to 56 million gallons per day (MGD) permitted maximum day capacity
- Installed AMI in the Town of Cary
- Completed construction of the jointly owned WWRWRF with a permitted capacity of 18 MGD
- Received IBT Certificate modification to 31 MGD for transfers from the Haw River basin to the Neuse River basin and 2 MGD for transfers from the Haw River basin to the Cape Fear River basin. These are regulated on a maximum month average day (MMAD) basis.

The Towns each also manage their own infrastructure:

- Town of Cary infrastructure
  - North Cary and South Cary WRFs (permitted at 12.0 MGD and 12.8 MGD, respectively)
  - A reclaimed water distribution system currently serviced with reclaimed water from Durham County, the North Cary Water Reclamation Facility (NCWRF), and the South Cary Water Reclamation Facility (SCWRF)
- Town of Apex infrastructure
  - Apex WRF (permitted at 3.6 MGD)
  - While the Town holds a reclaimed water distribution permit, it does not currently have reclaimed water infrastructure in place

The Towns maintain water interconnections with the City of Durham, City of Raleigh, and the Town of Holly Springs. In addition, they have an agreement that allows mutual aid with adjacent municipalities through their direct connections. The Town of Cary also maintains a wastewater interconnection with Durham County. These connections provide resiliency and flexibility for emergencies and operational maintenance needs.

Changing Land Uses and Development Patterns

The Towns are currently experiencing different types of growth and development. With less available land, the Town of Cary has less capacity for development than the Town of Apex. This dynamic is driving an increase in redevelopment and mixed-use development in Cary, leading to densification. Population projections are listed in Table ES-1. The Town's planning efforts as documented in the *Imagine Cary* Community Plan also include a focus on revitalizing areas and promoting the Town center (Town of Cary, 2017). The Town's planning efforts and projects are captured in the parcel-based land use information used in the CommunityViz model (Triangle J COG, 2018) and used in this evaluation.

The Town of Apex is experiencing a high rate of residential growth, which is driving up demands. For this analysis, a per capita usage projection and a range of population projections were used in the forecasting. Results are not spatial as they are for the Town of Cary's service area.

Table ES-1. Historical and Projected Population for the Town of Cary Service Area
Includes the Towns of Cary and Morrisville

Town	2001	2007	2013	2015	2016	2045	2065
Cary	99,798	122,643	144,982	153,867	157,259	196,761	210,772
Morrisville	8,973	15,393	21,696	23,682	24,456	29,963	31,782

Notes:
Historical population provided by Town of Cary as reported in CH2M (2017).
Population in 2045 was developed using persons per household values of 2.78 (SFR) and 2.22 (MFR) for Town of Cary and 2.70 (SFR) and 2.18 (MFR) for Town of Morrisville and expected 2045 development from the CommunityViz model.
Population at full capacity is assumed for the purposes of this evaluation to occur in the year 2065.
Population at full capacity is taken from the CommunityViz model as an additive value to the 2015 population (Triangle J COG, 2018).

Identifying the Needs of the Future

Projections through 2065 provide a basis on which to evaluate the ability of the Towns' water supply and infrastructure capacity to meet existing and future demands. The effort in this 2018 LRWRP began with an analysis of customer water usage and water system patterns using the most recent five years of the Town of Cary's comprehensive collection of system data and customer billing information. The Town of Apex also provided future planning information which is included in Appendix B. The next step was to develop an updated forecast of future water demand and wastewater flows to reassess the strategies in the Water Resources Portfolio provided in the 2013 LRWRP. New from 2013, reclaimed water projections are a part of the forecast.

This LRWRP includes the following projections to 2065:

- Water demands, including raw water and finished water
- Wastewater flows
- Reclaimed water demands
- Interbasin transfer
- Required discharge

In 2017, CH2M HILL North Carolina, Inc. (CH2M) updated the Town's water use analysis; this serves as the basis for many of the water use statistics used in this forecast, including updated unit water demand factors (CH2M, 2017). Key years for the forecast are the following:

- 2016—baseline year
- 2025—selected to represent when current plans approved but not yet built will be online
- 2045—selected to align with regional planning efforts
- 2065—selected to represent reaching the Town's full capacity for development

The Town included a major assumption in its demand projections in the 2013 LRWRP: by 2040 the Towns would start to reach their buildout capacity for development, with buildout reached between 2050 and 2060. The Town updated this assumption in 2018, with the new date of 2065 representing buildout capacity for development. This represents a more linear growth curve than was predicted in 2013. When reviewing the demand projections from 2013 and 2018, average day finished water demand for the Towns (inclusive of Morrisville, RTP South, RDU, and the service areas of Cary and Apex) at full capacity is a little more than 40 MGD. The 2018 LRWRP expectation for growth is similar to the 2013 LRWRP; however, buildout will be reached at a later timestep than was projected in 2013.

To capture the uncertainty inherently present in the long-range planning process, in this 2018 LRWRP Update CH2M used a probabilistic forecasting methodology similar to that used for the 2013 LRWRP.

This uncertainty is useful in understanding the potential risk in water supply and treatment capacity development decisions. The Towns benefit from implementing actions at the right times and this approach supports the Towns' goals for efficient use of financial resources and minimizing impacts to rate payers. Figure ES-2 displays the annual average day raw water demand forecast for the Towns of Cary and Apex. Depictions of the 5th, 25th, 50th, 75th, and 95th percentile forecasts represent the estimate of probability of occurrence of the identified level of demand and below. The 2013 LRWRP baseline forecast is included for comparison. To account for uncertainty and to support planning efforts to maintain a reliable water supply and infrastructure capacity for water and wastewater treatment, CH2M recommends that the Towns use the 75th percentile of the 2018 probabilistic forecast for infrastructure planning purposes. CH2M identified the future water/wastewater facility capacity needs discussed in the following paragraphs using this probability level from the forecast.

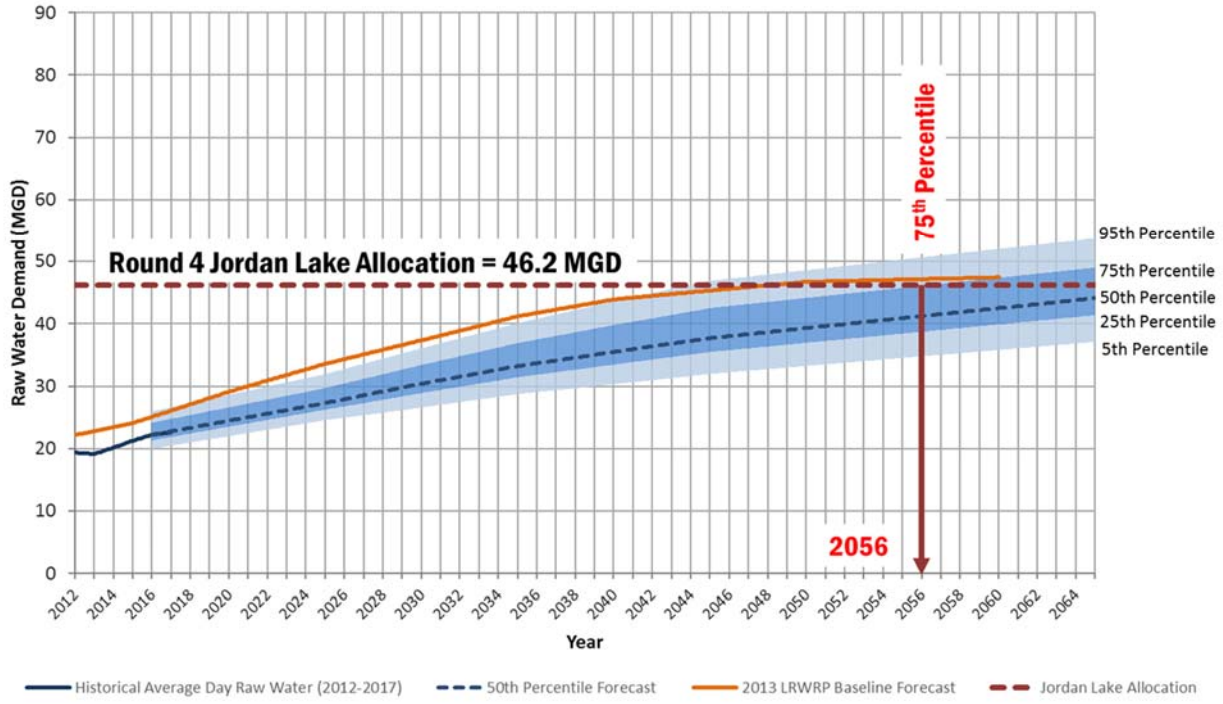

Figure ES-2. Annual Average Day Raw Water Demand Gap
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

The Towns may see the need to act to extend their Jordan Lake allocation farther into the future. One way to accomplish this could be by treatment efficiency improvements at the Cary/Apex WTF. Other ways to achieve efficiencies include demand management. The Town of Apex's rate of growth should be monitored closely against its portion of the Jordan Lake allocation so that plans can be implemented to extend the total allocation.

The maximum day finished water demand forecast is presented in Figure ES-3. The Towns' demands are expected to reach and exceed the total treatment capacity at the Cary/Apex WTF in the mid-2040s. Additional finished water capacity will be needed. This finished water demand could be met by further expanding the WTF, purchasing finished water from neighboring communities with whom the Towns have interconnections, or implementing other Water Resources Portfolio options provided in this LRWRP Update.

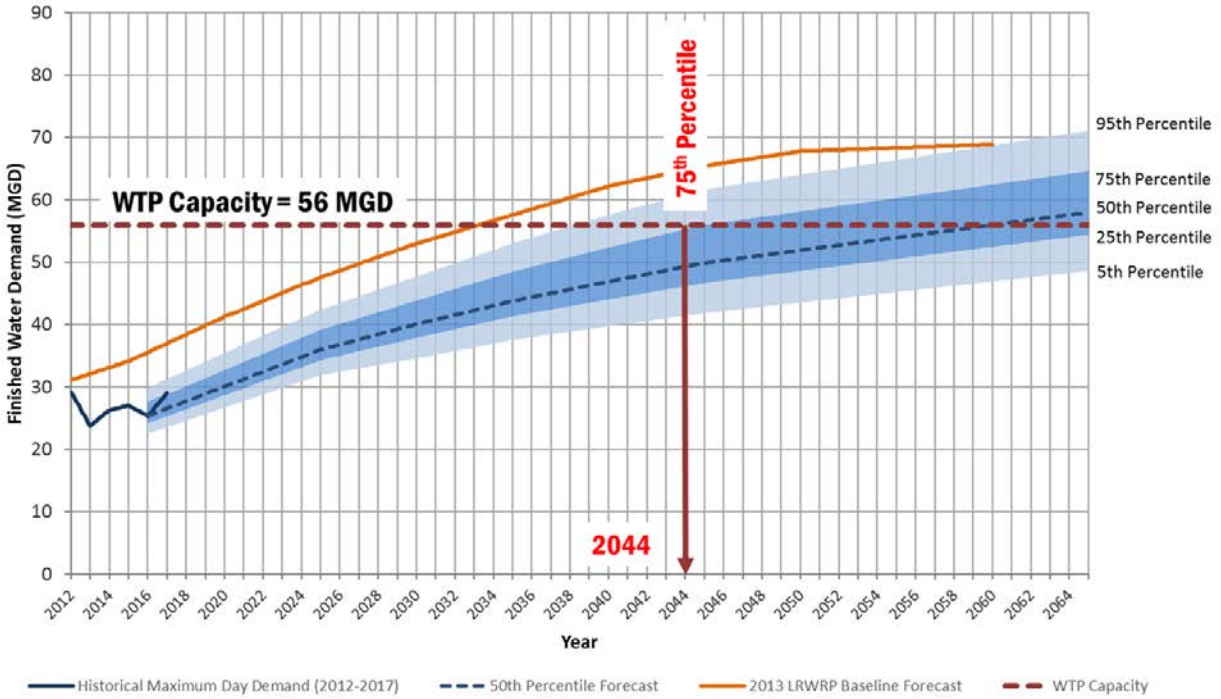

Figure ES-3. Maximum Day Finished Water Demand Projections
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Four water reclamation facilities within the Towns' service areas treat a portion of these water demands. By 2065, approximately 44.7 MGD of wastewater treatment capacity is needed, and the total current permitted capacity is 47.9 MGD. CH2M also evaluated future capacity needs by facility. The Town of Cary has an implementation strategy to obtain additional capacity at the NCWRF, raising its maximum month capacity to 13.5 MGD. If this strategy is implemented, the Town of Cary is expected to have sufficient wastewater capacity to meet its total needs with the two WRFs and its portion of capacity at the WWRWRF.

The Town of Apex WRF has a treatment capacity of 3.6 MGD; this amount is expected to be sufficient to meet future Neuse River Basin needs. However, the majority of growth in the Town of Apex is expected to occur in the Cape Fear River basin. The Town of Apex is likely to exceed its portion of capacity at the WWRWRF and the Beaver Creek Pump Station, which pumps to the WWRWRF. This gap in Apex's WWRWRF capacity allocation is expected to be over 3 MGD and is predicted to occur within the planning period to 2065 (Table ES-2). The Town of Apex is monitoring its growth and collaborating with the Town of Cary regarding the timing of additional capacity needs.

Table ES-2. 75th Percentile Wastewater Flow Projections by Water Reclamation Facility, 2016 to 2065, MGD, Maximum Month Average Day

Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Jurisdiction	Permitted Discharge	2016 Actual	2025	2030	2035	2040	2045	2065	2065 Gap[1]
NCWRF	**12.0**	7.3	8.2	9.0	9.7	10.2	10.6	12.4	0.4
SCWRF	**12.8**	6.5	6.8	7.5	8.1	8.5	8.9	11.3	-
Apex WRF	**3.6**	0.9	1.4	1.5	1.6	1.7	1.7	1.7	-
WWRWRF Total	**18.0**	6.3	10.4	12.2	13.9	15.4	17.0	19.3	1.3
WWRWRF—Cary	**11.88**	3.8	5.7	6.4	7.0	7.5	8.1	10.0	-
WWRWRF—Apex	**6.12**	2.5	4.7	5.8	6.9	7.9	8.9	9.3	3.2
Total Flow	**47.9**	**21.0**	**26.8**	**30.2**	**33.3**	**35.8**	**38.2**	**44.7**	**-**

Notes:
[1]The 2065 Gap value is calculated as the difference between the 2065 projection and the current WRF permitted discharge value.

In addition to water demand and wastewater flow projections, the Towns also monitor IBT and required discharge to the Cape Fear River. The 2015 IBT certificate allows Cary and Apex to transfer up to 31 MGD to the Neuse River basin and up to 2 MGD to the Cape Fear River basin from Jordan Lake (in the Haw River source basin) on a MMAD basis. Figure ES-1 shows the river basin boundaries as defined in North Carolina's IBT regulations. This represents the amount of water that can be consumed within the Cape Fear River and Neuse River receiving basins without being returned to the Haw River source basin. Obtaining this increased IBT flexibility was one of the recommendations outlined in the 2013 LRWRP and provides the Towns with more flexibility as development and redevelopment occur throughout the Towns' service areas.

Transfers to the Neuse River basin from Town of Cary demands are expected to grow approximately 50 percent during the planning period. Transfers driven by growth in the Town of Apex to the Neuse River basin are expected to grow approximately 25 percent and to the Cape Fear River basin are expected to increase seven-fold. Projections for the Neuse River basin IBT are shown in Figure ES-4. The Towns' transfers are expected to remain below the maximums listed in the IBT certificate, so compliance throughout the planning period is expected. However, the Town of Apex's high rate of predicted growth leads to more uncertainty around the forecasted transfer to the Cape Fear River. Figure ES-5 shows this forecast. Only Apex has part of its service area in the portion of the Cape Fear River basin below the Haw River confluence. Growth there could lead to the need for the Towns to revisit this transfer amount.

As part of their IBT certificate, the Towns are required to discharge a portion of their wastewater effluent to the Cape Fear and Haw River basins. This requirement is defined using a calculation comprised of average annual day finished water usage in the Neuse River basin and wastewater discharge to the Cape Fear River basin. This is currently achieved by the discharge of the WWRWRF but can also be met by other means, such as wastewater sent to Durham County. For the purposes of this LRWRP Update evaluation, the projected average annual discharge from the WWRWRF was used in the calculation.

To calculate future required discharge, CH2M captured the uncertainty associated with the location and rate of development and redevelopment by using the 25th, 50th, and 75th percentiles of the forecast. In all scenarios, the projected wastewater flow from the WWRWRF into the Cape Fear River is greater than the calculated minimum discharge requirement by more than 4 MGD at the end of the planning period.

Therefore, the Towns are expected to remain in compliance with this minimum required discharge throughout the planning period.

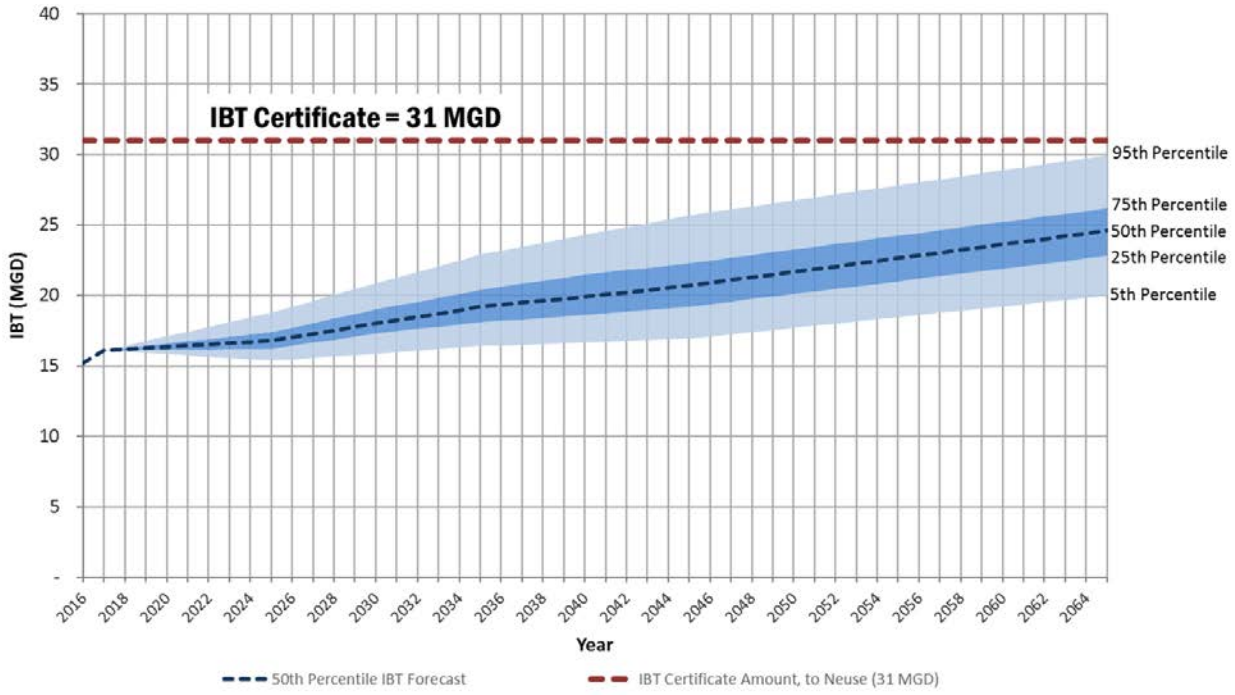

Figure ES-4. Interbasin Transfer to the Neuse River Basin Projections, Maximum Month Average Day
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

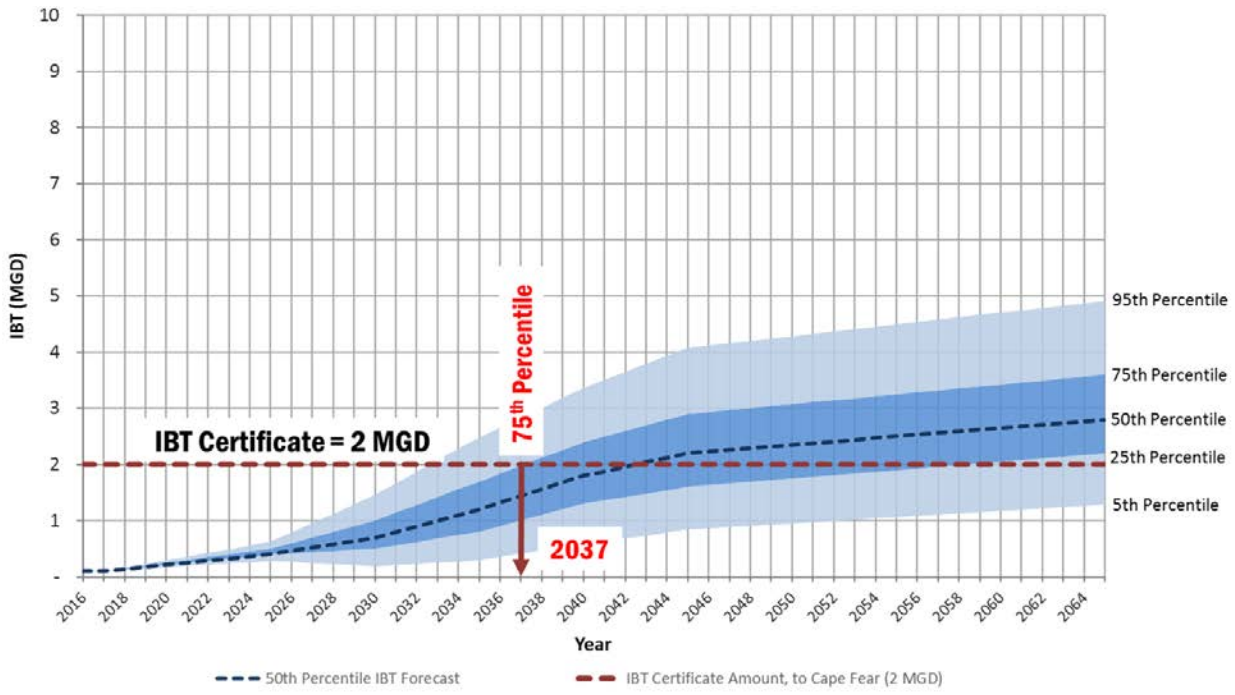

Figure ES-5. Interbasin Transfer to the Cape Fear River Basin Projections, Maximum Month Average Day
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

The Planning Process

The planning process used for the 2018 LRWRP Update and outlined in Figure ES-6 is similar to that conducted for the 2013 LRWRP. In this update, CH2M reviewed, revalidated, and updated the 2013 short list of water resources portfolio strategies to reflect current needs as defined by the forecast of future demands.

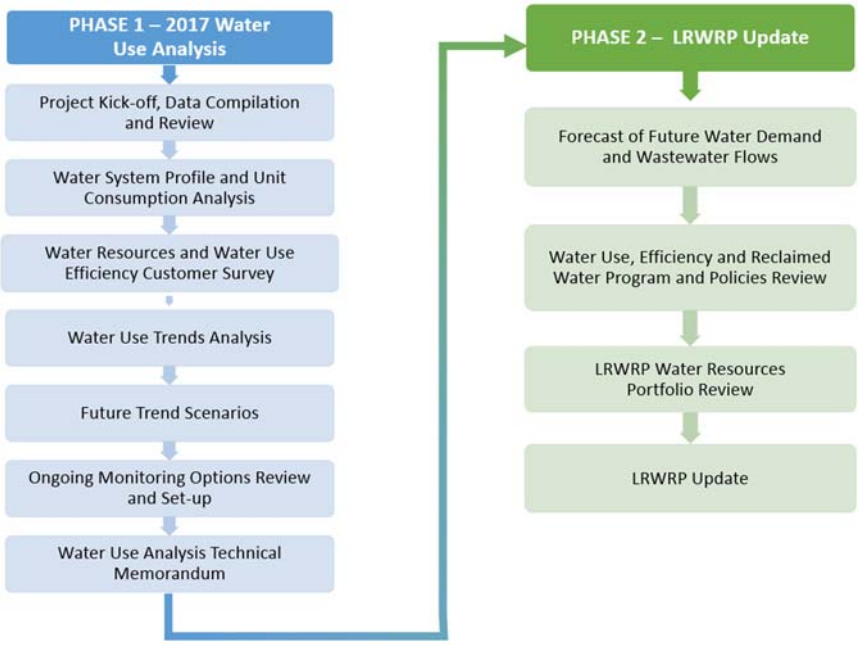

Figure ES-6. The LRWRP Update Planning Process
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

The customer survey was also repeated to assess changing customer behaviors, understanding of the Town of Cary's conservation program and goals, and preferred methods of communication for conservation messages. CH2M and the Town then incorporated these responses into an updated water conservation strategy (Appendix C). The Town's water conservation program and expected future water efficiency gains were incorporated into the 2018 LRWRP Update.

The Water Resources Portfolio

The Town developed a Water Resources Portfolio, a diverse set of strategy and source options to meet and manage water supply needs into the future under a variety of uncertainties. Source, infrastructure, and adaptive management solutions are included.

The 2013 LRWRP included a portfolio of water supply sources including interconnections, management tools, and resource recovery options. The portfolio was updated in 2018 into the following options:

- Strategy 1—Increase Water Supply via Jordan Lake Allocation
- Strategy 2—Increase Water Supply and/or Storage by Other Means
  - Strategy 2A—Increase Jordan Lake Water Supply Pool
  - Strategy 2B—Water Supply from Crabtree Creek with Storage in Existing Triangle Quarry
  - Strategy 2C—Water Supply from the Cape Fear River Watershed
  - Strategy 2D—Water Supply Development from Source Outside the Triangle
- Strategy 3—Purchase of Capacity via Triangle Regional Agreements
- Strategy 4—Integrated Master Planning and Strategic Utility Resource Utilization
- Strategy 5—Best Management Practices
  - Strategy 5A—Supply Side Management—Optimize Internal Operations
  - Strategy 5B—Demand Side Management—Manage Customer Demands for Improved Efficiency
  - Strategy 5C—Reclaimed Water

These strategies are summarized in Table ES-3 with details regarding treatment capacity requirements, implementation requirements, regulatory considerations, policy implications, key uncertainties, and benefits.

Implementation Plan

CH2M and the Town formulated an updated set of recommendations from the refreshed list of Water Resources Portfolio strategies. A combination of these strategies is most likely to reliably meet future demands. After considering the implemented actions recommended in the 2013 LRWRP, CH2M prepared an updated 2018 list of projected gaps in water supply and facility capacity and formulated near-term recommendations to meet finished water needs, as listed in Table ES-4. The Towns can implement these recommendations, allowing the Towns to meet demands in the short-term while delaying the potential need for large infrastructure investments until near the end of the planning period. These projects do not take decades to develop; instead each recommendation can be done in a few years, providing the Towns with flexibility to make investments and act at the right times. By monitoring demands and updating them when needed, such as when the Town of Apex's land use plan is completed, the Towns can implement recommendations in the short-term while keeping other, larger scale recommendations available for implementation if long range planning updates suggest they may be necessary. A full summary of each Water Resources Portfolio strategy is included in Table ES-3.

Gaps and recommendations to meet expected wastewater capacity needs are listed in Table ES-5. The timing of implementation will likely be driven by the Town of Apex's growing demands, as depicted in Figures ES-7 and ES-8. Capacity is likely needed at the jointly-owned Beaver Creek pump station and WWRWRF. The Town of Apex's pace of growth and corresponding wastewater flows are the likely drivers in the timing of these needs. To better understand these flows, additional flow monitoring and collection system modeling is necessary. The Towns would also benefit from development and use of a joint model that would help facilitate discussions regarding a path forward for the capacity agreements and any expansion(s) needed at these facilities. The Town of Cary's NCWRF will also likely reach its 12.0 MGD capacity during the planning period; the re-rating recommended for this facility, increasing its capacity to 13.5 MGD, will likely be sufficient to meet future flows.

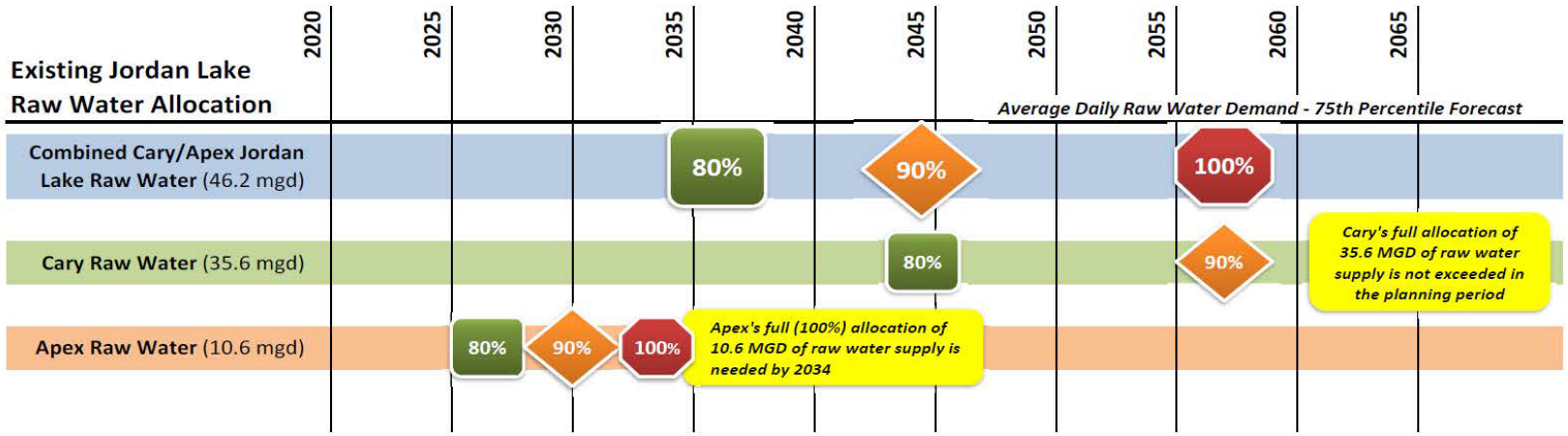

Figure ES-7. Timeline for Need for Additional Raw Water Supply

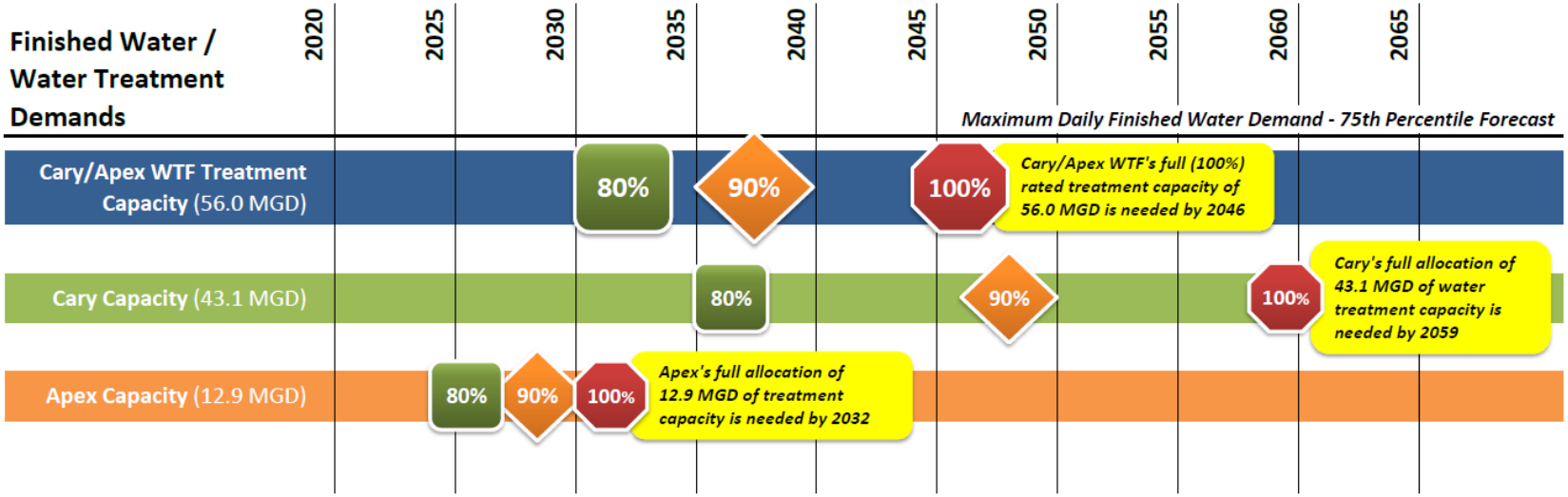

Figure ES-8. Timeline for Need for Additional Finished Water Capacity

Table ES-4. Summary of Water Resources Portfolio Recommended Actions
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Gap Identified	Recommendation	Benefits	Drivers
Raw Water Supply	5A: Supply Side Management via Cary/Apex WTF Optimization	Optimizes and extends Jordan Lake Allocation Project can be implemented quickly when needed	Timing of implementation driven by Apex's growing demands
Finished Water Capacity	3: Purchase of Capacity via Triangle Regional Agreements	Uses existing interconnections to supplement daily supply if agreement(s) can be reached Agreements can be reached prior to timing of actual need Can be used to bridge the gap in daily demands until towards near end of planning period; assess need for future expansion or additional source later	Timing of implementation driven by Apex's growing demands

Table ES-5. Summary of Wastewater Treatment Recommended Actions
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Gap Identified	Recommendation	Benefits	Drivers
Capacity at Beaver Creek Pump Station	Flow monitoring and modeling to better understand flows from Cary and Apex Adjust Interlocal Agreement following detailed analysis	Improved understanding of flows Supports capacity needs throughout planning period	Timing of solution driven by Apex's growing demands
Capacity at Western Wake Regional WRF	Conduct analysis following completion of Beaver Creek Pump Station review Short-term: Plan to adjust Interlocal Agreement following detailed analysis Long-term: Plan for expansion to meet future capacity needs	Improved understanding of flows Actions may meet Apex's needs in short-term Short-term actions may support delay of longer-term capacity needs, deferring larger capital investments	Timing of solution driven by Apex's growing demands
Capacity at North Cary WRF	Complete re-rating of facility from 12 MGD to 13.5 MGD	Re-rating approach is less expensive and faster than an expansion Supports needs until near end of planning period; assess need for future expansion then	Flows can be monitored, and a trigger used to determine when Cary needs to take action

Table ES-3. Strategies for Meeting Water Supply Needs

	Strategy 1 Increase Water Supply Via Jordan Lake Allocation	Strategy 2A Increase Water Supply and/or Storage by Other Means: Increase Jordan Lake Water Supply Pool (216 Study or reallocation of sediment pool)	Strategy 2B Increase Water Supply and/or Storage by Other Means: Water Supply from Crabtree Creek, Storage in Triangle Quarry, and new WTP	Strategy 2C Increase Water Supply and/or Storage by Other Means: Water Supply from Cape Fear River Watershed	Strategy 2D Increase Water Supply and/or Storage by Other Means: Water Supply Development from Source Outside the Triangle	Strategy 3 Purchase of Capacity via Triangle Regional Agreements	Strategy 4 Integrated Master Planning and Strategic Utility Resource Utilization	Strategy 5A Best Management Practices: Supply Side Management – Optimize Internal Operations	Strategy 5B Best Management Practices: Demand Side Management – Manage Customer Demands for Improved Efficiency	Strategy 5C Best Management Practices: Reclaimed Water
Objective	Increase the average day raw water supply to the CAWTF through obtaining additional allocation from the existing water supply of Jordan Lake, located in the Haw River Basin. The increase would also include an expansion of the WTF to meet future finished water needs.	Increase the average day raw water supply accessible from the conservation pool of Jordan Lake to the CAWTF. Options include re-evaluating the safe yield of the conservation pool or reallocating storage from sediment or flood control storage to the conservation pool, which would increase water supply storage.	Increase the water supply for the Towns by "skimming" high flows from Crabtree Creek and storing the water in the existing Wake Stone Corporation Triangle Quarry.	Increase the water supply for the Towns from a new water supply intake on the Cape Fear River downstream of Jordan Lake and to treat the water at either a new WTF or at the existing CAWTF. Another source within the Cape Fear River watershed could be Harris Lake.	Increase the Towns' average day raw water supply by accessing a water supply outside the Triangle region. This would likely be implemented in partnership with another utility and would also involve another water treatment facility.	Increase average day finished water supply through long-term water purchase agreements with other regional utilities, and then to access the purchased water through existing or new interconnections.	Integrate community planning, water resources management, utility planning, and sustainable development. Unifying these planning efforts will promote development practices that support the Towns' commitment to responsible growth and the wise use of water.	Increase the available average day raw water supply to the CAWTF through capital and operational improvements at the treatment plant. This strategy reduces and/or recycles process water that is currently sent to waste (i.e. "lost") and therefore, if implemented, would capture some portion of the raw water supply that is currently unavailable for treatment and distribution.	Influence customers to use water wisely – resulting in reduced water demand - through policies. Demand-side management approaches are increasingly relied upon for water resource management and complement more traditional supply side management measures. A combination of price-based and alternative (non-price-based) demand side management policies could be most beneficial.	Offset potable water system demands through the beneficial utilization of reclaimed water. This potential is explored in the Town of Cary's Strategic Reclaimed Water System Plan objectives and policies and is linked with Strategy 4.
Potential Raw Water Supply Need, identified as approx. 5 MGD ADD for Apex	Possibly the full need of 5 MGD could be allocated under Round 5 for Apex	Possibly the full need of 5 MGD for Apex could be allocated under the 46.2% total current allocation	Safe yield and timing are key uncertainties; possibility that the full 5 MGD would not be available; additional distribution system infrastructure needed	5 MGD possible; could work in partnership with another utility	5 MGD possible; could work in partnership with another utility	Sufficient finished water supply to be provided through interconnections or through partnering on an expansion project; the total water supply required could be provided through agreements phased with multiple utilities	Integrated system modeling would provide better understanding of system loss and improve forecasting.	Could achieve a maximum process waste recovery potential of 7.8 MGD, sufficient to meet the projected need.	Up to 1.5 MGD of savings expected by 2065 and included in forecast. Additional benefits could be achieved by strengthening program.	Offsets finished water demand by additional reclaimed water demand 0.5-1.2 MGD ADD, 3.0 MGD MDD by 2065
Treatment Capacity Needs identified need of up to 10 MGD MDD	Expansion of CAWTF to meet Cary and Apex needs	Expansion of CAWTF to meet Cary and Apex needs	Obtain Triangle quarry; new WTF needed to meet Cary and Apex needs; may not be available before 2035	Potential for new WTF; could work in partnership with another utility	Potential for new WTP needed; could work in partnership with another utility	Potential for new WTF if raw water is purchased or share of another WTP's capacity	No additional capacity achieved	No direct increase in treatment capacity; potential for raw water supply capacity augmentation through optimized operations only at CAWTF	No additional capacity achieved; would offset some demand	No additional capacity achieved; would offset some demand
Implementation Requirements	Jordan Lake allocation process; Cape Fear River Basin Hydrologic model and safe yield study; Cape Fear River Basin Water Supply Plan	Updated Hydrologic Model; updated USACE Section 216 study; evaluation of raising pool with current dam structure	Water quality study (Crabtree Creek and quarry); Treatability study; Water blending study; design, permit, and construct infrastructure	Treatability study; Finished water blending study; Preliminary Engineering Report for intake, pipeline route; approval from other entities for construction of infrastructure within their jurisdictions; design, permit, and construct infrastructure	Treatability study; Finished water blending study; Preliminary Engineering Report for intake or reservoir improvements, pipeline route; approval from other entities for construction of infrastructure within their jurisdictions; design, permit, and construct infrastructure	Triangle Regional Water Supply Plan; Phase 2 Interconnect Study for Triangle Regional Partnership (TRP); booster pumps or pressure regulating valves, and bi-directional metering; approval from entities for construction of infrastructure	Master planning and modeling efforts linked directly with water resources planning/ management; use Strategy 4 information and the LRWRP as resource in upcoming land use planning projects	Necessary to conduct a study to better understand SuperPulsator blowdown volume and percent solids under current operation; assessment of existing Recycle Pump Station	Rate study; program/method for incorporating AMI customer data into email messaging and communication plan; messaging should include the broad perspective of water resources management and include new demand management programs developed; Cary to implement Conservation Program recommendations	Capital projects to extend transmission lines; Cary to maximize customer base through expansion of system as described in master planning

Table ES-3. Strategies for Meeting Water Supply Needs

	Strategy 1 Increase Water Supply Via Jordan Lake Allocation	Strategy 2A Increase Water Supply and/or Storage by Other Means: Increase Jordan Lake Water Supply Pool (216 Study or reallocation of sediment pool)	Strategy 2B Increase Water Supply and/or Storage by Other Means: Water Supply from Crabtree Creek, Storage in Triangle Quarry, and new WTP	Strategy 2C Increase Water Supply and/or Storage by Other Means: Water Supply from Cape Fear River Watershed	Strategy 2D Increase Water Supply and/or Storage by Other Means: Water Supply Development from Source Outside the Triangle	Strategy 3 Purchase of Capacity via Triangle Regional Agreements	Strategy 4 Integrated Master Planning and Strategic Utility Resource Utilization	Strategy 5A Best Management Practices: Supply Side Management – Optimize Internal Operations	Strategy 5B Best Management Practices: Demand Side Management – Manage Customer Demands for Improved Efficiency	Strategy 5C Best Management Practices: Reclaimed Water
Regulatory Considerations	Jordan Lake allocation process; may require IBT process (Cape Fear transfer); SEPA process (for WTP expansion); Secondary and Cumulative Impact Master Management Plan (SCIMMP) updates; Authorization to Construct	USACE Section 216 process could require EA or EIS; Jordan Lake allocation process; may require IBT process; SEPA process (for WTP expansion); SCIMMP updates; Authorization to Construct	Reclassification of Crabtree Creek and quarry; SEPA process; Crabtree Creek passing flow requirements, 401/404 Permit; SCIMMP updates, Authorization to Construct	Potential Jordan Lake allocation; SEPA process; SCIMMP updates; 401/404 Permit; Authorization to Construct	Potential need for allocation process and/or USACE Section 216 process; Could require EA or EIS; IBT process; SEPA process; SCIMMP updates; 401/404 Permit; Authorization to Construct	May require IBT process; permitting for infrastructure	No new regulations required; however, some changes to the Unified Development Ordinance can be considered	Approval of PWSS for residuals process water enhancements	None identified	Continued compliance with 15A North Carolina Administrative Code (NCAC).02U for reclaimed water use
Policy Implications	None likely	None likely	Other jurisdictions may need to update policies to reflect water supply watershed requirements	Interlocal agreements would be required; May require programs to mitigate downstream water resources issues	Interlocal agreements would be required between municipal partners	Interlocal agreements for finished water purchases will be required	Policies to direct future growth to locations of available water supply and infrastructure, including reclaimed water; Apex to review the potential benefit and feasibility of a reclaimed water policy	Potential interlocal agreement to expand Cary hydraulic modeling to include integration of Apex system	Affordability; revenue stability with decreased consumption per connection; ability to implement recommended actions	Connection/development requirements and costs; capital costs of expanding the reclaimed water system; customer service adjustments to address issues unique to reclaimed water
Key Uncertainties	Round 5 allocation from Jordan Lake to be received; ability of reservoir to meet total regional water demands; level of stakeholder involvement and issues	Federal funding for Section 216 study (cost share); Section 216 study requirements and outcome; Ability of reservoir to meet total regional water demands; Level of stakeholder involvement and issues; weather variability	Availability of quarry and timeframe of availability are not definite; cost of quarry could be much greater than assessed tax value; source water availability could be impacted by passing flow requirements; water quality of Crabtree Creek and quarry; reclassification of Crabtree Creek watershed and quarry; limited safe yield due to system variability; distribution system requirements from a new treatment facility	May require a Jordan Lake allocation or at minimum coordination with Triangle Water Supply Partnership; regional water demands and the potential impact it may have on Cape Fear River water supply potential; availability of flow from the Cape Fear River and requirements for instream flow studies; Duke Energy water needs and availability of Harris Lake as an option; water quality in Harris Lake; Indirect potable reuse; construction and permitting costs and timeline associated with a new water source	Likely the most expensive strategy; federal funding for Section 216 study (federal portion); Section 216 study requirements; study outcome; likely would require a utility partner due to cost; timing of partner's needs; pumping costs to service area	May require a Jordan Lake allocation; Single agreement may not be able to provide entire additional water supply needs; permanent water supply allocation from regional utility is uncertain without capacity purchase or participation in joint water supply capacity project; timing of agreements and availability of water; other entities are also currently reviewing their own water supply options; water blending issues; pressure differentials across system; capacity limitations of interconnects with other utilities; IBT certificate modifications; new distribution system infrastructure and current system improvements	Societal trends driving the development market; Policies can be changed by governing bodies; timing and level of new growth will affect potential for benefits	Potential changes to PWSS requirements; would require action on another strategy to completely meet future demands; the actual amount of process waste currently generated is relative to its sources; impact of recycle on blended water quality; increase in operational complexity; potential impacts on downstream water quality; potential degradation in future raw water quality may impact feasibility of process waste recovery; limit on types of polymers that may be used	Actual price elasticity of water demand based on price may not reflect calculated savings because factors other than price influence water use; participation levels in conservation programs may be different than planned participation; rate structures need to be easily understood and accepted by the customer; revenue implications; policies can be changed by governing bodies; Apex program initiation; billing software needs to be capable of calculating billing alternative rate structures	The level and timing of new growth will affect demand for reclaimed water public and commercial concerns related to water quality; practicality and cost of seasonally supplying reclaimed water; cost for developer installed or Cary installed infrastructure

Table ES-3. Strategies for Meeting Water Supply Needs

	Strategy 1 **Increase Water Supply Via Jordan Lake Allocation**	Strategy 2A **Increase Water Supply and/or Storage by Other Means: Increase Jordan Lake Water Supply Pool (216 Study or reallocation of sediment pool)**	Strategy 2B **Increase Water Supply and/or Storage by Other Means: Water Supply from Crabtree Creek, Storage in Triangle Quarry, and new WTP**	Strategy 2C **Increase Water Supply and/or Storage by Other Means: Water Supply from Cape Fear River Watershed**	Strategy 2D **Increase Water Supply and/or Storage by Other Means: Water Supply Development from Source Outside the Triangle**	Strategy 3 **Purchase of Capacity via Triangle Regional Agreements**	Strategy 4 **Integrated Master Planning and Strategic Utility Resource Utilization**	Strategy 5A **Best Management Practices: Supply Side Management – Optimize Internal Operations**	Strategy 5B **Best Management Practices: Demand Side Management – Manage Customer Demands for Improved Efficiency**	Strategy 5C **Best Management Practices: Reclaimed Water**
Benefits	Continue to leverage the work of the Triangle Water Supply Partnership; Jordan Lake is currently one of the most reliable water supplies in the region; utilizes a single water supply source and maximizes investment in the CAWTF and associated distribution infrastructure, resulting in a straightforward implementation	Continue to leverage the work of the Triangle Water Supply Partnership Jordan Lake is currently one of the most reliable water supplies in the region; downstream users support for a Section 216 study; utilizes a single water supply source and maximizes investment in the CAWTF and associated distribution infrastructure, resulting in a straightforward implementation	Water supply diversification; potential for increased operational flexibility and the management of finished water supplies for planned WTF maintenance activities or unplanned outages; finished water supply directly to Cary's central pressure zone areas furthest from the CAWTF; helps minimize future IBT; quarry site is close to the Cary service area	Water supply diversification; potential for increased operational flexibility and the management of finished water supplies for planned WTF maintenance activities or unplanned outages; potential for reduction in IBT	Water supply diversification and resiliency to water quality changes and weather variability; potential for increased operational flexibility and the management of finished water supplies for planned WTP maintenance activities or unplanned outages	Water supply diversification; potential for increased operational flexibility and the management of finished water supplies for planned WTP maintenance activities or unplanned outages; operational benefit if interconnections are created in areas within the distribution system that have potential for water quality or pressure issues; could help to minimize IBT	Reduction of demands defers need for infrastructure investments and interlocal agreements; could help minimize IBT	Potential to extend available raw water supply; achieve increased operational flexibility and the management of finished water supplies for planned WTF maintenance activities or unplanned outages	Reduction of demands defers need for infrastructure investments and interlocal agreements; could help minimize IBT	Reduction of demands defers need for infrastructure investments and interlocal agreements; Rates for reclaimed water versus potable water to both encourage its use and generate sufficient revenue; could help to minimize IBT

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Abbreviations and Acronyms

ADSM	alternative demand side management
AMI	advanced metering infrastructure
CAMPO	Capital Area Metropolitan Planning Organization
CH2M	CH2M HILL North Carolina, Inc.
COG	Council of Governments
COM	commercial
DWR	Division of Water Resources
EMC	Environmental Management Commission
ft^2	square feet
GIS	geographic information system
GPCD	gallon(s) per capita per day
IBT	interbasin transfer
ICI	industrial, commercial, and institutional
LRWRP	Long Range Water Resources Plan
MFR	multifamily residential
MGD	million gallons per day
MMAD	maximum month average day
NCDEQ	North Carolina Department of Environmental Quality
NCWRF	North Cary Water Reclamation Facility
OWASA	Orange Water and Sewer Authority
PWSS	Public Water Supply Section
RDU	Raleigh-Durham International Airport
RTP South	Wake County portion of Research Triangle Park
SCIMMP	Secondary and Cumulative Impact Master Management Plan
SCWRF	South Cary Water Reclamation Facility
SFR	single-family residential
Town	Town of Cary
TWSP	Triangle Water Supply Partnership
USACE	U.S. Army Corps of Engineers
WWRWRF	Western Wake Regional Water Reclamation Facility
WRF	water reclamation facility
WTF	water treatment facility
WTP	water treatment plant

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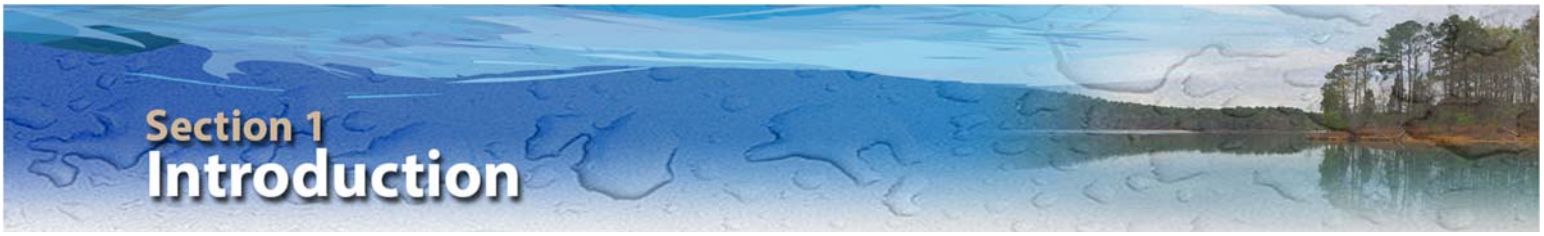

Section 1 Introduction

This report is the 2018 update to the Long Range Water Resources Plan (LRWRP) for the Towns of Cary, Apex and Morrisville and Wake County. This LRWRP serves as a working strategy for the Towns to actively manage a flexible portfolio of water resources options. Strategies and options in the 2013 LRWRP were re-appraised for their ability to meet updated projections of future water and wastewater demands to identify and recommend the best path forward to meet these growing and changing needs.

1.1 Long Range Water Resources Plan Update Approach

In early 2017, the Town of Cary (Town) partnered with CH2M HILL North Carolina, Inc. (CH2M) to update the 2013 LRWRP, to be executed in two phases. One of the initial tasks for Phase One of the LRWRP Update was to update the 2010 Water Use Analysis (CH2M, 2010). The 2010 work included an in-depth analysis of water consumption trends from 2005–2009, incorporating prior analysis results from the 2007 *Integrated Water Resources Management Plan* (CH2M, 2007) and providing a record of consumption trends from 2001–2009. As part of the 2013 LRWRP, recommendations were made for unit consumption factors to be used in forecasting future water demand and wastewater flows through 2060 based on the observed trends through 2009. In addition, the analysis results were used in evaluating the effectiveness of water conservation and demands for reclaimed water.

This LRWRP Update continues to provide the Towns with a guide for development of a reliable, flexible water supply and management solutions that are financially responsible, maintain quality of service provided to customers, and support the commitment to protecting health and being good stewards of the natural environment.

Since the 2010 water use analysis, the Town has replaced its water meter system with an advanced metering infrastructure (AMI) system, Aquastar. Aquastar provides water meter reading data on an hourly and daily basis, compared to the previous system that only provided monthly billing data. The increased frequency of the meter readings offers a more accurate representation of the daily and seasonal consumption patterns, compared to monthly billing data used in prior analyses. The finer resolution of consumption data for the period 2013–2016 allows a more robust comparative analyses to be completed with other daily data, such as the Cary/Apex Water Treatment Facility (WTF) production data, daily wastewater flow monitoring data, and weather data.

CH2M completed the updated water use analysis under Phase One of this 2018 LRWRP Update, summarizing insights on water consumption trends from 2013–2016 for the entire Town of Cay service area, including the Town of Cary, the Town of Morrisville, the Wake County portion of Research Triangle Park (RTP South), and Raleigh-Durham International Airport (RDU) (Figure 1-1). CH2M used Aquastar data to develop a better understanding of the daily and seasonal consumption patterns (CH2M, 2017; Appendix A). In total, the analysis integrates 2010 analysis results with 2017 data to provide long-term consumption trends for a period of time that has included two significant droughts (2002 and 2007), an economic recession (2008–2010), and most recently, a series of years with normal weather patterns when compared to 30-year averages (State Climate Office of North Carolina, 2017).

Town of Cary and Town of Morrisville citizens were also surveyed as part of Phase One, to assess changing water use behaviors, their understanding of Town conservation program and goals, and their preferred methods of receiving conservation-related messages.

Under Phase Two of the update, CH2M separately built demand projections for the service areas for the Towns of Cary and Apex. Apex projections are built from population data and per capita consumption data (Appendix B). CH2M then used these projections to assess future water resources needs and refresh each of the strategies presented in the Water Resources Portfolio of the 2013 LRWRP. Additionally, CH2M revisited the potential impacts of water conservation programs, reclaimed water strategies, and the potential impact of redevelopment and infill on demands as part of Phase Two of the 2018 LRWRP Update (Figure 1-1).

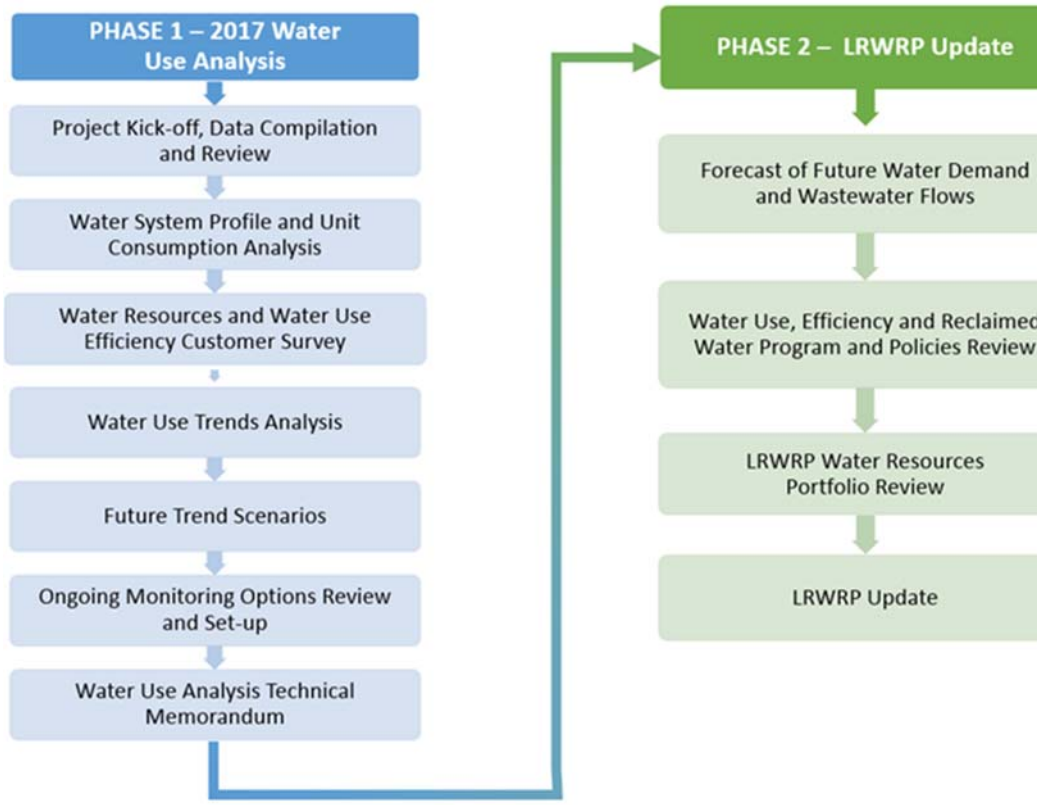

Figure 1-1. The LRWRP Update Planning Process
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

1.2 The Regional Setting

1.2.1 Triangle Water Supply Partnership and the Future

The Towns of Cary and Apex have actively participated in the regional water supply planning efforts regarding Jordan Lake. The Jordan Lake Partnership, the planning group begun in 2009, was recently renamed the Triangle Water Supply Partnership (TWSP) to better reflect the need for broader scale efforts to collectively plan for sustainable water supply for the Triangle region. Water supply resiliency goals in the region have prompted utilities to construct interconnections and form agreements to share water from sources other than just Jordan Lake. Through this planning effort and others, the Towns have constructed interconnections with the City of Durham, City of Raleigh, and Harnett County via the

Town of Holly Springs. These interconnections are currently only used for emergency or short-term needs such as purchasing water during periods of operational maintenance.

This regional planning and resiliency approach is a key strength in the Towns' broad Water Resources Portfolio and planning efforts. The Towns are committed to maintaining active roles in this planning group.

1.2.2 Regional Growth Planning

The Town of Cary established an objective for this update to use recent regional planning information, including development projections through 2045. The Triangle J Council of Governments (COG), along with other regional planning organizations, worked to create a transportation model through 2045. The Town of Cary and other jurisdictions (or municipalities) in the region provided land use and development data to the Triangle J COG to support development of the CommunityViz 2.0 model (Triangle J COG, 2018). Appendix B includes an overview of the model and a map of the participating region. Also included in Appendix B is the Capital Area Metropolitan Planning Organization (CAMPO) 2017 *Connect 2045 Place Type Summary for Raleigh, Cary, and Morrisville*.

The information provided to Triangle J COG was produced by the Town of Cary in 2015 and 2016, with review comments submitted in 2017. The Town then elected to use the model's output for development, modeled using an algorithm that worked around transportation corridors, and the Town's assessment of full capacity for development as the future land use inputs into CH2M's future demands model. The Town of Cary has opted to use the CAMPO model's geographic information system (GIS) parcel-based output to reflect development status in 2045. The Town of Cary also selected the year 2065 to represent the Town's full capacity for development. Therefore, while the allocations will be used to inform the projected water system demands in the year 2045, the full development capacities will be used to inform the projected water system demands in the year 2065.

1.3 Water Resources Infrastructure for the Towns of Cary, Apex, Morrisville, and RTP South

Since the 2013 LRWRP was issued, the Towns of Cary and Apex have worked to expand water supply allocation and infrastructure capacity to meet customer needs in their service areas and plan for growth. The Towns of Cary and Apex jointly own and share treatment capacity in the Cary/Apex WTF and Western Wake Regional Water Reclamation Facility (WWRWRF). They also share an interbasin transfer (IBT) certificate, providing the flexibility to distribute water across their service areas. The Town of Cary's service area includes Cary, the Town of Morrisville, RTP South and RDU; a portion of Cary lies within Chatham County. The Town of Apex's service area includes Apex and its planned utility service area (Figure 1-2).

Since 2013, the Towns have completed the following actions:

- Received additional water supply from Jordan Lake Round 4 allocation
- Completed expansion of Cary/Apex WTF expansion to 56 million gallons per day (MGD)
- Installed AMI in the Town of Cary
- Completed construction of the jointly owned WWRWRF with a capacity of 18 MGD
- Received an IBT Certificate modification (31 MGD to the Neuse River basin and 2 MGD to the Cape Fear River basin from Jordan Lake in the Haw River basin) on a maximum month basis

The Towns each also manage their own infrastructure:

- Town of Cary infrastructure

  - North Cary and South Cary WRFs (12.0 MGD and 12.8 MGD, respectively)
  - A reclaimed water distribution system currently serviced with reclaimed water from Durham County, the North Cary Water Reclamation Facility (NCWRF) and the South Cary Water Reclamation Facility (SCWRF)
- Town of Apex infrastructure
  - Apex WRF (3.6 MGD)
  - While the Town holds a reclaimed water distribution permit, it does not currently have reclaimed water infrastructure in place

For the Towns to be able to access their full current Jordan Lake allocation of 46.2 MGD, an IBT certificate modification was approved by the North Carolina Environmental Management Commission (EMC) in 2015. Water supply for the Cary/Apex WTF is withdrawn from Jordan Lake in the Haw River basin, and currently most of this water is consumed and/or discharged in the Neuse River basin. The Towns hold a transfer certificate of 31 MGD to the Neuse River basin and 2 MGD to the Cape Fear River basin (as defined by state statute). The Towns' WWRWRF discharges to the Cape Fear River downstream of Jordan Lake, satisfying required discharge requirements.

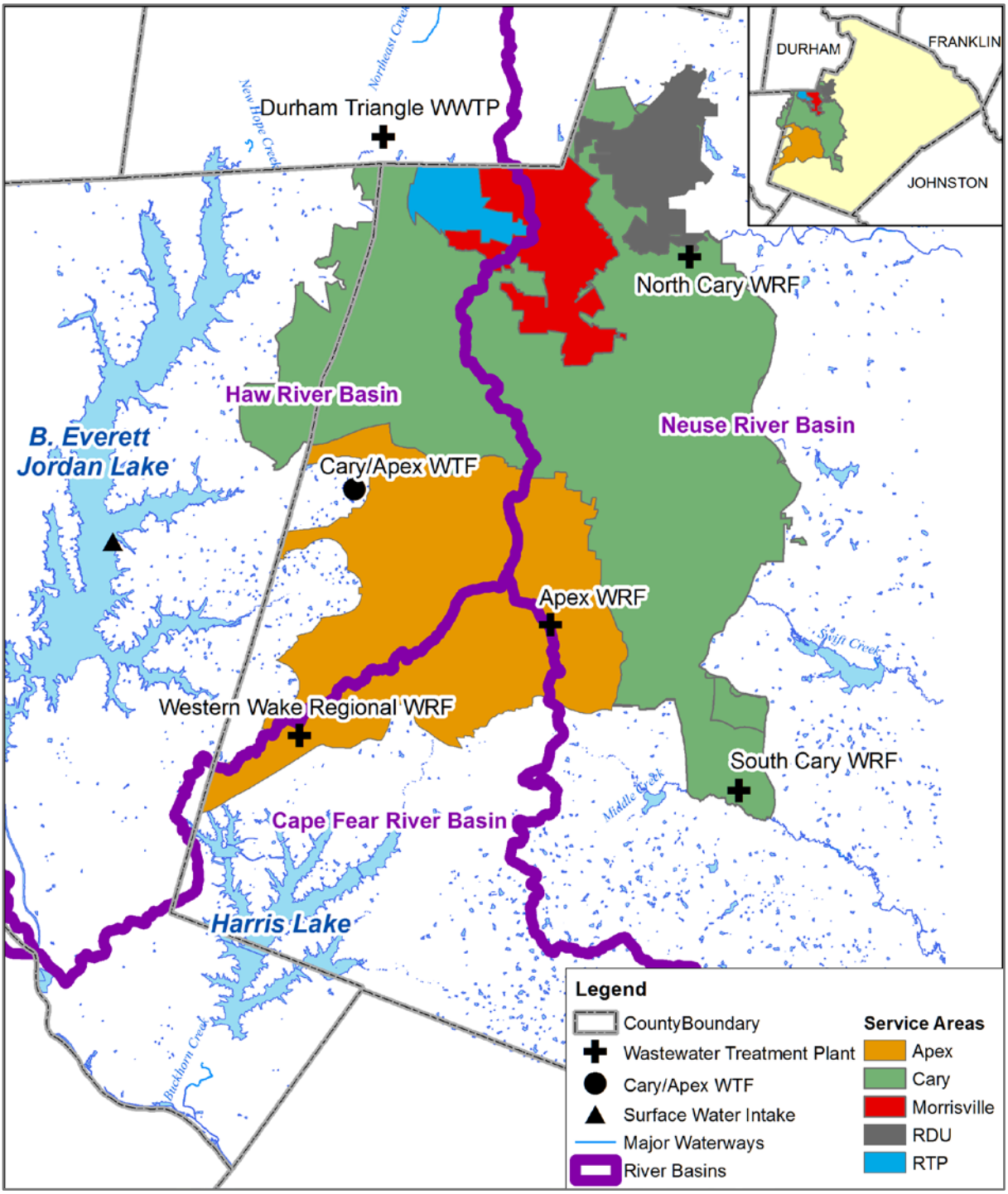

Figure 1-2. Service Areas for the Towns of Cary and Apex
Long Range Water Resources Plan Update

The Towns also maintain water interconnections with the City of Durham, City of Raleigh, and the Town of Holly Springs. In addition, they have an agreement that allows mutual aid with adjacent municipalities through their direct connections. The Town of Cary also maintains a wastewater interconnection with Durham County. These connections provide the Towns with resiliency and flexibility for activities such as infrastructure maintenance.

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Section 2
Identifying the Needs for the Future

Long range resource planning was prepared by looking forward towards the expected full capacity for development of the Towns. This effort was built from land use planning information provided by the Town of Cary and population projections provided by the Town of Apex. Based on currently available planning information and connected to regional planning activities, the farther in the future demands are projected the greater the uncertainty.

Building from recent water use statistics and future land use projections, the Towns' forecasts for water and wastewater were developed to inform the Towns' decision making and support the Towns' goals to reliably and sustainably meet the water resources needs of the community.

Forecasting is a critical element of the Towns' ability to plan, design, and construct capital-intensive infrastructure, such as major water supply and treatment facilities, which can take upwards of a decade to place online. The Towns also take regulatory processes into consideration, as the Towns hold an IBT certificate and Jordan Lake water supply allocations. These processes may involve multiple stakeholders and years of analysis and negotiations. Forecasting of these elements is also essential to understanding the sensitivity of current supply capacity limitations and the timing for new supplies and infrastructure, ensuring that capacity is available to meet the growing needs of the community.

The Towns can utilize these projections to evaluate the ability of their water supply and infrastructure capacity to meet existing and future demands. The Town of Cary has invested in reclaimed water infrastructure and a water conservation program to offset potable water demands. These programs are incorporated into this forecast. A more modest expansion of the reclaimed water program may result in a small increase in potable water demands in areas where reclaimed water may not be available. These projections will also be used to evaluate the potential of water resources portfolio alternatives to meet projected demands, as was conducted for the 2013 LRWRP.

2.1 Historical Water Demand

2.1.1 Town of Cary

Since the 2010 water use analysis, the Town has replaced its water meter system with an AMI system, Aquastar. Aquastar provides the Town with water meter reading data on an hourly and daily basis, compared to the previous system that only supplied monthly billing data. The increased frequency of the meter readings provides for a more accurate representation and understanding of the daily and seasonal consumption patterns, compared to monthly billing data used in prior analyses. The finer resolution of consumption data for the period 2013-2016 allows a more robust comparative analyses with other daily data, such as the Cary/Apex WTF production data, daily wastewater flow monitoring data, and weather data. In total, the analysis integrates 2010 analysis results with current data to provide long-term consumption trends for a period of time that has included two significant droughts (2002 and 2007), an economic recession (2008–2010), and most recently, a series of years with normal weather patterns when compared to 30-year averages (State Climate Office of North Carolina, 2017).

With the availability of AMI data, the Town of Cary can more deeply analyze demand drivers; this availability better equips Cary to monitor changing trends. Details of the Town of Cary water use analysis completed for the 2013–2016 timeframe are included in Appendix A.

The Cary/Apex WTF production data provide a summary of the overall finished water demands for the Town's service area; Figure 2-1 compares daily finished water pumped (including purchases and excluding sales) to the Town's service area to the annual average daily demand value from 1997 through 2016.

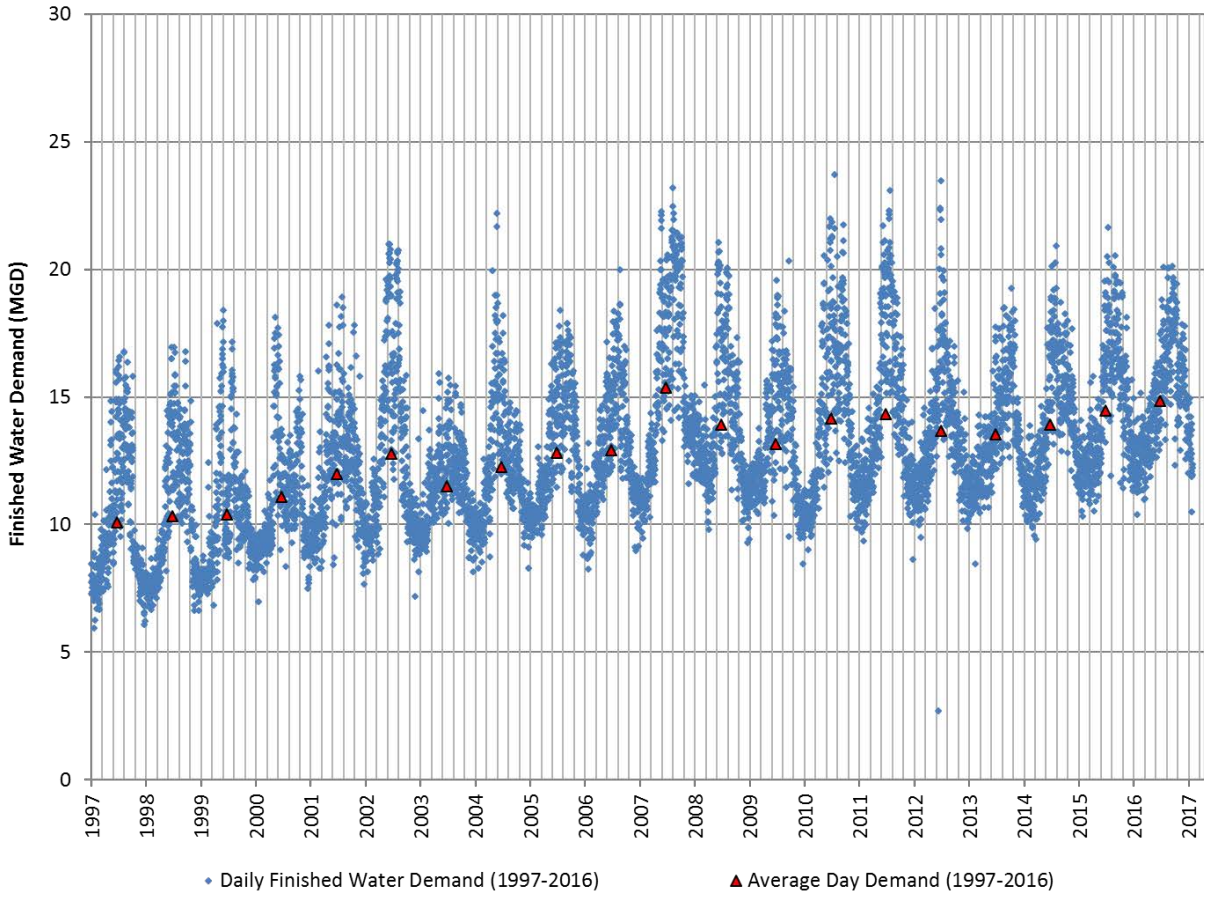

Figure 2-1. Daily Finished Water Demand–1997–2016
Includes the Towns of Cary and Morrisville; RTP South; and RDU

Figure 2-2 compares the population growth to the growth in finished water demand from the Cary/Apex WTF for the Town's service area from 2001 through 2016. Since 2001, population has averaged an annual growth rate of 5 percent, and water demand has grown at an average rate of approximately 1 percent per year. Since 2013, the population's annual growth rate has remained steady at near 5 percent, while total water demand has increased slightly, at a rate of 2 percent per year. As observed on Figure 2-2, with population increasing at a faster rate than water demand, the Town's water customers are using less water on a unit basis. The overall system gallons per capita per day (GPCD) has decreased from 114 to 81 GPCD, approximately 29 percent, from 2001 through 2016. One factor supporting this is increased efficiency of indoor appliances.

The growth rate in the Town is expected to remain steady due to a shift from new development to redevelopment as the Town approaches buildout. The Town's shift in demographics is not only driven by reduced amounts of vacant land, but also changing demographics as the Town is seeing an increase in young professionals, singles, couples without children, seniors, and empty-nesters. The *Imagine Cary* Community Plan emphasizes downtown, targeted locations, underperforming land and building assets,

as well as vacant areas served by existing infrastructure. Therefore, more project-specific, localized forecasting will be necessary to determine smaller scale future impacts to the Town's infrastructure.

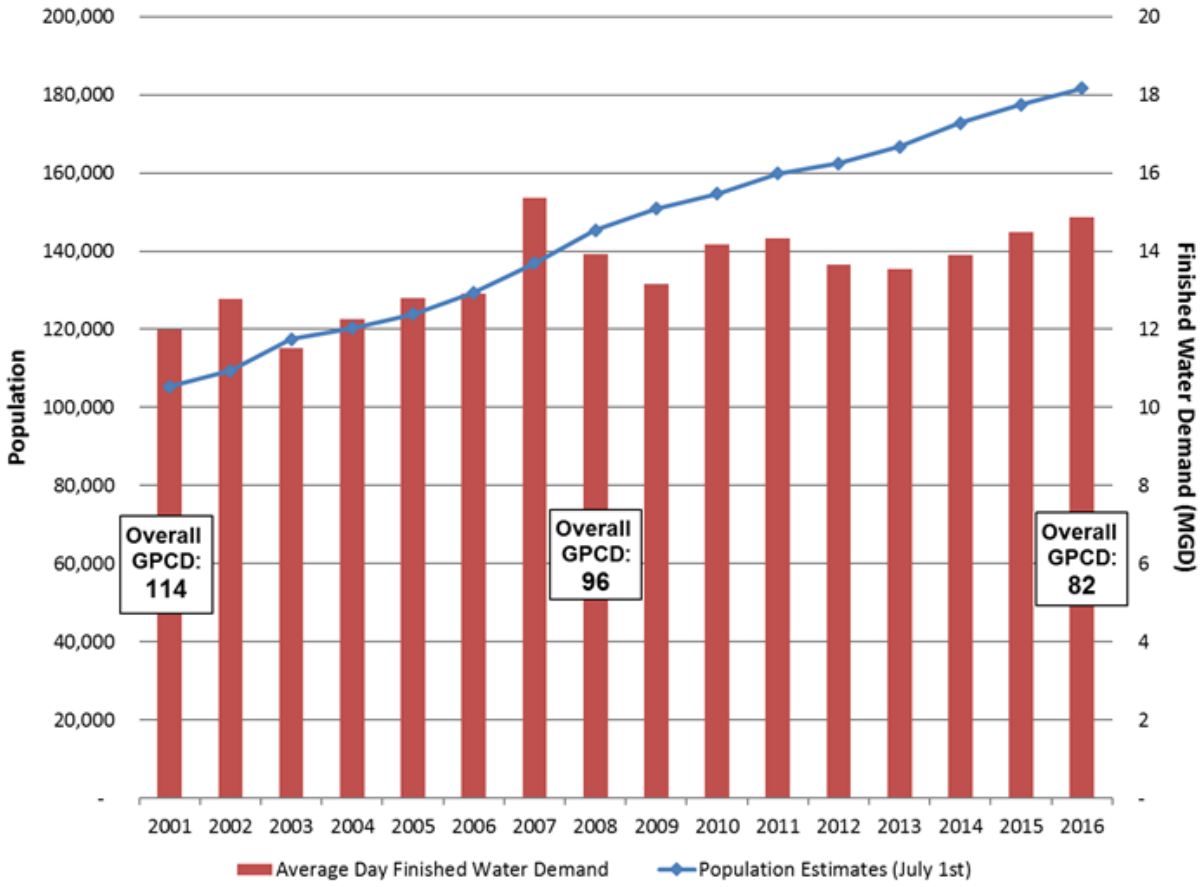

Figure 2-2. Comparison of Annual Population and Water Demand Growth—2001–2016
Includes the Towns of Cary and Morrisville; RTP South; and RDU

Figure 2-3 presents the Town's 2016 average day metered demand by customer type. Single family residential (SFR) and commercial (COM) are the largest customer type components of the Town's forecast, comprising approximately 47 percent and 27 percent of the 2016 finished water customer demands, respectively. Changes in water use habits by these customer types are demand drivers in the forecast. For example, the Town's irrigation demands have decreased since the 2013 LRWRP was completed (CH2M and Brown and Caldwell, 2013). Since 2013, the Town has seen a decline in irrigation system installation. The installation rate is now 13 percent, down from the 33 percent rate used in the 2013 LRWRP. Additionally, average new home lot sizes are smaller, which leads to smaller per-household outdoor water demands in newer homes.

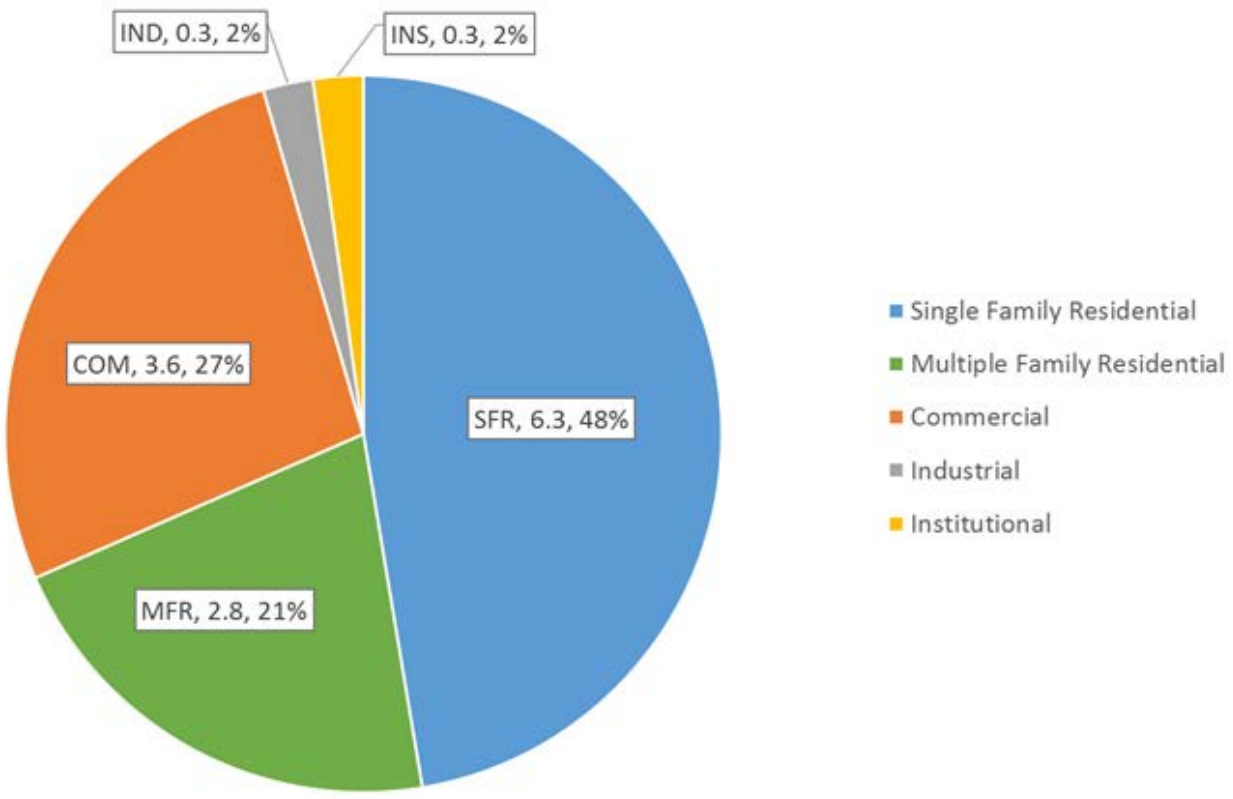

Figure 2-3. Town of Cary 2016 Demand by Customer Type, Average Day Metered Demand, MGD
Includes the Towns of Cary and Morrisville; RTP South; and RDU

2.1.2 Town of Apex

Total water use in the Town of Apex is higher than that used in the 2013 LRWRP, increasing as a result of residential growth. The Town has seen little change in overall per capita usage which has remained steady at 60–64 GPCD (Appendix B). The Town of Apex currently has a larger amount of available land than the Town of Cary and expects to remain a primarily residential community.

The Town of Apex is currently seeing a significant rate of residential growth, with over 8,000 approved housing units to be built in the near future (Echols, 2018, pers. comm.). The Town is also predicting that the growth rate will be steepest from now until 2025, slow slightly to 2045, and then begin to level off between 2045 and 2065. This residential growth continues to drive demands, with supporting commercial and institutional demands following this growth. Similar to the Town of Cary, the Town of Apex has seen a decline in installation of separately metered irrigation systems.

The Town of Apex's Apex WRF is expected to remain in operation throughout the planning period. Recent trends show more growth in the Town of Apex's WWRWRF service area; this trend is expected to continue.

2.2 Future Water Demand

The approach to this forecast is described and all input parameters and their sources are documented in Appendix B. This approach methodology included the development of a GIS–based tool and an update to the Excel-based portion of the previous Forecast Tool. The Town of Cary's utility service area, as it was defined in 2016, was used as the basis for this update and includes the Towns of Cary and Morrisville as well as RDU and RTP South. Town of Apex projections were also incorporated into each forecast to evaluate future need to revise agreements or expand jointly-owned facilities. The water

demand forecast is representative of each Town's current programs and policies. This LRWRP includes the following projections to 2065:

- Water demands, including raw water and finished water
- Wastewater flows
- Reclaimed water demands
- Interbasin transfer
- Required discharge

These demands should be reviewed within the context of historical and future population projections as well as land uses and Town policies and programs that influence water use. Table 2-1 presents population data for the Towns. The Town of Cary's 2065 population was calculated for inclusion here using CommunityViz model output. The Town of Apex provided future population projections that show a total by the year 2065 that reaches the Town of Cary's current population. Alternatively, the Town of Morrisville has little land remaining available for development and is expecting little population growth in the future. These population forecasts help provide perspective for what densities of development are possible within each Town and its service areas.

Table 2-1. Historical and Projected Town Populations
Includes the Towns of Cary, Morrisville, and Apex

	Years					
Town	**2001**	**2013**	**2015**	**2016**	**2045**	**2065**
Cary	99,798	144,982	153,867	157,259	196,761	210,772
Morrisville	8,973	21,696	23,682	24,456	29,963	31,782
Apex	23,393	42,206	45,472	47,349	148,380	157,170

Notes:
Historical population provided by Town of Cary as reported in CH2M (2017)

Population in 2045 was developed using persons per household values of 2.78 (SFR) and 2.22 (MFR) for Town of Cary and 2.70 (SFR) and 2.18 (MFR) for Town of Morrisville and expected 2045 development from the CommunityViz model.

Population at full capacity is assumed for the purposes of this evaluation to occur in the year 2065

Population at full capacity is taken from the CommunityViz model as an additive value to the 2015 population (Triangle J COG, 2018)

Along with residential growth, the Town of Cary is also expected to see growth in the industrial, commercial, and institutional (ICI) sectors. A summary of projected ICI development is included in Table 2-2 (Triangle J COG, 2018). RDU has not been included in this summary as the scale of it in the COM customer type skews the perception of trends in the other jurisdictions; it is expected to grow in both passenger count and building area during the planning period. RDU plans to expand both runway and terminal capacity, with water demands rising proportionally.

According to Town land use records, approximately 16 percent of buildable vacant area remains. Additionally, some parcels are expected to redevelop, with a resulting increase in mixed use developments.

Table 2-2. Projected ICI Development

Includes the Towns of Cary and Morrisville, and RTP South (RDU Excluded)

Customer Type	2016	2045	2065
COM (ft^2)	465,553,128	484,789,037	532,500,195
Industrial (ft^2)	12,296,782	15,135,601	15,145,907
Institutional (ft^2)	27,188,210	28,450,168	29,941,005

Notes:
ft^2 = square feet

Current square footage provided by Town of Cary as reported in CH2M (2017)
Full capacity for development is assumed for the purposes of this evaluation to occur in the year 2065

The Town is expecting to see an increase in mixed use development (Table 2-3). This, along with information included in Table 2-2, is depicted in Figure 2-4. The CommunityViz model output includes details on the components of expected mixed uses, such as a mix of multi-family and commercial land uses. For the purposes of forecasting, these components were used in the development of demand projections. Table 2-3 accounts for the components of mixed-use development that were used in the forecast, which include SFR, multifamily residential (MFR), and COM customer types. Note that mixed use was not a categorized customer type in 2016, therefore, current values are not provided.

The total number of parcels included in the MIX customer type is 1,756. Of these, 91 percent of them are comprised of all three customer types, 5 percent are comprised of MFR and COM, while 4 percent are comprised of SFR and MFR. All MIX parcels include the MFR customer type, therefore, no parcels include only SFR and COM customer types.

Table 2-3. Mixed Use Development Components of Future Customer Types

Includes the Towns of Cary and Morrisville; RTP South; and RDU

Customer Type	2045	2065	Percentage Increase
SFR (Dwelling Unit)	4,266	4,365	2%
MFR (Dwelling Unit)	3,612	7,735	114%
COM (ft^2)	14,399,454	50,117,187	248%

Notes:
Full capacity for development is assumed for the purposes of this evaluation to occur in the year 2065

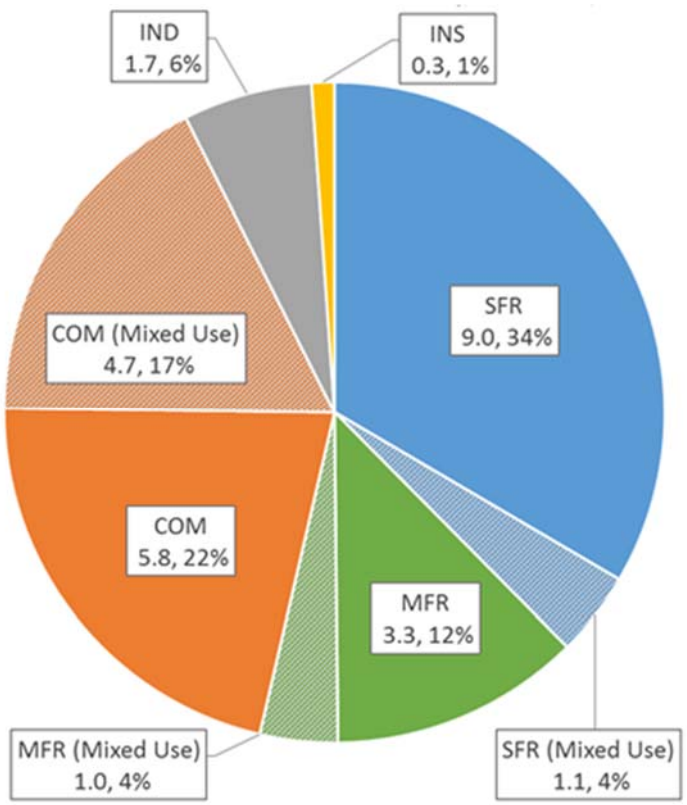

Figure 2-4. Expected Customer Types by 2065
For the Towns of Cary and Morrisville; and RTP South

2.2.1 Demands Development

The 2017 Water Use Analysis laid the foundation for developing further demand projections, included as Appendix B. CH2M then integrated the factors developed from historical data into the water demand forecast model as probabilistic variables. These probabilistic variables are:

- Growth rate (rate at which new development occurs)
- Amount of process water used during the treatment process
- Non-revenue water (percentage of total finished water demand, including operational use)
- Maximum day peaking factors (maximum day versus annual average daily demand)

The purpose of the 2017 Water Use Analysis was to update the 2010 water use analysis to understand the patterns and trends in water usage within the Town's service area, in support of defining the unit consumption values to be used to forecast future water demand and wastewater flows, and plan for future water resources management.

The forecasting tool developed for this update has two components: the LRWRP Calculation Tool, a GIS-based tool that uses spatial relationships to identify and group data required to calculate future demands, and the Excel Forecasting Tool, an Excel-based spreadsheet that references these data as well as water use statistics such as unit factors to develop the baseline forecast. As such, the type of development and the rate at which it occurs influence the forecast and it is not driven by population alone. The forecast tool also supports the spatial aggregation of data.

The primary purpose of the LRWRP Calculation Tool is to produce data summaries of the service area's existing meters' demand and future parcels' development in a format that can be accepted by the Excel Forecasting Tool. For this update, CH2M used the Town's AMI data for 2016 as the existing demands. For the future parcels' development, the LRWRP Calculation Tool again utilizes service area and sewer subbasin layers to group parcels which can accommodate future development. This provides the Excel Forecasting Tool with 2045 Allocations and 2065 Capacities, per subbasin, as expressed in number of dwelling units for residential development and in square footage for commercial, industrial, and institutional development.

The LRWRP Forecasting Tool tallies total water demand by first summarizing existing demand and assuming this demand continues through the planning period. The LRWRP Forecasting Tool then determines what percentage of the 2045 Allocations will be developed year-by-year and calculates the expected water demand from this future development by applying unit factors tailored to each general customer category. After applying vacancy rates and expected conservation rates, the Tool superimposes on one another existing meter and future parcel water demands by year to achieve the final water demand forecast.

2.2.2 Projected Future Water Demands

The Cary/Apex WTF was expanded to 56 MGD, a project identified as necessary in the water resources strategy included in the 2013 LRWRP. Projections included in this section indicate that additional capacity as well as raw water supply may be needed before the Town of Cary reaches its full capacity for development. These probabilistic forecasts represent an estimate of the probability of occurrence of the identified level of demand and below (e.g., the 75th percentile forecast estimates a 75 percent chance that the water demand level will be equal to or less than the forecasted demand). To account for uncertainty and to support planning efforts to maintain a reliable water supply and infrastructure capacity for water and wastewater treatment, CH2M recommends that the Towns use the 75th percentile of the 2018 probabilistic forecast for infrastructure planning purposes.

Table 2-4 summarizes the 75th percentile annual average day and maximum day finished and raw water demand projections by jurisdiction. The 75th percentile annual average day finished water demand projections are presented by river basin in Table 2-5. Figure 2-5 depicts the 75th percentile projections for raw water supply as allocated to Cary and Apex while Figure 2-6 depicts the 75th percentile projections for finished water capacity for each Town.

Table 2-4. 75th Percentile Total Water Demand Projections by Jurisdiction, 2016 to 2065, MGD

Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Jurisdiction	2016	2025	2030	2035	2040	2045	2065
Cary	13.3	16.8	18.5	20.1	21.2	22.3	26.9
Apex	3.1	5.7	6.9	8.0	9.1	10.1	10.4
Sub-total Billed Water Demand	**16.4**	**22.5**	**25.4**	**28.1**	**30.3**	**32.4**	**37.3**
Cary Non-revenue (Incl. Operational)	1.3	1.4	1.4	1.5	1.6	1.7	2.1
Apex Non-revenue (Incl. Operational)	0.5	0.8	1.0	1.1	1.3	1.4	1.5
Annual Average Day Finished Water Demand	**18.2**	**24.7**	**27.8**	**30.7**	**33.2**	**35.5**	**40.9**
Cary Annual Average Day Raw Water Demand	18.0	21.8	23.9	25.7	27.3	28.5	34.5
Apex Annual Average Day Raw Water Demand	4.2	7.9	9.5	11.2	12.5	14.0	14.5
WTP System Annual Average Day Process Water	4.0	5.0	5.6	6.2	6.6	7.0	8.1
Annual Average Day Raw Water Demand	**22.2**	**29.7**	**33.4**	**36.9**	**39.8**	**42.5**	**49.0**
Percent of Jordan Lake Allocation (46.2 MGD)	*48%*	*64%*	*72%*	*80%*	*86%*	*92%*	*106%*
Cary Maximum Day Finished Water	20.2	29.0	31.5	34.0	35.9	37.8	45.7
Apex Maximum Day Finished Water	5.2	10.2	12.4	14.5	16.5	18.2	18.9
Maximum Day Finished Water Demand	**25.4**	**39.2**	**43.9**	**48.5**	**52.4**	**56.0**	**64.6**
Percent of Cary/Apex WTF Capacity (56.0 MGD)	*45%*	*70%*	*78%*	*87%*	*94%*	*100%*	*115%*
WTP System Maximum Day Process Water	4.7	6.6	7.5	8.1	8.5	9.1	10.5
Maximum Day Raw Water Demand	**30.1**	**45.8**	**51.4**	**56.6**	**60.9**	**65.1**	**75.1**

Table 2-5. 75th Percentile Finished Water Demand Projections by River Basin, 2016 to 2065, MGD, Annual Average Day

Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

River Basin	2016	2025	2030	2035	2040	2045	2065
Cary Neuse River	10.0	11.5	12.6	13.6	14.3	14.9	17.8
Apex Neuse River	1.0	1.6	1.7	1.8	1.9	2.0	1.9
Sub-total Neuse River	**11.0**	**13.1**	**14.3**	**15.4**	**16.2**	**16.9**	**19.7**
Cary Haw River	3.3	5.3	5.9	6.5	6.9	7.4	9.1
Apex Haw River	1.9	3.8	4.5	5.0	5.5	6.0	5.9
Sub-total Haw River	**5.2**	**9.1**	**10.4**	**11.5**	**12.4**	**13.4**	**15.0**
Apex Cape Fear River	0.2	0.3	0.7	1.2	1.7	2.1	2.6
Sub-total Cape Fear River	**0.2**	**0.3**	**0.7**	**1.2**	**1.7**	**2.1**	**2.6**
Sub-total Billed Water Demand	**16.4**	**22.5**	**25.4**	**28.1**	**30.3**	**32.4**	**37.3**
Cary Non-revenue (Incl. Operational)	1.3	1.4	1.4	1.5	1.6	1.7	2.1
Apex Non-revenue (Incl. Operational)	0.5	0.8	1.0	1.1	1.3	1.4	1.5
Annual Average Day Finished Water Demand	**18.2**	**24.7**	**27.8**	**30.7**	**33.2**	**35.5**	**40.9**

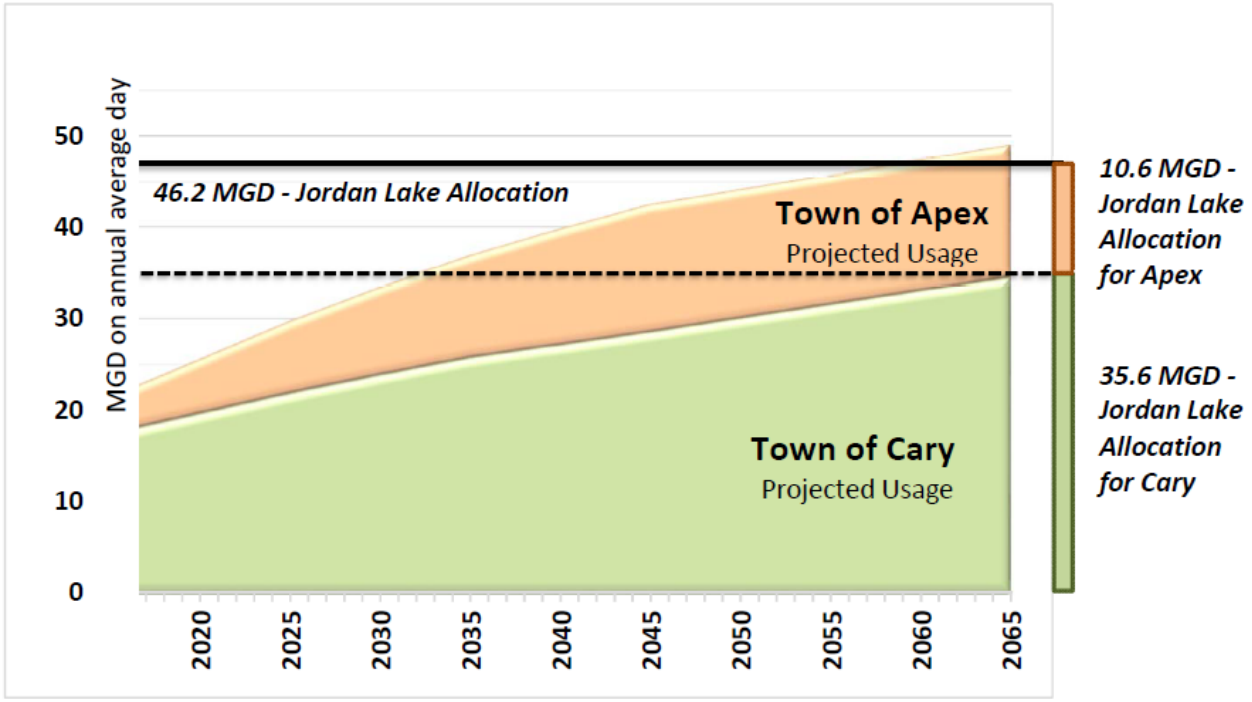

Figure 2-5. Projected Raw Water Demands, Average Annual Day, 75th Percentile
For the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

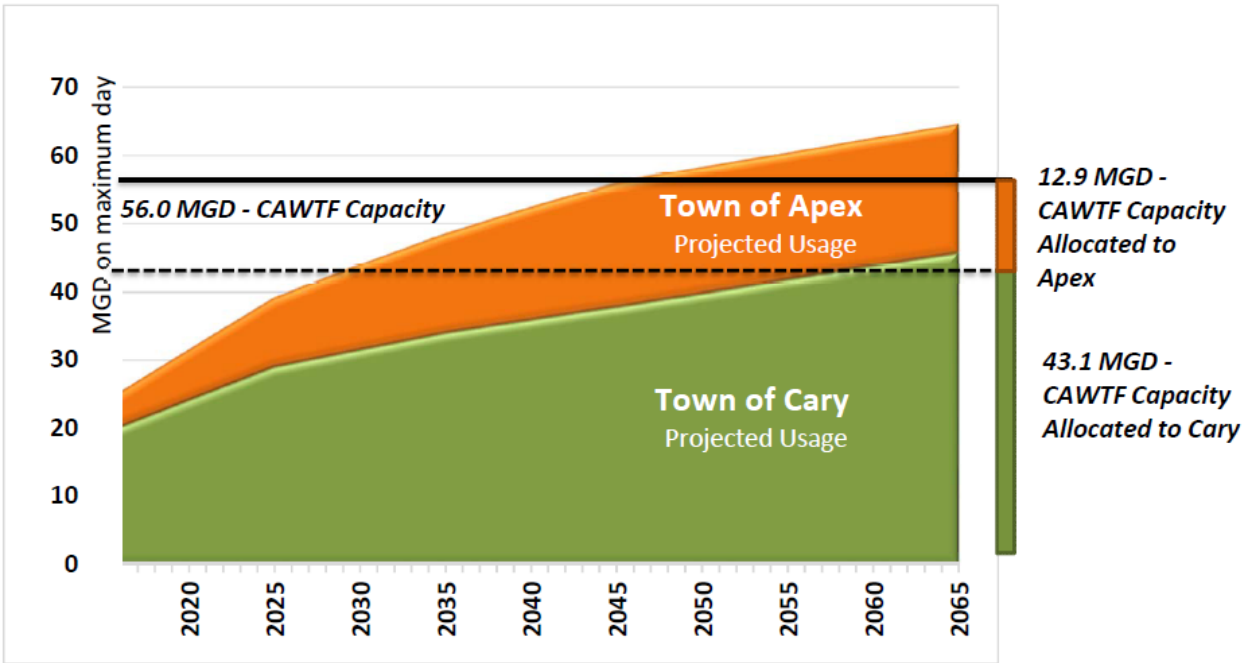

Figure 2-6. Projected Finished Water Demands, Maximum Day, 75th Percentile
For the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

2.3 Water Demand vs. Water Supply Capacity

The forecasts presented in this section identify the potential range in water demands for the Towns of Cary, Apex, and Morrisville; RTP South; and RDU. This information is extremely relevant to understanding the potential risks in water supply capacity development decisions. To provide the Towns with information to facilitate decisions about their combined and individual water supply and treatment capacity needs, the projected demands are presented relative to the Towns' combined and individual Jordan Lake allocations and treatment capacity at the Cary/Apex WTF in Figures 2-7 and 2-8. Based on the 75th percentile projections, Figure 2-7 indicates that additional raw water supply will be needed in approximately 2056 and Figure 2-8 indicates that additional water treatment capacity will be needed in approximately 2044. This probabilistic modeling approach shows how the timing of water supply needs can shift depending on the rate of growth in demands.

The forecasts presented herein show that the Towns should plan for additional water supply and finished water capacity towards the end of the planning period.

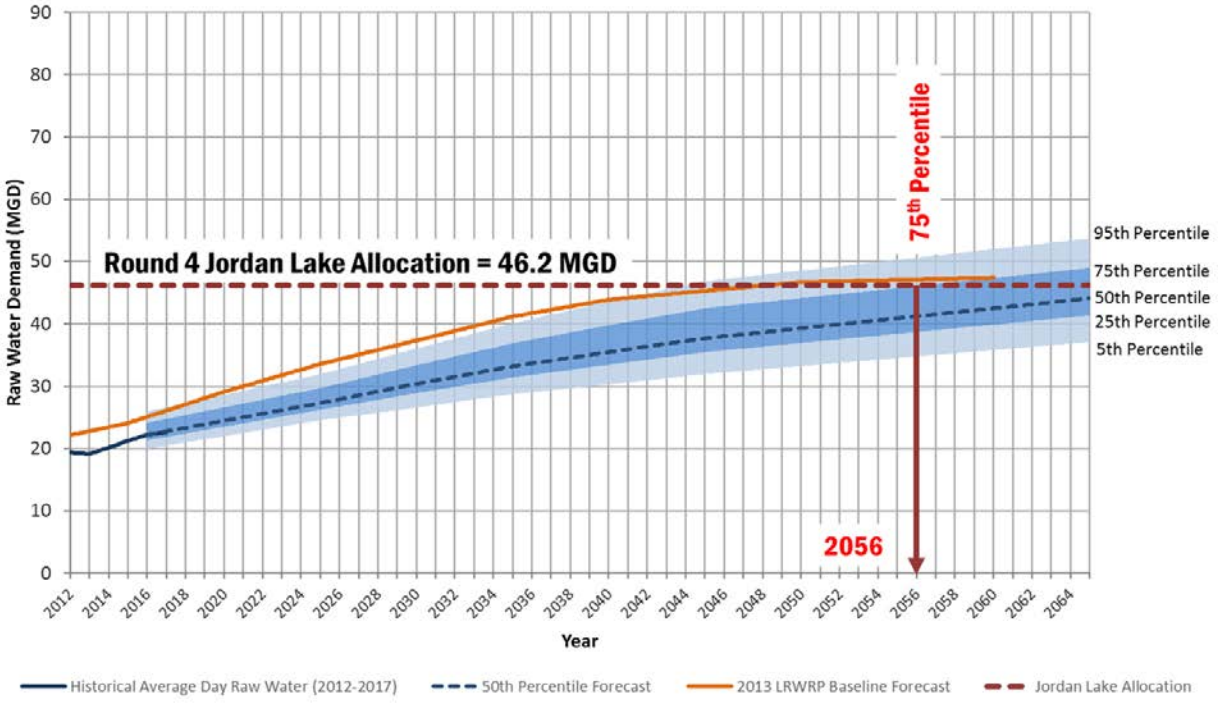

Figure 2-7. Projected Average Day Raw Water Supply Demands and Projected Gap
For the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

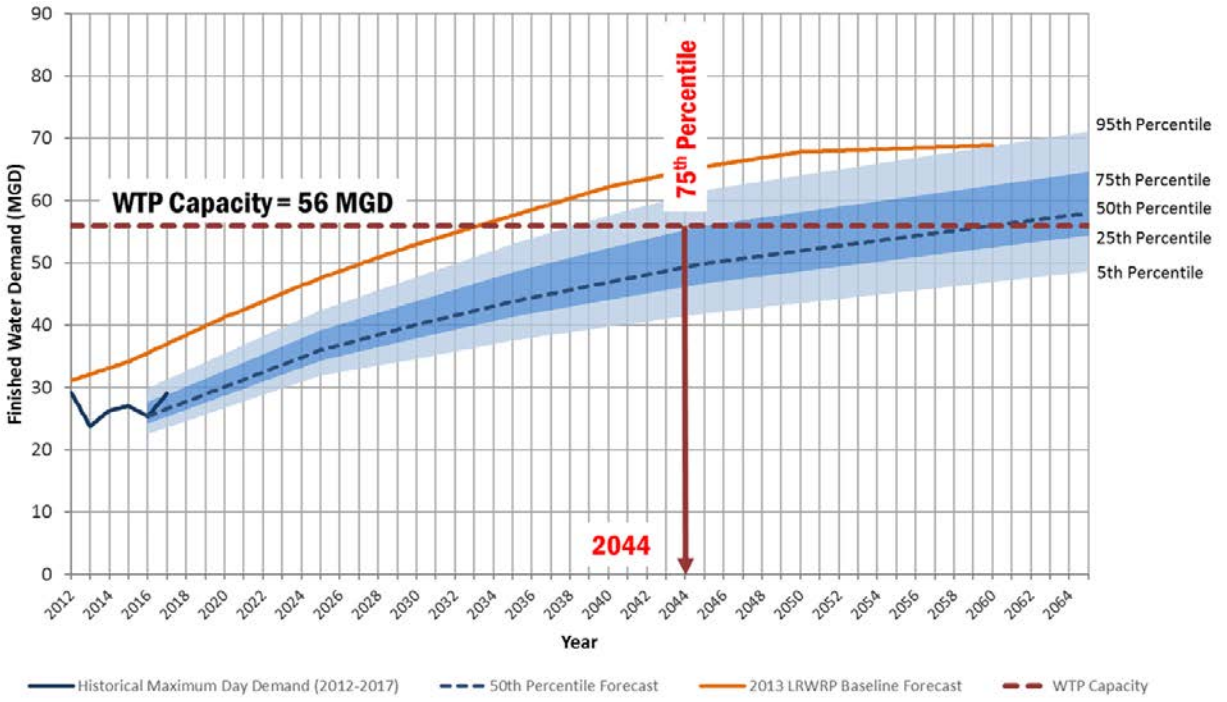

Figure 2-8. Projected Maximum Day Finished Water Demands and Projected Capacity Gap
For the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

2.4 Future Wastewater Flows

The 75th percentile wastewater flow projections are calculated using the projected finished water demand and the historical percentage of wastewater returned to each treatment facility. Tables 2-6 and 2-7 summarize the 75th percentile annual average day and maximum month average day (MMAD) wastewater flow projections, respectively, by WRF.

Table 2-6. 75th Percentile Wastewater Flow Projections by Water Reclamation Facility, 2016 to 2065, MGD, Annual Average Day
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Jurisdiction	Permitted Discharge	2016	2025	2030	2035	2040	2045	2065	2065 Percentage of Permitted Discharge
NCWRF	**12.0**	6.2	7.5	8.2	8.8	9.2	9.7	11.3	94%
SCWRF	**12.8**	5.5	5.8	6.4	6.9	7.2	7.6	9.6	75%
Apex WRF	**3.6**	0.8	1.2	1.3	1.4	1.4	1.5	1.5	42%
WWRWRF Total	**18.0**	5.5	9.1	10.6	12.2	13.5	14.8	16.9	94%
WWRWRF—Cary	**11.88**	3.3	5.0	5.6	6.2	6.6	7.1	8.8	74%
WWRWRF—Apex	**6.12**	2.2	4.1	5.0	6.0	6.9	7.7	8.1	132%
Total Flow	**47.9**	**18.0**	**23.6**	**26.5**	**29.3**	**31.3**	**33.6**	**39.3**	**82%**

Note: Permitted discharge is a maximum month average day value.

Table 2-7. 75th Percentile Wastewater Flow Projections by Water Reclamation Facility, 2016 to 2065, MGD, Maximum Month Average Day

Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Jurisdiction	Permitted Discharge	2016	2025	2030	2035	2040	2045	2065	2065 Percentage of Permitted Discharge
NCWRF	**12.0**	7.3	8.2	9.0	9.7	10.2	10.6	12.4	103%
SCWRF	**12.8**	6.5	6.8	7.5	8.1	8.5	8.9	11.3	88%
Apex WRF	**3.6**	0.9	1.4	1.5	1.6	1.7	1.7	1.7	47%
WWRWRF Total	**18.0**	6.3	10.4	12.2	13.9	15.4	17.0	19.3	107%
WWRWRF—Cary	**11.88**	3.8	5.7	6.4	7.0	7.5	8.1	10.0	84%
WWRWRF—Apex	**6.12**	2.5	4.7	5.8	6.9	7.9	8.9	9.3	152%
Total Flow	**47.9**	**21.0**	**26.8**	**30.2**	**33.3**	**35.8**	**38.2**	**44.7**	**93%**

2.5 Wastewater Flows vs. Treatment Capacity

CH2M evaluated wastewater treatment capacity to facilitate decisions about future wastewater treatment needs. Wastewater flows projected on a MMAD basis to each of the Town's WRFs were compared to the facilities' existing permitted capacities, which are as follows:

- North Cary WRF—12 MGD
- South Cary WRF—12.8 MGD
- Western Wake Regional WRF (Cary)—11.88 MGD (capacity allocation for only the Towns of Cary [including RTP South and RDU]) and Morrisville,
- Western Wake Regional WRF (Apex)—6.12 MGD (capacity allocation for only the Town of Apex)
- Apex WRF—3.6 MGD

The following conclusions were drawn from the comparison:

- The Town's NCWRF and SCWRF are expected to exceed 80 percent capacity during the planning period for both the 50th and 75th percentile projections.
- The NCWRF is also expected to exceed 90 percent capacity, and the permitted capacity would be exceeded during the 75th percentile projections.
- The Apex WRF is expected to have sufficient capacity throughout the planning period. However, the expected growth in the Town of Apex's WWRWRF service area may lead to the need for additional capacity or an adjustment in the current capacity share agreement.

This evaluation of necessary wastewater treatment capacity, as presented below, does not consider the potential for wastewater strengths to change over time. Strength refers to the concentration of the constituents in the wastewater. If the concentrations are higher than designed for the capacity of a facility, the facility may meet its capacity to treat these concentrations and maintain NPDES permit compliance before the influent flow exceeds the hydraulic capacities outlined in the preceding bullets.

The Towns' long-term planning will need to take into consideration the capacity deficits at the NCWRF and in Apex's share of the WWRWRF. An important variable in the treatment capacity total in the future will be the long-term plan for the Apex WRF; currently the Town of Apex is planning to keep this

treatment facility online. CH2M carried this plan forward into the recommendations, however these flows could also be transferred to SCWRF or WWRWRF.

2.6 Interbasin Transfer

As stated in Section 1, the Towns monitor IBT and required wastewater discharge to the Cape Fear River. The Towns hold an IBT certificate from the Haw River basin. The permitted transfer amount is 31 MGD from the Haw River basin to the Neuse River basin and 2 MGD from the Haw River basin to the Cape Fear River basin on a MMAD basis. The basin boundaries, as defined by state statute, are depicted on Figure 1-2. The terms of this certificate increase IBT flexibility over the previous version by providing an increased amount and by changing the compliance metric to a monthly calculation instead of a daily maximum. The 2013 LRWRP included a recommendation for increased IBT flexibility, and it was achieved prior to the start of the 2018 LRWRP update. This certificate provides the Towns with more flexibility as development and redevelopment occur throughout the Towns' service areas.

The IBT certificate includes a condition for management so that none of the certificate holders are prevented from using their respective Jordan Lake water supply storage allocations, and the Towns are required to provide access at their existing intake site to other Jordan Lake water allocations holders that need access to utilize their allocation. This supports regional cooperation in water resources management.

CH2M prepared the 2018 LRWRP Update IBT forecast using a maximum month metric to align with the current certificate and built it from the probabilistic water demand forecast discussed in Section 2.2. The projected transfers to the Neuse River basin and Cape Fear River basin were considered separately. Figure 2-9 presents the MMAD probabilistic forecast for IBT from the Haw River basin to the Neuse River basin. This projection is driven by finished water demands sent to the Neuse River receiving basin. The updated IBT forecast indicates that the IBT for the Towns is not expected to exceed the Towns' current IBT certificate limit of 31 MGD during the planning period.

Transfers to the Neuse River basin from Town of Cary demands are expected to grow approximately 50 percent during the planning period. Transfers driven by the Town of Apex to the Neuse River basin are expected to grow approximately 25 percent and to the Cape Fear River basin are expected to increase seven-fold. The high rate of growth predicted in the Town of Apex, where more developable land is available, leads to more uncertainty around the forecasted transfer to the Cape Fear River basin. The updated IBT forecast shown in Figure 2-10 indicates that the IBT to the Cape Fear River basin should be closely monitored along with WWRWRF discharges to the Cape Fear River and consumptive use to assess the potential need to revisit this portion of the Towns' current IBT certificate, a limit of 2 MGD MMAD in during the planning period.

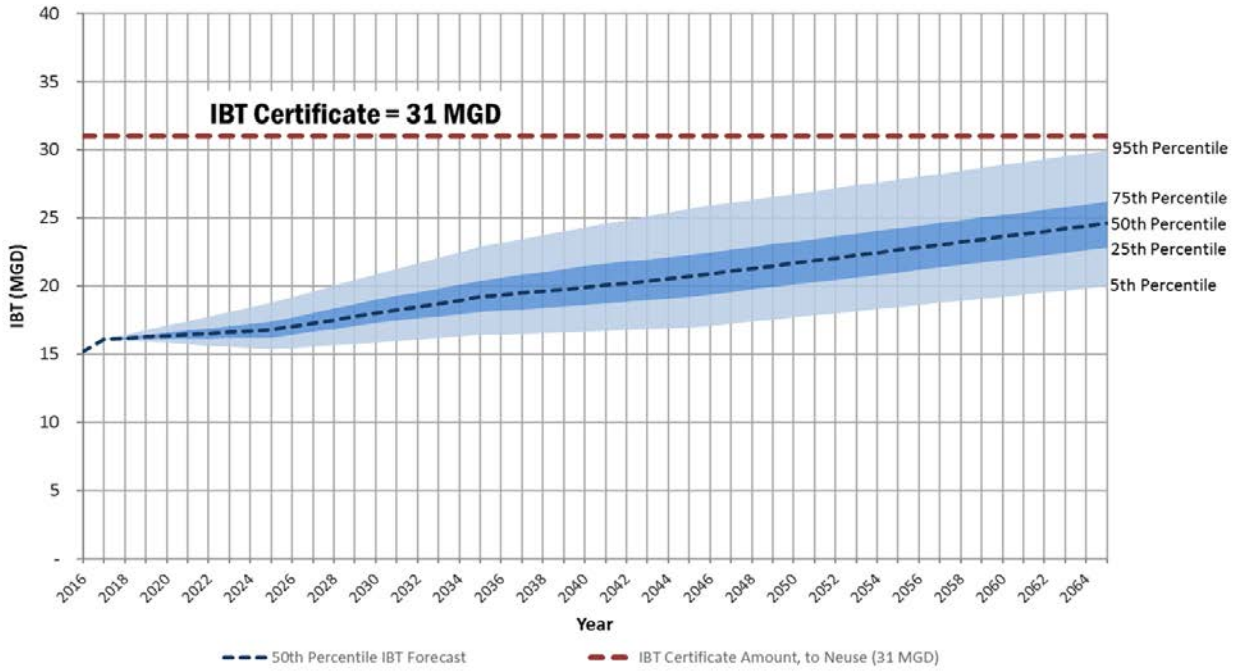

Figure 2-9. Projected Interbasin Transfer to the Neuse River Basin, MMAD
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

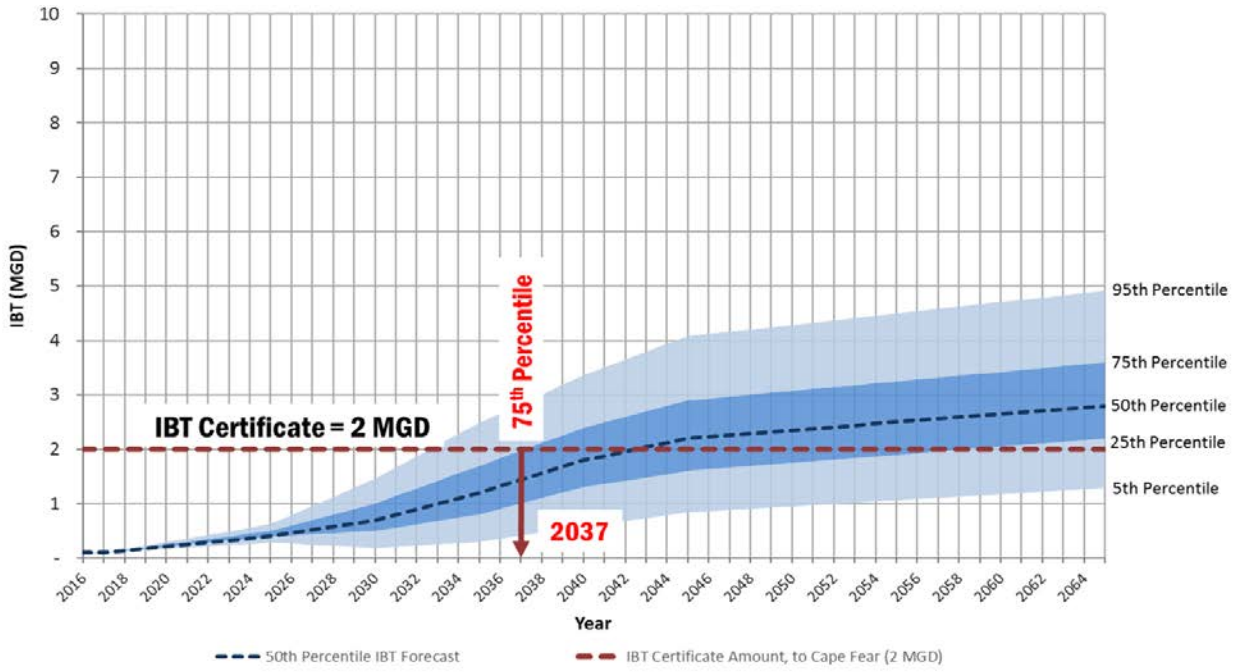

Figure 2-10. Projected Interbasin Transfer to the Cape Fear River Basin, MMAD
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Table 2-8 summarizes the 75th percentile MMAD IBT projections from the Haw to the Neuse River basin and transfer from the Haw to the Cape Fear River basin by jurisdiction. The Towns' calculated, not forecasted, values are included for 2016. The Towns currently do not calculate values by jurisdiction.

Table 2-8. 75th Percentile IBT Projections—Total by Jurisdiction and River Basin, 2016 to 2065, MGD, Maximum Month Average Day

Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Jurisdiction	Certificate Limit	2016	2025	2030	2035	2040	2045	2065	2065 Percentage of Limit
Haw to Neuse River Basin									
Cary			15.5	16.9	18.1	19.1	19.8	23.8	
Apex			1.9	2.1	2.3	2.4	2.5	2.4	
Total IBT—Haw to Neuse	**31.0**	**15.2**	**17.4**	**19.0**	**20.4**	**21.5**	**22.3**	**26.2**	**85%**
Haw to Cape Fear River Basin									
Cary			—	—	—	—	—	—	
Apex			0.5	1.0	1.7	2.4	2.9	3.6	
Total IBT—Haw to Cape Fear	**2.0**	**0.1**	**0.5**	**1.0**	**1.7**	**2.4**	**2.9**	**3.6**	**180%**

Note: Calculated, not forecasted, values are included for 2016. The Towns currently do not calculate values by jurisdiction.

2.7 Required Discharge

As part of their IBT certificate, the Towns are required to discharge a portion of their wastewater effluent to the Cape Fear and Haw River basins (as shown in Figure 1-2). This requirement is defined using a calculation comprised of average annual day finished water usage in the Neuse River basin and wastewater discharge to the Cape Fear River basin. This is currently achieved by the discharge of the WWRWRF but can also be met by other means, such as wastewater sent to Durham County. For the purposes of this LRWRP Update evaluation, the projected average annual discharge from the WWRWRF was used in the calculation. The Required Discharge set for 2016 was 1.5 MGD and for 2017 was 1.7 MGD (Town of Cary, 2018).

To capture the uncertainty associated with the location and rate of development and redevelopment, CH2M calculated the 25th, 50th, and 75th percentiles of the forecast. In all scenarios, the projected actual discharge from the WWRWRF into the Cape Fear River is greater than the calculated required discharge by more than 4 MGD at the end of the planning period. Therefore, the Towns are expected to remain in compliance with this minimum required discharge throughout the planning period.

Table 2-9. 25th Percentile Required Discharge Projections by Jurisdiction, 2016 to 2065, MGD, Annual Average Day
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

	2016	2025	2030	2035	2040	2045	2065
Neuse River Basin Finished Water Demands							
Cary	-	11.1	11.8	12.3	12.7	13.0	15.8
Apex	-	1.2	1.3	1.3	1.4	1.4	1.4
Non-revenue (Incl. Operational)	-	0.9	1.1	1.1	1.1	1.2	1.4
Total Neuse Finished Water Demand	**11.2**	**13.2**	**14.2**	**14.7**	**15.2**	**15.6**	**18.6**
Required Discharge to the Cape Fear River Basin							
Required Discharge	1.5	3.5	4.5	5.0	5.5	5.9	8.9
Actual Discharge to the Cape Fear River Basin							
WWRWRF Discharge—Cary	—	4.8	5.2	5.7	6.0	6.4	8.0
WWRWRF Discharge—Apex	—	2.7	3.3	3.9	4.5	5.0	5.2
Actual Discharge	**4.9**	**7.5**	**8.5**	**9.6**	**10.5**	**11.4**	**13.2**

Table 2-10. 50th Percentile Required Discharge Projections by Jurisdiction, 2016 to 2065, MGD, Annual Average Day
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

	2016	2025	2030	2035	2040	2045	2065
Neuse River Basin Finished Water Demands							
Cary	-	11.3	12.2	12.9	13.4	13.9	17.0
Apex	—	1.3	1.5	1.6	1.6	1.7	1.6
Non-revenue (Incl. operational)	-	1.1	1.1	1.2	1.3	1.3	1.5
Total Neuse Finished Water Demand	11.2	13.7	14.8	15.7	16.3	16.9	20.1
Required Discharge to the Cape Fear River Basin							
Required Discharge	1.5	4.0	5.1	6.0	6.6	7.2	10.4
Actual Discharge to the Cape Fear River Basin							
WWRWRF Discharge—Cary	-	4.9	5.4	5.9	6.3	6.7	8.4
WWRWRF Discharge—Apex	-	3.3	4.1	4.9	5.6	6.3	6.6
Actual Discharge	4.9	8.2	9.5	10.8	11.9	13.0	15.0

Table 2-11. 75th Percentile Required Discharge Projections by Jurisdiction, 2016 to 2065, MGD, Annual Average Day
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

	2016	2025	2030	2035	2040	2045	2065
Neuse River Basin Finished Water Demands							
Cary	-	11.5	12.6	13.6	14.3	14.9	17.8
Apex	—	1.6	1.7	1.8	1.9	2.0	1.9
Non-revenue (Incl. Operational)	-	1.2	1.2	1.3	1.3	1.4	1.7
Total Neuse Finished Water Demand	**11.2**	**14.3**	**15.5**	**16.7**	**17.5**	**18.3**	**21.4**
Required Discharge to the Cape Fear River Basin							
Required Discharge	1.5	4.6	5.8	7.0	7.8	8.6	11.7
Actual Required Discharge							
WWRWRF Discharge—Cary	-	5.0	5.6	6.2	6.6	7.1	8.8
WWRWRF Discharge—Apex	-	4.1	5.0	6.0	6.9	7.7	8.1
Actual Discharge	**4.9**	**9.1**	**10.6**	**12.2**	**13.5**	**14.8**	**16.9**

2.8 Reclaimed Water

Reclaimed water continues to be a part of the Town of Cary's total water management strategy and is included in this 2018 LRWRP Update. Currently, the Town of Apex does not have reclaimed water infrastructure. In the 2013 LRWRP, reclaimed water was not formally included in demand projections. Within the past five years the Town of Cary has completed updates to its Reclaimed Water Master Plan, most recently in December 2017 (CDM Smith, 2017) and formally met with Durham County (a source of reclaimed water) to discuss the future availability of this resource.

The Town of Cary maintains three reclaimed water service areas. The North service area is served by the North Cary WRF, the West service area is served by a connection with Durham County, and the South service area is served by the South Cary WRF. In 2016, the Town's annual average reclaimed water customer demands totaled 0.31 MGD. Usage in the West and North Cary service areas totaled 0.26 MGD while in the South Cary service area, usage totaled 0.05 MGD on an average annual basis. On the peak day, reclaimed water customer demands totaled almost 0.7 MGD (CH2M, 2018c). Peaks are driven by outdoor water use. These demands reflect distribution to customers and do not include operational use including metered flushing and unmetered use.

Data for 2016 usage and future projections at the 75th percentile of the forecast are included in Table 2-12 for annual average day demand and Table 2-13 for maximum day demand. A maximum day peaking factor of 2.5 is used throughout the forecast, except for operational values which are not influenced by this. Usage at the NCWRF and SCWRF is not included. These projections assume all customers with installed reclaimed water systems in their neighborhoods will receive reclaimed water service by 2028. These and other assumptions made by the Town regarding the future direction of its reclaimed water program are summarized in the Reclaimed Water Program Business Case Evaluation (CH2M, 2018c), in Appendix D.

Table 2-12. 75th Percentile Total Reclaimed Water Demand Projections by Service Area, 2016 to 2065, MGD, Annual Average Day

Includes the Towns of Cary and Morrisville and RTP South

Service Area	Use	2016	2025	2045	2065
North	Residential	0.05	0.09	0.18	0.25
	Cooling & ICI	0.11	0.12	0.17	0.19
	Operational	0.25	0.26	0.29	0.29
West	Residential	0.01	0.05	0.13	0.28
	Cooling & ICI	0.09	0.17	0.23	0.30
	Operational	0.01	0.02	0.04	0.07
South	Residential	0.01	0.02	0.03	0.04
	Cooling & ICI	0.09	0.09	0.14	0.15
	Operational	0.06	0.06	0.07	0.08
Total Reclaimed Water (Without Operational)		**0.36**	**0.54**	**0.88**	**1.21**
Total Reclaimed Water (Including Operational)		**0.68**	**0.88**	**1.28**	**1.65**

ICI = industrial, commercial, and institutional customers

Table 2-13. 75th Percentile Total Reclaimed Water Demand Projections by Service Area, 2016 to 2065, MGD, Maximum Day

Includes the Towns of Cary and Morrisville and RTP South

Service Area	Use	2016	2025	2045	2065
North	Residential	0.13	0.21	0.45	0.63
	Cooling & ICI	0.28	0.32	0.42	0.48
	Operational	0.25	0.26	0.29	0.29
West	Residential	0.02	0.14	0.32	0.69
	Cooling & ICI	0.22	0.42	0.57	0.75
	Operational	0.01	0.02	0.04	0.07
South	Residential	0.04	0.05	0.08	0.10
	Cooling & ICI	0.04	0.05	0.18	0.19
	Operational	0.06	0.06	0.07	0.08
Total Reclaimed Water (Without Operational)		**0.73**	**1.19**	**2.02**	**2.84**
Total Reclaimed Water (Including Operational)		**1.05**	**1.53**	**2.42**	**3.28**

The reclaimed projections included herein are based on the service area boundaries as they are today. However, the Town is currently evaluating future expansion options (Appendix D). If a more modest

expansion of the reclaimed water program occurs, a small increase in potable water demands in areas where reclaimed water may not be available may result. An additional 1 to 1.5 MGD ADD of potable water demand may result by the end of the planning period from this more modest level of expansion.

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Section 3
The Planning Process

For this LRWRP Update, CH2M updated the Water Use Analysis, customer survey, and water conservation evaluation to reflect data from the period 2013–2016. The Water Use Analysis was summarized in Section 2 and is provided in Appendix A. Updates to the water resources portfolio and major observations from the customer survey are included in this section. The customer survey and water conservation evaluation are included in Appendix C.

3.1 Recommendations Implemented from the 2013 LRWRP

The Towns implemented the following near-term recommendations from the 2013 LRWRP:

- Jordan Lake Round 4 allocation of water supply
- Completion of Cary/Apex WTF expansion to 56 MGD
- IBT Certificate modification to 31 MGD for transfers from the Haw River basin to the Neuse River basin and 2 MGD for transfers from the Haw River basin to the Cape Fear River basin.

CH2M took these actions and updated facility capacities into account when assessing the Water Resources Portfolio in this 2018 LRWRP Update.

3.2 Updating the Water Resources Portfolio

In this update, CH2M reviewed, revalidated, and updated the short list of water resources portfolio strategies to reflect current needs as defined by forecasted future demands. CH2M and the Town discussed the following items during workshops as part of this planning process:

- The continued necessity of each option
- Required implementation timelines and associated decision pathways
- Jordan Lake allocations of the Towns and other allocation holders
- Local Water Supply Planning rules
- Towns' goal of achieving long-term water supply opportunities with partners holding available water supply
- Infrastructure needs:
  - Water system interconnection feasibility
  - Cost-effective infrastructure options
  - Goal of achieving long-term water supply opportunities with partners holding available water supply

Outcomes of these discussions led to the following updates: revising Strategy 2D, Water Supply Development from Source Outside the Triangle, to more broadly reflect the possibility of a water supply source outside of the triangle region and updating Strategy 3, Purchase of Capacity via Triangle Regional

Agreements, to reflect the ability to either purchase capacity or use interconnections and finished water sales contracts to address water needs. Portfolio strategies will be further discussed in Section 4.

3.3 Current Customer Thoughts on Water Use and Conservation

CH2M followed a water conservation planning process similar to that conducted for the 2013 LRWRP (Figure 3-1).

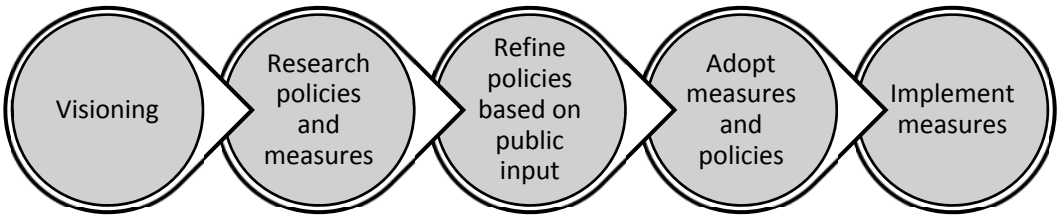

Figure 3-1. Water Conservation Plan Update Phasing
For the Town of Cary Service Area

The first step was a repeat of the customer survey to assess changing customer behaviors, understanding of the Town of Cary's conservation program and goals, and preferred methods of communication for conservation messages. CH2M then incorporated these responses into an updated water conservation strategy. The Town's water conservation program and expected future water efficiency gains were incorporated into this 2018 LRWRP Update.

The Town has recognized the importance of conservation for over 20 years and continues to incorporate water demand management into its long range water plans. Continued integration of demand management strategies into the Town's LRWRP is essential to the success of the Plan for several reasons:

- The success of the Town's water conservation program in achieving its water-saving goals in the past is a strong indication of its ability to realize new and higher levels of water efficiency in the future
- Water conservation—or demand management—is a key component of the Town's LRWRP, which is consistent with the American Water Works Association's recommended process for the development of integrated resources plans
- Ongoing reductions in indoor residential and nonresidential domestic water demands because of national water efficiency standards for plumbing fixtures and appliances are expected to occur for all United States water systems over the coming decades.

The Town's water conservation program is a component of the Town's comprehensive long term water supply planning, providing supply and demand management benefits.

The Town continues to see water use efficiency gains and should seek to maintain and even improve upon the water efficiency gains and associated customer conservation-aware mindset achieved to date.

To assess current customer thoughts on water use and conservation, BLK Research conducted a telephone survey in May and June of 2017 using similar methodology to the survey completed for the 2013 LRWRP. Full details are included in Appendix C. Administered to 400 residents of Cary and

Morrisville, BLK Research compared results to assess any changes in residents' views of the Town's water conservation programs and water supply reliability. This effort helps the Town frame the opportunities for program improvement as well as identify methods of communication preferred by respondents. The profile of respondents is included in Table 3-1.

Table 3-1. 2017 Customer Survey Profile of Respondents
For the Towns of Cary and Morrisville

Respondents	Profile	Details
Years living in the community	< 2 years	11.6%
	2-5 years	31.5%
	6-10 years	22.7%
	11-20 years	17.6%
	> 20 years	16.6%
Household type	Single-family	76.1%
	Multi-family (including townhomes)	19.6%

Note: For the purposes of this survey, multi-family housing includes townhomes

Key outcomes of the 2018 customer survey include little change in top methods preferred by customers for communication of water efficiency information (Table 3-2) and that only approximately 35 percent of respondents were familiar with Aquastar. However, 75 percent of respondents stated that they had tracked their water use through Aquastar. This may signal a general lack of understanding of the benefits of Aquastar data and communication options available to residents. The majority still view their water use graph on their bill for usage information.

Customers do prefer more direct outreach in water emergency situations, as outlined in Table 3-3. Almost 80 percent of respondents preferred text messages, and almost 17 percent responded that they were signed up for the ReadyWake Emergency Notification service. This shows the growing preference in emergency communications to reach individuals on personal devices.

Table 3-2. Customer Preferences for Water Efficiency Communication Methods
Includes the Towns of Cary and Morrisville

2017 Top 10 Information Sources (2011 rank)	% Yes	% No
1. Postcards (#2)	82.8	17.2
2. BUD (#1)	78.9	21.1
3. Television (#9)	57.0	43.0
4. Cary's website (#4)	56.8	43.2
5. Homeowners Association (#6)	50.9	49.1
6. Cary's email list service (#3)	50.3	49.7
7. Text messages (#20)	42.3	57.7
8. Cary News (#5)	33.8	66.2
9. Radio (#17)	33.3	66.7
10 Cary's Parks & Recreation Brochure (#7)/Aquastar (#15)	28.8	71.2

Table 3-3. 2017 Customer Preferences for Water Emergency Communications
Includes the Towns of Cary and Morrisville

Emergency Communication Sources	% Yes	% No
Text messages	78.4	21.6
Door hanger	70.9	29.1
Cary's email list service	64.3	35.7
Television	56.4	43.6
Radio	26.4	73.6
Cary's website	25.9	74.1
NextDoor	22.9	77.1
Facebook	19.3	80.7
ReadyWake	18.5	81.5
Twitter	9.0	91.0
Cary's Block Leader Program	6.3	93.7

The preference for text message alerts during emergencies is reflected in the increased number of citizens choosing to set up their own alert messages as shown in Table 3-4. More notable is the increase in the amount of accounts using DigiPay. As outreach continues and new accounts are established, the Town expects to see this number continue to grow.

Table 3-4. Aquastar Data
Includes the Towns of Cary and Morrisville

Aquastar Data	2014	2015	2016	2017
DigiPay Accounts	0	12,008	28,178	40,683
Alerts set up	N/A	N/A	2,142	2,979
Alerts sent, average day	92	152	200	238
Alerts sent, per year	33,514	55,530	72,991	86,870

Source: Town of Cary

To understand what efficiencies could be recognized into the future, CH2M and Amy Vickers and Associates compiled water use data for indoor appliances. Single-family homes with efficient and best available technologies in 2018 may have a residential usage of 35 GPCD, while homes installing the most efficient technologies coming into the market may see usage drop down to 25 GPCD (CH2M, 2018d). Responses to the survey also show that customers are actively taking action in their homes, both indoors and outdoors, to reduce water usage. Customer conservation actions reported in 2018 and listed in Table 3-5 are similar to those reported in the 2011 survey.

There is a general perception that the Town has plenty of water supply for the future and a high level of satisfaction with the Town's utility services and water efficiency program implementation. Opportunities to raise customer awareness of how much water is used in their households exist and would likely result in improving household indoor and outdoor efficiencies.

Table 3-5. 2017 Customer Indoor Water Conservation Actions

Includes the Towns of Cary and Morrisville

2017 Inside Water Conservation Actions (2011 rank)	% Yes	% No
Use clothes washer less/fuller loads (#2)	87.4	12.6
Repaired leak in faucet/toilet (#4)	86.7	13.3
Use dishwasher less/fuller loads (#1)	84.0	16.0
Take shorter showers (#3)	78.8	21.2
Installed water-efficient clothes washer (#6)	53.9	46.1
Installed low-flow showerheads (#8)	53.6	46.4
Installed new toilets (#9)	51.7	48.3
Installed water efficient dishwasher (#7)	41.7	58.3
Catch water to reuse as water warms (#10)	18.5	81.5

The Town has achieved significant water savings since the inception of its conservation program in the 1990s, with a decrease in the overall system GPCD from 114 to 81 GPCD, approximately 29 percent, from 2001 through 2016. and has exceeded its initial conservation goals. Changes in community development patterns, the 2017 adoption of the *Imagine Cary* Community Plan, and anticipated continued growth in the community suggest that the time is right to refocus the Water Conservation Program on maintaining awareness of the value water and water use efficiency, establishing development standards and policies so current conservation efficiencies are not eroded and preparing response and resilience measures that could be implemented if future demands exceed, or future supplies are less than, projections.

The Town continues to see water use efficiency gains and should seek to maintain and even improve upon the water efficiency gains and associated customer conservation-aware mindset achieved to date. As customers shift to online bill pay, customer awareness of how much water they use is declining. Outreach methods to target this are needed, in addition to continuing education of the Town's available water resources and programs. The Town has a short-term goal to increase awareness of customer water usage and citizen participation (a weakness identified in the survey), while also working toward a longer-term goal of recognizing the benefits of implementation of additional Aquastar functionality to reach customers and drive water usage behavior changes.

How much water can be saved by these strategies, and how they will impact future demands, needs to be determined as part of a more detailed study that is typically undertaken in the development of a water conservation plan that is outside the scope of this update. With the Town's current programs and expected water conservation gains expected through continued technology improvements in household appliances, the Town is likely to see measurable reductions in future water demands on the scale of approximately 1 MGD in 2065 compared to if these programs were not in place.

Opportunities for the Town to support changing land use, development, and building codes can have wide-ranging market impacts, such as redevelopment costs, resale value, affordable housing, and resource use. Therefore, an inclusive and deliberative process that includes stakeholders in policy formulation and implementation timelines is often an effective approach to developing successful and widely accepted policies. Appendix C provides a more detailed discussion of strategic Water Conservation Program considerations.

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Section 4
Water Resources Portfolio

The Town developed a Water Resources Portfolio in the 2013 LRWRP, consisting of a range of strategies that will individually or collectively satisfy the project purpose. The portfolio itself represents a diverse set of strategies and sources for implementation to provide the Towns with a robust set of options to meet and manage water supply needs into the future under a variety of uncertainties. Source, infrastructure and adaptive management solutions are included.

The 2013 LRWRP included a portfolio of water supply sources including interconnections, management tools, and resource recovery options. CH2M and the Towns updated the portfolio in 2018 into the following options:

- Strategy 1—**Increase Water Supply via Jordan Lake Allocation**
- Strategy 2—**Increase Water Supply and/or Storage by Other Means**
  - Strategy 2A—Increase Jordan Lake Water Supply Pool
  - Strategy 2B—Water Supply from Crabtree Creek with Storage in Existing Triangle Quarry
  - Strategy 2C—Water Supply from the Cape Fear River Watershed
  - Strategy 2D—Water Supply Development from Source Outside the Triangle
- Strategy 3—**Purchase of Capacity via Triangle Regional Agreements**
- Strategy 4—**Integrated Master Planning and Strategic Utility Resource Utilization**
- Strategy 5—**Best Management Practices**
  - Strategy 5A—Supply Side Management—Optimize Internal Operations
  - Strategy 5B—Demand Side Management—Manage Customer Demands for Improved Efficiency
  - Strategy 5C—Reclaimed Water

Table 4-1 summarizes these strategies with details regarding treatment capacity requirements, implementation requirements, regulatory considerations, policy implications, key uncertainties, and benefits. Implementing any strategy is subject to permitting rules at the time initiated, which may differ from those currently in place. Each strategy and the necessary aspects to analyze before implementation are discussed in detail herein. Each identified need is based on the 75th percentile of the probabilistic forecast. The projected water demand and comparison to available water supply and treatment capacity used to determine need and update these strategies was presented in Section 2.

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Table 4-1. Strategies for Meeting Water Supply Needs

	Strategy 1 Increase Water Supply Via Jordan Lake Allocation	Strategy 2A Increase Water Supply and/or Storage by Other Means: Increase Jordan Lake Water Supply Pool (216 Study or reallocation of sediment pool)	Strategy 2B Increase Water Supply and/or Storage by Other Means: Water Supply from Crabtree Creek, Storage in Triangle Quarry, and new WTP	Strategy 2C Increase Water Supply and/or Storage by Other Means: Water Supply from Cape Fear River Watershed	Strategy 2D Increase Water Supply and/or Storage by Other Means: Water Supply Development from Source Outside the Triangle	Strategy 3 Purchase of Capacity via Triangle Regional Agreements	Strategy 4 Integrated Master Planning and Strategic Utility Resource Utilization	Strategy 5A Best Management Practices: Supply Side Management – Optimize Internal Operations	Strategy 5B Best Management Practices: Demand Side Management – Manage Customer Demands for Improved Efficiency	Strategy 5C Best Management Practices: Reclaimed Water
Objective	Increase the average day raw water supply to the CAWTF through obtaining additional allocation from the existing water supply of Jordan Lake, located in the Haw River Basin. The increase would also include an expansion of the WTF to meet future finished water needs.	Increase the average day raw water supply accessible from the conservation pool of Jordan Lake to the CAWTF. Options include re-evaluating the safe yield of the conservation pool or reallocating storage from sediment or flood control storage to the conservation pool, which would increase water supply storage.	Increase the water supply for the Towns by "skimming" high flows from Crabtree Creek and storing the water in the existing Wake Stone Corporation Triangle Quarry.	Increase the water supply for the Towns from a new water supply intake on the Cape Fear River downstream of Jordan Lake and to treat the water at either a new WTF or at the existing CAWTF. Another source within the Cape Fear River watershed could be Harris Lake.	Increase the Towns' average day raw water supply by accessing a water supply outside the Triangle region. This would likely be implemented in partnership with another utility and would also involve another water treatment facility.	Increase average day finished water supply through long-term water purchase agreements with other regional utilities, and then to access the purchased water through existing or new interconnections.	Integrate community planning, water resources management, utility planning, and sustainable development. Unifying these planning efforts will promote development practices that support the Towns' commitment to responsible growth and the wise use of water.	Increase the available average day raw water supply to the CAWTF through capital and operational improvements at the treatment plant. This strategy reduces and/or recycles process water that is currently sent to waste (i.e. "lost") and therefore, if implemented, would capture some portion of the raw water supply that is currently unavailable for treatment and distribution.	Influence customers to use water wisely – resulting in reduced water demand - through policies. Demand-side management approaches are increasingly relied upon for water resource management and complement more traditional supply side management measures. A combination of price-based and alternative (non-price-based) demand side management policies could be most beneficial.	Offset potable water system demands through the beneficial utilization of reclaimed water. This potential is explored in the Town of Cary's Strategic Reclaimed Water System Plan objectives and policies and is linked with Strategy 4.
Potential Raw Water Supply Need, identified as approx. 5 MGD ADD for Apex	Possibly the full need of 5 MGD could be allocated under Round 5 for Apex	Possibly the full need of 5 MGD for Apex could be allocated under the 46.2% total current allocation	Safe yield and timing are key uncertainties; possibility that the full 5 MGD would not be available; additional distribution system infrastructure needed	5 MGD possible; could work in partnership with another utility	5 MGD possible; could work in partnership with another utility	Sufficient finished water supply to be provided through interconnections or through partnering on an expansion project; the total water supply required could be provided through agreements phased with multiple utilities	Integrated system modeling would provide better understanding of system loss and improve forecasting.	Could achieve a maximum process waste recovery potential of 7.8 MGD, sufficient to meet the projected need.	Up to 1.5 MGD of savings expected by 2065 and included in forecast. Additional benefits could be achieved by strengthening program.	Offsets finished water demand by additional reclaimed water demand 0.5-1.2 MGD ADD, 3.0 MGD MDD by 2065
Treatment Capacity Needs identified need of up to 10 MGD MDD	Expansion of CAWTF to meet Cary and Apex needs	Expansion of CAWTF to meet Cary and Apex needs	Obtain Triangle quarry; new WTF needed to meet Cary and Apex needs; may not be available before 2035	Potential for new WTF; could work in partnership with another utility	Potential for new WTP needed; could work in partnership with another utility	Potential for new WTF if raw water is purchased or share of another WTP's capacity	No additional capacity achieved	No direct increase in treatment capacity; potential for raw water supply capacity augmentation through optimized operations only at CAWTF	No additional capacity achieved; would offset some demand	No additional capacity achieved; would offset some demand
Implementation Requirements	Jordan Lake allocation process; Cape Fear River Basin Hydrologic model and safe yield study; Cape Fear River Basin Water Supply Plan	Updated Hydrologic Model; updated USACE Section 216 study; evaluation of raising pool with current dam structure	Water quality study (Crabtree Creek and quarry); Treatability study; Water blending study; design, permit, and construct infrastructure	Treatability study; Finished water blending study; Preliminary Engineering Report for intake, pipeline route; approval from other entities for construction of infrastructure within their jurisdictions; design, permit, and construct infrastructure	Treatability study; Finished water blending study; Preliminary Engineering Report for intake or reservoir improvements, pipeline route; approval from other entities for construction of infrastructure within their jurisdictions; design, permit, and construct infrastructure	Triangle Regional Water Supply Plan; Phase 2 Interconnect Study for Triangle Regional Partnership (TRP); booster pumps or pressure regulating valves, and bi-directional metering; approval from entities for construction of infrastructure	Master planning and modeling efforts linked directly with water resources planning/ management; use Strategy 4 information and the LRWRP as resource in upcoming land use planning projects	Necessary to conduct a study to better understand SuperPulsator blowdown volume and percent solids under current operation; assessment of existing Recycle Pump Station	Rate study; program/method for incorporating AMI customer data into email messaging and communication plan; messaging should include the broad perspective of water resources management and include new demand management programs developed; Cary to implement Conservation Program recommendations	Capital projects to extend transmission lines; Cary to maximize customer base through expansion of system as described in master planning

Table 4-1. Strategies for Meeting Water Supply Needs

	Strategy 1 Increase Water Supply Via Jordan Lake Allocation	Strategy 2A Increase Water Supply and/or Storage by Other Means: Increase Jordan Lake Water Supply Pool (216 Study or reallocation of sediment pool)	Strategy 2B Increase Water Supply and/or Storage by Other Means: Water Supply from Crabtree Creek, Storage in Triangle Quarry, and new WTP	Strategy 2C Increase Water Supply and/or Storage by Other Means: Water Supply from Cape Fear River Watershed	Strategy 2D Increase Water Supply and/or Storage by Other Means: Water Supply Development from Source Outside the Triangle	Strategy 3 Purchase of Capacity via Triangle Regional Agreements	Strategy 4 Integrated Master Planning and Strategic Utility Resource Utilization	Strategy 5A Best Management Practices: Supply Side Management – Optimize Internal Operations	Strategy 5B Best Management Practices: Demand Side Management – Manage Customer Demands for Improved Efficiency	Strategy 5C Best Management Practices: Reclaimed Water
Regulatory Considerations	Jordan Lake allocation process; may require IBT process (Cape Fear transfer); SEPA process (for WTP expansion); Secondary and Cumulative Impact Master Management Plan (SCIMMP) updates; Authorization to Construct	USACE Section 216 process could require EA or EIS; Jordan Lake allocation process; may require IBT process; SEPA process (for WTP expansion); SCIMMP updates; Authorization to Construct	Reclassification of Crabtree Creek and quarry; SEPA process; Crabtree Creek passing flow requirements, 401/404 Permit; SCIMMP updates, Authorization to Construct	Potential Jordan Lake allocation; SEPA process; SCIMMP updates; 401/404 Permit; Authorization to Construct	Potential need for allocation process and/or USACE Section 216 process; Could require EA or EIS; IBT process; SEPA process; SCIMMP updates; 401/404 Permit; Authorization to Construct	May require IBT process; permitting for infrastructure	No new regulations required; however, some changes to the Unified Development Ordinance can be considered	Approval of PWSS for residuals process water enhancements	None identified	Continued compliance with 15A North Carolina Administrative Code (NCAC).02U for reclaimed water use
Policy Implications	None likely	None likely	Other jurisdictions may need to update policies to reflect water supply watershed requirements	Interlocal agreements would be required; May require programs to mitigate downstream water resources issues	Interlocal agreements would be required between municipal partners	Interlocal agreements for finished water purchases will be required	Policies to direct future growth to locations of available water supply and infrastructure, including reclaimed water; Apex to review the potential benefit and feasibility of a reclaimed water policy	Potential interlocal agreement to expand Cary hydraulic modeling to include integration of Apex system	Affordability; revenue stability with decreased consumption per connection; ability to implement recommended actions	Connection/development requirements and costs; capital costs of expanding the reclaimed water system; customer service adjustments to address issues unique to reclaimed water
Key Uncertainties	Round 5 allocation from Jordan Lake to be received; ability of reservoir to meet total regional water demands; level of stakeholder involvement and issues	Federal funding for Section 216 study (cost share); Section 216 study requirements and outcome; Ability of reservoir to meet total regional water demands; Level of stakeholder involvement and issues; weather variability	Availability of quarry and timeframe of availability are not definite; cost of quarry could be much greater than assessed tax value; source water availability could be impacted by passing flow requirements; water quality of Crabtree Creek and quarry; reclassification of Crabtree Creek watershed and quarry; limited safe yield due to system variability; distribution system requirements from a new treatment facility	May require a Jordan Lake allocation or at minimum coordination with Triangle Water Supply Partnership; regional water demands and the potential impact it may have on Cape Fear River water supply potential; availability of flow from the Cape Fear River and requirements for instream flow studies; Duke Energy water needs and availability of Harris Lake as an option; water quality in Harris Lake; Indirect potable reuse; construction and permitting costs and timeline associated with a new water source	Likely the most expensive strategy; federal funding for Section 216 study (federal portion); Section 216 study requirements; study outcome; likely would require a utility partner due to cost; timing of partner's needs; pumping costs to service area	May require a Jordan Lake allocation; Single agreement may not be able to provide entire additional water supply needs; permanent water supply allocation from regional utility is uncertain without capacity purchase or participation in joint water supply capacity project; timing of agreements and availability of water; other entities are also currently reviewing their own water supply options; water blending issues; pressure differentials across system; capacity limitations of interconnects with other utilities; IBT certificate modifications; new distribution system infrastructure and current system improvements	Societal trends driving the development market; Policies can be changed by governing bodies; timing and level of new growth will affect potential for benefits	Potential changes to PWSS requirements; would require action on another strategy to completely meet future demands; the actual amount of process waste currently generated is relative to its sources; impact of recycle on blended water quality; increase in operational complexity; potential impacts on downstream water quality; potential degradation in future raw water quality may impact feasibility of process waste recovery; limit on types of polymers that may be used	Actual price elasticity of water demand based on price may not reflect calculated savings because factors other than price influence water use; participation levels in conservation programs may be different than planned participation; rate structures need to be easily understood and accepted by the customer; revenue implications; policies can be changed by governing bodies; Apex program initiation; billing software needs to be capable of calculating billing alternative rate structures	The level and timing of new growth will affect demand for reclaimed water public and commercial concerns related to water quality; practicality and cost of seasonally supplying reclaimed water; cost for developer installed or Cary installed infrastructure

Table 4-1. Strategies for Meeting Water Supply Needs

	Strategy 1 **Increase Water Supply Via Jordan Lake Allocation**	**Strategy 2A** **Increase Water Supply and/or Storage by Other Means: Increase Jordan Lake Water Supply Pool (216 Study or reallocation of sediment pool)**	**Strategy 2B** **Increase Water Supply and/or Storage by Other Means: Water Supply from Crabtree Creek, Storage in Triangle Quarry, and new WTP**	**Strategy 2C** **Increase Water Supply and/or Storage by Other Means: Water Supply from Cape Fear River Watershed**	**Strategy 2D** **Increase Water Supply and/or Storage by Other Means: Water Supply Development from Source Outside the Triangle**	**Strategy 3** **Purchase of Capacity via Triangle Regional Agreements**	**Strategy 4** **Integrated Master Planning and Strategic Utility Resource Utilization**	**Strategy 5A** **Best Management Practices: Supply Side Management – Optimize Internal Operations**	**Strategy 5B** **Best Management Practices: Demand Side Management – Manage Customer Demands for Improved Efficiency**	**Strategy 5C** **Best Management Practices: Reclaimed Water**
Benefits	Continue to leverage the work of the Triangle Water Supply Partnership; Jordan Lake is currently one of the most reliable water supplies in the region; utilizes a single water supply source and maximizes investment in the CAWTF and associated distribution infrastructure, resulting in a straightforward implementation	Continue to leverage the work of the Triangle Water Supply Partnership Jordan Lake is currently one of the most reliable water supplies in the region; downstream users support for a Section 216 study; utilizes a single water supply source and maximizes investment in the CAWTF and associated distribution infrastructure, resulting in a straightforward implementation	Water supply diversification; potential for increased operational flexibility and the management of finished water supplies for planned WTF maintenance activities or unplanned outages; finished water supply directly to Cary's central pressure zone areas furthest from the CAWTF; helps minimize future IBT; quarry site is close to the Cary service area	Water supply diversification; potential for increased operational flexibility and the management of finished water supplies for planned WTF maintenance activities or unplanned outages; potential for reduction in IBT	Water supply diversification and resiliency to water quality changes and weather variability; potential for increased operational flexibility and the management of finished water supplies for planned WTP maintenance activities or unplanned outages	Water supply diversification; potential for increased operational flexibility and the management of finished water supplies for planned WTP maintenance activities or unplanned outages; operational benefit if interconnections are created in areas within the distribution system that have potential for water quality or pressure issues; could help to minimize IBT	Reduction of demands defers need for infrastructure investments and interlocal agreements; could help minimize IBT	Potential to extend available raw water supply; achieve increased operational flexibility and the management of finished water supplies for planned WTF maintenance activities or unplanned outages	Reduction of demands defers need for infrastructure investments and interlocal agreements; could help minimize IBT	Reduction of demands defers need for infrastructure investments and interlocal agreements; Rates for reclaimed water versus potable water to both encourage its use and generate sufficient revenue; could help to minimize IBT

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4.1 Strategy 1—Increase Water Supply via Jordan Lake Allocation

The Towns of Cary (including Morrisville and RTP South) and Apex currently hold a Jordan Lake allocation of 46.2 percent of the storage in the lake's water supply pool, equivalent to 46.2 MGD. This breaks down as 35.6 MGD for the Town of Cary and its service area and 10.6 MGD for the Town of Apex. This amount, approved during Round 4 of the allocation process, represented a water supply need predicted to be sufficient, at the time the request was made, through 2045.

The objective of Strategy 1 is to increase the average day raw water supply to the Cary/Apex WTF through obtaining additional allocation from the existing water supply of Jordan Lake, located in the Haw River Basin. The increase would also include an expansion of the WTP to meet future finished water needs.

4.1.1 Potential Raw Water Supply Capacity

Updated forecasts prepared for this 2018 LRWRP include average day raw water demands in the range of 45 to 49 MGD by the year 2065 (CH2M, 2018c). CH2M and the Towns also reviewed the State's local water supply planning requirements while preparing the estimate of total future potential raw water supply capacity needed; these requirements include the need for available contingency supply, as stated in Local Water Supply Planning rules (NCGS 143-355 (l)). By 2065, the Towns may require approximately 9 MGD of additional raw water supply, which includes the predicted gap of over 3 MGD and an allowance for contingency supply. The Town of Apex's demand projections drive this raw water supply gap, as shown in Table 4-2.

Table 4-2. 75th Percentile Raw Water Demand Projections by Jurisdiction, 2016 to 2065
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

		Allocation	2016	2025	2035	2045	2065
Cary	MGD	35.6	18.0	21.8	25.7	28.5	34.5
	Percent of Total	*77*	*81*	*73*	*70*	*67*	*70*
Apex	MGD	10.6	4.2	7.9	11.2	14.0	14.5
	Percent of Total	*23*	*19*	*27*	*30*	*33*	*30*
Total	MGD	46.2	**22.2**	**29.7**	**36.9**	**42.5**	**49.0**
	Percent of Jordan Lake Allocation		*48*	*64*	*80*	*92*	*106*
Gap	MGD	-	-	-	-	-	2.8

4.1.2 Implementation Requirements

A Round 5 allocation process would be necessary to implement Strategy 1 and allocate additional water from the Jordan Lake water supply pool. Steps to implement this strategy include the development of a hydrologic model and an updated regional water supply plan of the Cape Fear River Basin. Also, an expansion must be done to the existing Cary/Apex WTF in order to treat the additional raw water supply from Jordan Lake.

After the Jordan Lake Round 4 process was completed, the North Carolina Division of Water Resources (DWR) and the EMC allocated 95.9 percent of the total water supply pool. If another process were

started to allocate the remaining portion of supply, all stakeholders in Jordan Lake would participate. This process would likely take years, as have the other allocation processes.

4.1.3 Regulatory Considerations

The Towns now have sufficient flexibility with their current IBT certificate to use additional raw water allocation from the Haw River basin. In order to expand the Cary/Apex WTF, a SEPA process may be necessary and an Authorization to Construct must be acquired. Also, each Town's Secondary and Cumulative Impact Master Management Plan (SCIMMP) may need to be updated.

4.1.4 Policy Implications

There are no likely policy implications.

4.1.5 Key Uncertainties

The key uncertainty associated with this strategy is the start time of a Jordan Lake Round 5 allocation process. The needs of the Towns alone are not likely sufficient to start the process. Apex's need for raw water supply is likely earlier than other stakeholders. However, other municipalities shifting to alternate water supply sources could start the allocation process as well. Other key uncertainties that must be addressed before implementing this strategy include:

- Regional water demands and the potential impact it may have on the safe yield of Jordan Lake
- Continued reliability of Jordan Lake as a regional water supply

4.1.6 Key Benefits

The Towns continue to benefit from their involvement in the regional TWSP (formerly known as the Jordan Lake Partnership). Jordan Lake is considered one of the most reliable water supplies in the region. This approach is increasingly important, as regional cooperation and agreements continue to play a role in water supply allocation. In addition, this strategy utilizes a single water supply source and maximizes investment in the Cary/Apex WTF and associated distribution infrastructure, resulting in a straightforward implementation.

4.2 Strategy 2A—Increase Jordan Lake Water Supply Pool

The objective of Strategy 2A is to increase the average day raw water supply accessible from the conservation pool of Jordan Lake to the Cary/Apex WTF. Options include re-evaluating the safe yield of the conservation pool or reallocating storage from sediment or flood control storage to the conservation pool, which would increase water supply storage.

Managed by the U.S. Army Corps of Engineers (USACE), Jordan Lake is a multi-purpose reservoir with water supply, flood control, sediment storage, and recreational objectives. The water supply pool is currently 45,800 acre-feet of storage which is assumed to provide a yield of 100 MGD. The storage amounts, as shown in Figure 4-1, have not been revisited or re-analyzed. Sediment storage is important in a reservoir, recognizing that some storage volume is lost over time to incoming suspended sediment load that settles in a reservoir. Additionally, the Towns (and others) discharge wastewater into the Cape Fear River downstream of Jordan Lake but upstream of the Lillington U.S. Geologic Survey (USGS) gage. The target flow at this gage is used to manage release from the water quality (low flow augmentation pool in Figure 4-1) pool of Jordan Lake. The discharge location for the Towns has the effect of increasing the reliability of the

water quality pool since it is meeting some of the flow requirements at the gage station with water originating from the water supply pool.

Under this scenario, the Towns would request that the USACE and North Carolina DWR initiate a reevaluation of the water supply pool and determine if additional yield is available.

4.2.1 Potential Raw Water Supply Capacity

Updated forecasts prepared for this 2018 LRWRP include average day raw water demands in the range of 45 to 49 MGD by the year 2065 (CH2M, 2018c). By 2065, the Towns may require approximately 9 MGD of additional raw water supply, which includes the predicted gap of over 3 MGD and an allowance for contingency supply. The Town of Apex's demand projections drive the need for additional raw water supply need and reevaluation of the allocation, as shown in Table 4-2.

4.2.2 Implementation Requirements

Currently, each of the three storage pools in Jordan Lake has a specific volume as shown in Figure 4-1. In order to reallocate water from one of the other storage pools (such as flood control storage or sediment storage), a USACE Section 216 study would need to be conducted. The USACE Section 216 study would evaluate the impact of reallocating storage on all Jordan Lake uses including downstream flow and users. This study includes:

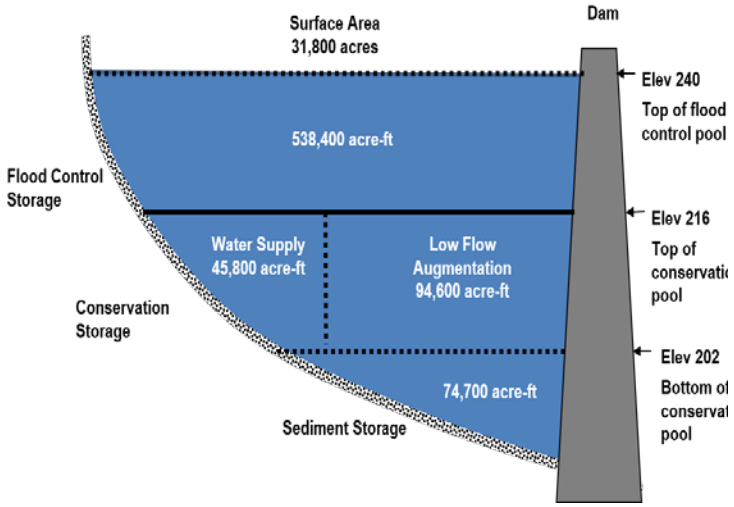

Figure 4-1. Jordan Lake Storage Diagram

- Reconnaissance Study – The USACE leads and pays for this high-level evaluation
- Section 216 Study – Compares the benefits lost by reducing the sediment or flood control pools with the benefits gains. The Federal and local governments share the cost of this study.

In addition to implementing this strategy, the Cary/Apex WTF may need to be expanded to accommodate additional supply.

4.2.3 Regulatory Considerations

This approach could include hydrologic modeling to reassess the safe yield of the conservation pool or reallocating storage from the sediment or water quality pools. Under the first step, using modeling to reevaluate the conservation pool, North Carolina DWR could increase the safe yield available for water supply without undergoing a USACE 216 study. If reallocation from another pool is needed, then a USACE Section 216 study would be required. In addition, during the Section 216 study, it would be determined if an environmental assessment or environmental impact statement is necessary. An implication of this strategy is the potential for downstream water resources issues. Therefore, programs would need to be in place to remedy or avoid these possible problems before reallocating from sediment or flood control storage to the conservation pool and increasing the overall water supply.

The Towns now have sufficient flexibility with their current IBT certificate to use additional raw water allocation. In order to expand the Cary/Apex WTF, a SEPA process must be followed and an Authorization to Construct must be acquired. Also, each Town's SCIMMP must be updated.

4.2.4 Policy Implications

There are no likely policy implications.

4.2.5 Key Uncertainties

The key uncertainties associated with this strategy are the start time of a Section 216 process, if needed, and the availability of federal funding for the cost-share. The Town of Apex's need for raw water supply is likely earlier than other stakeholders, and is not likely sufficient on its own for the USACE to begin a large-scale modeling effort and re-evaluation of Jordan Lake's safe yield. Key uncertainties that must be addressed before implementing this strategy include:

- Section 216 study outcomes
- Regional water demands and the potential impact this may have on the safe yield of Jordan Lake
- Weather variability and development of an approach for incorporation of this uncertainty into the safe yield evaluation
- Ability to reliably meet downstream flow requirements and downstream stakeholder support for the process

4.2.6 Key Benefits

The Towns continue to benefit for their involvement in the regional TWSP. Jordan Lake is considered one of the most reliable water supplies in the region. Benefits are similar to those of Strategy 1.

4.3 Strategy 2B—Water Supply from Crabtree Creek with Storage in Existing Triangle Quarry

Crabtree Creek, located in the Town of Cary and the Neuse River basin, could be an additional source of raw water. Raw water would be pumped from Crabtree Creek, stored in the Wake Stone Corporation Triangle Quarry, treated at a new water treatment plant (WTP) located nearby or sent to the Cary/Apex WTF, and distributed through the existing water system.

The objective of Strategy 2B is to increase the water supply for the Towns by "skimming" high flows from Crabtree Creek and storing the water in the existing Wake Stone Corporation Triangle Quarry.

For this strategy, raw water would be withdrawn under operational guidelines based on thresholds for different withdrawal scenarios that could occur based on available flows in Crabtree Creek. The evaluation conducted for the 2013 LRWRP concluded that:

- Water would be withdrawn only when flows in the creek are above approximately 17 MGD
- 30 MGD would be the maximum withdrawal capacity
- The difference between the daily water withdrawn and the daily demand would refill the quarry
- When the quarry reaches 100 percent storage capacity, the withdrawals from the creek would return to the amount of the average day demand

Based on these preliminary guidelines, an annual average safe yield of 10 MGD from Crabtree Creek is projected. During the summer peak demand months, up to 12 MGD could be provided from the quarry storage.

4.3.1 Potential Raw Water Supply Capacity

The quarry has the potential to provide up to 4.6 billion gallons of raw water storage at the projected final excavated volume. This amount could meet the Towns' predicted raw water supply needs, although this supply is located away from the rising demands in the Town of Apex. Additional distribution system infrastructure would also be needed.

4.3.2 Implementation Requirements

In order to implement this strategy, a water quality study and treatability study on Crabtree Creek and the quarry is necessary. The driving factor for this need is the presence of a Superfund site in the headwaters of the Crabtree Creek watershed. An instream flow study may also be needed to ensure downstream habitat in Crabtree Creek is protected.

Additionally, a water blending study would need to be conducted as two sources (and treatment plants) would be providing water to the Towns' distribution systems.

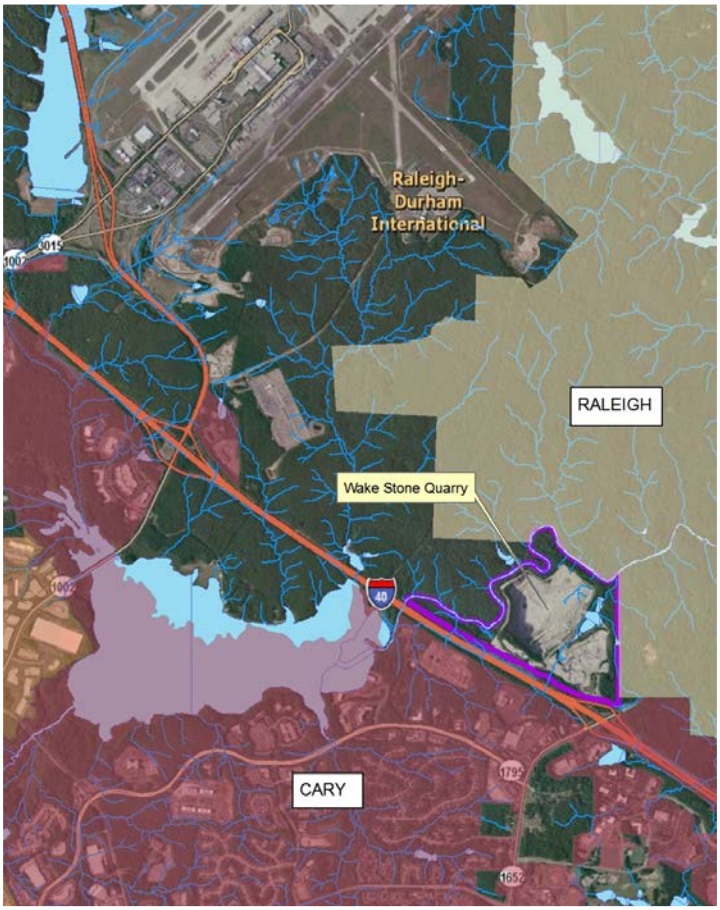

Figure 4-2. Wake Stone Corporation Triangle Quarry Location

Another implementation requirement is the ability to obtain the Triangle quarry and nearby land for a new WTP. The quarry is currently under mining operation. However, if the quarry mining operations are not complete when this strategy needs to be initiated, the total storage volume would be reduced, and the Towns could have to purchase the remaining un-mined rock. This would add significant costs to this strategy, effectively making this strategy more expensive with less water supply yield. In addition, the State of North Carolina has the first right of refusal for the quarry parcel when the mining is complete, so the state would have to agree to relinquish that right to the property prior to implementation.

Crabtree Creek would also need to be reclassified by North Carolina DWR and the EMC as a water supply watershed. Reclassification of the highly urbanized Crabtree Creek watershed to a water supply watershed would involve land not only in Cary but potentially in the Town of Morrisville, City of Raleigh, City of Durham, Wake County and Durham County. This reclassification would result in limited land use options within the water supply watershed.

4.3.3 Regulatory Considerations

Crabtree Creek and the quarry must be reclassified as a water supply watershed, and water quality must be sufficient to meet water quality standards. Additionally, downstream flow requirements to protect instream habitat must be met. Section 401/404 permits must also be obtained as mandated by the Clean Water Act. A blending study would also be required. North Carolina's SEPA processes at the time of project initiation would be followed.

4.3.4 Policy Implications

Other jurisdictions within the water supply watershed area may have to update their land use policies.

4.3.5 Key Uncertainties

The key uncertainty is the suitability of Crabtree Creek and the quarry to serve as a water supply. The Towns would also need to update the water distribution system model to assess how best to send treated water to the Town of Apex. This would include a blended water study for the distribution system. Other key uncertainties that must be addressed before implementing this strategy include:

- Availability of the quarry and timeframe of availability
- Cost of the quarry could be greater than assessed tax value
- Source water availability (safe yield) which could be impacted by passing flow requirements
- Ability to reclassify of Crabtree Creek watershed and quarry for water supply
- Citizen concerns about perceived indirect potable use
- Distribution system requirements from a new treatment facility

4.3.6 Key Benefits

Key benefits to the Towns of this strategy include the potential to diversify their water supply, providing some resiliency. This source is also in the Neuse River basin, which would help to offset IBT. Other benefits include:

- Potential for increased operational flexibility and the management of finished water supplies for planned WTP maintenance activities or unplanned outages
- Potential for operational savings by sending a finished water supply directly to Cary's central pressure zone areas furthest from Cary/Apex WTF
- Location of the quarry site close to the Cary service area

4.4 Strategy 2C—Water Supply from Cape Fear River Watershed

The objective of Strategy 2C is to increase the water supply for the Towns from a new water supply intake on the Cape Fear River downstream of Jordan Lake and to treat the water at either a new WTP or at the existing Cary/Apex WTF. Another source within the Cape Fear River watershed could be Harris Lake.

Under this strategy, the Towns would use a new source of raw water from the Cape Fear River in the reach between Jordan Lake Dam and the Town of Lillington. Water would be withdrawn using either a reservoir intake within the Buckhorn Dam impoundment or a run-of-river intake. Based on an initial evaluation of this reach, a range of approximately 11 MGD to 31 MGD of average day water supply could be available in the summer peak demand months.

Water would be treated either at a new WTP sited between the intake location and the connection to the Towns' current distribution systems, or at the existing Cary/Apex WTF. To transmit water from the source on the Cape Fear River to the Towns' current distribution facilities would require approximately 21 miles of pipeline, depending on the point of interconnection.

The City of Sanford and Harnett County each have existing raw water intakes on this reach of the Cape Fear River and present partnership opportunities for facility expansions. It is likely that partnering with Harnett County would lead to a strategy implementation similar to Strategy 3.

Other options would be to use Harris Lake, currently managed by Duke Energy, or to partner with Duke Energy on an intake in the Cape Fear River. Harris Lake is currently classified as WS-V waters, which are protected as water supplies and are generally upstream and draining to Class WS-IV waters (the Cape Fear River) or waters used by industry to supply their employees. Duke Energy could use the water to supplement its cooling water supply. Duke Energy has investigated the potential to raise Harris Lake to create additional volume for cooling water storage at the Shearon Harris Nuclear Power Plant. This project, if implemented, may also provide the Towns with a partnership opportunity to create an additional source of raw water for the Towns.

4.4.1 Potential Raw Water Supply Capacity

This strategy likely has the ability to meet the Towns' raw water needs of approximately 9 MGD.

4.4.2 Implementation Requirements

Regardless of the Cape Fear River watershed source, a treatability study and finished water blending study must be completed prior to implementation of this strategy. Also, a preliminary engineering report for intake, WTP, and pipeline will also need to be developed. In order for construction of infrastructure to begin, approval must be granted from other entities as the area of construction is within their jurisdiction. Development of an environmental document and permitting would be necessary for the new water supply and infrastructure.

Withdrawals must be considered along with the cumulative withdrawals in the river. Since there is a hydrologic model for this river basin, the Towns and North Carolina DWR would evaluate the cumulative withdrawals along this reach of the Cape Fear River to determine if an instream flow study is necessary to support permitting.

4.4.3 Regulatory Considerations

Use of this source on the Cape Fear River may require a Jordan Lake allocation or, at minimum, coordination with the TWSP. As with other strategies, the Towns would need to complete water quality and blending studies. Other regulatory considerations include obtaining an Authorization to Construct and meeting environmental permitting requirements including the SEPA process and SCIMMP updates. Section 401/404 permitting would also be required.

4.4.4 Policy Implications

Interlocal agreements may be required as this strategy crosses jurisdiction lines.

4.4.5 Key Uncertainties

As with Strategy 2B, Water Supply from Crabtree Creek, one of the key issues associated with receiving the appropriate approvals will be how to address potential direct impacts of the water withdrawal, including maintaining minimum instream flows to meet habitat and water quality requirements. The Towns must address other key uncertainties before implementing this strategy:

- Water quality in Harris Lake
- Regional water demands and the potential impact it may have on Cape Fear River water supply potential
- Construction and permitting costs and timeline associated with a new water source and its associated treatment and distribution infrastructure

4.4.6 Key Benefits

This strategy would help the Towns diversify their water supply, providing resiliency. This strategy, using a Cape Fear River basin source, also helps to limit IBT to the Cape Fear River basin. The Towns currently have the ability to transfer up to 2 MGD from the Haw River basin to the Cape Fear River basin; if a source in the Cape Fear River basin were used to serve customers in the Cape Fear River basin, this transfer would likely be eliminated. Operational flexibility could also be achieved with two sources.

4.5 Strategy 2D—Water Supply from a Source Outside the Triangle

This strategy is different from others that fall under Strategy 2's grouping of new raw water supply sources in that the source would be outside the Jordan Lake and Cape Fear River watersheds.

The objective of Strategy 2D is to increase the Towns' average day raw water supply by accessing a water supply outside the Triangle region. This would likely be implemented in partnership with another utility and would also involve another WTP.

Potential sources include obtaining raw water from other reservoirs in the region such as Kerr Lake or the City of Durham's Lake Michie. In 2001, the Town of Cary, City of Raleigh, City of Durham, and Granville County completed a feasibility study to use of Kerr Lake, managed by the USACE, as a raw water source (CH2M, 2001). On behalf of the group, Raleigh submitted an allocation request for 50 MGD to the USACE in 2002, but the USACE elected not to consider this request in its recent Section 216 study. Subsequently, Granville County has pursued other options to access water from Kerr Lake by working with the Kerr Lake Regional Water Supply partners, led by the City of Henderson.

The Towns would likely purchase water treatment capacity from its partner utility in conjunction with access to raw water. This way water could be treated at its source and then piped to the Towns' distribution system. Other communities in the region may also benefit from a joint venture to expand a water supply.

4.5.1 Potential Raw Water Supply Capacity

The Towns would enter into an agreement with the partner utilities to fully meet projected finished water needs or to partially meet these demands.

4.5.2 Implementation Requirements

The Towns must complete a finished water blending study prior to implementation of this strategy. Depending on the source, a Section 216 study may be necessary. Significant distribution infrastructure may also be needed to transport the finished water to the Towns. Other approvals including environmental permits and an Authorization to Construct would be needed.

4.5.3 Regulatory Considerations

Obtaining a municipal water supply allocation from a USACE-managed reservoir would require a Section 216 study process. Depending on the source basin, an IBT certificate may be needed. Updates to the Towns' SCIMMP documents would also be required to support permitting.

4.5.4 Policy Implications

An interlocal agreement would be required between utility partners in order to undergo this strategy. Other agreements may be necessary if pipeline infrastructure must cross other jurisdictions.

4.5.5 Key Uncertainties

Key uncertainties for this strategy involve the willingness of another utility to partner on a water supply project and the costs and timing associated with their needs. If applicable, another key uncertainty would be securing federal funding for a Section 216 study and the outcome of that study.

4.5.6 Key Benefits

This strategy would diversify the Towns' water supply sources and provide some resiliency to water quality changes and weather variability. Depending on location, this strategy could also reduce the Towns' IBT; conversely, this could also be a regulatory concern if the location requires an IBT certificate.

4.6 Strategy 3—Increase Water Supply and/or Storage via Interconnections

The objective of Strategy 3 is to increase average day finished water supply through long-term water purchase agreements with other regional utilities, and then to access the purchased water through existing or new interconnections.

Since 2008, the Towns have invested in interconnections to increase their operational maintenance flexibility or emergencies. These interconnections, or a new one, may be leveraged through water purchase agreements to meet future demands. The Towns have also invested in regional water supply planning through the TWSP, previously known as the Jordan Lake Partnership. Members of this group may benefit financially from increased interconnection agreement(s) with the Towns while maintaining sufficient supply to meet their own customer demands.

A number of water sharing agreements, primarily for emergency water supply, are already in place between various combinations of utilities within Wake, Durham, Orange, and Chatham Counties. Several of these utilities have sufficient supply and treatment capacity to meet at least a portion of the Towns' future demands or to meet demands as a "bridge" until longer-term and larger supply options are developed.

The utilities most likely to meet the Towns' needs, even partially, include Harnett County (via an interconnection with Holly Springs), the City of Durham either via Jordan Lake or a potentially expanded Lake Michie, and potentially Orange Water and Sewer Authority (OWASA) via its connection with the City of Durham. Table 4-3 summarizes potential interconnection options. The City of Durham and OWASA are currently each undergoing a long range water supply planning process; the Towns should monitor these processes and outcomes. The City of Raleigh is currently investigating its own additional water supply options and is likely not a future partner for additional supply.

Table 4-3. Summary of Existing Potable Water Interconnections and Potential Water Supply Purchase Agreement Partners
For the Towns of Cary, Morrisville, and Apex; and RTP South

Partner Utility	Add/Capacity (MGD)	Planned Year Online	Source of Supply
Raleigh	10	Phased Infrastructure Improvements	Multiple source options; new source being developed; Availability depends on Raleigh's growth; A temporary purchase may be feasible
OWASA	3	2035	Quarry Reservoir Expansion
Orange County	1	2035	Mebane purchase
Durham	Could partner on Lake Michie expansion	2020, Future	Teer Quarry and/or expanded Lake Michie
Harnett County	10	online	Cape Fear River intake; via Holly Springs Interconnection

Notes: Sales amounts were selected to maintain a ratio less than 90 percent of the total available supply
Sources: Local Water Supply Plans; Triangle Regional Water Supply Plan

4.6.1 Potential Finished Water Capacity

This strategy involves the purchase of finished water. The total water supply needed is expected to be provided through agreements with multiple utilities. The Towns could phase these agreements as finished water demands grow. For example, an agreement with Harnett County could be used to bridge the gap until a Lake Michie expansion is completed with the City of Durham.

4.6.2 Implementation Requirements

These interconnections have the capacity necessary to meet finished water demands of the Towns. However, infrastructure needs such as booster pump stations must be evaluated to address pressure zone needs and preserve water quality. Bi-directional metering may be necessary. Additionally, blending studies would be necessary.

4.6.3 Regulatory Considerations

Depending on sources, this strategy may present the potential need for IBT certificate modification.

4.6.4 Policy Implications

Interlocal agreements for finished water purchases will be required.

4.6.5 Key Uncertainties

Multiple interlocal agreements may need to be negotiated. Additionally, permanent water supply allocation from a regional utility is uncertain without capacity purchase or participation in a joint water supply capacity project. Water blending issues would also need to be addressed. New distribution system infrastructure and current system improvements would also be needed, creating uncertainty in both timeline and cost.

4.6.6 Key Benefits

A key benefit of this approach is the Towns' ability to purchase only the amount of water needed at any given time. Following likely upfront fees to purchase capacity, the Towns may have cost savings in only purchasing what they need. This approach allows the Towns to scale up purchases as demands rise. This strategy also supports water supply diversification and provides operational flexibility. Finally, this strategy may help offset or reduce IBT.

4.7 Strategy 4—Increase Master Planning and Strategic Utility Resource Utilization

This strategy builds on the Towns' history of and commitments to integrated water resources and land use planning. Taking this approach to another level, many local and state governments are recognizing that integration of their land use planning with water resources and infrastructure planning enhances sustainable practices and enables better use of public funds and natural resources. This strategy involves a transition from past land use frameworks toward a wider and more integrated concept of community planning.

The objective of Strategy 4 is to integrate community planning, water resources management, utility planning, and sustainable development. Unifying these planning efforts will promote development practices that support the Towns' commitment to responsible growth and the wise use of water.

Most recently, the Town of Cary completed its *Imagine Cary* Community Plan. Within it, certain areas are specifically identified for redevelopment, mixed use, or more dense development. Additionally, other areas are recommended for preservation as lower density areas, and green spaces are set aside for protection. This approach, coupled with the Town's reclaimed water utilization policy and other strategies to curb outdoor water use, supports strategic water resources utilization.

The Town of Apex, which is currently experiencing rapid growth, should consider the benefits and feasibility of a similar policy. Apex is updating its land use plan; outcomes of this planning process should be reviewed within the context of this LRWRP Update and opportunities for strategic water resources utilization.

4.7.1 Potential Raw Water Supply Capacity

This effort alone would not yield sufficient water supply savings to meet projected demands but should continue to be considered as best practice when guiding development and redevelopment within the Towns. Instead, this strategy may help offset a portion of projected future demands.

4.7.2 Implementation Requirements

Master planning efforts are linked directly with water resources planning and management. It will be necessary for future land use and projects to utilize the LRWRP.

4.7.3 Regulatory Considerations

No new regulations are required to implement this strategy; however, some changes to the Unified Development Ordinance could be considered.

4.7.4 Policy Implications

For this strategy, policies must be developed to direct future growth to locations of available water supply and infrastructure, including reclaimed water. The *Imagine Cary* Community Plan and future planning efforts in the Towns should consider infrastructure capacity and issues such as IBT when guiding development and particularly redevelopment.

4.7.5 Key Uncertainties

The effectiveness of this strategy in limiting water use sufficiently to improve system efficiencies and available supplies is uncertain.

4.7.6 Key Benefits

This strategy supports a critical best practice in linking long range planning and resource availability. This strategy could be most beneficial when guiding redevelopment and promoting practices such as reclaimed water usage.

4.8 Strategy 5A—Supply Side Management: Optimize Internal Operations

The objective of Strategy 5A is to increase the available average day raw water supply to the Cary/Apex WTF through capital and operational improvements at the treatment plant. This strategy reduces and/or recycles process water that is currently sent to waste (i.e. "lost") and therefore, if implemented, would capture some portion of the raw water supply that is currently unavailable for treatment and distribution.

Through the last LRWRP processes, a number of water resources strategies described as "best practices" or "management tools" were identified. These best practices include internal operations improvements, measures to enhance customer water use efficiency, and the utilization of reclaimed water. Strategy 5A is one of these opportunities.

The Cary/Apex WTF is currently estimated to use approximately 17 percent of the raw water withdrawn from Jordan Lake as part of the treatment process, which is often referred to as "process water" or "process waste." Under current operations, all process waste is discharged via a permitted discharge outfall or sent to the sanitary sewer.

The Cary/Apex WTF process waste is generated from three primary treatment steps: (1) sedimentation (SuperPulsator blowdown), (2) granular media filter backwash waste, and (3) solids dewatering.

The waste generated by the sedimentation and filter backwash processes comprises a majority of the liquid waste volume, with the centrate generated by the centrifuges as part of the solids dewatering process contributing a very small amount of low quality liquid waste. Given the low volume and poor water quality of the centrate, recovery of the waste generated by the solids dewatering process is not recommended at this time and so is not considered further. Recovery options for the sedimentation and filter backwash waste include recycling as well as the potential for reduction of process waste through operational optimization.

In North Carolina, process waste recycle to the head of a surface water plant is typically limited by regulators to a maximum of 10 percent of the raw water flow. As a result, the difference between the 10 percent limit and the actual process waste (in this case, approximately 7 percent of raw water flow) is unavailable for recycle. The resulting volume is what would be a candidate for reduction through changes in current operations.

Cary/Apex WTF staff report that the SuperPulsator blowdown represents approximately 75 percent of the total process waste. This waste volume is largely driven by the percent solids content of the blowdown; the higher the percent solids, the lower the volume. While every source water is different, SuperPulsators are typically designed to reliably achieve between 0.2 and 0.3 percent solids in the blowdown. As reported in the *Phase III Cary/Apex Water Treatment Plant Expansion* (HDR, 2012), blowdown solids were observed to be approximately 0.1 percent, or roughly half of typical values. This dilute sludge represents a potential opportunity for process waste reduction.

4.8.1 Potential Raw Water Supply Capacity

While this strategy does not directly increase raw water supply, the potential recovery of treatment process water through waste reduction, recycling, or both would have a similar effect. The potential for raw water supply capacity augmentation through optimized operations is summarized in Table 4-4.

Table 4-4. Cary/Apex WTF Process Waste Recovery Potential, MGD, Annual Average Day
Cary/Apex WTF Process Waste Recovery Potential (Average Day)

	Current Operations		Optimized Operations			
Year	Annual Average Day Raw Water Demand[a]	WTP System Process Waste[b]	Process Waste Reduction Potential[c,d]	Process Waste Recycle Potential[e]	Maximum Process Waste Recovery Potential	WTP System Process Waste[f]
2016	22.4	3.9	1.5	2.2	3.7	0.2
2025	29.1	5.0	1.9	2.9	4.8	0.2
2030	32.6	5.6	2.1	3.3	5.4	0.2
2035	36.0	6.2	2.3	3.6	5.9	0.3
2040	38.8	6.6	2.5	3.9	6.4	0.2
2045	41.6	7.0	2.6	4.2	6.8	0.2
2065	47.8	8.1	3.0	4.8	7.8	0.3

[a] Raw water demand at the Cary/Apex WTF (75th percentile forecast), refer to Section 3.2 for projection methodology and additional details.

[b] Forecasted as 17 percent of annual average raw water demand, refer to Section 3.2 for methodology and additional details.

[c] Per Town of Cary WTP Operations Staff, SuperPulsator blowdown estimated to be approximately 75 percent of total WTP Process Waste.

[d] Resulting from potential 50 percent reduction of estimated SuperPulsator blowdown waste volume through operational optimization.

[e] Recycled process waste assumed to be 10 percent of annual average day raw water flow to Cary/Apex WTF.

[f] Represents theoretical thickened solids underflow from DensaDeg clarifiers based on assumed 1.5–2.0 percent clarifier waste solids and 657 lbs/MG raw water processed.

4.8.2 Implementation Requirements

The potential reduction of process waste at the Cary/Apex WTF does not require any major capital improvements. Prior to implementation, a study should be conducted to better understand

SuperPulsator blowdown volume and percent solids under current operations and to evaluate the possibility of operational changes such as shorter blowdown duration and/or less frequent blowdowns and any related process modifications that may be required to accomplish this (e.g. higher SuperPulsator polymer dosage or different polymer formulation). The study may include bench-scale, pilot-scale and/or full-scale demonstration studies. As part of the study, the resulting settled water turbidity should be closely monitored to ensure continued compliance with the operational targets required to maintain the plant's long-standing American Water Works Association "Partnership for Safe Water" certification.

In addition, the Cary/Apex WTF is currently engaged in a pilot-scale study of biologically active filtration and is evaluating post-filtration polishing technologies for emerging contaminants. As such, any evaluation of the feasibility of both process waste reduction and recycling strategies should also consider the potential impacts (both positive and negative) related to possible major treatment technology changes that may be implemented in the future.

Recycling of process waste is common at drinking WTPs and was previously evaluated and recommended for implementation in the *Phase III Cary/Apex Water Treatment Plant Expansion* (HDR, 2012). As observed in the Phase III preliminary engineering report, recycling at the Cary/Apex WTF may be achieved through the rehabilitation of the existing Recycle Pump Station. The existing Recycle Pump Station is located within the residuals treatment complex, adjacent to the North Residuals Lagoon. The pump station influent wetwell is tied into the 24-inch DensaDeg effluent line, and discharges via approximately 150 linear feet of 16-inch diameter ductile iron piping and check valve prior to tie-in with the existing 54-inch diameter raw water line.

However, the existing Recycle Pump Station has been out of service for an extended period of time and is not reported to be in good condition. In addition, the existing station's rated firm capacity of 4.0 MGD is only sufficient to serve the maximum anticipated recycle flow rate through the year 2040.

Preliminary phases of recycle implementation should include a condition and capacity assessment of the existing Recycle Pump Station and associated discharge piping and valves. For the purposes of this evaluation, in light of the age and reported condition of the existing Recycle Pump Station, it is assumed that the process mechanical equipment and exposed piping and valves would be replaced as required to provide 4.8 MGD firm capacity in the same location; the existing below-grade concrete wetwell, valve vault, buried suction and discharge piping would remain.

4.8.3 Regulatory Considerations

Recycle of process waste at a drinking WTP is governed by the *Filter Backwash Recycling Rule* (USEPA, June 2001) and as directed by the North Carolina Department of Environmental Quality (NCDEQ) Public Water Supply Section (PWSS). In 2009, NCDEQ-PWSS previously approved a maximum 10 percent recycle at the Cary/Apex WTF in the event of water supply emergency, peak flow condition or similar, with additional conditions and operational requirements.

Since the 2009 approval, there have been changes at both the Cary/Apex WTF (e.g., full-scale operational experience with the DensaDeg clarifiers), and at NCDEQ, such that an updated regulatory review and approval of recycle is recommended as part of this strategy.

4.8.4 Key Uncertainties

Key uncertainties that must be addressed before implementing this strategy include:

- The actual amount of process waste currently generated and its relative sources
- Potential impact on quantity and quality of process waste streams due to changes in treatment process (e.g. conversion to biologically active filtration, finished waster polishing through granular activated carbon/ion exchange, etc.).

- Regulatory changes or limitations related to the frequency, quantity, or required quality of recycle streams
- Potential impact of recycled water on blended raw water quality
- Increase in operational complexity and potential impacts on downstream water quality due to "tighter" operational control targets (e.g. SuperPulsator blowdown percent solids and/or settled water turbidity)
- Potential degradation in future raw water quality may impact feasibility of process waste recovery

4.8.5 Other Considerations

The incorporation of process waste recovery at the Cary/Apex WTF as part of standard operations will increase operational complexity. The ability to recycle and/or optimize process waste reduction may require periodic suspension due to unplanned treatment upsets or raw water quality excursions. Recycle may limit the type of polymers that may be used in the clarification and/or filtration processes.

4.8.6 Key Benefits

Implementation of this strategy would allow the Towns to stretch their limited raw water supply from Jordan Lake. This strategy delays the need for additional raw water supply, buying time for the Towns to develop an additional source to meet the needs projected towards the end of the planning period. This strategy is also relatively quick to implement compared to other strategies.

4.8.7 Cost

The estimated cost of $1.5 to $2.0 M (in 2018 dollars) assumes 30 percent contingency, 15 percent engineering design and construction administration, and $150,000 for full-scale pilot testing and conceptual design.

4.9 Strategy 5B—Demand Side Management - Manage Customer Demands for Improved Efficiency

There are two main types of demand side management: price-based and alternative (non-price based) management. Each could play a role in reducing future water needs.

4.9.1 Price-Based Demand Side Management

The Towns have employed this strategy by using an inclining tiered rate structure and separate rates for irrigation usage. The theory behind this strategy is that increasing costs will motivate customers to monitor and limit their water use. The Town has seen limited benefits as water usage has been monitored over time. However other price-based management strategies such as the price of a separate irrigation meter have proven effective.

The Town also uses water budgets for its commercial customers for irrigation. This encourages water efficiency and has proven effective.

The objective of Strategy 5B is to influence customers to use water wisely – resulting in reduced water demand - through policies. Demand-side management approaches are increasingly relied upon for water resource management and complement more traditional supply side management measures. A combination of price-based and alternative (non-price-based) demand side management policies could be most beneficial.

Further details about potential opportunities to improve efficiency are described in Appendix C.

Typically, as water rates and charges increase over time, consumers become increasingly interested in the cost of water. The following price-based demand side management strategies were considered in 2013 and are still applicable if the Town elects to implement them:

- Time of use rate structures involve applying different water rate structures for daily, seasonal, and drought periods to encourage efficient water use, especially during periods when maximizing the water supply is most critical (while balancing rate impacts when water supply and capacity is available).
- A water budget is a set amount of water allocated to a customer to meet the customer's anticipated efficient water needs; the amount of water within the first block is based on the estimated, efficient water needs of an individual customer. Those with usage above the efficient budget pay a significantly higher rate for "inefficient" or "wasteful" usage. This individual customer water budget approach could be implemented beyond its current commercial irrigation customer applications.

4.9.2 Alternative Demand Side Management (Non-Price-Based)

Alternative demand side management (ADSM) strategies are those that do not directly change the unit price of water but may include water use regulations, rationing, public education, and incentives for adoption of more water-efficient technologies. These efforts can be effective in reducing both average day and peak demands.

The Town of Cary began implementing on these approaches in 2011 with the installation of AMI. The Town continues to improve the application of the system by promoting its automated alerts and web portals to view usage. Aquastar has the potential to be a more powerful tool that can influence customers' water usage based on social norms such as knowing where one "ranks" against average or similar customers. Another example of effective ADSM usage by the Town of Cary is the requirement for rain sensors on irrigation systems.

The Towns considered the following non-price-based ADSM strategies in the 2013 LRWRP and they remain viable opportunities:

- Peak load management in a water system is a strategy to balance the supply of water with the water demands by adjusting or controlling the demands rather than providing additional water. While there is currently no known peak load management in operation by a United States water utility, discussions of such capabilities in water-scarce areas are occurring.
- Both the Towns of Cary and Apex have water conservation programs in place and this strategy should remain as an important tool to manage potable water demands. As seen in the 2012 and 2017 customer surveys for the Town of Cary, many water customers support water conservation.
- Other ADSM strategies that the Town of Cary has used in the past and may elect to implement in the future include incentives for emerging water-efficient technologies, which in particular can drive down indoor water use.

4.9.3 Potential Raw Water Supply Capacity

While this demand-side management strategy alone is not likely to meet future water supply needs, it plays a role in working to defer capital investments. The Towns have seen the benefits of this strategy reflected in the downward trend of per capita water usage over the years that the Towns have conducted long range water supply planning efforts. These approaches can also be implemented to address short-term capacity needs such as those that arise during a drought, if needed.

4.9.4 Implementation Requirements

Implementation requirements include conducting a rate study to assess any revenue impacts that may result from demand-side management strategies. Opportunities and requirements are further discussed in the Conservation Program Evaluation included in Appendix C. The Town should continue to develop its use of AMI customer data to reach customers and influence their decisions to use water efficiently.

4.9.5 Regulatory Considerations

There are no identified regulations to consider for this strategy.

4.9.6 Policy Implications

Implications of this strategy include the relative affordability of water once prices are adjusted and potential impacts to revenue. Policy decisions regarding efforts to incentivize efficient water use may not be a necessary or appropriate means to drive down water use. As utilities encourage more efficient use of water, the amount of water purchased by customers decreases, and with it, revenue also decreases. It is necessary to maintain revenue stability with decreased consumption per connections.

4.9.7 Key Uncertainties

Water savings may fluctuate even if financial tools such as inclining rate structures are used. Other societal drivers may influence water use; customer education must go hand-in-hand with these types of programs. Participation levels in conservation programs may be different than planned participation.

This approach often requires careful consideration and political approval before adoption. Maintaining customer confidence is important. This must be coupled with a strategy to ensure customers feel adequate water supply is available for their needs; this is especially important for industrial customers.

As with price-based incentives, the effect of any ADSM program on the amount of customer water use must be carefully considered to avoid unintended negative impacts on revenue. Wise water use should be promoted; however, the Towns need to assess rate structure impacts so as to avoid an unanticipated reduction in revenue. Customer affordability should also be considered when setting rates.

Also, with non-price-based incentives, it is easy for customers to assume that when they reduce their water use, their bills will go down. However, since most water utility costs are fixed, this is not often the case. As a result, customers total water bills will not likely decrease much, if at all.

4.9.8 Key Benefits

Wise water use helps the Towns promote a positive, sustainable community image and support belief that the Towns are desirable places to live and work. This approach can also support efforts to delay infrastructure investments by stretching their useful life, providing benefits to rate payers.

4.10 Strategy 5C—Reclaimed Water

The objective of Strategy 5C is to offset potable water system demands through the beneficial utilization of reclaimed water. This potential is explored in the Town of Cary's Strategic Reclaimed Water System Plan objectives and policies and is linked with Strategy 4.

The Town of Cary currently uses reclaimed water for non-potable applications to help reduce potable water demands within its reclaimed water service areas. The Town of Apex holds a permit to use reclaimed water, but currently does not have a reclaimed program or infrastructure except for operational uses.

The Town of Cary currently promotes its reclaimed water program for uses including

irrigation, cooling water, manufacturing processes, and commercial toilet flushing. As a result, reclaimed water offsets potable demands in these service areas. This is most effective in reducing peak demands associated with seasonal outdoor water use but can help reduce year-round demands through industrial and cooling water uses.

This strategy is somewhat effective to date in helping to reduce or delay the construction of infrastructure needed for new potable water supplies. In addition to potable water use reductions, reclaimed water utilization reduces nutrient discharges to surface waters from reclamation facilities. This program has also benefited the Town in regulatory processes by providing evidence of the Town's commitment to water resources efficiency.

The use of reclaimed water to offset potable water demands is also linked to Strategy 4—Integrated Master Planning and Strategic Utility Resource Utilization. Many opportunities exist for the Towns to expand the use of reclaimed water to each Town's identified growth areas, some of which have the potential for intensive water use. Future advances in technologies and customer preferences may also impact the relative costs and public acceptance of reclaimed water. Emerging reclaimed water technologies, such as indirect or direct potable reuse, might play a role in meeting the Town's total water demands at some point in the future

It may benefit Apex to perform another benefit and cost analysis of a potential reclaimed water system during this high rate of growth, to take advantage of partnerships with developers.

4.10.1 Potential Finished Water Demand Reductions

In the Town of Cary, if the system is expanded, reclaimed water demands are expected to increase to over 1.5 MGD, average day, by the year 2065. Additional benefit occurs on peak days, when outdoor water use increases. The Town is currently reviewing its reclaimed water policies. If expansion is limited to opportunistic actions such as connecting commercial customers with year-round demands, this increase in demands may not be realized and instead potable water demands may increase slightly more than projected.

4.10.2 Implementation Requirements

For the implementation of this project, it is necessary to continue extending transmission lines for the use of reclaimed water. The Town of Cary is currently reviewing alternatives presented in the business case evaluation to determine the best path forward for the program. The Town should also reevaluate its pricing strategy to incentivize year-round usage and to continue ensuring that revenue covers the operations and maintenance costs of the program. Future pricing evaluations should also consider opportunities for emerging technologies.

4.10.3 Regulatory Considerations

The use of non-potable water must be in compliance with 15A North Carolina Administrative Code .02U for reclaimed water use. Spills must be reported, and water quality must be maintained through flushing and continual assessment.

4.10.4 Policy Implications

The implications of this strategy include customer expectations for sustainable water use options, connection/development requirements, and costs and capital costs to expand the already existing reclaimed water system.

4.10.5 Key Uncertainties

Key uncertainties that must be addressed with continued implementation of this strategy include:

- Seasonal vs year-round demands and how these influence operational costs
- Rates of outdoor irrigation system installations
- Costs associated with connecting those with reclaimed water meters but not yet connected to the reclaimed water distribution system
- Public perception related to reclaimed water quality

4.10.6 Key Benefits

The Town of Cary's reclaimed water program provides the following key benefits: reduction of peak demands, reduced discharge (including nutrients) to receiving streams, and the potential to offset IBT. Commercial and industrial customers also often have sustainability goals, and the Town's program helps support their commitment and image.

4.11 Water Resources Portfolio Summary

Each of these strategies comes with a cost and potential benefits, either by creating additional water supply or by deferring water demands-driven capital investments. Another key consideration is the level of stakeholder involvement needed for implementation; strategies that require regional cooperation or additional regulatory approvals may have more uncertainty of timing or costs than those projects that the Towns can implement independently. Table 4-5 summarizes the potential uncertainties and cost implications of each strategy.

Table 4-5. Summary of Water Resources Portfolio Recommended Actions
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Strategy	Implementation Period	Timing Uncertainty	Relative Costs	Level of Stakeholder Involvement	Supplemental Strategy Only
1: Jordan Lake Allocation	Long	High	Medium	Medium	
2A: Increase Jordan Lake Water Supply Pool	Medium	Medium	Medium	High	
2B: Crabtree Creek	Long	High	High	Medium	
2C: Cape Fear River	Medium	Low	High	High	
2D: Source Outside the Triangle	Long	High	High	Medium	
3: Regional Agreements & Interconnections	Short	Low	Low	Medium	✓
4: Integrated Master Planning	Long	Low	Medium	Medium	✓
5A: Supply Side Management via WTP Optimization	Short	Low	Low	Low	
5B: Demand Side Management	Long	Low	Medium	Low	✓
5C: Reclaimed Water	Medium	Low	Medium	Low	✓

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Section 5
Implementation Plan

Recommendations were formulated from the refreshed list of Water Resources Portfolio strategies. A combination of these strategies is most likely to benefit the Towns' ability to meet future demands reliably. These recommendations allow the Towns to meet demands in the short-term, delaying the potential need for larger infrastructure investments until towards the end of the planning period. These projects do not take decades to develop; instead each recommendation can be done in a few years, providing the Towns with flexibility to act when needed and make investments at the right times.

Through the actions completed since the 2013 LRWRP, routine updates to projections and strategies, and continued implementation of water conservation strategies, the Towns are well positioned to meet future demands.

5.1 Water Supply and Treatment

Building from implemented actions recommended in the 2013 LRWRP, the updated 2018 list of projected gaps and near-term recommendations to meet finished water needs are listed in Table 5-1. The timing of implementation will likely be driven by the Town of Apex's growing demands, as depicted in Figures 5-1 and 5-2. It may be necessary in the near-term to reevaluate the Towns' current cost-share agreements for water supply and treatment.

Table 5-1. Summary of Water Supply and Treatment Portfolio Recommended Actions
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Gaps Identified	Recommendation	Benefits	Drivers
Raw Water Supply	5A: Supply Side Management via Cary/Apex WTF Optimization	Optimizes and extends Jordan Lake Allocation Project can be implemented quickly when needed	Timing of implementation driven by Apex's growing demands
Finished Water Capacity	3: Purchase of Capacity via Triangle Regional Agreements	Uses existing interconnections to supplement daily supply if agreement(s) can be reached Agreements can be reached prior to timing of actual need Can be used to bridge the gap in daily demands until towards near end of planning period; assess need for future expansion or additional source later	Timing of implementation driven by Apex's growing demands

5.2 Wastewater Treatment

Gaps and recommendations to meet expected wastewater capacity needs are listed in Table 5-2. Capacity is likely needed at the jointly owned Beaver Creek Pump Station and WWRWRF. Driving the timing of these needs will be the pace of Apex's growth and corresponding wastewater flows. To better understand these flows, additional flow monitoring and collection system modeling is necessary. A joint model would help facilitate discussions regarding a path forward for the capacity agreements and any expansion(s) needed at these facilities. The Town of Cary's NCWRF will also likely reach its 12.0 MGD capacity during the planning period; the re-rating planned for this facility, increasing its capacity to 13.5 MGD will likely be sufficient to meet future flows.

Capacity needs by the Town of Apex will likely drive actions in the short-term.

Table 5-2. Summary of Wastewater Treatment Recommended Actions
Includes the Towns of Cary, Morrisville, and Apex; RTP South; and RDU

Gap Identified	Recommendation	Benefits	Drivers
Capacity at Beaver Creek Pump Station	Flow monitoring and modeling to better understand flows from Cary and Apex Adjust Interlocal Agreement following detailed analysis	Improved understanding of flows Supports capacity needs throughout planning period	Timing of solution driven by Apex's growing demands
Capacity at Western Wake Regional WRF	Conduct analysis following completion of Beaver Creek Pump Station review Short-term: Plan to adjust Interlocal Agreement following detailed analysis Long-term: Plan for expansion to meet future capacity needs	Improved understanding of flows Actions may meet Apex's needs in short-term Short-term actions may support delay of longer-term capacity needs, deferring larger capital investments	Timing of solution driven by Apex's growing demands
Capacity at North Cary WRF	Complete re-rating of facility from 12 MGD to 13.5 MGD	Re-rating approach is less expensive and faster than an expansion Supports needs until near end of planning period; assess need for future expansion then	Flows can be monitored, and a trigger used to determine when Cary needs to take action

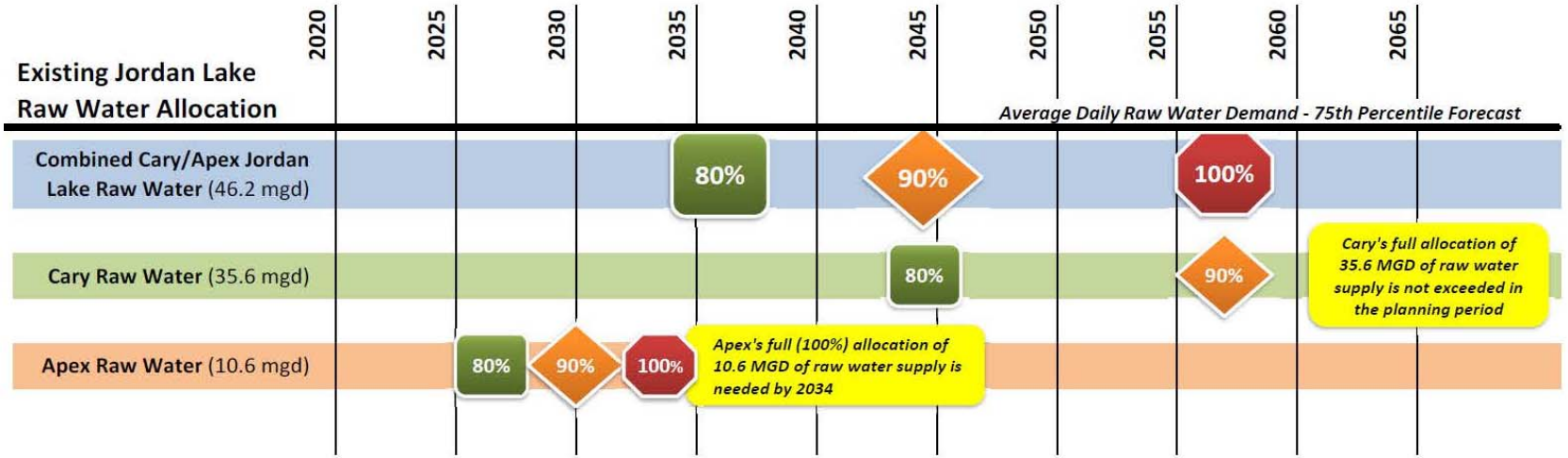

Figure 5-1. Timeline for Need for Additional Raw Water Supply

Figure 5-2. Timeline for Need for Additional Finished Water Capacity

5.3 Monitoring and Reappraisal of the Water Resources Portfolio

By monitoring demands and updating them when needed, such as when the Town of Apex's land use plan is completed, the Towns can implement recommendations in the short-term while keeping other, larger-scale recommendations available for implementation if long range planning updates suggest they may be necessary.

The Towns of Cary and Apex are experiencing growth at different rates, caused by the difference in available land for development and other growth drivers. With Apex's rate of growth currently outpacing that of Cary's, it is expected that Apex's portion of finished water demands will exceed that reflected in the Towns' current interlocal agreement for cost sharing. Figure 5-3 captures this changing ratio, developed from the demand projections presented in Section 2. This ratio should continue to be monitored so that the Towns can have informed discussions regarding cost-sharing and capital investments. These discussions are needed in the near-term.

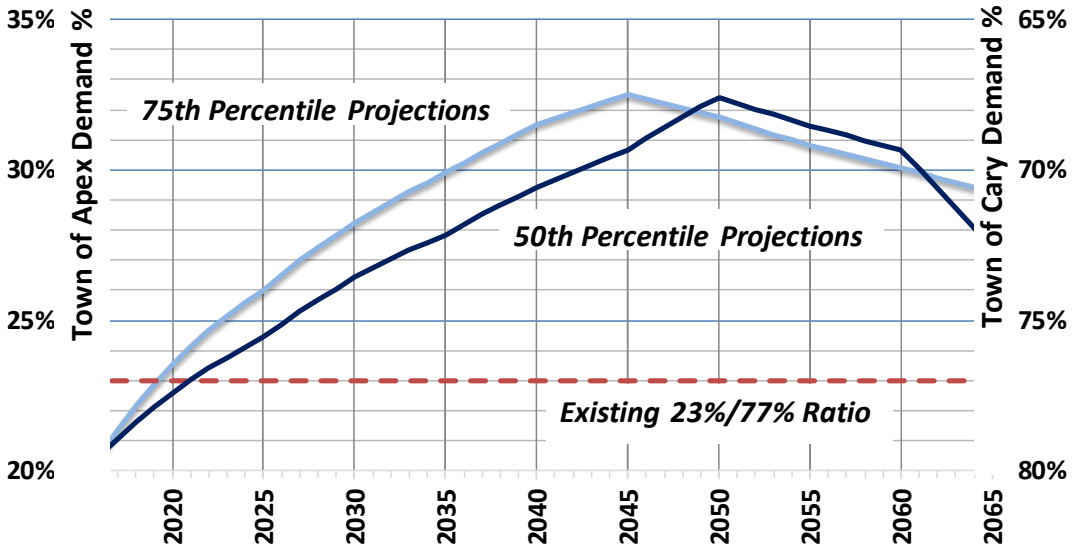

Figure 5-3. Town of Apex to Town of Cary Ratio of Finished Water Demands

The Towns must also actively monitor and re-appraise the need to act on additional water supply strategies. The Water Use Analysis included in Appendix A highlights some monitoring strategies that the Towns may use to track water use trends. Additionally, the Town of Cary may use the GIS tool to assess the impact of each new development and potential redevelopment project on its infrastructure.

The Town of Cary's potable water demands are also influenced by customer participation in the reclaimed water program. The Town of Cary is evaluating future options for its reclaimed water program. If a more modest expansion occurs, a small increase in potable demands may result. This additional 1 to 1.5 MGD of finished potable water demand may result in a shift forward in time for additional water supply and treatment capabilities. This is one example of the uncertainly associated with long range planning and may result in the need for water supply a year earlier than currently predicted and possibly shift forward the need for additional treatment capacity by three years. These needs are near the end of the current planning period and will be further evaluated in future updates to this LRWRP.

The Towns' demands may also change in response to other factors such as weather patterns including drought and economic factors. The Towns have evidence of reduced per capita usage following the last

lengthy drought in 2001 and 2002. This pattern of reduction continued through the 2007-2008 drought. After implementation of water restrictions and other factors, customer behaviors never returned to pre-drought conditions. Such shifts may occur after future significant events. These trends point to the role water conservation can play in deferring infrastructure investments and promoting sustainable water use.

Demands can also be influenced by economic factors. Both the rate and the location of growth in the future drive demands. This is especially important to monitor in the Town of Apex as more land is available for development there. For the Town of Cary, economic factors will drive the timing of redevelopment and mixed use development. These land use changes create uncertainty in any long range planning.

Water supply may also be affected by climate and weather factors. Factors such as more extreme and flashy weather patterns may occur in the future, with more frequent large wet weather events occurring in the Southeast. In turn, this may influence the water supply reliability of reservoirs such as Jordan Lake. This is something that should be evaluated in future updates to the LRWRP and by the TWSP, utilizing resources such as the National Climate Assessment (U.S. Global Change Research Program, 2018).

The Towns should maintain their commitment to update projections routinely as part of their long range planning best practices. This 2018 update to the LRWRP refreshed many of the strategies listed in the 2013 LRWRP and acknowledges how increased capacities of their combined facilities and an IBT certificate modification, among other actions, have positioned the Towns well to meet future demands. Significant facility expansions are not needed in the near-term; instead some gaps can be met with interlocal agreement adjustments and/or other similar cooperative approaches.

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Section 6
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